Saanich Peninsula Inflow & Infiltration Management Plan

Saanich Peninsuala Wastewater

Capital Regional District | July 2024

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Executive Summary

From 2020 to 2023, the Saanich Peninsula Wastewater Commission approved three years' worth of funding to initiate inflow & infiltration (I&I) management plans for the Peninsula municipalities ($136,000 total). The project scope was limited to generating sewer flow data from municipal pump station SCADA data, mapping pump station catchments, assessing flow data quality, I&I analyses, and recommendations. The work leveraged the resources and expertise of the Core Area I&I program. The work was carried out to address some "in progress" I&I commitments in the Saanich Peninsula Liquid Waste Management Plan.

I&I refers to rainwater and groundwater that enters the sanitary sewer system. Inflow refers to clean water entering sewers through improper plumbing connections (i.e. roof drains). Infiltration refers to groundwater that seeps into sewers through cracks. A certain amount of I&I is unavoidable and is accounted for in routine sewer design. However, too much I&I can cause overflows and increase conveyance / treatment costs.

I&I Management Plans are long term endeavors. They require periodic updates (i.e. 5-year intervals) and build on the previous versions of the plan. The plans are setup around four phases:

- Phase 1: Divide municipality into appropriately sized sewer catchments, collect flow data, analyze for I&I, determine if any catchments merit follow up action.
- Phase 2: Investigate catchments found to have elevated I&I (i.e., smoke testing, CCTV).
- Phase 3: Rehabilitate sewers, when appropriate, based on priority, with defined schedules and budgets.
- Phase 4: Conduct post-rehabilitation monitoring to verify the effectiveness of rehabilitation effort.

This is the initial I&I management plan for the Saanich Peninsula, so the work focused on the actions from Phase 1. This was problematic because prior to 2020 the Saanich Peninsula municipalities had virtually no sewer flow data. The only available flow data came from nine CRD billing meters and two CRD pump stations. The lack of sewer data was an issue because:

- It is expensive to collect. New permanent flow meter sites cost >$100K. Temporary flow meters costs ~$10K/year per meter if done by a contractor.
- Each peninsula municipality needs ~10 metering sites for adequate I&I coverage.
- It can take multiple years to acquire sufficient storm event data to carry out I&I analyses.

To address this issue, sewer flow data was generated using SCADA data (i.e. pump starts/stops and levels) from 38 Saanich Peninsula municipal pump stations and from 11 existing CRD meters. Catchment maps were prepared for each site. (Catchments are like "puzzle pieces" the divide a map.) Overall, these catchments provide sufficient I&I monitoring coverage for each municipality, except Sidney, which would need additional metering in the future (i.e. 2 portable meters) to fill a gap in meter coverage.

Before using flow data, it's important to understand the source of the data and its level of accuracy because poor flow data, which is common, can result in poor decisions (i.e. inaccurate sewer models, development decisions.) For this project, a consultant assessed the flow data generated for each site. The consultant concluded that the pattern of the data was reliable, but the magnitude of the data was not. This was due to limitations in the SCADA data quality. As a result, the I&I analyses was confined to metrics comparing measured flows to average dry weather flows (ADWF). The consultant made recommendations for improving future flow data for each site to make it universally useful (i.e. calibrating sewer models, capacity studies and advanced I&I analyses.)

For this report, 50 flow metering sites were analyzed for I&I including 16 sites in Central Saanich, 14 in North Saanich, 12 in Sidney along with Tseycum First Nation, Pauquachin First Nation, IOS, BC Ferries, and the Victoria Airport Authority. Table ES1 shows an example of the I&I metrics analyzed for each catchment and Figure ES1 summarizes the results for the key metric on a map.

Table ES1: Example of I&I Statistics Analyzed for Each Catchment

Catchment Name	Size (ha)	I&I Analyses			
		Peak 24hr Flow vs ADWF	Peak 1hr Flow vs ADWF	Typical Winter Dry Day Flow vs Summer ADWF	Summer Groundwater Expressed as a % of ADWF
Example Catchment: Saanich Peninsula Total	1,688	5.0 x ADWF	7.4 x ADWF	1.5 x ADWF	24% ADWF

ADWF = Average Dry Weather Flow

Based on the I&I analyses results, approximately half of the catchments exceed 4x average dry weather flow, which indicates that there is significant I&I, which should be monitored/managed into the future. Note, however, that each jurisdiction's flows are currently meeting their regional sewer flow allocations. Also note that there currently are no I&I related sewer overflows on the Saanich Peninsula for sub 5-year storms. The only known I&I related overflows occurred during a 100-year storm in 2021.

The Peninsula municipalities have a history of carrying out significant I&I related work despite having minimal sewer flow data. Below are a few highlights:

Central Saanich initiated a major sewer renewal project in the Brentwood Bay area in 2024 that includes replacing 0.7 km of sewer main and 3 km of forcemain, replacing two pump stations with one larger pump station, installing inspection chambers at the connections to the new sewer pipe, and rerouting sections of gravity pipe to better optimize the system. In 2025, Central Saanich will be updating its sewer master plan and sewer model. The municipality annually carries out ~15 km of sewer camera inspections and ~300 manhole inspections. From 2006 and 2015, smoke testing was conducted in older areas of the sewer system including the Keating industrial area. Central Saanich monitors and maintains two Tsartlip FN Lift Stations, which has known I&I issue, and takes efforts to assist with identifying defects.

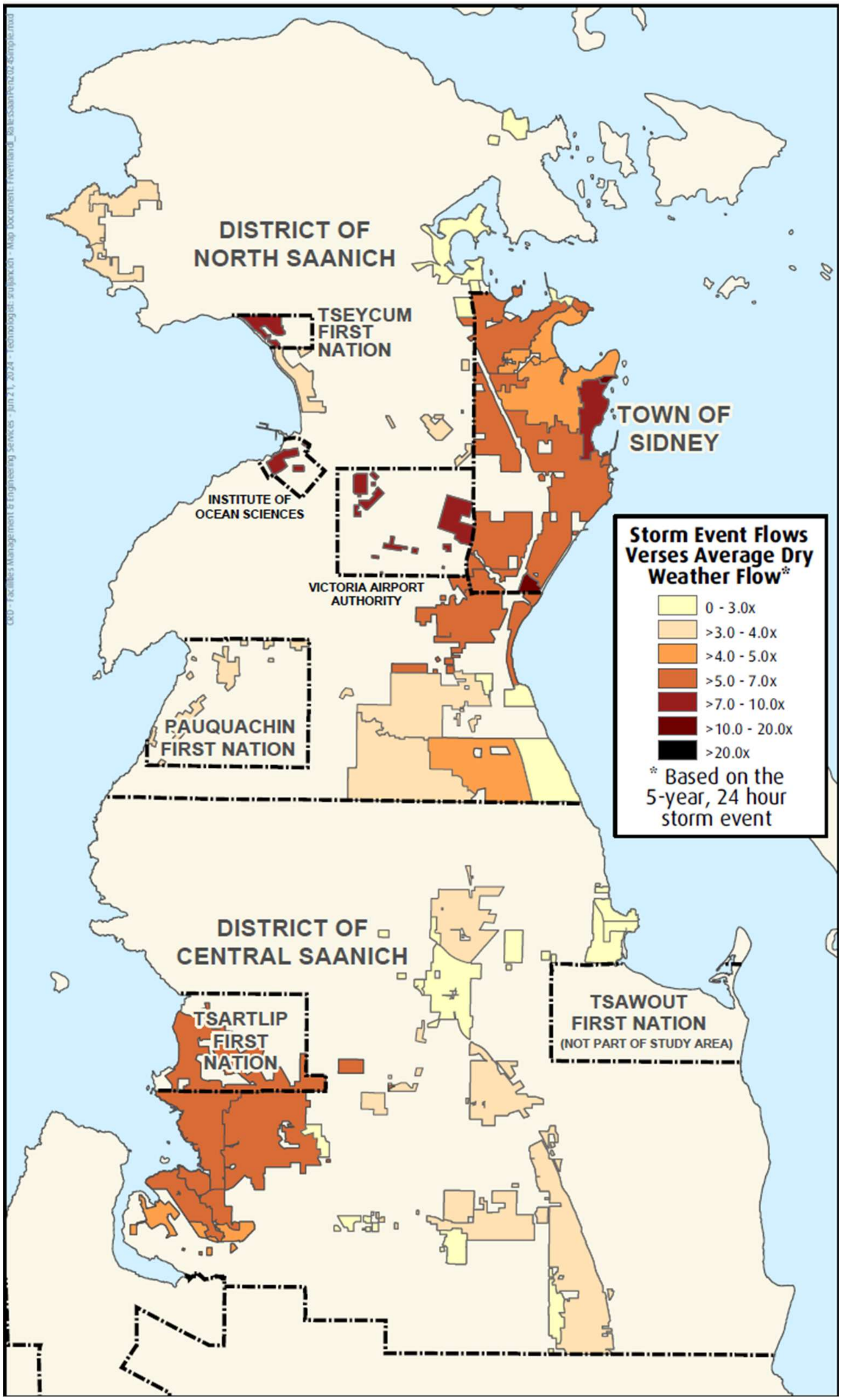
North Saanich's sewer master plan and sewer model were completed in 2017. These will be updated in 2025/26 following completion of North Saanich's official community plan. The main recommendations in the current sewer master plan are to begin a CCTV program (will start in 2025), commence an "asbestos cement gravity main" rehabilitation program (2025), and to assess and upgrade pump stations as conditions require. The sewer master plan indicated that a focused I&I reduction was not yet needed.

Sidney's past I&I related projects include a manhole grouting program, smoke testing programs, pipe relining and replacement projects. Efforts continue with pipe replacement and relining projects identified through Sidney's Asset Management plans. Sidney continues to work with private properties, including the installation of inspection chambers, to resolve I&I identified through smoke testing programs. Sidney has an annual sewer CCTV program, inspecting approximately one fifth of the municipality's sewer mains and manholes each year in efforts to identify sources of I&I. In 2024, Sidney updated its sewer model and will be updating its underground infrastructure replacement plans.

The key recommended from the report included:

- Peninsula municipalities to improve the quality of their flow data by addressing "SCADA timestamp" issues at 33 pump stations and "wetwell volume" issues at 8 pump stations. This would make the data universally useful for things like calibrating sewer models, capacity studies and advanced I&I analyses.
- CRD to do minor SCADA programming to improve the flow data at 9 billing meter sites and two CRD pump stations.
- Peninsula municipalities to review catchments with elevated I&I to determine if follow-up efforts are needed (i.e. sewer investigation work). The process should be documented to ensure that the findings are available for future use.
- CRD to conduct follow-up I&I analyses for inclusion in the 5-year update of this plan (2029).
- CRD to provide I&I related support to the municipalities as appropriate (funding dependent).
- Update the plan at 5-year intervals.

Figure ES1: Summary of I&I Rates for the Saanich Peninsula



1 Introduction

1.1 Background

The Saanich Peninsula Liquid Waste Management Plan (SPLWMP), last consolidated in 2009, contains several commitments related to inflow and infiltration (I&I) (see Section 1.3). Prior to 2020, some of the commitments were "in progress" due to an absence of sewer flow data, which is needed to measure I&I.

From 2020 to 2023, the Saanich Peninsula Wastewater Commission approved three years' worth of funding to initiate I&I management plans for the Peninsula municipalities: $30,000 in 2020, $41,000 in 2021, and $65,000 in 2022. The goal was to leverage the resources and expertise of the Core Area I&I program to help initiate I&I actions on the Peninsula. Based on need, the focus was on sewer flow data, which is the foundation of I&I management plans. The purpose of this report is to document the work completed and to chart a path forward.

1.2 Local Context

The Saanich Peninsula wastewater system serves the municipalities of Central Saanich (including Tsartlip First Nation), North Saanich, and the Town of Sidney, as well as the Swartz Bay Ferry Terminal, Victoria International Airport, the Institute of Ocean Sciences and the Tseycum and Pauquachin First Nations. (The Tsawout First Nation has its own wastewater system and treatment plant and is not connected to the Saanich Peninsula wastewater system.)

Sewer flows in the system are conveyed to the Saanich Peninsula Wastewater Treatment plant. The plant provides secondary treatment prior to discharging the treated effluent to Bazen Bay. The plant commenced operation in 2000. It replaced three individual CRD sewage treatment plants that were constructed in the early 1970's that generally served each of the individual municipalities.

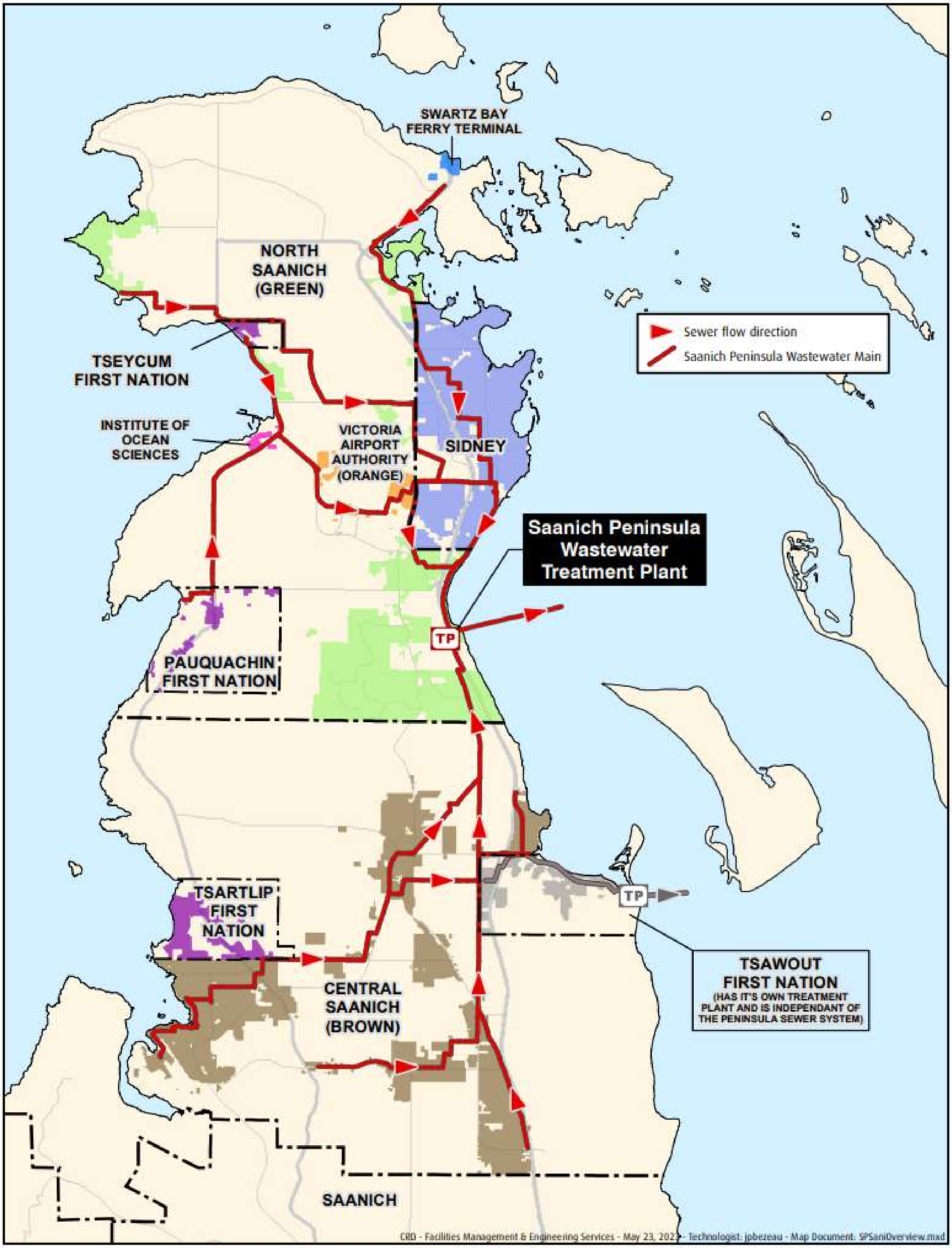
A map of the Saanich Peninsula wastewater system is in Figure 1.1. A summary of sewer infrastructure is in Table 1.1.

Table 1.1: Sewer Infrastructure in the CRD Saanich Peninsula

Jurisdiction [1]	Gravity Sewers (km)	Force Mains (km)	Manholes (#)	Pump Stations (#)	Laterals (#)	Average Pipe Age (years)	% Developed Properties Connected to Sewer
Central Saanich	88,320	6,866	961	14	3516	n/a	80.7%
North Saanich	62,488	14,948	784	12	2267	26	48.6%
Sidney	48,025	2,900	555	12	2766	52	99.6%
CRD	12,002	5,374	70	3	NA	29	NA

[1] Data was not available for the Swartz Bay Ferry Terminal, Victoria International Airport, the Institute of Ocean Sciences or the Tseycum and Pauquachin First Nations.

Figure 1.1 Map of the Saanich Peninsula Wastewater System



CRD - Facilities Management & Engineering Services - May 23, 202 - Technologist: jpbezeau - Map Document: SPSaniOverview.mxd

1.3 Saanich Peninsula Liquid Waste Management Plan Commitments

The SPLWMP contains seven commitments related to I&I. A number of these commitments were part of the original plan from 1996. The commitments are as follows:

- To develop and carry out a detailed program for identification and sources and quantity of inflow and infiltration (I&I) by the end of 1999.
- To develop guidelines for use by the member municipalities and federal jurisdictions to prioritize areas within which rehabilitation works are warranted and cost effective.
- To provide additional funds for I&I reduction that are either economically or environmentally justified by avoidance of future costs to convey, treat and dispose of I&I, or by protecting effluent quality.
- Where rehabilitation works for I&I reduction are undertaken, to measure flows before and after carrying out such works, to document I&I expenditures and achievements, and to use this information to refine cost benefit curves developed to optimize expenditures.
- To standardize and pass appropriate bylaws, or amendments to bylaws, in each municipality or jurisdiction to reduce or eliminate the incidence of storm water connections to the sanitary sewer system.
- That in areas of high infiltration, to address concerns of exfiltration from the systems to groundwater.
- That the CRD, as an aspect of operating the wastewater treatment plant, shall monitor flows from the participants and shall advise of the need for investigation of I&I problems.

In 2024, the CRD will be reconvening the Saanich Peninsula LWMP Technical Advisory Committee to determine if the current LWMP is sufficient or if updates are warranted. Potentially, this process could eventually lead to future changes to the I&I commitments in the plan.

1.4 Regulatory Context

The following table summarizes some of the main drivers for I&I reduction in the CRD.

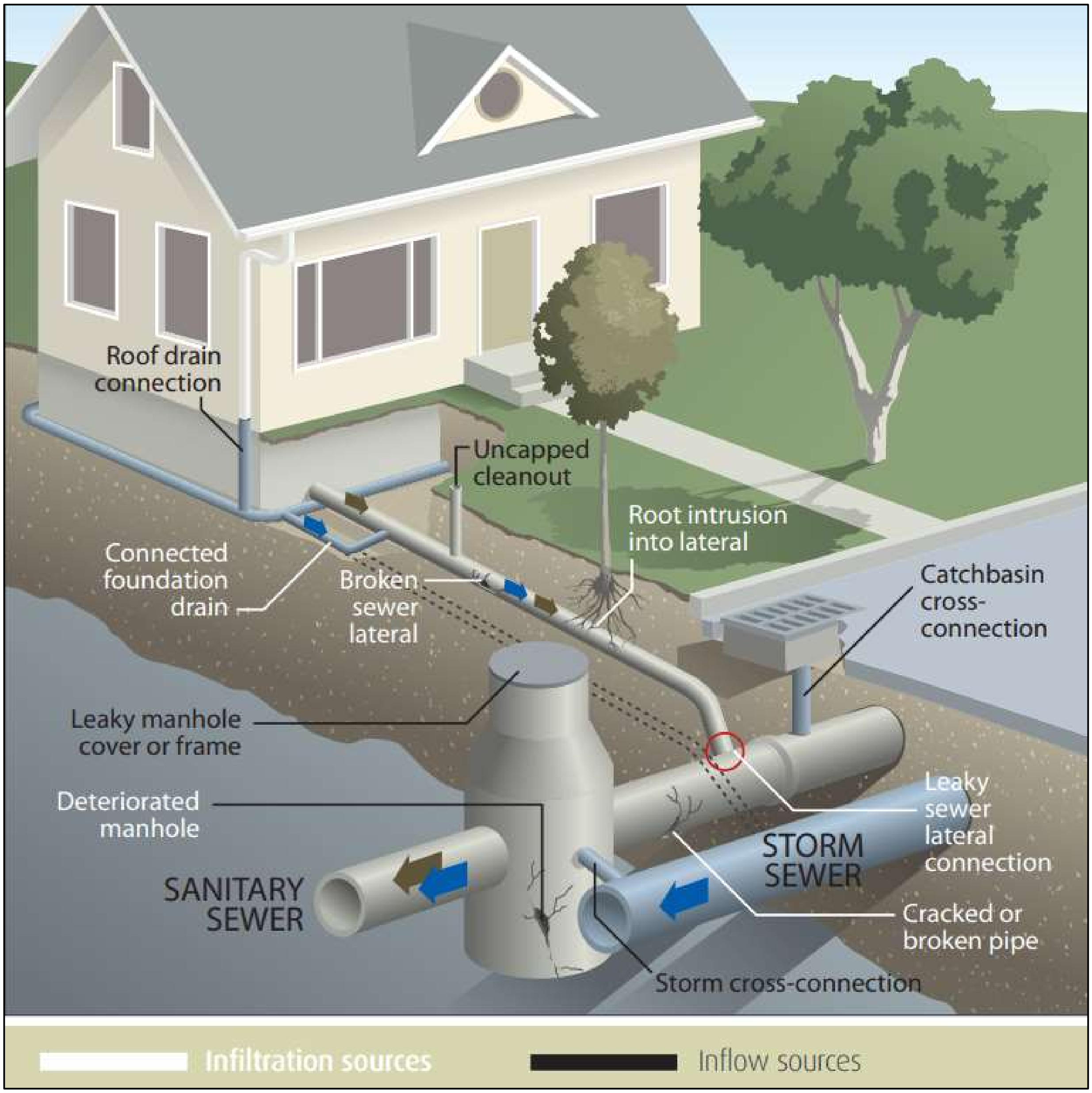
Table 1.2: Regulatory Documents Related to I&I

Level of Government	Regulatory Documents
Federal	CCME: Canada Wide Strategy for the Management of Municipal Wastewater Effluent
	National Guide to Sustainable Municipal Infrastructure: Innovations and Best Practices (InfraGuide)
Provincial	Municipal Wastewater Regulation
	BC Building Code
Regional	Saanich Peninsula Liquid Waste Management Plan
	CRD Sewer Use Bylaw

1.5 Inflow & Infiltration

I&I refers to rainwater and groundwater that enters the sanitary sewer through a variety of defects as shown in the Figure 1.2. Inflow sources allow rainwater to enter the sanitary sewer through improper connections (i.e. roof drain connections, catch basin cross connections) and holes in manhole covers. Infiltration sources allow groundwater to seep into the sanitary sewer through cracks or bad joints in sewer pipes and manholes. 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 treatment and disposal costs.

Figure 1.2: Common Sources of I&I

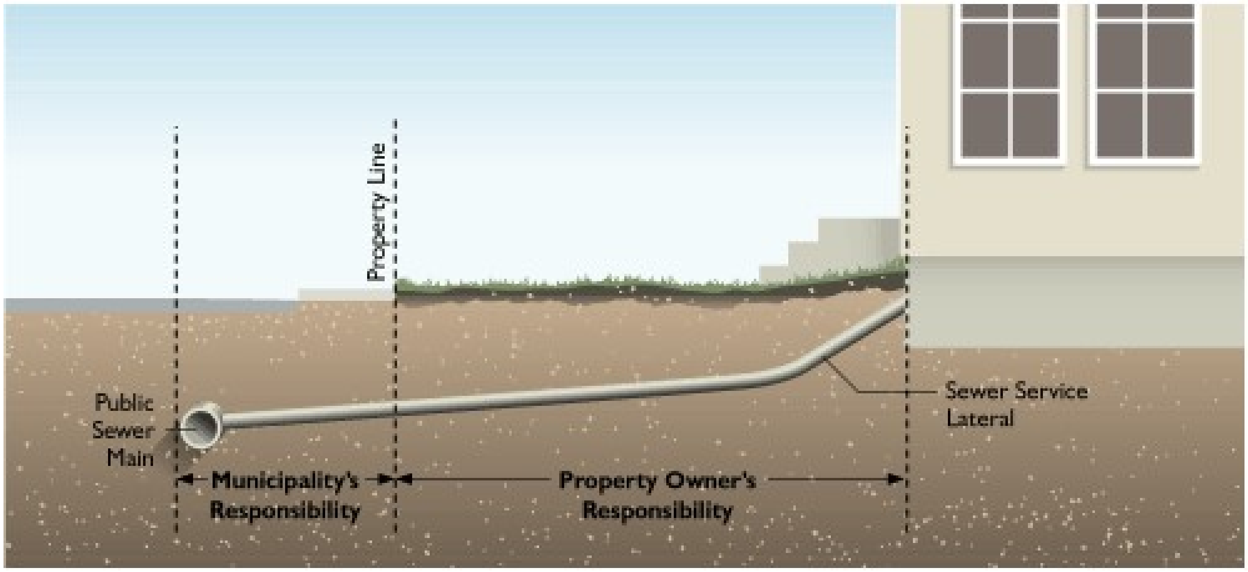


1.6 Private Property I&I (PPI&I)

Property owners own and are responsible for maintaining the portion of the laterals located between their home/building and the property line (Figure 1.3). Municipalities own and are responsible for maintaining the portion of the pipe located between the property line and the municipal sewer main. Property owners generally don't inspect or repair their laterals unless a pipe failure or blockage has occurred. It's rare for property owners to proactively inspect and repair their pipes.

Studies show that approximately 50% of I&I comes from private property. Sources of this I&I can include roof and foundation drains that are connected to the sanitary sewer, leaky pipes or improper plumbing connections between your house and the sewer system. Section 7 provides additional details related to private property I&I and issues related to addressing it.

Figure 1.3: Sewer Lateral Ownership and Responsibility



1.7 Drivers for I&I Reduction

Municipalities have finite resources and budgets. These must be allocated based on their council's priorities and direction. For an I&I related capital project to be approved, it generally needs to strongly support one or more of the following interrelated "drivers".

a) Regulatory Compliance
    - Preventing overflows and excessive I&I
b) Asset management
    - Maintaining sanitary sewer systems and replacing components at the end of their service life
c) Future Growth

- Maintaining or creating sewer capacity for future development / densification.

d) Climate Change
  - Climate models predict more extreme rainfall events in the future. As such, sewer capacity needs to be maintained to prevent overflows.

e) Synergistic Upgrades
  - Finding cost savings by combining related work when doing upgrades. For example, if a road is already dug up to replace sewer pipes, there may be an opportunity to cost effectively replace other underground infrastructure at the same time.

1.8 I&I Management Plans

In general, I&I Management Plans are long term plans that are updated at set intervals (i.e., five years). The actions in the plans fall into the following sequential phases:

Phase 1: Divide municipality into appropriately sized catchments, collect sewer flow data and analyze for I&I. The resulting data is used to rank catchments based on I&I from best to worst and to track changes in I&I rates over time.

Phase 2: Investigate catchments found to have elevated I&I (i.e., smoke testing, CCTV);

Phase 3: Rehabilitate sewers based on priority with defined schedules and budgets; and

Phase 4: Conduct post-rehabilitation monitoring to verify the effectiveness of rehabilitation effort.

The approach noted above aligns with the best practice guide "Infiltration/Inflow Control/Reduction for Wastewater Collections Systems", which was prepared through a collaboration of the Federation of Canadian Municipalities (FCM) and the National Research Council (NRC), in 2003, as part of the National Guide to Sustainable Municipal Infrastructure: Innovations and Best Practices. Appendix A contains a chart illustrating the approach.

1.9 Overflows

Sanitary sewer overflows are releases of raw sewage into storm drains and/or local waterways. They can occur as a result of excessive I&I overwhelming the sewer system, pipe blockages (pipe failure and pump station failures. Sewer overflows can expose people, pets, and the environment to harmful chemicals, infectious bacteria, viruses, parasites, etc. The impact of overflows is influenced by the characteristics of the receiving environment, such as:

- 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 coastline or in-land waters).

I&I is predicted to increase overtime due to aging sewers and larger storms due to climate change. For these reasons, I&I reduction efforts are essential for preventing overflows now and into the future.

In British Columbia, the Municipal Sewage Regulation requires that all unauthorized bypasses, emergency overflows and spills be reported in accordance the Spill Reporting Regulation. In the CRD, when sewer overflows occur, they are investigated, documented, and reported to Emergency Management BC.

The CRD monitors its Saanich Peninsula regional trunk sewers for overflows using level sensors at CRD's Keating, Sidney and Turgoose pump stations. The data is collected using the CRD SCADA system, which stores the data and allows it to be viewed in real-time. The SCADA system also has alarms that are designed to proactively help operators avoid overflows." From 2018 to May 2023, there was only one I&I related sanitary sewer overflow in the CRD's Saanich Peninsula regional trunk sewer system, which occurred on November 15, 2021, a 100-year storm event.

Information on municipal overflows in the Saanich Peninsula is included in the municipal sections of this report (Sections 3-5.)

1.10 Asset Management

Long-term municipal sewer asset management programs are a key pathway for addressing I&I. These programs focus on the planned replacement of infrastructure based on "remaining service life". Preferably, the timing of the actual replacements is determined through condition assessments. However, asset age is often used as a proxy in the absence of condition assessment data.

In general, I&I rates correlate to sewer infrastructure age. This is due to sewer infrastructure decaying over time (like all infrastructure) and to changes in sewer design/materials/installation practices over time. New sewers tend to have lower I&I. Old sewers often have higher I&I.

I&I rates provide insights into the condition of municipal sewer assets. If a catchment with young sewers has atypically high I&I rates, it may indicate the presence of a major defect that is worth finding and fixing.

With Public Standard 3150 having been in place for several years, most municipalities have a reasonably good inventory of assets with book value and asset age. I&I related data can provide valuable insight into the condition of those assets and their remaining service life.

1.11 Climate Change

A changing climate brings much uncertainty. At a global scale, a changing climate has already resulted in a warmer atmosphere, warmer and more acidic oceans, reduced amounts of snow and ice, and higher sea levels. At the local level, scientists project that the Capital Region will continue to experience hotter, drier summers; warmer, wetter winters; more intense and frequent rain and windstorms; and sea level rise. These changes will directly impact infrastructure, (e.g. water supply, sewer and storm water systems), social and economic systems (e.g. heat waves, disruptions to work, competitiveness), and natural systems (e.g. biodiversity and habitat loss, invasive species).

Most climate change projections indicate that future rainfall events will be more extreme in size and intensity resulting in the potential for greater I&I. This will stress the capacity of existing sewer infrastructure potentially leading to more overflows. To account for this, municipalities should implement I&I reduction programs and size new sewers with additional capacity to account for climate change.

2 Key Actions Completed (2020 to 2023)

2.1 Establishing Long-Term Sewer Catchments

There are two key considerations when establishing long-term flow monitoring catchments. The first is the desire for manageable sized catchments (i.e. ~30-100 hectares). The second is the need for high-quality low-cost long-term flow data. For reference, below are the three broad categories of sewer flow meters along with their pros and cons:

- Pump station SCADA data can be used to generate consistent, reliable, long-term, low-cost flow data. The setup time is only a few hours per pump station. Of benefit, SCADA systems already collect and store multiple years' worth of the required data (pump starts/stops and levels).

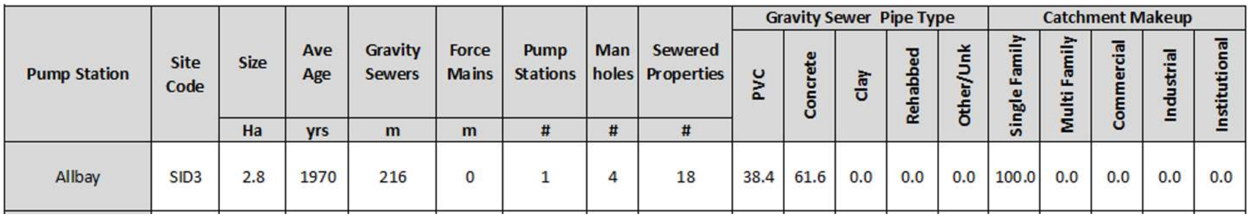
- Permanent meters with telemetry (weirs, flumes, surface RADAR, magnetic flow meters) provide high quality, consistent long-term data. Aside from mag meters, they need periodic staff time for calibration and cleaning. They are expensive to install, typically well over $100K when factoring in electrical and kiosk.

- Temporary open channel flow meters (of which there are various types) provide data of varying quality depending on site conditions and contractor skill. Typically, they are installed, and data is provided as a turn-key service from specialized contractors. Rough monthly cost per site is $2,000, meaning a typical winter monitoring season per site is around $10K. Alternatively, municipalities can also buy their own meters (~$10,000 each) and use their municipal staff for the installations (installer, traffic control, CSE, etc.) The quality of data collected by temporary meters varies widely often making analyses challenging.

For the Saanich Peninsula municipalities, new sewer catchments were built around municipal pump station catchments. These pump stations are already on the Saanich Peninsula SCADA system which has data stored back to 2012, allowing for years of flow data to be generated at low relatively low cost. Catchments were also built for the 11 existing CRD permanent flow meters on the Saanich Peninsula.

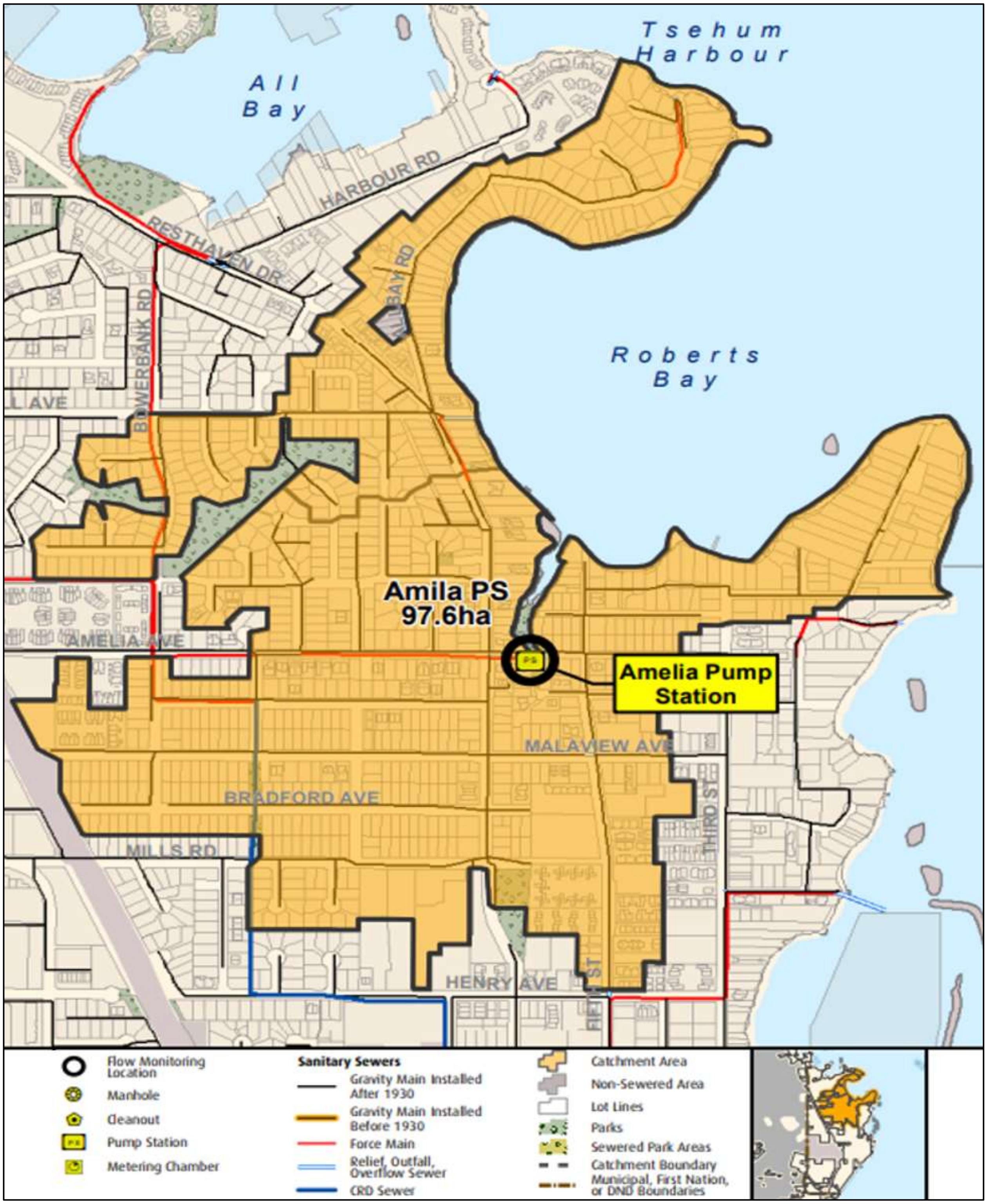
For each catchment, CRD GIS staff prepared catchment maps (Figure 2.1) and summarized key catchment statistics (Table 2.1).

Table 2.1: Example Key Catchment Statistics Table



Pump Station	Site Code	Size	Ave Age	Gravity Sewers	Force Mains	Pump Stations	Man holes	Sewered Properties	Gravity Sewer Pipe Type					Catchment Makeup				
		Ha	yrs	m	m	#	#	#	PVC	Concrete	Clay	Rehabbed	Other/Unk	Single Family	Multi Family	Commercial	Industrial	Institutional
Allbay	SID3	2.8	1970	216	0	1	4	18	38.4	61.6	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0

Figure 2.1: Example of a Catchment Map



2.2 Turning Municipal Pump Stations SCADA Data into Sewer Flow Data

In its simplest form, pump station inflow calculations are 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-stamped data of flow entering pump station. 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.

There are 38 municipal pump stations on the Saanich Peninsula including 14 in Central Saanich, 12 in North Saanich, and 12 in Sidney. These do not have purpose-built flow meters. As part of this project, flow data was derived using on the following:

- Wet well level and pump start/stop data spanning multiple years downloaded from the Saanich Peninsula SCADA system;
- Metadata provided by each municipality including wet well shape, wetwell cross-sectional area, storage tanks, inlet sewer elevation; and
- Purpose-built flow data analyses tools on www.Flowworks.com to convert the SCADA data to flow data. (Flowworks is a subscription service utilized by the CRD that provides flow data analysis tools including graphing, reporting, rainfall event analysis, I&I analysis, and the pump station inflow calculator.)

2.3 Assessing the Quality of the Flow Data

The accuracy and reliability of sewer flow data can vary dramatically based on flow meter technologies and site-specific conditions. For example, mag meters generally produce data that is more accurate than flumes. However, if a mag meter is installed in sub-optimal conditions (i.e., turbulence with air entrapment), its accuracy could be much lower than expected. Overall, it’s important to understand the quality of the flow data before using it.

Not all end users need high quality flow data. For example, some I&I analyses can be done with somewhat lower quality flow data. Conversely, some end users require accurate data (i.e. calibrating sewer models, sewer capacity related decisions).

For this project, the accuracy of the pump station flow data was assessed and following key issues were noted:

1. SCADA Time Stamp Issues (36 of 38 sites)

   The Peninsula SCADA system polls each pump station approximately every 45 seconds to 5 minutes and can only record the data that it sees at the time of polling. This is substantially less accurate than "event based" SCADA systems, where the events (i.e. pump starts/stops) are accurately timestamped when they happen. This issue affects all of the Saanich Peninsula municipal pump stations except for two pump stations in North Saanich, which were uniquely were setup with DNP2 data collection which produces accurate time stamped data. This issue can be addressed by either:

   - Installing dataloggers (~$5000 each plus installation), which use simple connections to the wet well level, pump start/stop signals and flow meter channels as available/appropriate. With a modem (~$500) with monthly cellular bills and a monthly fee (~$35/site), the data can be sent hourly to FlowWorks.com. These dataloggers are fast and relatively easy to install. However, they may require periodic maintenance (i.e. restarts, modem upgrades over time).

   - Upgrading the Peninsula SCADA system to bring its capabilities inline with what's been used in the Core Area since ~2008. This would be a significant project with costs of approximately $8000 per pump station (i.e., new SCADA packs, antennas, and programming) and related system upgrade costs. Of note, the current pump station SCADA packs are no longer supported by the manufacturer and should be replaced anyway. Also, SCADA upgrades were previously recommended to the Saanich Peninsula Commission but were rejected due to budget constraints.

2. Unknown wet well fill cycle volumes (8 of 38 sites)

An accurate wet well fill cycle volume is important when calculating sewer flow data. However, some sites are complicated by storage tanks connected to the wetwell or inlet pipes that backwater during pump station fill cycles. This issue affected 5 pump stations in Central Saanich, 2 in North Saanich, and 1 in Sidney making their data less reliable. Despite this, the pattern of the data still allowed for some I&I analysis.

This issue can be addressed by having a consultant carry out an analysis to calculate the wetwell level to volume relationship. For example, with clear record drawings of the station and incoming sewer, aided by GIS records of the upstream pipes if available, an engineer or technologist could typically do the analysis and calculate the required curve in four to eight hours. Then the level to volume relationships can be used to update the FlowWorks.com calculations, resolving the issue.

3. Complex sites (1 of 38 sites)

   Some pump stations are too complex to generate reliable SCADA derived sewer flow data. This may be due to: multiple pumps routinely running at once, long running pump cycles, variable rate pumps, and complex configurations. The only complex site in the Peninsula is the Hagan pump station in Central Saanich.

   Complex sites are generally best addressed by installing permanent flow meters (either a full-pipe magmeter or clamp-on ultrasonic or Doppler) on the pump station forcemains but it's recommended that an experienced engineer assess the options. Potentially, there could be simple inexpensive options that are viable. If not, expensive options are only worthwhile if there is a strong need for the flow data (i.e., cost allocations, key monitoring locations).

Appendix B contains a consultant memo that summarized the work completed to generate the sewer flow data and a summary of the flow data grades for each pump station. Enclosure A documents how the flow data was generated. Enclosure B includes individual grading sheets for each pump station, an example of which is located in Figure 2.2.

Appendix C contains a consultant memo with specific recommendations for improving the flow data from each of the municipal pump stations. These recommendations are also summarized in the municipal sections of this report (Section 3-5).

Figure 2.2: Example of Pump Station SCADA Flow Assessment Worksheet

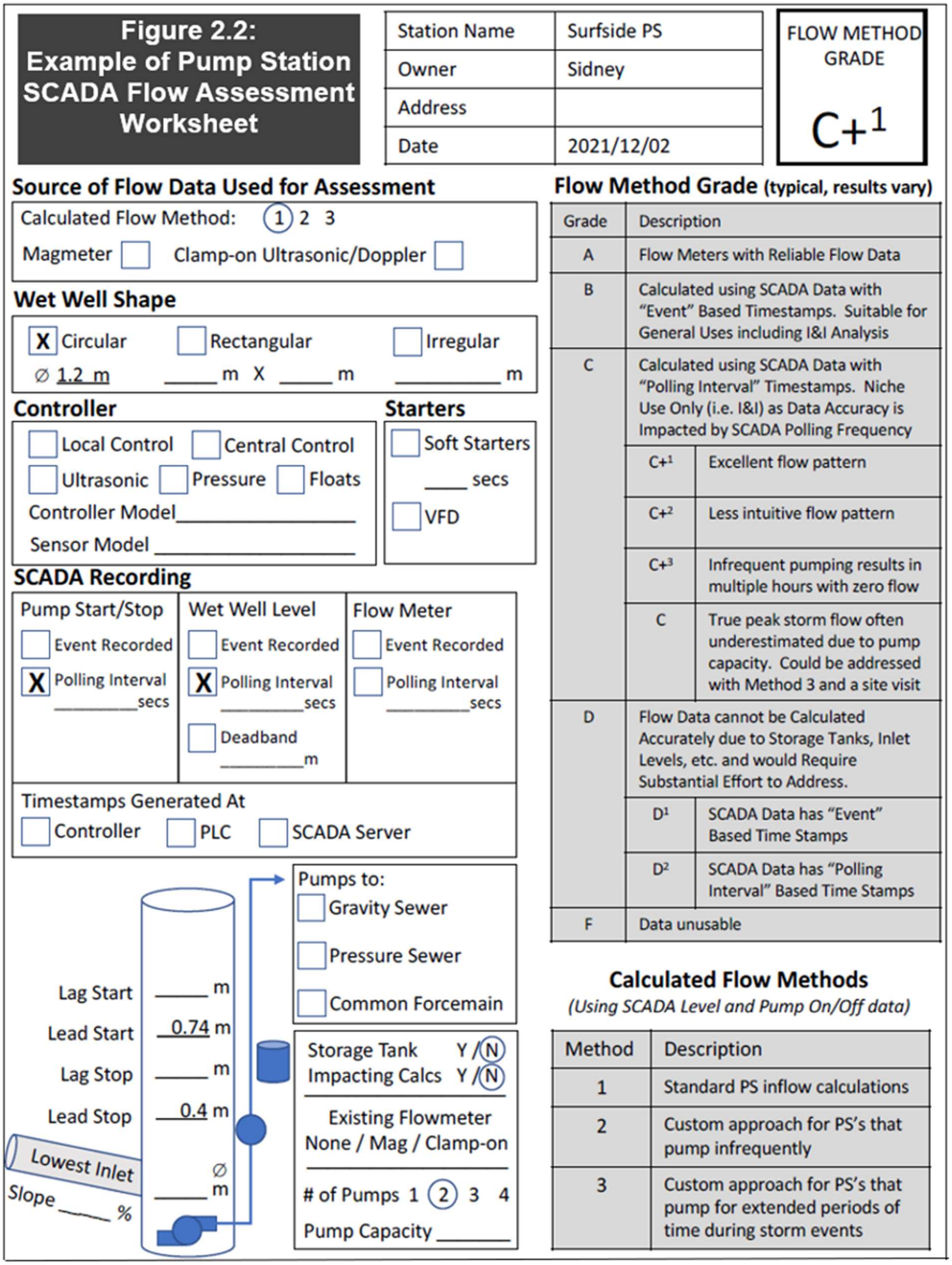


Figure 2.2: Example of Pump Station SCADA Flow Assessment Worksheet

Station Name	Surfside PS
Owner	Sidney
Address	
Date	2021/12/02

FLOW METHOD GRADE

$C+^{1}$

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 0.74 m

Lag Stop ______ m

Lead Stop 0.4 m

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		Flow Meters with Reliable Flow Data
B		Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis
C		Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency
	$C+^{1}$	Excellent flow pattern
	$C+^{2}$	Less intuitive flow pattern
	$C+^{3}$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D		Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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

2.4 I&I Analyses

The flow data generated from municipal pump station SCADA data was not accurate enough for general use (i.e. sewer modeling, capacity studies). However, the pattern of the flow data is reliable allowing for relative comparisons of wet weather flows to average dry weather flow (ADWF). This is highly valuable for understanding I&I in catchments and between the catchments. The I&I analyses included the following three end items:

<u>Hydrographs</u>

Preparing storm event hydrographs (4 to 8) for each catchment (example in Figure 2.3). These graphs contain 10 days' worth of data and show:

- Hourly rainfall on the top (red)
- Measured total flow (blue)
- Typical winter flows when it isn't raining; aka dry weather seasonal flow (pink)
- Rainfall dependant I&I, which is the difference between the measured total flow and the dry weather seasonal flow (black).

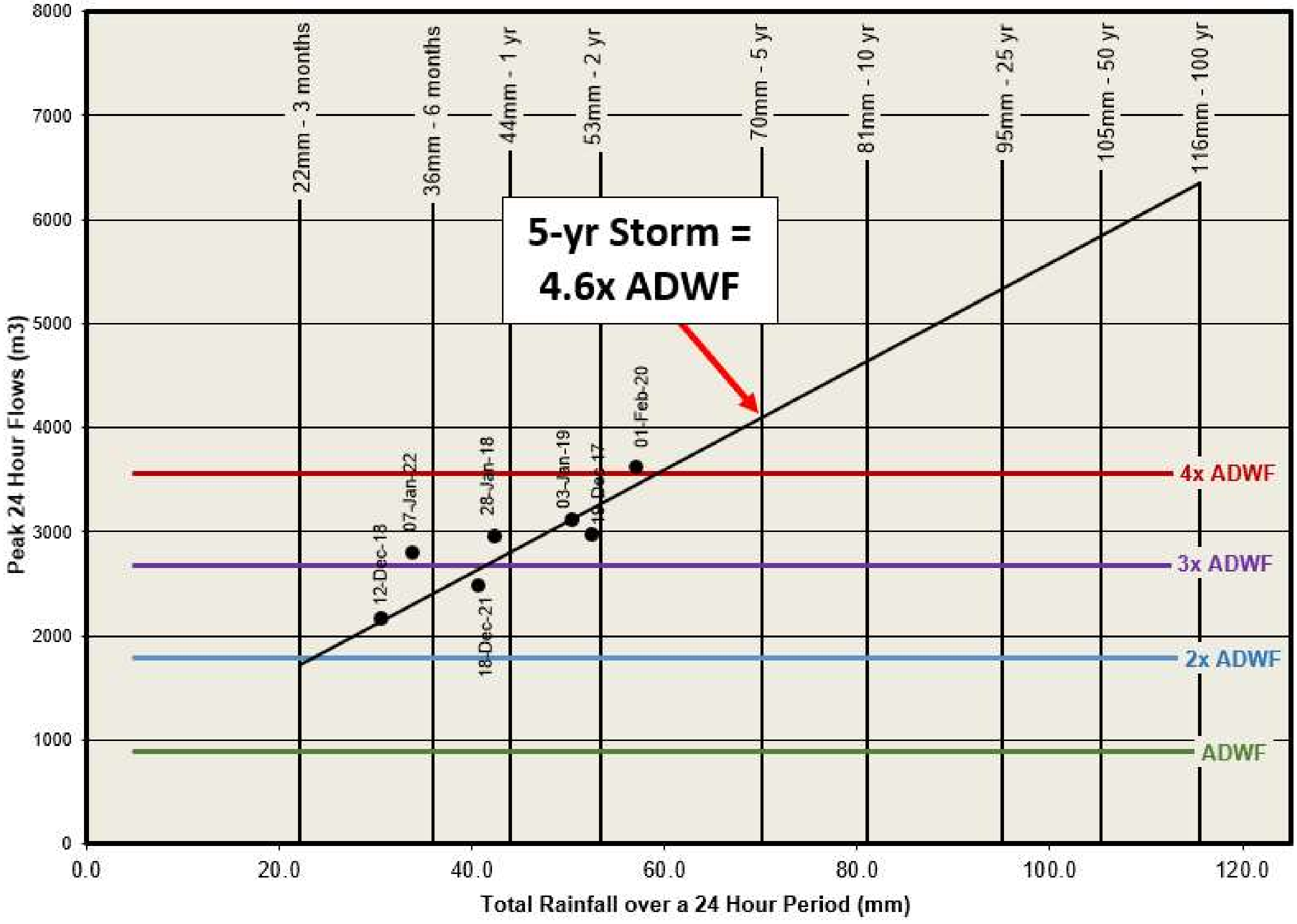
Figure 2.3: Example of a Hydrograph

Specialized Charts Showing Peak 24-hr Storm Event Flows vs Rainfall

These charts (example in Figure 2.4) are used to determine the expected 24-hour sewer flow for a 5-year storm. This metric allows I&I to be compared between sites, regardless of the storm events used. The charts contain the following attributes:

- The y-axis is peak 24-hour flow.
- The x-axis is peak 24-hour rainfall.
- The vertical lines show the 24-hour rainfall return periods based on the Environment Canada rain gauge at the Victoria International Airport.
- The dots represent individual storms based on peak 24-hour flow and rainfall.
- The colored horizontal lines show the ADWF, 2x ADWF, 3x ADWF and 4x ADWF.
- The diagonal line is a "best fit" line for dots. The point at which the horizontal line intersects with the 5-year rainfall return period line is the flow for a 5-year storm.

Figure 2.4: Example of Specialized Chart Showing Peak 24-hr Storm Event Flows vs Rainfall



Summary Table Comparing I&I Metrics Between Catchments

The summary table (example in Table 2.2) contains the following:

- Peak 24 hr flows for the statistical 5-year storm vs average dry weather flow. This metric allows comparisons to the following:
  - The Municipal Sewer Regulation, which requires municipalities to have a Liquid Waste Management Plan if their flows over 2x ADWF.
  - The Core Area I&I Management Plan, which contains a commitment for the municipalities to be below 4x ADWF by 2030.
- Peak 1 hr flow vs average dry weather flow. This metric shows how quickly I&I enters the sewer system during rain events. If this value is high, it could indicate significant cross connections in the catchment.
- Typical winter dry days vs ADWF. This metric shows how much more groundwater drains into the sewer in winter vs summer. It provides key insights to the "peak 24 hr flows vs ADWF" metric.
- Summer groundwater infiltration vs average dry weather flow. This metric is typically 85% of the minimum hourly flows in the summer.

Table 2.2: Summery of Key I&I Metrics

Catchment Name	Size (ha)	I&I For A 5-yr Storm		Typical Winter Dry Day Flow vs ADWF (summer)	Summer GWI as a % of ADWF
		Peak 24hr Flow vs ADWF	Peak 1hr Flow vs ADWF		
Catchment 1	85	4.4 x ADWF	6.9 x ADWF	1.6 x ADWF	17% of ADWF
Catchment 2	15	2.7 x ADWF	3.8 x ADWF	1.0 x ADWF	21% of ADWF
Catchment 3	38	3.5 x ADWF	5.6 x ADWF	1.3 x ADWF	16% of ADWF

3 Central Saanich

3.1 Overview

I&I management plans require sewer flow data to assess and rank catchments for I&I and to quantify the effectiveness of I&I reduction work. Prior to 2020, Central Saanich had minimal sewer flow data. The focus of this initial I&I Management Plan was to establish long-term flow monitoring catchments for the municipality, generate sewer flow data for these catchments, and analyze the data for I&I. This report is considered a foundational first step towards I&I management that can be built upon in future years.

For context, the following table summarizes some of the key I&I benchmarks for the municipality.

Table 3.1: Key I&I Benchmarks

Key I&I Benchmarks *(for 5-year storms)*	Status
Municipality has I&I related overflows?	No
Municipal I&I contributes to downstream CRD overflows?	No
Municipality exceeds its flow allocations into the CRD trunk sewer system?	No
Existing flow metering sites (PS's, CRD billing meters, etc.) are sufficient to cover the municipality with suitably sized I&I management plan catchments?	Yes, but flow data needs improvement
Number of catchments exceeding 4x average dry weather flow (ADWF) [1]	6 of 16

[1] Catchments >4x ADWF warrant further examination as they exceed the key I&I commitment in the Core Area LWMP.

3.2 Establishing Long Term Sewer Monitoring Catchments

Central Saanich's long-term I&I catchments were established based on its municipal pump stations and existing permanent CRD flow meters (i.e. billing meters). These catchments provide adequate I&I monitoring coverage for Central Saanich's sewer system. Three of the catchments exceed the recommended 100 ha maximum catchment size but this isn't a problem for the following reasons:

- The Brentwood catchment is only slightly greater than 100 ha., which is close enough to 100 ha to be considered reasonable. In addition, the Brentwood catchment has nested catchments, which can be subtracted to get below the 100-ha threshold. For example:

"Brentwood Remainder" (81 ha) = Brentwood (114 ha) - Delamere (9 ha) - Butchart (24 ha)

- The "Hagan Remainder" catchment is 114 ha, which is close enough to 100 ha to be considered reasonable.
- The "Keating Remainder" catchment is large at 250 ha. However, it has very low I&I and won't be worth sub-dividing unless warranted by higher I&I rates in the future.

Appendix D includes a map of the municipality showing all the municipal catchments along with individual catchment maps for each catchment.

3.3 I&I Analyses

The flow generated from the municipal pump stations is suitable for I&I analyses only. For reasons documented in Section 2.3, the pattern of the flow data is reliable, but the magnitude of the data is not. As such, I&I analyses was limited to comparisons of wet weather flow to average dry weather flow (ADWF), which is useful for understanding I&I in a municipality. Table 3.2 summarizes the results of the I&I analyses. The key metric from this table, the "peak 24- hour flow vs ADWF" metric. This metric is summarized on a map of the Saanich Peninsula in Figure 8.1.

Table 3.2: Summary of I&I Analyses Results

Pump Station	Size (ha)	I&I Analyses			
		Peak 24hr Flow vs ADWF	Peak 1hr Flow vs ADWF	Typical Winter Dry Day Flow vs Summer ADWF	Summer Groundwater Expressed as a % of ADWF
Arthur PS	7.8	5.0 x ADWF	7.4 x ADWF	1.2 x ADWF	35% of ADWF
Brentwood PS	113.6	5.5 x ADWF	14.2 x ADWF	1.3 x ADWF	16% of ADWF
Butchart PS	23.6	4.9 x ADWF	7.3 x ADWF	2.1 x ADWF	23% of ADWF
Butler PS	10.6	Minimal I&I		0.6 x ADWF	28% of ADWF
Central PS	11.5	2.6 x ADWF	4.0 x ADWF	0.9 x ADWF	28% of ADWF
Cultra PS	2.3	No measurable I&I		0.6 x ADWF	30% of ADWF
Delemere PS	8.8	5.2 x ADWF	7.4 x ADWF	1.2 x ADWF	16% of ADWF
Hagan PS	234.0	5.3 x ADWF	10.4 x ADWF	2.1 x ADWF	16% of ADWF
Holm PS	8.0	6.2 x ADWF	10.5 x ADWF	1.7 x ADWF	41% of ADWF
Keating PS	4.8	1.8 x ADWF	3.5 x ADWF	1.1 x ADWF	18% of ADWF
Kirkpatrick PS	13.7	3.3 x ADWF	5.6 x ADWF	1.3 x ADWF	35% of ADWF
Lancelot PS	6.1	No measurable I&I		0.9 x ADWF	20% of ADWF
Newton PS	3.8	n/a	n/a	n/a	n/a
Silverdale PS	6.2	2.8 x ADWF	5.9 x ADWF	1.9 x ADWF	23% of ADWF
CRD Keating PS	328.7	3.3 x ADWF	4.4 x ADWF	1.4 x ADWF	14% of ADWF
CRD Turgoose PS	34.1	2.3 x ADWF	4.0 x ADWF	1.2 x ADWF	19% of ADWF
SPWWTP Mag Meter #1	919.3	4.0 x ADWF	5.2 x ADWF	1.4 x ADWF	25% of ADWF

Supporting data for Central Saanich's I&I analyses can be found in Appendix D, which includes:

- A map of the municipality showing all the municipal catchments
- A summary table documenting key catchment stats for each catchment (i.e., pipe length, number of manholes, pipe type, and land use)
- A section for each individual catchment that includes:
    - catchment map

    - 10-day hydrographs charting sewer flows and rainfall for large storms
    - specialized chart used to quantify the peak 24-hour flow for a 5-year storm
    - specialized chart used to quantify the peak 1 hour I&I for a 5-year storm.

Key takeaways from the I&I analyses include:

- The municipality has low to moderate I&I.
- Large areas of the municipality have low I&I including the SPWWTP Mag Meter #1 (919 ha) and the CRD Keating PS (328.7 ha).
- Moderate I&I is found in the greater Hagan PS catchment. However, this I&I is typical given the age of the sewers pipes which were installed as early as the 1960's.
- During some large storms the Brentwood PS has high peak 1hr flows.
- Due to data quality issues, the I&I analyses was limited to comparisons to average dry weather flow (ADWF). However, the results of this analyses are useful and appear reliable.
- If the quality of the flow data is improved in the future (Section 3.4), additional I&I analyses could be completed including quantitative metrics (l/ha/day, m3/day, etc.).

3.4 Assessment of the Flow Data / Recommendations for Improvement

Before using sewer flow data, it's important to understand the source of the data and its level of accuracy as even the most accurate of meters can produce poor data if installed incorrectly.

Most of the flow data used for this report was generated from municipal pump station SCADA data. The method used is summarized in Section 2.2. Appendixes B and C contain consultant memos detailing how the flow data from each site was generated and assessed. It also contains recommendations for improving the data in the future.

Of note, the flow data from all sites is impacted by the Peninsula SCADA system polling frequency, which polls pump stations approximately every 45 seconds to 5 minutes and can only record the data that it sees at the time of polling. This is substantially less accurate than "event based" SCADA systems, where the events (i.e. pump starts/stops) are timestamped at the exact time that they happen. This issue can be addressed through one of the following options:

- Installing dataloggers with modems in the pump station kiosk to accurately log the data (~$5000 each, plus installation costs and a monthly cellular fee for each modem); or

- Upgrading the Peninsula SCADA system to enable the logging of “event based” data (~$8000/pump station plus system upgrade costs.) Of note, the Peninsula SCADA system is out of date and its SCADA packs are no longer sold or supported by the manufacturer. Upgrading the SCADA system, which the CRD has recommended in the past, would also bring the Peninsula SCADA system it in line with what’s been used in the Core Area since 2008.

For either approach, it’s recommended that the data be sent wirelessly to FlowWorks.com (~$35/site/month), to convert the SCADA data to flow data. The calculations are already setup and were used to generate the flow data for this report. (FlowWorks.com has easy to program, purpose-built tools designed for viewing and analyzing municipal sewer flow data in real-time.)

In addition, some pump stations require an engineering exercise to accurately calculate the fill cycle volume. This relates to pump stations whose inlet pipes backup during pump station fill cycles. It also applies to pump stations with storage tanks.

Table 3.3 summarizes the results of the flow data assessments and recommendations. By addressing these issues, the flow data would be dramatically improved making the data sufficient for sewer capacity related decisions, sewer models, and quantified I&I analyses (l/s, l/ha/day, etc.).

Table 3.3: Assessment of Flow Data Summary

Group No.	Flow Data Issue	Meter Grouping	Notes/Discussion/Solution
1	SCADA Polling Frequency Issue	Butler *(10.6 ha)* Central *(11.5 ha)* Holm *(8.0 ha)* Keating *(4.8 ha)* Kirkpatrick *(13.7 ha)* Lancelot *(6.1ha)*	Time stamp issue: Can be addressed by installing dataloggers or upgrading the SCADA system.
2	SCADA Polling Frequency Issue + Unknown fill volume due to inlet pipes that back up during the wetwell fill cycle	Arthur *(7.8 ha)* Delamere *(8.8 ha)*	Time stamp issue: Can be addressed by installing dataloggers or upgrading the SCADA system.
		Silverdale *(6.2 ha)*	The fill volume issue could be addressed by building a lookup table of "wetwell levels to wetwell volumes" that incorporates backup in the inlet pipe during the wetwell fill cycle. Potentially, this is a straightforward desktop exercise based on as-built drawings. The information could also be collected through a site visit.
3	Issues from Group 2 + Could be more complex because these PS's also have storage tanks	Brentwood *(113.6)*	Time stamp issue: Can be addressed by installing dataloggers or upgrading the SCADA system.
		Butchart *(23.6 ha)*	A small desktop exercise (i.e. as-built review) or site visit should be carried out to determine if a simple method for determining the fill cycle volume is possible. If not, options other options

Group No.	Flow Data Issue	Meter Grouping	Notes/Discussion/Solution
			should be considered (custom solutions, permanent flow meters, etc.)
4	Issues from Group 2 + Multiple pumps running at same time during storm events	Hagan *(234.0 ha)*	This is a complex site that would likely require a sewer flow meter to address.
5	N/A, Catchment Too Small	Cultra *(2.3 ha)*	These catchments are very small and less useful for I&I studies, sewer modelling, capacity studies, etc.
		Newton *(3.8 ha)*	

3.5 Overflows

The Central Saanich sanitary system has not experienced I&I attributed overflows. All stations are fitted with SCADA for water level reporting through automated alarm dispatch to Duty On-Call staff. High sewage level response procedures are in place, trucked bypass pumping is routinely actioned where necessary. Of note, the three Lift Stations on the Tsartlip First Nation system are not fitted with SCADA. Two of the stations are maintained by CS, emergency or after-hour calls are received by phone call or dispatch.

3.6 Municipal I&I Related Work

General I&I program components for the municipality are summarized in Table 3.4.

Table 3.4: Snapshot of Current I&I Related Actions

I&I Program Component	Description
Flow Metering	• 10 pump stations with SCADA derived data (flow data only suitable for I&I analyses) • 3 permanent CRD flow meters.
Sewer Master Plan	• Created in 2015 (will be updated in 2025)
Sewer Model	• Created in 2015 (will be updated in 2025)
Camera Inspections	• New sewers upon installation • Approximately every 7 years thereafter
Private Property I&I Program	• All new sewer lateral connections since 2007 have inspection chambers. • The municipality doesn't have a specific program for private property I&I because I&I is relatively low throughout the municipality.
Asset Management	• Preliminary asset management plans have been created and continue to expand

In 2024, Central Saanich initiated a major capital project for the renewal and optimization of the original sanitary system in Brentwood Bay. The work will greatly reduce the potential for accidental overflows to the environment should system failure occur. The project includes:

- replacement of ~700m of existing sanitary mains, which were installed as part of the original system;
- adding inspection chambers to the connections of the replaced sewer mains;
- installation of 3000m of new sanitary forcemain allowing for abandonment of the original forcemain;
- construction of a single large sanitary pump station to replace two ageing pump stations (Hagan and Brentwood);
- upgrading the Silverdale pump station with increased capacity; and
- replacement and rerouting of sections of gravity mains for optimization.

Central Saanich I&I Reduction program includes:

- 300 manhole condition inspections conducted annually, defects noted and corrected.
- 15 km of CCTV inspection conducted annually with defects corrected. (The last cycle was completed in 2021 and the next cycle is planned to start in 2025.)
- From 2006 and 2015, smoke testing was conducted on older areas of the sewer system including the Keating industrial area. (Annual smoke testing is not conducted on a recurring basis.)

3.7 Next Steps

The key recommended next steps for Central Saanich include:

- Carry out the recommendations to improve the flow data quality from their pump stations (i.e. timestamp issue at 11 sites and wetwell volume issues at five sites).
- Map the municipality’s potential sewer overflow locations (which may or may not actually overflow) and consider installing level sensors when appropriate. Document the results of the process.
- Review catchments with elevated I&I. Confirm whether investigation data (i.e. camera inspection data, smoke testing) is available to help identify the sources of the I&I. If not, decide if it is worth collecting this investigation data and scheduling the work. Document the results of the process.
- Support the update of this report at 5-year intervals.
- Central Saanich monitors and maintains two Tsartlip FN Lift Stations. It is known that the Tsartlip sanitary system does experience very high I&I. Efforts are ongoing to assist with identifying defects.
- Carrying out the actions noted in the Sewer Master Plan.

4 North Saanich

4.1 Overview

I&I management plans require sewer flow data to assess and rank catchments for I&I and to quantify the effectiveness of I&I reduction work. Prior to 2020, North Saanich had minimal sewer flow data. The focus of this initial I&I Management Plan was to establish long-term flow monitoring catchments for the municipality, generate sewer flow data for these catchments, and analyse the data for I&I. This report is considered a foundational first step towards I&I management that can be built upon in future years.

For context, the following table summarizes some of the key I&I benchmarks for the municipality.

Table 4.1: Key I&I Benchmarks

Key I&I Benchmarks *(for 5-year storms)*	Status
Municipality has I&I related overflows?	No
Municipal I&I contributes to downstream CRD overflows?	No
Municipality exceeds its flow allocations into the CRD trunk sewer system?	No
Existing flow metering sites (PS's, CRD billing meters, etc.) are sufficient to cover the municipality with suitably sized I&I management plan catchments?	Yes, but flow data improvement needs improvement
Number of catchments exceeding 4x average dry weather flow (ADWF) [1]	4 of 14

[1] Catchments >4x ADWF warrant further examination as they exceed the key I&I commitment in the Core Area LWMP.

4.2 Establishing Long Term Sewer Monitoring Catchments

North Saanich's long-term I&I catchments were established based on its municipal pump stations and existing permanent CRD flow meters (i.e. billing meters). These catchments provide adequate I&I monitoring coverage for North Saanich's sewer system. Two of the catchments exceed the recommended 100 ha maximum catchment size but this isn't a problem for the following reasons:

- The Reay Creek catchment has nested catchments, which can be subtracted to get below the 100-ha threshold.

  "Reay Creek Remainder" (76 ha) = Reay Creek (162 ha) – Munro (74 ha) – Bazen Bay (12 ha)

- The Ebor catchment has nested catchments as well, which can be subtracted to get below the 100-ha threshold.

Appendix E includes A map of the municipality showing all the municipal catchments along with individual catchment maps for each catchment.

4.3 I&I Analyses

The flow generated from the municipal pump stations is suitable for I&I analyses only. For reasons documented in Section 2.3, the pattern of the flow data is reliable, but the magnitude of the data is not. As such, I&I analyses was limited to comparisons of wet weather flow to average dry weather flow (ADWF), which is useful for understanding I&I in a municipality. Table 4.2 summarizes the results of the I&I analyses. The key metric from this table, the "peak 24-hour flow vs ADWF" metric. This metric is summarized on a map of the Saanich Peninsula in Figure 8.1.

Table 4.2: Summary of I&I Analyses Results

Pump Station	Size (ha)	I&I Analyses			
		Peak 24hr Flow vs ADWF	Peak 1hr Flow vs ADWF	Typical Winter Dry Day Flow vs Summer ADWF	Summer Groundwater Expressed as a % of ADWF
SPWWTP Mag Meter #2	82.8	5.8 x ADWF	9.5 x ADWF	1.1 x ADWF	28% of ADWF
Amity	40.3	2.8 x ADWF	4.3 x ADWF	1.1 x ADWF	21% of ADWF
Bazen Bay	11.9	1.8 x ADWF	n/a	1.3 x ADWF	47% of ADWF
Cromar	43.6	3.7 x ADWF	4.8 x ADWF	1.2 x ADWF	17% of ADWF
Ebor	170.0	4.2 x ADWF	5.7 x ADWF	1.5 x ADWF	16% of ADWF
Marina	20.0	3.7 x ADWF	6.2 x ADWF	1.2 x ADWF	17% of ADWF
McDonald	48.5	Minimal I&I		1.2 x ADWF	19% of ADWF
Mills	84.5	4.4 x ADWF	6.9 x ADWF	1.0 x ADWF	17% of ADWF
Munro	74.2	3.9 x ADWF	6.7 x ADWF	1.2 x ADWF	17% of ADWF
Reay Creek	161.5	6.0 x ADWF	8.3 x ADWF	1.5 x ADWF	13% of ADWF
Towner	57.2	3.9 x ADWF	7.5 x ADWF	1.0 x ADWF	15% of ADWF
Trincomali	99.2	3.5 x ADWF	4.8 x ADWF	1.5 x ADWF	20% of ADWF
West Saanich	15.8	3.2 x ADWF	6.2 x ADWF	1.2 x ADWF	20% of ADWF
Parkland	1.6	Too small to analyze			

Supporting data for North Saanich's I&I analyses can be found in Appendix E, which includes:

- A map of the municipality showing all the municipal catchments
- A summary table documenting key catchment stats for each catchment (i.e., pipe length, number of manholes, pipe type, and land use)
- A section for each individual catchment that includes:
  - catchment map
  - 10-day hydrographs charting sewer flows and rainfall for large storms
  - specialized chart used to quantify the peak 24-hour flow for a 5-year storm
  - specialized chart used to quantify the peak 1 hour I&I for a 5-year storm.

Key takeaways from the I&I analyses include:

- The municipality has low to moderate I&I.
- Most of the municipality has low to moderate I&I.

- Two North Saanich catchments have elevated I&I which merit closer scrutiny in future:
    - The Reay Creek PS catchment has elevated peak 24-hour flows but comparatively moderate peak 1-hour flows. This indicates that the I&I is based more on infiltration than inflow. The source of the I&I appears to be Reay Creek Remainder, which is calculated as Reay Creek minus (Munro plus Bazen). Both Munro and Bazen have relatively low I&I so the I&I must come from Reay Creek Remainder.
    - The SPWWTP Mag Meter #2 (82 hectares) has elevated I&I and is worth looking into. *(Note that the flow data from this catchment is highly accurate and it's I&I results are reliable.)*
- Due to flow data quality issues, the I&I analyses was limited to comparisons to average dry weather flow (ADWF). However, the results of this analyses are useful and appear reliable.
- If the quality of the flow data is improved in the future (Section 4.4), additional I&I analyses could be completed including quantitative metrics (l/ha/day, m3/day, etc.).

4.4 Assessment of the Flow Data / Recommendations for Improvement

Before using sewer flow data, it's important to understand the source of the data and its level of accuracy as even the most accurate of meters can produce poor data if installed incorrectly.

Most of the flow data used for this report was generated from municipal pump station SCADA data. The method used is summarized in Section 2.2. Appendixes B and C contain consultant memos detailing how the flow data from each site was generated and assessed. It also contains recommendations for improving the data in the future.

Of note, the flow data from all sites is impacted by the Peninsula SCADA system polling frequency, which polls pump stations approximately every 45 seconds to 5 minutes and can only record the data that it sees at the time of polling. This is substantially less accurate than "event based" SCADA systems, where the events (i.e. pump starts/stops) are timestamped at the exact time that they happen. This issue can be addressed through one of the following options:

- Installing dataloggers with modems in the pump station kiosk to accurately log the data (~$5000 each, plus installation costs and a monthly cellular fee for each modem); or

- Upgrading the Peninsula SCADA system to enable the logging of "event based" data (~$8000/pump station plus system upgrade costs.) Of note, the Peninsula SCADA system is out of date and its SCADA packs are no longer sold or supported by the manufacturer. Upgrading the SCADA system, which the CRD has recommended in the past, would also bring the Peninsula SCADA system it in line with what's been used in the Core Area since 2008.

For either approach, it's recommended that the data be sent wirelessly to FlowWorks.com (~$35/site/month), to convert the SCADA data to flow data. The calculations are already setup and were used to generate the flow data for this report. (FlowWorks.com has easy to program, purpose-built tools designed for viewing and analyzing municipal sewer flow data in real-time.)

In addition, some pump stations require an engineering exercise to accurately calculate the fill cycle volume. This relates to pump stations whose inlet pipes backup during pump station fill cycles. It also applies to pump stations with storage tanks.

Table 4.3 summarizes the results of the flow data assessments and recommendations. By addressing these issues, the flow data would be dramatically improved making the data sufficient for sewer capacity related decisions, sewer models, and quantified I&I analyses (l/s, l/ha/day, etc.).

Table 4.3: Assessment of Flow Data Summary

Group No.	Flow Data Issue	Meter Grouping	Notes/Discussion/Solution
1	Excellent Flow Data, No Issues	Cromar *(43.6 ha)* Towner *(57.2 ha)* SPWWTP Mag Meter #2	These sites use DNP2 data collection and produce very good quality data
2	Locations with CRD Sewer Billing Meters whose Data Is Impacted by the SCADA Polling Frequency Issue	Amity Mag *(40.3 ha)* Ebor Flume *(169.5 ha)* McDonald Mag *(48.58 ha)* Reay Creek Mag *(161.5 ha)*	The CRD will address the issues at these billing meter sites by programming the kiosk to log hourly flows. This "simple fix" is only possible because these locations have existing flow meters (i.e., mag meters).
3	SCADA Polling Frequency Issue	Bazen Bay *(11.9 ha)* Deep Cove Marina *(20 ha)* Munro *(74.2 ha)* West Saanich *(15.8 ha)*	Time stamp issue: Can be addressed by installing dataloggers or upgrading the SCADA system.
4	SCADA Polling Frequency Issue + Unknown fill volume due to storage tanks	Mills *(84.5 ha)* Trincomali *(99.2 ha)*	Time stamp issue: Can be addressed by installing dataloggers or upgrading the SCADA system. The unknown fill volume may be more complex. A small desktop assessment should be completed to determine if the issue can be addressed by customizing the calculations to account for the storage tanks. If not, flow meters could be an option (mag meters, clamp-on meters, etc.)
5	N/A, Catchment Too Small	Parkland *(1.8 ha)*	These catchments are very small and less useful for I&I studies, sewer modelling, capacity studies, etc.

4.5 Overflows

North Saanich's sewer system doesn't overflow at its pump stations due to rain events and North Saanich isn't aware of any other locations that overflow. Overflows due to line failures are documented and reported.

4.6 Municipal I&I Related Work

General I&I program components for the municipality are summarized in the following table.

Table 4.4: Snapshot of Current I&I Related Actions

I&I Program Component	Description
Flow Metering	• 10 pump stations with SCADA derived data (flow data only suitable for I&I analyses) • 3 permanent CRD flow meters.
Sewer Master Plan	• Yes (completed in 2017) • An update is planned for 2025/26 following completion of North Saanich's official community plan.
Sewer Model	• Yes (completed in 2017) • An update is planned for 2025/26 following completion of North Saanich's official community plan.
Camera Inspections	• Planned to commence in 2025
Private Property I&I Program	• Nothing formal
Asset Management	• N/A

North Saanich's Sewer Master Plan indicated that an I&I reduction program was not warranted at the time of plan (2017). The main recommendations in the plan were to begin a CCTV program, commence an AC Gravity Main rehabilitation program in 2025, and assess and upgrade pump stations as conditions require.

4.7 Next Steps

The key recommended next steps for North Saanich include:

- Carry out the recommendations to improve the flow data quality from their pump stations (i.e. timestamp issue at 6 sites and wetwell volume issues at two sites).

- Map the municipality's potential sewer overflow locations (which may or may not actually overflow) and consider installing level sensors when appropriate. Document the results of the process.
- Review catchments with elevated I&I. Confirm whether investigation data (i.e. camera inspection data, smoke testing) is available to help identify the sources of the I&I. If not, decide if it is worth collecting this investigation data and scheduling the work. Document the results of the process.
- Support the update of this report at 5-year intervals.
- Continue with the actions documented in the Sewer Master Plan.

5 Sidney

5.1 Overview

I&I management plans require sewer flow data to assess and rank catchments for I&I and to quantify the effectiveness of I&I reduction work. Prior to 2020, Sidney had minimal sewer flow data. The focus of this initial I&I Management Plan was to establish long-term flow monitoring catchments for the municipality, generate sewer flow data for these catchments, and analyse the data for I&I. This report is considered a foundational first step towards I&I management that can be built upon in future years.

For context, the following table summarizes some of the key I&I benchmarks for the municipality.

Table 5.1: Key I&I Benchmarks

Key I&I Benchmarks *(for 5-year storms)*	Status
Municipality has I&I related overflows?	No
Municipal I&I contributes to downstream CRD overflows?	No
Municipality exceeds its flow allocations into the CRD trunk sewer system?	No
Existing flow metering sites (PS's, CRD billing meters, etc.) are sufficient to cover the municipality with suitably sized I&I management plan catchments?	No. Unfortunately, there is an 203 hectare area in Sidney that isn't covered by existing Sidney or CRD pump stations. To derive flow data for this area would require a few portable flow meters as ideally, I&I catchments would be under 100 hectares in size.
Number of catchments exceeding 4x average dry weather flow (ADWF) [1]	9 of 14

[1] *Catchments >4x ADWF warrant further examination as they exceed the key I&I commitment in the Core Area LWMP.*

5.2 Establishing Long Term Sewer Monitoring Catchments

Sidney's long-term I&I catchments were established based on its municipal pump stations and existing permanent CRD flow meters (i.e. billing meters). These catchments provide adequate I&I monitoring coverage for much of Sidney. The exception to this is a 203-hectare area called "Sidney PS Remainder", which would require ~2 temporary sewer flow meters address in the future.

Appendix F includes a map of the municipality showing all the municipal catchments along with individual catchment maps for each catchment.

5.3 I&I Analyses

The flow generated from the municipal pump stations is suitable for I&I analyses only. For reasons documented in Section 2.3, the pattern of the flow data is reliable, but the magnitude of the data is not. As such, I&I analyses was limited to comparisons of wet weather flow to average dry weather flow (ADWF), which is useful for understanding I&I in a municipality. Table 5.2 summarizes the results of the I&I analyses. The key metric from this table, the "peak 24- hour flow vs ADWF" metric. This metric is summarized on a map of the Saanich Peninsula in Figure 8.1.

Table 5.2: Summary of I&I Analyses Results

Pump Station	Size (ha)	I&I Analyses			
		Peak 24hr Flow vs ADWF	Peak 1hr Flow vs ADWF	Typical Winter Dry Day Flow vs Summer ADWF	Summer Groundwater Expressed as a % of ADWF
Allbay	2.8	6.0 x ADWF	9.7 x ADWF	0.3 x ADWF	21% of ADWF
Amelia	97.6	4.6 x ADWF	6.2 x ADWF	1.3 x ADWF	21% of ADWF
Ardwell	26.6	5.1 x ADWF	7.4 x ADWF	1.3 x ADWF	16% of ADWF
Beacon	0.1	Catchment too small for I&I Analyses			
Frost	3.4	6.2 x ADWF	10.1 x ADWF	2.5 x ADWF	31% of ADWF
Harbour	59.8	5.1 x ADWF	7.8 x ADWF	1.2 x ADWF	17% of ADWF
Latch	2.6	No measurable I&I		0.9 x ADWF	26% of ADWF
Lochside	4.5	13.1 x ADWF	20.4 x ADWF	1.4 x ADWF	26% of ADWF
Rothesay	23.8	9.3 x ADWF	12.2 x ADWF	1.8 x ADWF	24% of ADWF
Seaport	1.2	No measurable I&I		1.1 x ADWF	23% of ADWF
Summergate	11.3	5.2 x ADWF	8.2 x ADWF	2.2 x ADWF	19% of ADWF
Surfside	1.3	19.5 x ADWF	27.5 x ADWF	2.2 x ADWF	38% of ADWF
SPWWTP Mag Meter #3	685.9	5.2 x ADWF	8.2 x ADWF	1.5 x ADWF	26% of ADWF

Supporting data for Sidney's I&I analyses can be found in Appendix F, which includes:

- A map of the municipality showing all the municipal catchments
- A summary table documenting key catchment stats for each catchment (i.e., pipe length, number of manholes, pipe type, and land use)
- A section for each individual catchment that includes:
    - catchment map
    - 10-day hydrographs charting sewer flows and rainfall for large storms
    - specialized chart used to quantify the peak 24-hour flow for a 5-year storm
    - specialized chart used to quantify the peak 1 hour I&I for a 5-year storm.

Key takeaways from the I&I analyses include:

- The municipality has moderate I&I, which is inline with the age of the municipal sewers.
- The Lochside and Surfside catchments are very small but have substantial I&I. These should be investigated.
- The Rothesay catchment has high Peak 24 hour I&I. Some of this is due to the higher overall winter flows compared to summer flows, which could indicate that the catchment drains substantial groundwater during the winter.
- The All Bay Catchment has elevated flows, but the catchment is small, and the quality of the data is low. It should be reviewed further to determine if its worth investigating.
- The Summergate catchment's flows are typically much higher in the winter than in the summer. This should be looked into to determine why. Note that Summergate catchment sewers and pump station are private and not owned or maintained by Sidney.
- Due to issues flow data quality, the I&I analyses was limited to comparisons to average dry weather flow (ADWF). However, the results of this analyses are useful and appear reliable.
- If the quality of the flow data is improved in the future (Section 5.4), additional I&I analyses could be completed including quantitative metrics (l/ha/day, m3/day, etc.). The data would then also be useful for capacity related needs (capacity studies, sewer models, etc.).

5.4 Assessment of the Flow Data / Recommendations for Improvement

Before using sewer flow data, it's important to understand the source of the data and its level of accuracy as even the most accurate of meters can produce poor data if installed incorrectly.

Most of the flow data used for this report was generated from municipal pump station SCADA data. The method used is summarized in Section 2.3. Appendixes B and C contain consultant memos detailing how the flow data from each site was generated and assessed. It also contains recommendations for improving the data in the future.

Of note, the flow data from all sites is impacted by the Peninsula SCADA system polling frequency, which polls pump stations approximately every 45 seconds to 5 minutes and can only record the data that it sees at the time of polling. This is substantially less accurate than "event based" SCADA systems, where the events (i.e. pump starts/stops) are timestamped at the exact time that they happen. This issue can be addressed through one of the following options:

- Installing dataloggers with modems in the pump station kiosk to accurately log the data (~$5000 each, plus installation costs and a monthly cellular fee for each modem); or

- Upgrading the Peninsula SCADA system to enable the logging of "event based" data (~$8000/pump station plus system upgrade costs.) Of note, the Peninsula SCADA system is out of date and its SCADA packs are no longer sold or supported by the manufacturer. Upgrading the SCADA system, which the CRD has recommended in the past, would also bring the Peninsula SCADA system it in line with what's been used in the Core Area since 2008.

For either approach, it's recommended that the data be sent wirelessly to FlowWorks.com (~$35/site/month), to convert the SCADA data to flow data. The calculations are already setup and were used to generate the flow data for this report. (FlowWorks.com has easy to program, purpose-built tools designed for viewing and analyzing municipal sewer flow data in real-time.)

In addition, some pump stations require an engineering exercise to accurately calculate the fill cycle volume. This relates to pump stations whose inlet pipes backup during pump station fill cycles. It also applies to pump stations with storage tanks.

Table 5.3 summarizes the results of the flow data assessments and recommendations. By addressing these issues, the flow data would be dramatically improved making the data sufficient for sewer capacity related decisions, sewer models, and quantified I&I analyses (l/s, l/ha/day, etc.).

Table 5.3: Assessment of Flow Data Summary

Group No.	Flow Data Issue	Meter Grouping	Notes/Discussion/Solution
1	SCADA Polling Frequency Issue	Amelia *(97.6 ha)* Ardwell *(26.6 ha)* Harbour *(59.8 ha)* Rothesay *(23.8 ha)* Summergate *(11.3 ha)*	Time stamp issue: Can be addressed by installing dataloggers or upgrading the SCADA system.
2	SCADA Polling Frequency Issue (small catchments)	Allbay *(2.8 ha)* Latch *(2.6 ha)* Lochside *(4.5 ha)* Seaport *(1.2 ha)* Surfside *(1.3 ha)*	Time stamp issue: Can be addressed by installing dataloggers or upgrading the SCADA system. Normally, catchments of this size are too small to be useful. However, the flow data from these catchments looks surprisingly reasonable.
3	SCADA Polling Frequency Issue + Small Catchments + Unknown Fill Volume due to Storage Tank	Frost *(3.4 ha)*	Time stamp issue: Can be addressed by installing dataloggers or upgrading the SCADA system. If there is a need for flow data from this location, a small desktop assessment could be completed to determine the simplest way to address the issue, which could be as simple as building a fill cycle volume lookup table whose calculations incorporate the storage tank.
4	N/A Catchment Too Small	Beacon *(0.1 ha)*	Due to its small size, it’s not worth generating flow data for this site.
5	Excellent Flow Data	SPWWTP Mag Meter #3	No issues

5.5 Overflows

Sidney does not have known I&I related overflows. The only I&I related overflows on the Saanich Peninsula occurred during a 100 year rainfall event on November 15, 2021.

5.6 Municipal I&I Related Work

General I&I program components for the municipality are summarized in the following table.

Table 5.4: Snapshot of Current I&I Related Actions

I&I Program Component	Description
Flow Metering	• 10 pump stations with SCADA derived data (flow data only suitable for I&I analyses) • 3 permanent CRD flow meters.
Sewer Replacement Plan	• Yes (updated in 2024)
Sewer Model	• Yes (updated in 2024)
Camera Inspections	• New sewers • New sewers at 1 year (for third party installations) • All sewers every 5 years
Private Property I&I Program	• Inspection chambers installed on new sewer laterals, for redevelopment and at anytime a lateral requires repairs. • Inspection chambers installed on sewer laterals where smoke testing identifies I&I. • The municipality doesn't have a specific program for private property I&I
Asset Management	• Extensive, well established asset management program and infrastructure replacement plan. • Continue to update the Asset Management Plan as new data is collected.

Sidney's past I&I related projects include a manhole grouting program, smoke testing programs, pipe relining and replacement projects. Efforts continue with pipe replacement and relining projects identified through Sidney's Asset Management plans. Sidney continues to work with private properties, including the installation of inspection chambers, to resolve I&I identified through smoke testing programs. Sidney has an annual sewer CCTV program, inspecting approximately one fifth of the municipality's sewer mains and manholes each year in efforts to identify sources of I&I. In 2024, Sidney updated its sewer model and will be updating its underground infrastructure replacement plans.

5.7 Next Steps

The key recommended next steps for Sidney include:

- Carry out the recommendations to improve the flow data quality from their pump stations (i.e. timestamp issue at 12 sites and wetwell volume issues at one site).
- Map the municipality's potential sewer overflow locations (which may or may not actually overflow) and consider installing level sensors when appropriate. Document the results of the process.
- Review catchments with elevated I&I. Confirm whether investigation data (i.e. camera inspection data, smoke testing) is available to help identify the sources of the I&I. If not, decide if it is worth collecting this investigation data and scheduling the work. Document the results of the process.
- Support the update of this report at 5-year intervals.
- Use portable flow meters to obtain flow data from the unmetered portion of Sidney.
- Continue with the actions noted in the Sewer Replacement Plan.

Table 6.1: Additional Flow Sites Assessed for I&I

Pump Station	Size	I&I Analyses			
		Peak 24hr Flow vs ADWF [1]	Peak 1hr Flow vs ADWF [1]	Typical Winter Dry Day Flow vs Summer ADWF	Summer Groundwater Expressed as a % of ADWF
	Ha				
SPWWTP Combined Inflow	1688.0	5 x ADWF	7.4 x ADWF	1.5 x ADWF	24% ADWF
Greater Victoria Airport Authority (PS#3)	71.0	8.4 x ADWF	13.4 x ADWF	1.6 x ADWF	22% of ADWF
Tseycum First Nation	10.1	7.2 x ADWF	9.8 x ADWF	1.5 x ADWF	20% of ADWF
BC Ferries	9.3	This catchment has no visible I&I.			

Institute of Ocean Sciences (IOS)	7.1	Peak 24 hours flows for a 5-year storm are around 10-15x ADWF, but this is largely due to the catchment's very low flows in summer, which is the basis of ADWF. In addition, the flow pattern in this catchment doesn't follow a consistent pattern and as such it doesn't lends itself well to I&I analyses.
Pauquachin First Nation	24.2	There's a moderate response to rainfall at this site of around 3.5x ADWF. However, the summer flow data varies between years and is not reliable enough to compare storm flows to ADWF.

Supporting information for the I&I analyses in included in Appendix G, which includes the following for each of the catchments in noted in the table above:

- catchment map
- 10-day hydrographs charting sewer flows and rainfall for large storms
- specialized chart used to quantify the peak 24-hour flow for a 5-year storm
- specialized chart used to quantify the peak 1 hour I&I for a 5-year storm.

6 First Nations, Airport, BC Ferries and IOS I&I

The focus of this report is I&I from the Saanich Peninsula municipalities. However, since flow data from some other existing flow meters was already available, it was also analyzed for I&I (Figure 6.1). The key metric from this table, the "peak 24- hour flow vs ADWF" metric whose results are summarized on a map of the Saanich Peninsula in Figure 8.1. Note that the flow data from these meters is impacted by the "SCADA timestamp" issue noted in Section 2.3. Being that each of these sites have existing magnetic flow meters, the issue can be resolved through a few hours of programming at each pump station kiosk. The CRD has implemented a project to address this issue in 2024.

Table 6.1: Additional Flow Sites Assessed for I&I

Pump Station	Size	I&I Analyses			
	Ha	Peak 24hr Flow vs ADWF [1]	Peak 1hr Flow vs ADWF [1]	Typical Winter Dry Day Flow vs Summer ADWF	Summer Groundwater Expressed as a % of ADWF
SPWWTP Combined Inflow	1688.0	5 x ADWF	7.4 x ADWF	1.5 x ADWF	24% ADWF
Greater Victoria Airport Authority (PS#3)	71.0	8.4 x ADWF	13.4 x ADWF	1.6 x ADWF	22% of ADWF
Tseycum First Nation	10.1	7.2 x ADWF	9.8 x ADWF	1.5 x ADWF	20% of ADWF
BC Ferries	9.3	This catchment has no visible I&I.			
Institute of Ocean Sciences (IOS)	7.1	Peak 24 hours flows for a 5-year storm are around **10-15x ADWF**, but this is largely due to the catchment's very low flows in summer, which is the basis of ADWF. In addition, the flow pattern in this			

		catchment doesn’t follow a consistent pattern and as such it doesn’t lends itself well to I&I analyses.
Pauquachin First Nation	24.2	There’s a moderate response to rainfall at this site of around 3.5x ADWF. However, the summer flow data varies between years and is not reliable enough to compare storm flows to ADWF.

Supporting information for the I&I analyses in included in Appendix G, which includes the following for each of the catchments in noted in the table above:

- catchment map
- 10-day hydrographs charting sewer flows and rainfall for large storms
- specialized chart used to quantify the peak 24-hour flow for a 5-year storm
- specialized chart used to quantify the peak 1 hour I&I for a 5-year storm.

7 Private Property I&I

7.1 Overview

By length, approximately 40% of the total length of the sewer system is composed of private property laterals. Property owners own and are responsible for the maintenance of their private property laterals. However, proactive inspection, maintenance and repair is rare. Property owners generally don't inspect or repair their laterals unless there has been a pipe failure or blockage has occurred. This is significant because studies show that approximately half of all I&I originates on private property.

Private property I&I (PPI&I) is not always a problem. PPI&I is generally an issue in catchments with old sewers and correspondingly high overall I&I. PPI&I may not be an issue in young sewers with correspondingly low I&I. Note, however, that cross-connections (i.e. roof drains connected to sewer) can contribute massive I&I, no matter what the age or overall condition of the sewer system.

7.2 Public's Understanding of the Issue

Property owners are generally aware of their responsibility to maintain their laterals and perimeter drains, however, they rarely think about their underground pipes, until they have a problem. They are aware that plumbers can inspect their laterals but are put off by the cost (i.e. $250) and potentially large repair cost (i.e. $1,200 to $20,000). Generally, property owners only get their pipes inspected if dealing with a plumbing problem (i.e. poor drainage rates, damp basement, basement flooding).

7.3 Education Approaches

Most municipalities do not have education initiatives focused on private property I&I. The small number that do encourage homeowners to inspect and repair their pipes to help reduce I&I and prevent overflows. Homeowners generally aren't interested in this type of education and recognize that it will costs them money to inspect and maintain their pipes but the benefits (i.e. lower I&I & overflows) go to the municipalities.

To address this, the Core Area I&I Program prepared education materials with the same end goal, to encourage pipe inspection and repair, but with a focus on "preventing basement flooding", which is more in the self interest of homeowners. The approach was developed in collaboration with professional groups that homeowners trust (i.e. Realtor Association, plumbers, home inspectors, insurance industry). These materials, along with traditional private property education materials, can be found at www.crd.bc.ca/pipes.

"Focused voluntary education approaches" can also be developed to address specific issues. Sometimes this is done in combination with municipal rebates/grant programs. For example, in areas where municipal sewers routinely surcharge causing basement flooding (i.e. areas with combined sewers), some municipalities have specific programs encouraging homeowners to install backflow preventers on their sewer laterals to prevent flooding. The education may also include municipal rebates/grants to help pay for the work.

Despite the best intentions, the effectiveness of all voluntary I&I education approaches is hindered by the high costs of pipe inspection and repair.

7.4 Effective Municipal Private Property I&I Programs are Rare

In North America, it's difficult to implement programs that significantly reduce private property I&I (i.e. measured reductions in I&I) for the following reasons:

1) These programs are rare. There are currently no such programs in Canada. The ~40 such programs that exist in the USA were mandated by the Environmental Protection Agency. (The exception to this are programs in municipalities with combined sewers.)
2) The work is expensive. Pipe inspections cost ~$250 and fixes typically cost in the thousands of dollars.
3) Municipalities face potential liability / risks related to private property I&I initiatives.
4) Municipalities face tough decisions for how they prioritize their finite municipalities resources (i.e. staff time, tax dollars).
5) The issue is complicated. For example:
    - I&I rates vary substantially within municipalities and across the region. In some areas, I&I may not even be a problem. Generally speaking, I&I tends to be low in catchments with young sewers and high in catchments with old sewers.
    - Fixing cross-connections is the most efficient way to address private property I&I but finding them is complex and time consuming.
    - Voluntary approaches generally have very little uptake.

- Effective approaches (i.e. requiring lateral inspection and fixes at time of sales) have the unintended downside of impacting all properties, not just the ones contributing to the problem.

7.5 Private Property I&I Programs from Around North America

In 2012, the Core Area I&I program commissions a report to document the various private property I&I programs from around North America. The report was subsequently updated in 2014 and again in 2022. Of note, significant efforts were made to find Canadian examples for municipalities with separated sewers. In general, the Canadian examples were limited to a small number of municipalities that require lateral inspections/maintenance as part of building permit applications over a certain dollar amount (i.e. $150,000). A copy of the most recent version of the report is located in Appendix H.

7.6 "Strong" Private Property I&I Programs are Difficult to Implement

In the early to mid 2010's, King County (Washington State) and Metro Vancouver tried to require their member municipalities to voluntarily implement bylaws requiring sewer lateral fixes during real estate transactions. Up to that point, highly effective programs of this nature had only been implemented when mandated by the US Environmental Protection Agency. After 5 years of planning, the King County approach was shelved weeks prior to implementation due to pressure from interest groups. Metro Vancouver's requirement for its municipalities to adopt this type of program was ignored. The lesson learned was that "strong" private property I&I programs don't survive politically unless mandated by regulators.

7.7 Efforts in the Core Area

For the reasons noted earlier in Section 7, it's very difficult to implement programs to address private property I&I. Since the early 2000's, the Core Area I&I Program held countless meetings on the topic, reviewed all potential options, commissioned reports to see what's used around North America, presented to realtors and home inspectors and held workshops for experts / politicians. The work was loosely coordinated with Metro Vancouver and in was in alignment with consultant recommendations. Despite the considerable efforts, minimal progress was made.

Metro Vancouver has recently made some progress on the topic by offering its member municipalities the two types of bylaw options for addressing private property I&I (each must adopt one):

- Requiring sewer laterals be inspected and fixed as part of building permits over a certain dollar amount.
- Adjusting sewer tax rates based on the age of the home; with reduced rates if the lateral has been replaced or proven through a camera inspection of being in good condition.

The Metro Vancouver municipalities appear to be okay with these options and some have already adopted the options into their bylaws. The Core Area I&I Program expects to follow the same path.

8 Closing

This initial I&I Management Plan for the Saanich Peninsula focused on setting up sewer catchments and high level I&I analyses. The plan is considered a first step that can be built upon in the future with updates recommended at 5-year intervals.

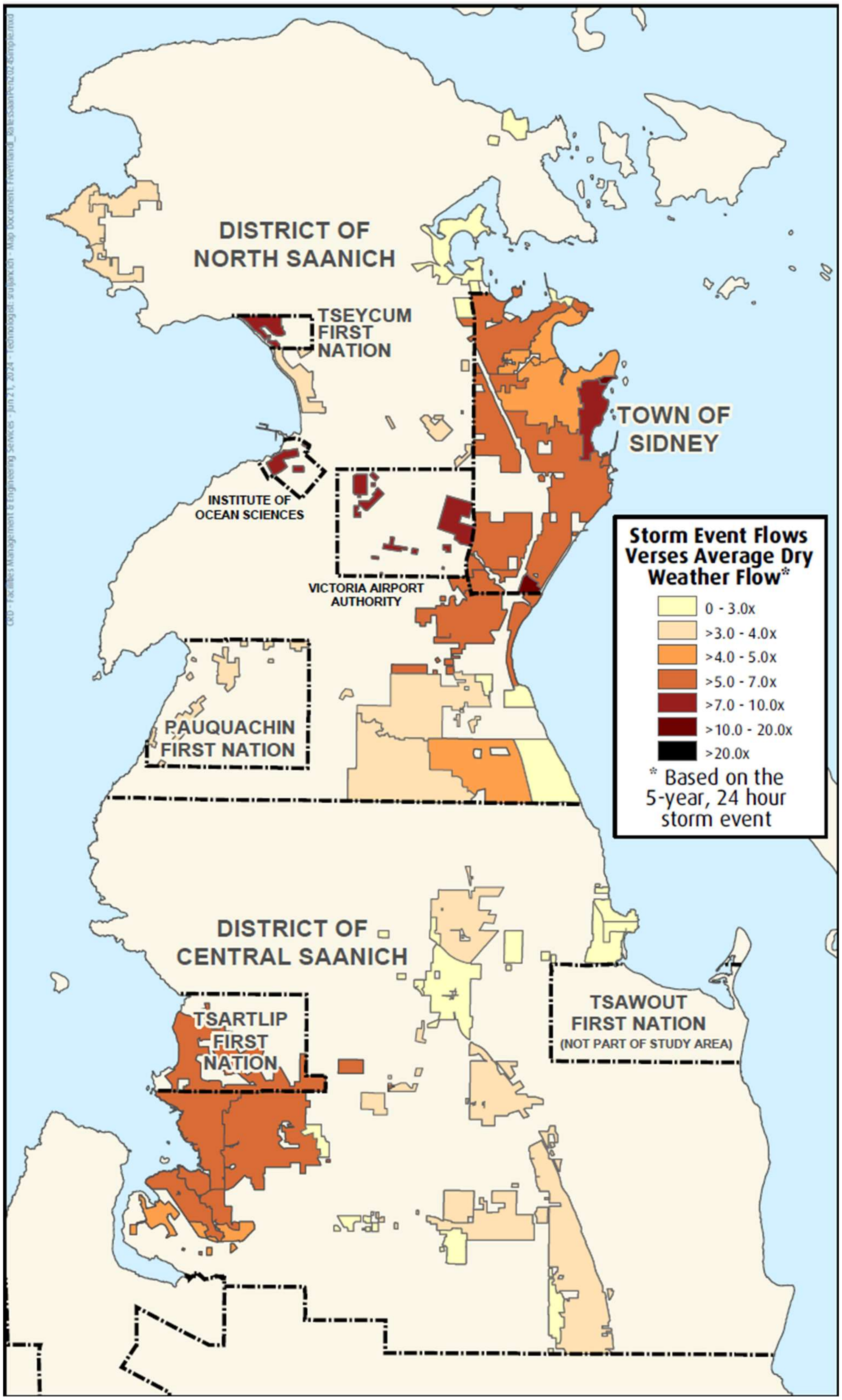
For this report, data from 44 sites was generated and analyzed. The key metric for the analyses was the "peak 24hr flow vs average dry weather flow (ADWF) metric; the results of which are summarized on a map in Figure 8.1. For reference, this is also the key the I&I commitment in the Core Area LWMP; to be below 4x ADWF by 2030.

The key recommended actions moving forward include:

- Municipalities to carry out the recommendations to improve the flow data quality from their pump stations (i.e. timestamp issue at 33 sites and wetwell volume issues at 8 sites). This would result in future data being useful for both I&I analyses and for municipal engineers (i.e. capacity studies, sewer modeling). The timestamp issues can be addressed by either:
    - Installing dataloggers with modems in the pump station kiosk to accurately log the data (~$5000 each, plus installation costs and a monthly cellular fee for each modem); or
    - Upgrading the Peninsula SCADA system to enable the logging of "event based" data (~$8000/pump station plus system upgrade costs.) Of note, the Peninsula SCADA system is out of date and its SCADA packs are no longer sold or supported by the manufacturer. Upgrading the SCADA system, which the CRD staff have recommended in the past, would also bring the Peninsula SCADA system it in line with what's been used in the Core Area since 2008.
- CRD are to carry out the recommendations to improve the flow data quality from 9 billing meter sites and two additional CRD pump stations. This option is relatively inexpensive (~$1000 per site) as each site already has a purpose-built flow meter (i.e., magnetic flow meter).
- Municipalities to map their potential sewer overflow locations (which may or may not actually overflow) and consider installing level sensors when appropriate. Document the results of the process.

- Municipalities to review catchments with elevated I&I. Confirm whether investigation data (i.e. camera inspection data, smoke testing) is available to help identify the sources of the I&I. If not, decide if it is worth collecting this investigation data and scheduling the work. Document the results of the process.
- The CRD to conduct follow-up I&I analyses prior to the 5-year update of this plan and to provide I&I related support to the municipalities as appropriate (funding dependant).
- Update this report at 5-year intervals.

Figure 8.1: Summary of I&I Rates for the Saanich Peninsula

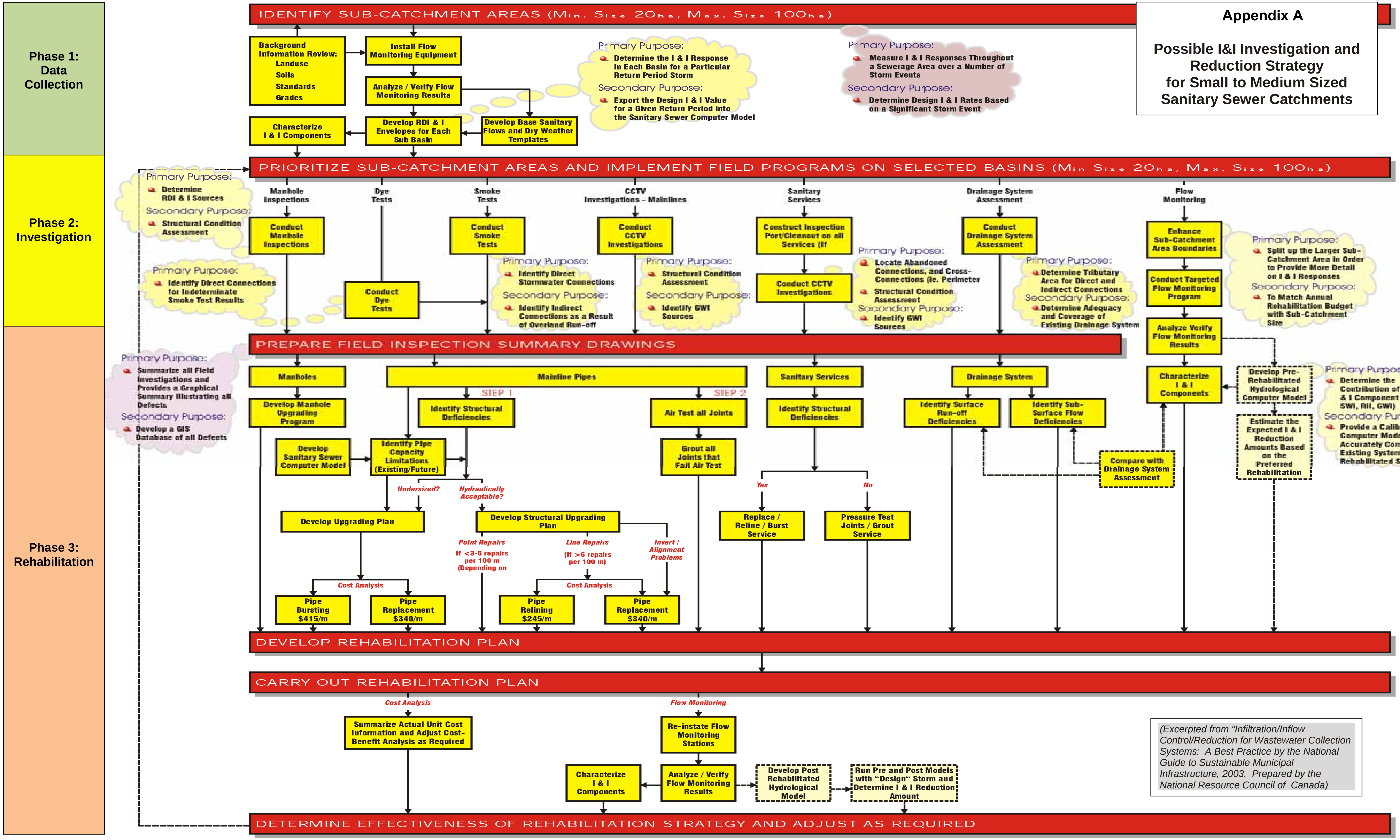


Appendix A:

Best Management Practice Flow Chart for I&I Programs

Appendix A

Possible I&I Investigation and Reduction Strategy for Small to Medium Sized Sanitary Sewer Catchments



Phase 1: Data Collection

IDENTIFY SUB-CATCHMENT AREAS (Min. Size 20ha, Max. Size 100ha)

- Background Information Review:
  - Landuse
  - Soils
  - Standards
  - Grades
- Install Flow Monitoring Equipment
- Analyze / Verify Flow Monitoring Results
- Develop Base Sanitary Flows and Dry Weather Templates
- Develop RDI & I Envelopes for Each Sub Basin
- Characterize I & I Components

Primary Purpose:
- Determine the I & I Response in Each Basin for a Particular Return Period Storm

Secondary Purpose:
- Export the Design I & I Value for a Given Return Period into the Sanitary Sewer Computer Model

Primary Purpose:
- Measure I & I Responses Throughout a Sewerage Area over a Number of Storm Events

Secondary Purpose:
- Determine Design I & I Rates Based on a Significant Storm Event

Phase 2: Investigation

PRIORITIZE SUB-CATCHMENT AREAS AND IMPLEMENT FIELD PROGRAMS ON SELECTED BASINS (Min Size 20ha, Max. Size 100ha)

Primary Purpose:
- Determine RDI & I Sources

Secondary Purpose:
- Structural Condition Assessment

Manhole Inspections
- Conduct Manhole Inspections

Dye Tests
- Conduct Dye Tests

Primary Purpose:
- Identify Direct Connections for Indeterminate Smoke Test Results

Smoke Tests
- Conduct Smoke Tests

Primary Purpose:
- Identify Direct Stormwater Connections

Secondary Purpose:
- Identify Indirect Connections as a Result of Overland Run-off

CCTV Investigations - Mainlines
- Conduct CCTV Investigations

Primary Purpose:
- Structural Condition Assessment

Secondary Purpose:
- Identify GWI Sources

Sanitary Services
- Construct Inspection Port/Cleanout on all Services (If
- Conduct CCTV Investigations

Primary Purpose:
- Locate Abandoned Connections, and Cross-Connections (ie. Perimeter
- Structural Condition Assessment

Secondary Purpose:
- Identify GWI Sources

Drainage System Assessment
- Conduct Drainage System Assessment

Primary Purpose:
- Determine Tributary Area for Direct and Indirect Connections

Secondary Purpose:
- Determine Adequacy and Coverage of Existing Drainage System

Flow Monitoring
- Enhance Sub-Catchment Area Boundaries
- Conduct Targeted Flow Monitoring Program
- Analyze Verify Flow Monitoring Results
- Characterize I & I Components

Primary Purpose:
- Split up the Larger Sub-Catchment Area in Order to Provide More Detail on I & I Responses

Secondary Purpose:
- To Match Annual Rehabilitation Budget with Sub-Catchment Size

- Develop Pre-Rehabilitated Hydrological Computer Model
- Estimate the Expected I & I Reduction Amounts Based on the Preferred Rehabilitation

Primary Purpose:
- Determine the Contribution of Each I & I Component (ie. SWI, RII, GWI)

Secondary Purpose:
- Provide a Calibrated Computer Model to Accurately Compare the Existing System to the Rehabilitated System

Phase 3: Rehabilitation

PREPARE FIELD INSPECTION SUMMARY DRAWINGS

Primary Purpose:
- Summarize all Field Investigations and Provides a Graphical Summary Illustrating all Defects

Secondary Purpose:
- Develop a GIS Database of all Defects

Manholes
- Develop Manhole Upgrading Program

Mainline Pipes
- Develop Sanitary Sewer Computer Model
- Identify Pipe Capacity Limitations (Existing/Future)
- STEP 1: Identify Structural Deficiencies
- Undersized? → Develop Upgrading Plan → Cost Analysis → Pipe Bursting $415/m; Pipe Replacement $340/m
- Hydraulically Acceptable? → Develop Structural Upgrading Plan
  - Point Repairs: If <3-6 repairs per 100 m (Depending on
  - Line Repairs (If >6 repairs per 100 m) → Cost Analysis → Pipe Relining $245/m; Pipe Replacement $340/m
  - Invert / Alignment Problems → Pipe Replacement $340/m
- STEP 2: Air Test all Joints → Grout all Joints that Fail Air Test

Sanitary Services
- Identify Structural Deficiencies
- Yes: Replace / Reline / Burst Service
- No: Pressure Test Joints / Grout Service

Drainage System
- Identify Surface Run-off Deficiencies
- Identify Sub-Surface Flow Deficiencies
- Compare with Drainage System Assessment

DEVELOP REHABILITATION PLAN

CARRY OUT REHABILITATION PLAN

- Cost Analysis: Summarize Actual Unit Cost Information and Adjust Cost-Benefit Analysis as Required
- Flow Monitoring: Re-instate Flow Monitoring Stations
- Analyze / Verify Flow Monitoring Results
- Characterize I & I Components
- Develop Post Rehabilitated Hydrological Model
- Run Pre and Post Models with "Design" Storm and Determine I & I Reduction Amount

DETERMINE EFFECTIVENESS OF REHABILITATION STRATEGY AND ADJUST AS REQUIRED

(Excerpted from "Infiltration/Inflow Control/Reduction for Wastewater Collection Systems: A Best Practice by the National Guide to Sustainable Municipal Infrastructure, 2003. Prepared by the National Resource Council of Canada)

Appendix B:

Saanich Peninsula Pump Station Flow Data Method and Assessment

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Technical Memorandum

DATE: March 14, 2023

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

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

RE: **SAANICH PENINSULA PUMP STATION SCADA DATA**
Data Assessments for Flow Measurement Purposes
Our File 0283.457-300

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 individual pump stations and between municipal SCADA systems. The data generated by the CRD I&I program is specifically generated for use in I&I analyses. However, other 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 technical memorandum 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 technical memorandum 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 Saanich Peninsula municipal SCADA systems. Enclosure A contains more detail on the inflow calculation methodology, while Enclosure 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 do 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 2016 to February 2022 (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 KWL’s 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 Associates Ltd. (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 2016 to February 2022 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 to judge the overall quality and suitability of the data. Please refer to Enclosure 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 and 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	Flow Meters with Reliable Flow Data	**A**	Magmeters or sites with field verified data
		A-	Clamp-on ultrasonic or doppler meters
B	Calculated using SCADA Data with 'Event' Based Timestamps. 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	Calculated using SCADA Data with 'Polling Interval' Timestamps. Niche Use Only (i.e., I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	**C+^{1}**	Excellent flow pattern
		C+^{2}	Less intuitive flow pattern
		C+^{3}	Infrequent pumping results in multiple hours with zero flow
		C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	**D^{1}**	SCADA Data has 'Event' based time stamps
		D^{2}	SCADA Data has 'Polling Interval' based time stamps.
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)

Limitation of Saanich Peninsula SCADA Data

There is a limitation on the data quality from the Saanich Peninsula municipal pump stations as the data used in the calculations, with the exception of Cromar and Towner in North Saanich, is not ‘event based’ with accurate timestamps (i.e., when the pumps turn on and off); rather it is timestamped on arrival at the central historian. As such, timestamps for all data varies based on the polling speed of the system. This limits nearly all Saanich Peninsula stations to a maximum score of C+. While this limits the overall accuracy of the calculated flow data, it still permits for good qualitative assessments of the amount of I&I present in each catchment. For example, it is still easy to see in the calculated flow data stations that have significant, moderate, or low levels of I&I, even if the absolute magnitude of the values cannot be relied upon.

Sidney

Table 3: Sidney PS Grades

Station	Grade	Notes
Allbay	C+[3]	Poor low-flow resolution, reduced polling frequency observed Sep-Dec 2021
Amelia	C	3 pumps
Ardwell	C+[2]	Noisy
Frost	D[2]	Storage tank, requires Method 3 & site visit. Effects of storage tank not currently calculated
Harbour	C+[1]	Reduced polling frequency observed Sep-Dec 2021
Latch	C+[3]	Poor low-flow resolution
Lochside	C+[1]	Reduced polling frequency observed Sep-Dec 2021
Rothesay	C+[1]	
Seaport	C+[3]	Poor low-flow resolution
Summergate	C+[1]	
Surfside	C+[1]	

North Saanich

Table 4: North Saanich PS Grades

Station	Grade	Notes
Bazen Bay	C+[2]	Noisy
Cromar	B	Uses DNP3 data collection protocol
Marina	C+[1]	Data used from March 2018 onwards
Mills	D[2]	Storage tank, requires Method 3 & site visit. Effects of storage tank not currently calculated
Munro	C+[3]	Poor low-flow resolution
Towner	B	Uses DNP3 data collection protocol
Trincomali	D[2]	Storage tank, requires Method 3 & site visit. Effects of storage tank not currently calculated
West Saanich	C+[3]	Poor low-flow resolution

Note that Amity, Ebor, McDonald, and Reay Creek pump stations were not assessed as part of this analysis as they already have flow meters (magmeters except for Ebor which has a flume). However, data from these sites is currently impacted by the same polling frequency issue as the rest of the pump stations, resulting in C grade data.

Central Saanich

Table 5: Central Saanich PS Grades

Station	Grade	Description
Arthur	D^2	High Inlet sewer elevation, requires Method 3 and site visit. Effect of inlet sewer not currently calculated
Brentwood	D^2	High inlet sewer elevation and storage tank, requires Method 3 and site visit. Effects of storage tank and inlet sewer not currently calculated
Butchart	D^2	High inlet sewer elevation and storage tank, requires Method 3 and site visit. Effects of storage tank and inlet sewer not currently calculated
Butler	C+^{3}	Poor low-flow resolution, noisy
Central	C+^{1}	Reduced polling frequency observed Sep-Dec 2021
Cultra	C+^{3}	Poor low-flow resolution, noisy
Delemere	D^2	High Inlet sewer elevation, requires Method 3 and site visit. Effect of inlet sewer not currently calculated
Hagan	D^2	High Inlet sewer elevation, requires Method 3 and site visit. Effect of inlet sewer not currently calculated
Holm	C+^{3}	Poor low-flow resolution, noisy
Keating	C+^{1}	
Kirkpatrick	C+^{2}	Noisy, reduced polling frequency observed Sep-Dec 2021
Lancelot	C+^{3}	Poor low-flow resolution
Silverdale	D^2	High Inlet sewer elevation, requires Method 3 and site visit. Effect of inlet sewer not currently calculated

Pump station assessment forms are included in Enclosure B.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:

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Associate

Reviewed by:

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Vice-President

JV/sk

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

Statement of Limitations

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Revision History

Revision #	Date	Status	Revision Description	Author
6	March 14, 2023	Final		JV
5	February 28, 2023	Draft	Client Requested Updates in Draft Format	JV
4	October 3, 2022	Draft	Client Requested Updates in Draft Format	JV
3	April 28, 2022	Final	Final Issue to Client	JV

Enclosure A

Use of Data for the Purpose of Inflow Calculations

Technical Memorandum, KWL April 28, 2022

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Technical Memorandum

DATE: April 28, 2022

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 0283.457

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	Elevation of incoming sewers – if an inlet sewer pipe provdes storage during the wetwell fill cycle then calculations based solely on wetwell volume are not reliable	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, which were used to set up the flow calculations and to provide context for the analyses.

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;

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Prepared by:	Reviewed by:
Jason Vine, M.A.Sc., P.Eng. Associate	Chris Johnston, P.Eng. Vice President

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Statement of Limitations

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Revision History

Revision #	Date	Status	Revision Description	Author
0	April 28, 2022	Final	Final Issued for Client	JV

Enclosure B

Pump Station Assessment Sheets

Pump Station SCADA Flow Assessment Worksheet

Station Name	Allbay PS
Owner	Sidney
Address	
Date	2021/10/27

FLOW METHOD GRADE

C+^{3}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.8 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

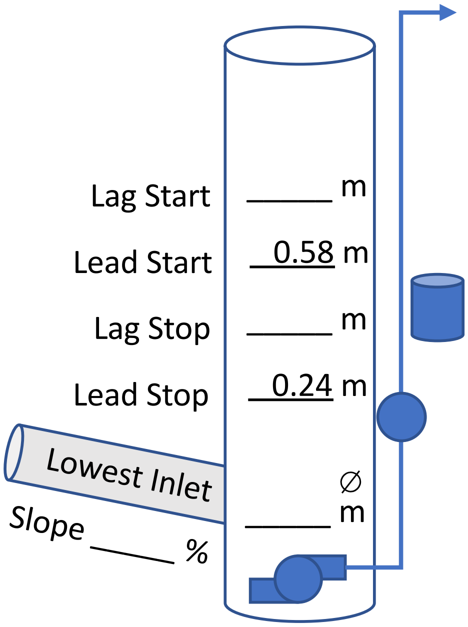
☐ VFD

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 0.58 m

Lag Stop _____ m

Lead Stop 0.24 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Amelia PS
Owner	Sidney
Address	
Date	2021/10/27

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 _3.2_ m X _3.5_ m __________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_______________

Sensor Model _______________

Starters

☐ Soft Starters

____ secs

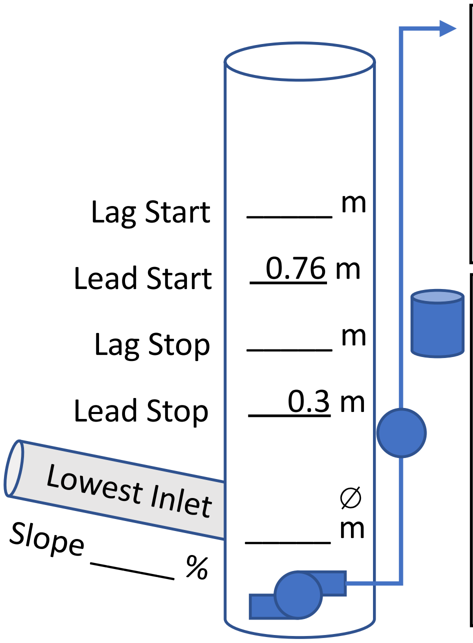
☐ VFD

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 _0.76_ 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
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	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Ardwell PS
Owner	Sidney
Address	
Date	2021/10/26

FLOW METHOD GRADE

C+^{2}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.8 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

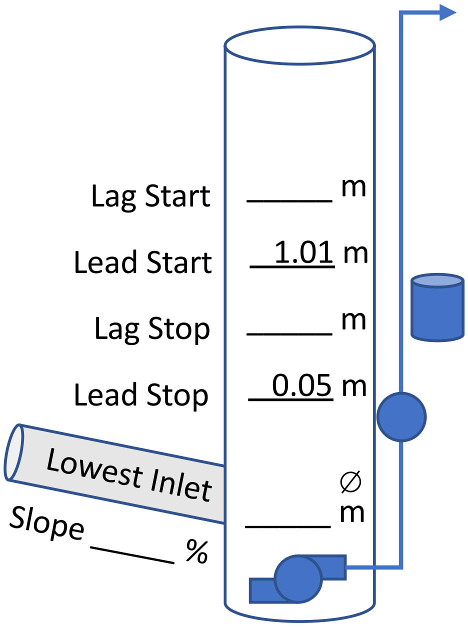
☐ VFD

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 1.01 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		Flow Meters with Reliable Flow Data
B		Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis
C		Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency
	C+^{1}	Excellent flow pattern
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	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Frost PS
Owner	Sidney
Address	
Date	2021/12/01

FLOW METHOD GRADE

D^2

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 2.4 m X 2.2 m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

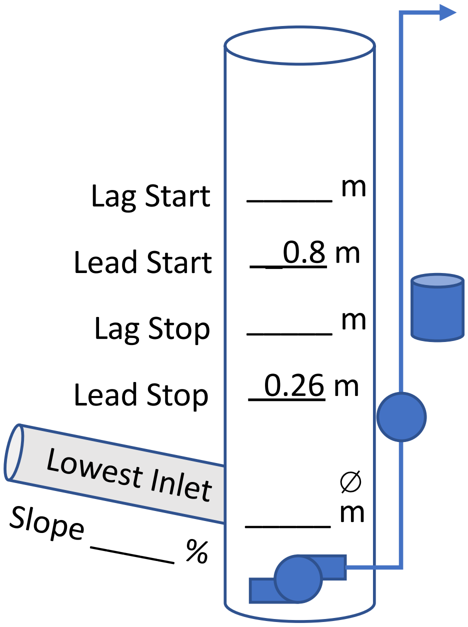
☐ VFD

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 0.26 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		Flow Meters with Reliable Flow Data
B		Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis
C		Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency
	$C+^1$	Excellent flow pattern
	$C+^2$	Less intuitive flow pattern
	$C+^3$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D		Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Harbour PS
Owner	Sidney
Address	
Date	2022-03-15

FLOW METHOD GRADE

$C+^1$

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 3.1 m X 2.8 m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

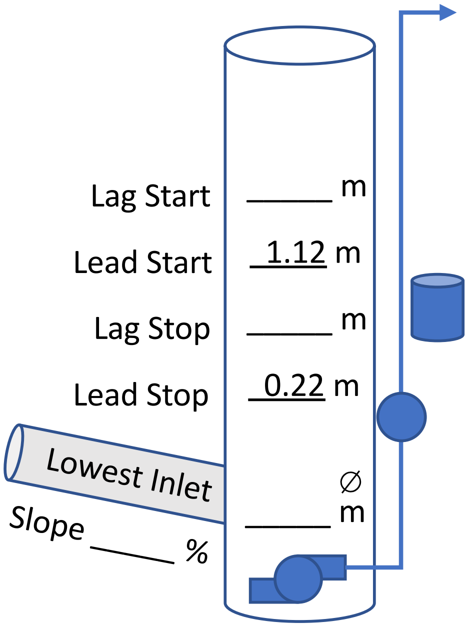
☐ VFD

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 1.12 m

Lag Stop ______ m

Lead Stop 0.22 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		Flow Meters with Reliable Flow Data
B		Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis
C		Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency
	$C+^1$	Excellent flow pattern
	$C+^2$	Less intuitive flow pattern
	$C+^3$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D		Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Latch PS
Owner	Sidney
Address	
Date	2022/03/15

FLOW METHOD GRADE

C+^{3}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.8 m ______ m X ______ m ____________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model__________________

Sensor Model __________________

Starters

☐ Soft Starters

_____ secs

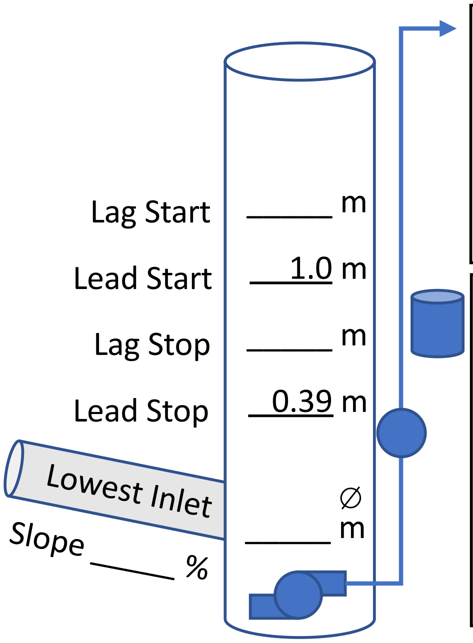
☐ VFD

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 1.0 m

Lag Stop ______ m

Lead Stop 0.39 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Lochside PS
Owner	Sidney
Address	
Date	2022/03/15

FLOW METHOD GRADE

C+^{1}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.8 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_______________

Sensor Model _______________

Starters

☐ Soft Starters

_____ secs

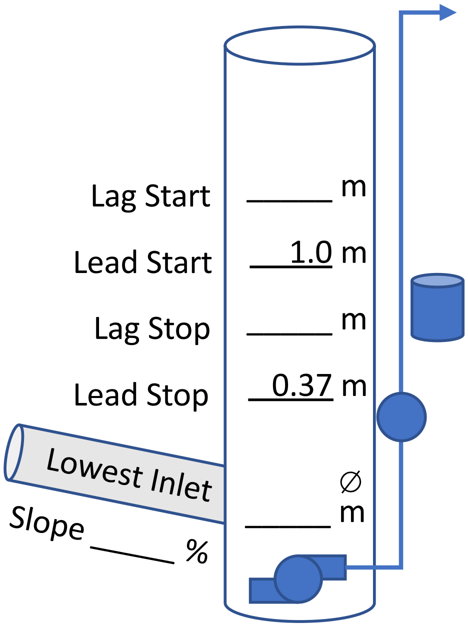
☐ VFD

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 1.0 m

Lag Stop ______ m

Lead Stop 0.37 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Rothesay PS
Owner	Sidney
Address	
Date	2022/03/15

FLOW METHOD GRADE

C+^{1}

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 3.1 m X 3.1 m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model ___________________

Starters

☐ Soft Starters

_____ secs

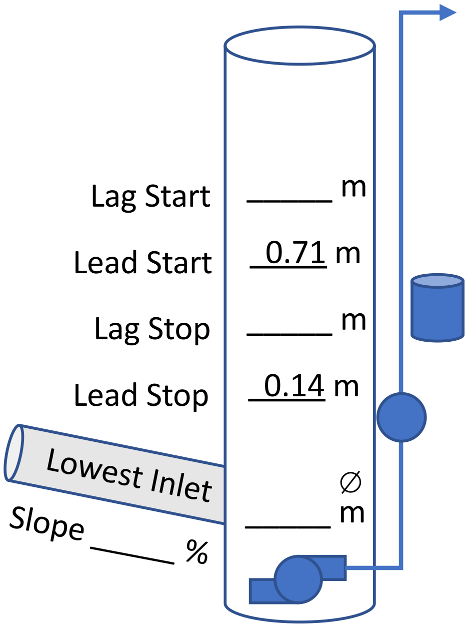
☐ VFD

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 0.71 m

Lag Stop ______ m

Lead Stop 0.14 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		Flow Meters with Reliable Flow Data
B		Calculated using SCADA Data with “Event” Based Timestamps. Suitable for General Uses including I&I Analysis
C		Calculated using SCADA Data with “Polling Interval” Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D		Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.
	D^{1}	SCADA Data has “Event” Based Time Stamps
	D^{2}	SCADA Data has “Polling Interval” Based Time Stamps
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	Seaport PS
Owner	Sidney
Address	
Date	2022/03/15

FLOW METHOD GRADE

C+^{3}

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 2.4 m X 2.4 m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

_____ secs

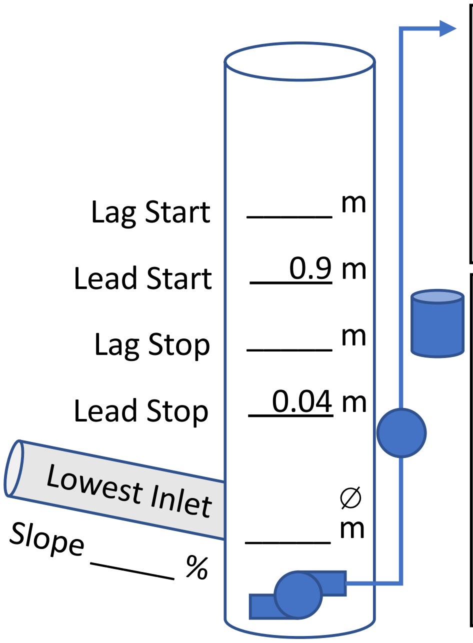
☐ VFD

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 0.04 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Summergate PS
Owner	Sidney
Address	
Date	2022/03/15

FLOW METHOD GRADE

C+^{1}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.8 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

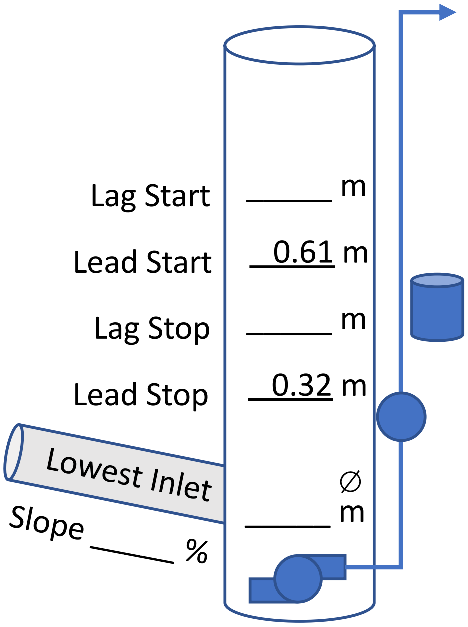
☐ VFD

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 0.61 m

Lag Stop _____ m

Lead Stop 0.32 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)

<table>
<tr><th>Grade</th><th colspan="2">Description</th></tr>
<tr><td>A</td><td colspan="2">Flow Meters with Reliable Flow Data</td></tr>
<tr><td>B</td><td colspan="2">Calculated using SCADA Data with “Event” Based Timestamps. Suitable for General Uses including I&I Analysis</td></tr>
<tr><td rowspan="5">C</td><td colspan="2">Calculated using SCADA Data with “Polling Interval” Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency</td></tr>
<tr><td>C+^{1}</td><td>Excellent flow pattern</td></tr>
<tr><td>C+^{2}</td><td>Less intuitive flow pattern</td></tr>
<tr><td>C+^{3}</td><td>Infrequent pumping results in multiple hours with zero flow</td></tr>
<tr><td>C</td><td>True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit</td></tr>
<tr><td rowspan="3">D</td><td colspan="2">Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.</td></tr>
<tr><td>D^1</td><td>SCADA Data has “Event” Based Time Stamps</td></tr>
<tr><td>D^2</td><td>SCADA Data has “Polling Interval” Based Time Stamps</td></tr>
<tr><td>F</td><td colspan="2">Data unusable</td></tr>
</table>

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	Surfside PS
Owner	Sidney
Address	
Date	2021/12/02

FLOW METHOD GRADE

$C+^{1}$

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

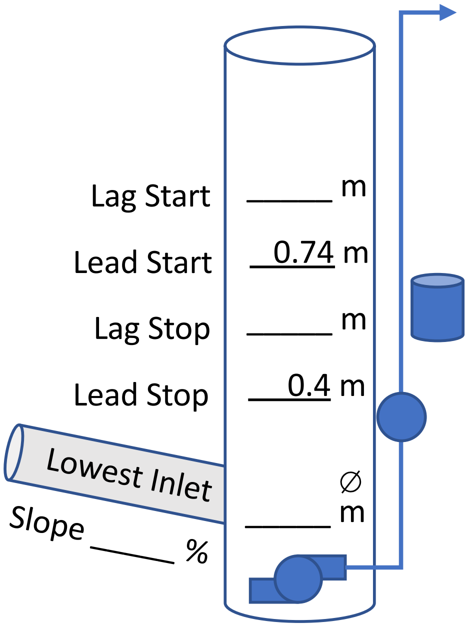
☐ VFD

SCADA Recording

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

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 0.74 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	$C+^{1}$	Excellent flow pattern
	$C+^{2}$	Less intuitive flow pattern
	$C+^{3}$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Bazen Bay PS
Owner	North Saanich
Address	
Date	2022/03/15

FLOW METHOD GRADE

$C+^{2}$

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 _2.4__ m X _2.4_ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model__________________

Sensor Model ____________________

Starters

☐ Soft Starters

____ secs

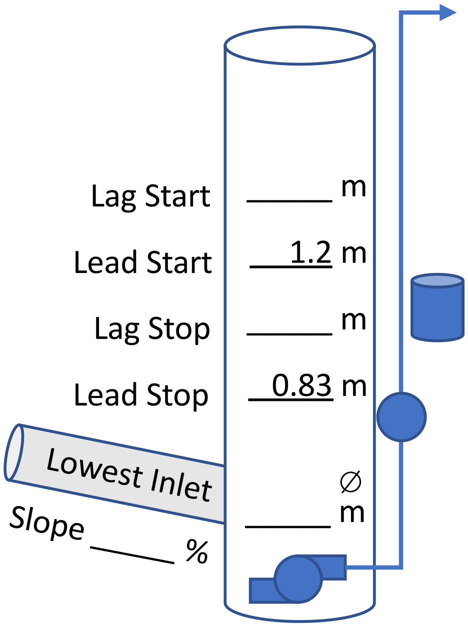
☐ VFD

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 _0.83 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	$C+^{1}$	Excellent flow pattern
	$C+^{2}$	Less intuitive flow pattern
	$C+^{3}$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Cromar PS
Owner	North Saanich
Address	
Date	2022/03/15

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

∅ 1.82 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

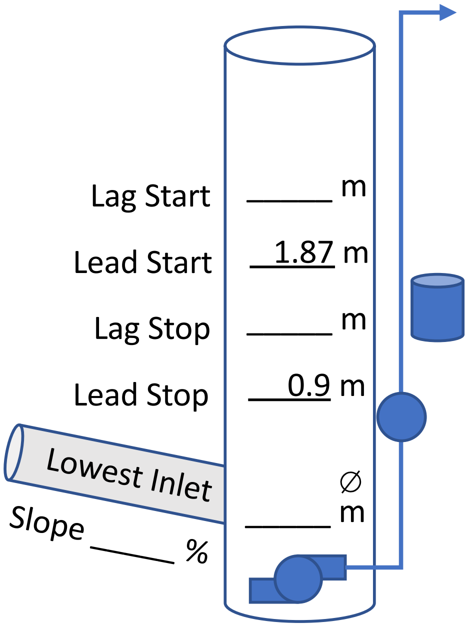
☐ VFD

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
DNP3	☒ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start _____ m

Lead Start 1.87 m

Lag Stop _____ m

Lead Stop 0.9 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+¹	Excellent flow pattern
	C+²	Less intuitive flow pattern
	C+³	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D¹	SCADA Data has "Event" Based Time Stamps
	D²	SCADA Data has "Polling Interval" Based Time Stamps
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	Deep Cove (Marina)
Owner	North Saanich
Address	
Date	2023/03/09

FLOW METHOD GRADE

$C+^1$

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.82 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

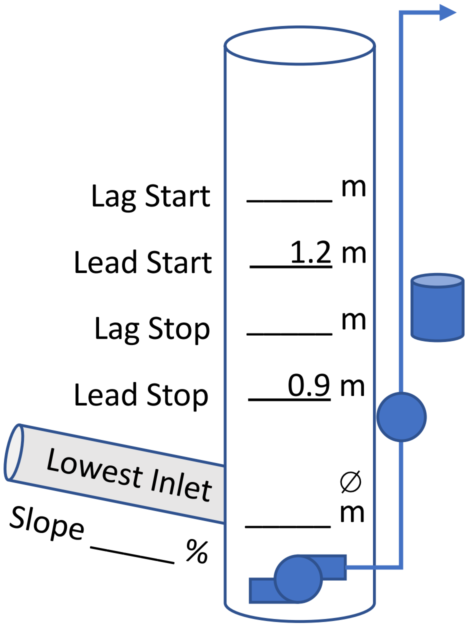
☐ Event Recorded

☐ Polling Interval

__________secs

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 1.2 m

Lag Stop ______ m

Lead Stop 0.9 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	$C+^1$	Excellent flow pattern
	$C+^2$	Less intuitive flow pattern
	$C+^3$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Mills PS
Owner	North Saanich
Address	
Date	2022/01/07

FLOW METHOD GRADE

D^2

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

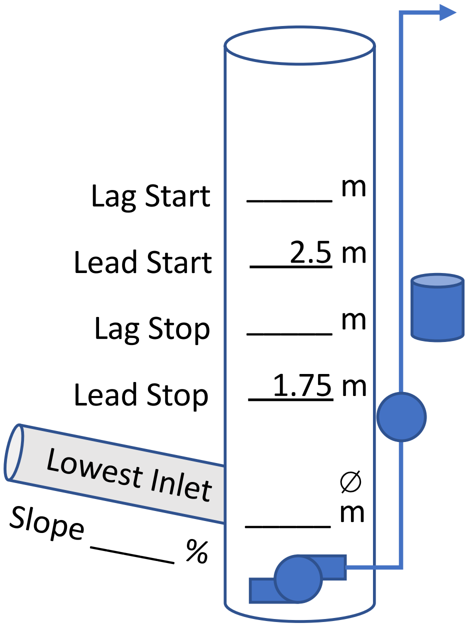
☐ VFD

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 2.5 m

Lag Stop ______ m

Lead Stop 1.75 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Munro PS
Owner	North Saanich
Address	
Date	2022/01/07

FLOW METHOD GRADE

$C+^3$

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ∅ 1.82 m

☐ Rectangular _____ m X _____ m

☐ Irregular ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

_____ secs

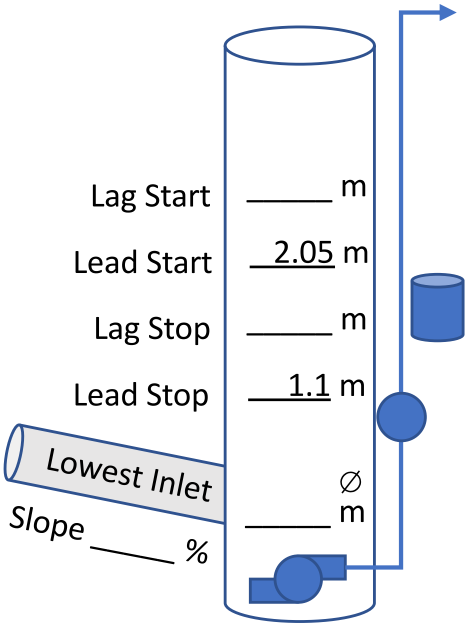
☐ VFD

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 2.05 m

Lag Stop _____ m

Lead Stop 1.1 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	$C+^1$	Excellent flow pattern
	$C+^2$	Less intuitive flow pattern
	$C+^3$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Towner PS
Owner	North Saanich
Address	
Date	2022/03/15

FLOW METHOD GRADE

$C+^1$

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ∅ 2.4 m

☐ Rectangular _____ m X _____ m

☐ Irregular ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

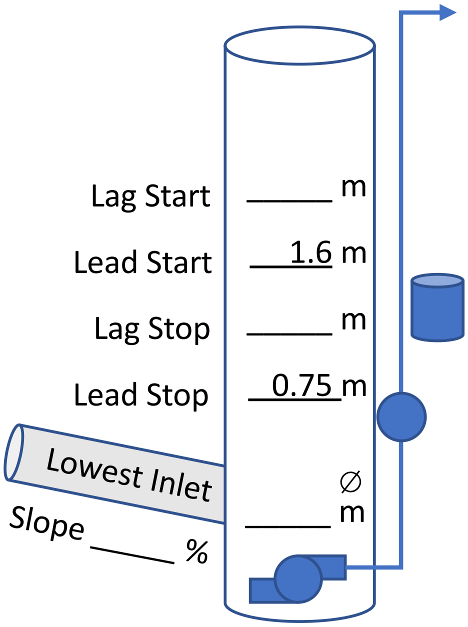
☐ VFD

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
DNP3	☒ Deadband _________m	

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 1.6 m

Lag Stop ______ m

Lead Stop 0.75 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	$C+^1$	Excellent flow pattern
	$C+^2$	Less intuitive flow pattern
	$C+^3$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Trincomali PS
Owner	North Saanich
Address	
Date	2022/01/07

FLOW METHOD GRADE

D^2

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 2.4 m X 2.4 m ________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model______________

Sensor Model ______________

Starters

☐ Soft Starters

____ secs

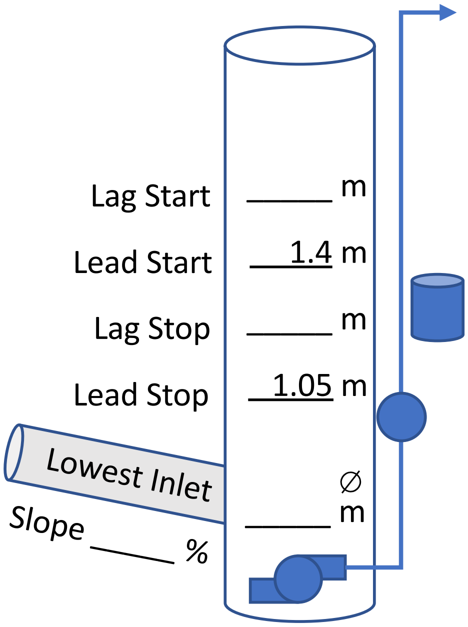
☐ VFD

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 1.4 m

Lag Stop ____ m

Lead Stop 1.05 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	West Saanich PS
Owner	North Saanich
Address	
Date	2022/03/15

FLOW METHOD GRADE

$C+^3$

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 2.43 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

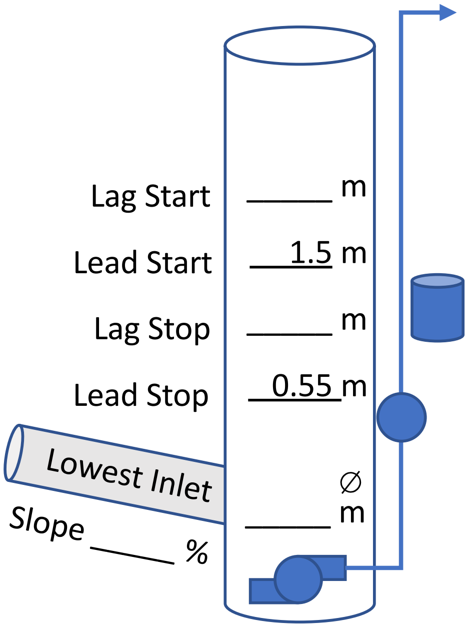
☐ VFD

SCADA Recording

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

Timestamps Generated At

☐ Controller ☐ PLC ☐ SCADA Server



Lag Start ______ m

Lead Start 1.5 m

Lag Stop ______ m

Lead Stop 0.55 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	$C+^1$	Excellent flow pattern
	$C+^2$	Less intuitive flow pattern
	$C+^3$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Arthur PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

D^{2}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ∅ 1.82 m

☐ Rectangular _____ m X _____ m

☐ Irregular ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

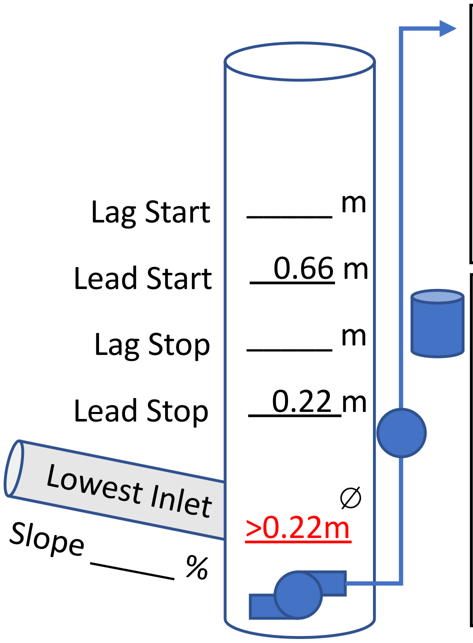
☐ VFD

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 0.66 m

Lag Stop ______ m

Lead Stop 0.22 m

Slope ______ %

∅ >0.22m

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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Brentwood PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

D^{2}

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

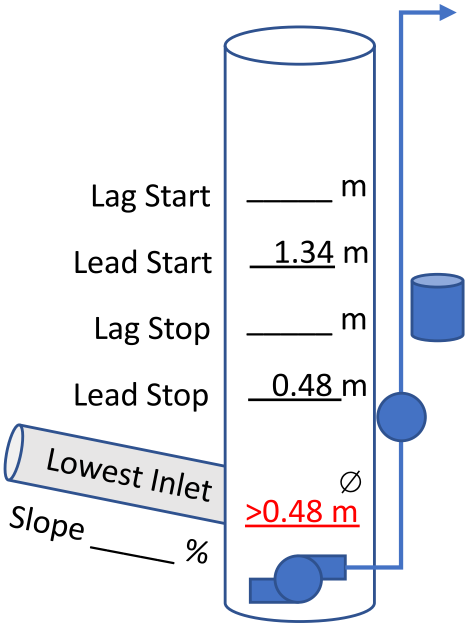
☐ VFD

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 1.34 m

Lag Stop _____ m

Lead Stop 0.48 m

Lowest Inlet

∅ >0.48 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Butchart PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

D^2

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 ________________

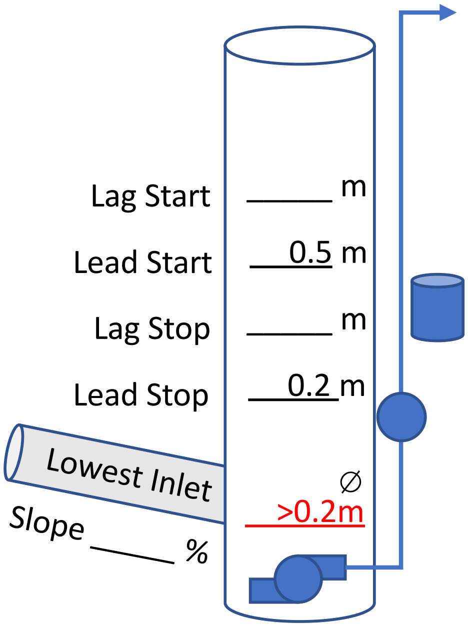
Starters

☐ 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 0.5 m
Lag Stop _____ m
Lead Stop 0.2 m
∅ >0.2m
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		Flow Meters with Reliable Flow Data
B		Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis
C		Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency
	$C+^1$	Excellent flow pattern
	$C+^2$	Less intuitive flow pattern
	$C+^3$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D		Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Butler PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

C+^{3}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.8 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_______________

Sensor Model _______________

Starters

☐ Soft Starters

____ secs

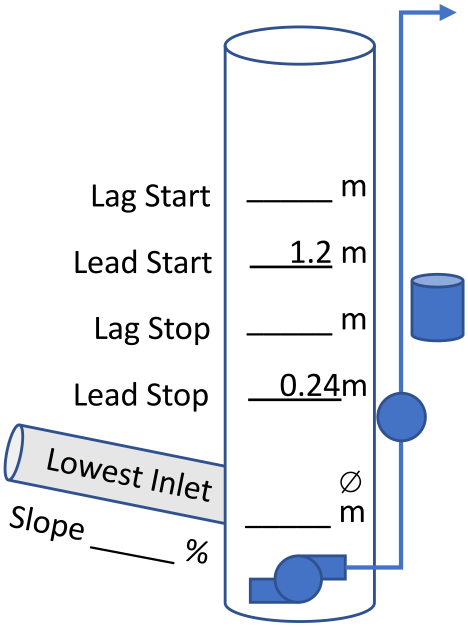
☐ VFD

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 0.24m

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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Central PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

C+^{1}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.8 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

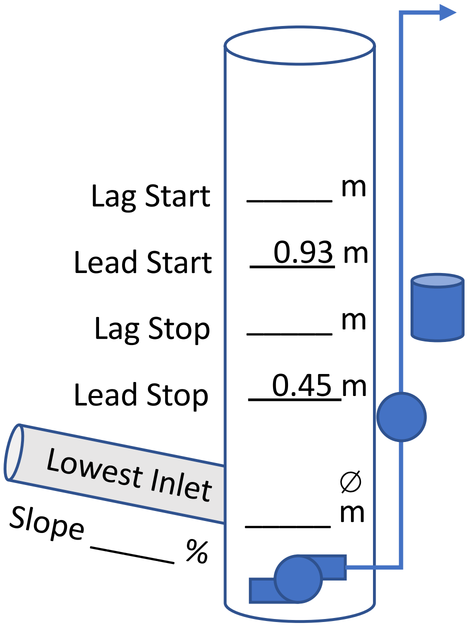
☐ VFD

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 0.93 m

Lag Stop _____ m

Lead Stop 0.45 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Cultra PS
Owner	Central Saanich
Address	
Date	2022/03/15

FLOW METHOD GRADE

$C+^3$

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ∅ 1.22 m

☐ Rectangular _____ m X _____ m

☐ Irregular __________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

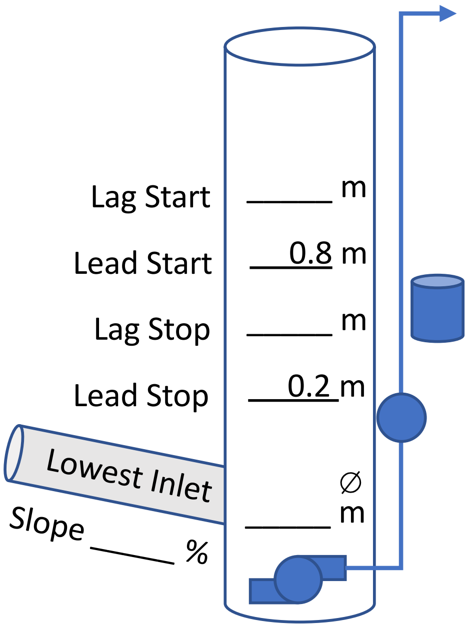
☐ VFD

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 0.8 m

Lag Stop ______ m

Lead Stop 0.2 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	Flow Meters with Reliable Flow Data		
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis		
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency		
		$C+^1$	Excellent flow pattern
		$C+^2$	Less intuitive flow pattern
		$C+^3$	Infrequent pumping results in multiple hours with zero flow
		C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.		
		D^1	SCADA Data has "Event" Based Time Stamps
		D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Delemere PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

D^{2}

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

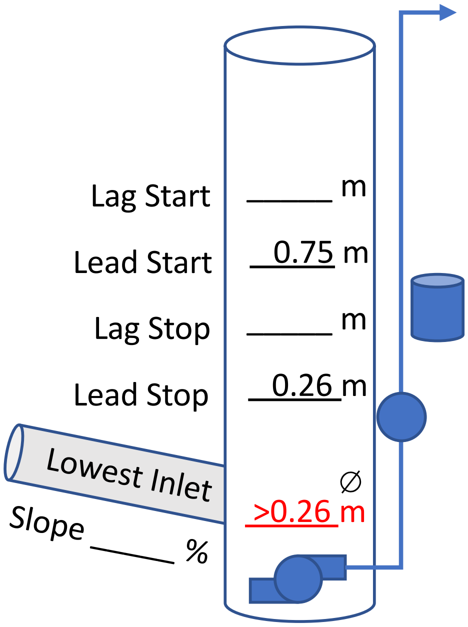
☐ VFD

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 0.75 m

Lag Stop ______ m

Lead Stop 0.26 m

∅

>0.26 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Hagan PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

D^2

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

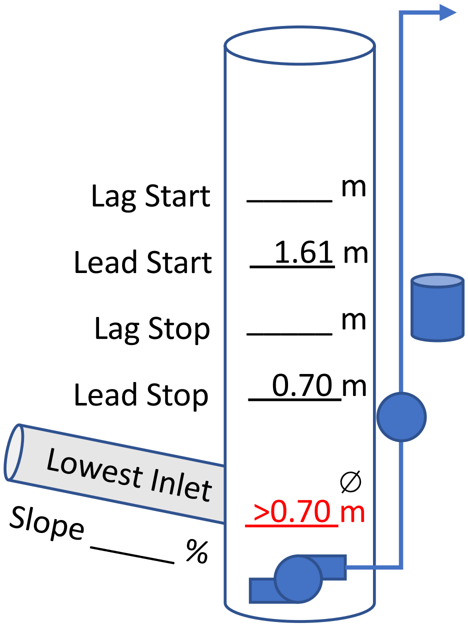
☐ VFD

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 1.61 m

Lag Stop _____ m

Lead Stop 0.70 m

Lowest Inlet ∅ >0.70 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Holm PS
Owner	Central Saanich
Address	
Date	2022/03/15

FLOW METHOD GRADE

C+^{3}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

⌀ 1.82 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model _________________

Starters

☐ Soft Starters

_____ secs

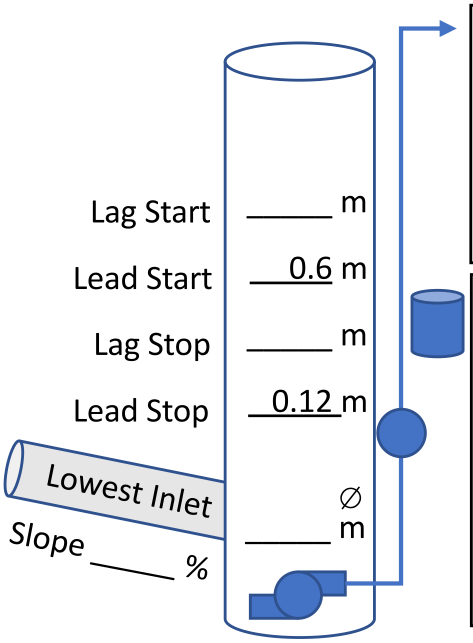
☐ VFD

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 0.6 m

Lag Stop ______ m

Lead Stop 0.12 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		Flow Meters with Reliable Flow Data
B		Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis
C		Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D		Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Keating PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

$C+^{1}$

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.82 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model_________________

Sensor Model ___________________

Starters

☐ Soft Starters

____ secs

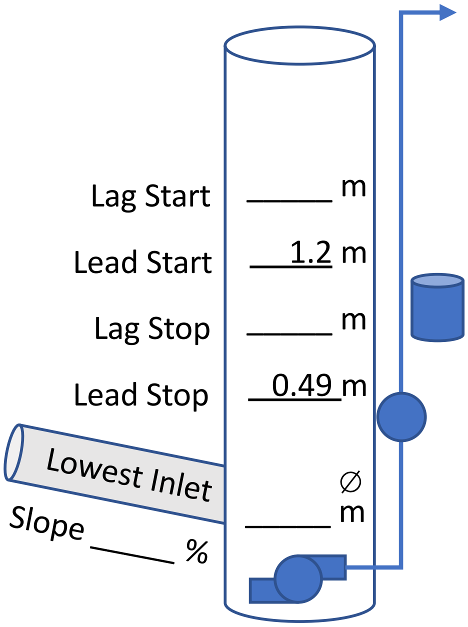
☐ VFD

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 0.49 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		Flow Meters with Reliable Flow Data
B		Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis
C		Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency
	$C+^{1}$	Excellent flow pattern
	$C+^{2}$	Less intuitive flow pattern
	$C+^{3}$	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D		Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.
	D^{1}	SCADA Data has "Event" Based Time Stamps
	D^{2}	SCADA Data has "Polling Interval" Based Time Stamps
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	Kirkpatrick PS
Owner	Central Saanich
Address	
Date	2022/03/15

FLOW METHOD GRADE

C+^{2}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.82 m _____ m X _____ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

_____ secs

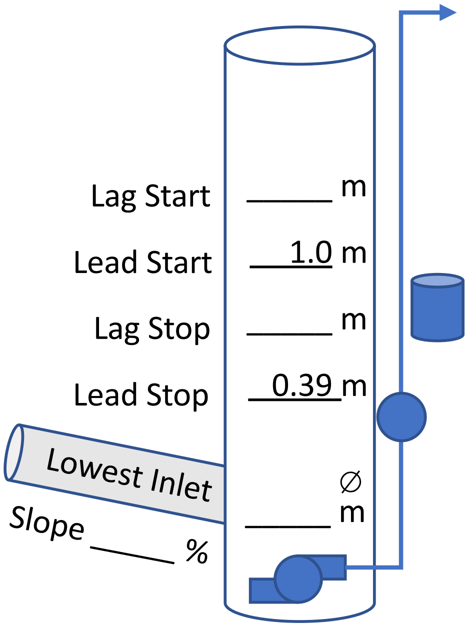
☐ VFD

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 1.0 m

Lag Stop _____ m

Lead Stop 0.39 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Lancelot PS
Owner	Central Saanich
Address	
Date	2022/03/15

FLOW METHOD GRADE

C+^{3}

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.82 m ______ m X ______ m ___________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

_____ secs

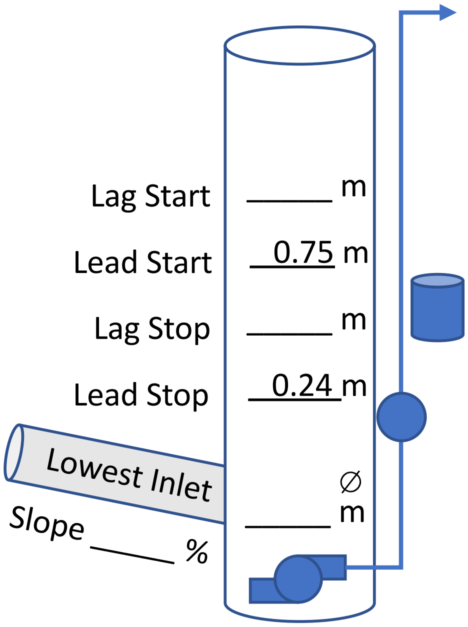
☐ VFD

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 0.24 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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	Silverdale PS
Owner	Central Saanich
Address	
Date	2022/01/10

FLOW METHOD GRADE

D^2

Source of Flow Data Used for Assessment

Calculated Flow Method: [✓ 1] 2 3

Magmeter ☐ Clamp-on Ultrasonic/Doppler ☐

Wet Well Shape

☒ Circular ☐ Rectangular ☐ Irregular

∅ 1.82 m _____ m X _____ m __________ m

Controller

☐ Local Control ☐ Central Control

☐ Ultrasonic ☐ Pressure ☐ Floats

Controller Model________________

Sensor Model ________________

Starters

☐ Soft Starters

____ secs

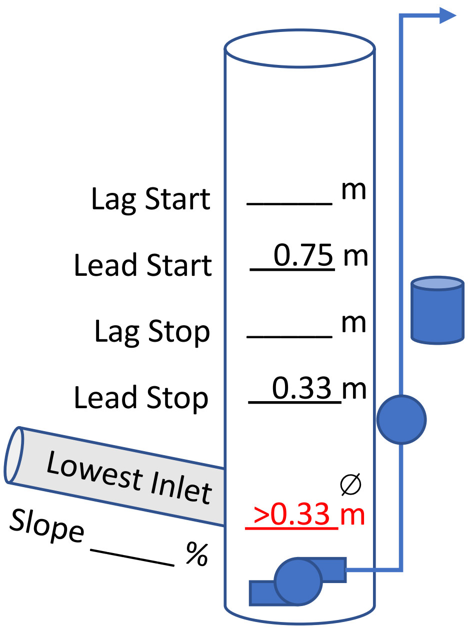
☐ VFD

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 0.33 m

Lowest Inlet ∅ >0.33 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	Flow Meters with Reliable Flow Data	
B	Calculated using SCADA Data with "Event" Based Timestamps. Suitable for General Uses including I&I Analysis	
C	Calculated using SCADA Data with "Polling Interval" Timestamps. Niche Use Only (i.e. I&I) as Data Accuracy is Impacted by SCADA Polling Frequency	
	C+^{1}	Excellent flow pattern
	C+^{2}	Less intuitive flow pattern
	C+^{3}	Infrequent pumping results in multiple hours with zero flow
	C	True peak storm flow often underestimated due to pump capacity. Could be addressed with Method 3 and a site visit
D	Flow Data cannot be Calculated Accurately due to Storage Tanks, Inlet Levels, etc. and would Require Substantial Effort to Address.	
	D^1	SCADA Data has "Event" Based Time Stamps
	D^2	SCADA Data has "Polling Interval" Based Time Stamps
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 C:

Saanich Peninsula Pump Station Flow Data Recommendations for Improvement

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Technical Memorandum

DATE: March 14, 2023

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

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

RE: **SAANICH PENINSULA INFLOW & INFILTRATION (I&I)**
Saanich Peninsula Pump Station SCADA/Cost Sharing Data
Our File 0283.457-300

Overview

The purpose of this technical memorandum is to support CRD work on an initial Inflow & Infiltration (I&I) management plan for the Saanich Peninsula municipalities. The technical memorandum focuses on work that was done in 2021/2022 to generate flow data from the Saanich Peninsula municipal pump stations, the inherent issues impacting the data accuracy, and recommendations for improving the data accuracy moving forward. The technical memorandum also examines flow data from some of the CRD sewer cost sharing sites. The focus on long term flow data is important as it forms the backbone for future I&I investigations and rehabilitation work.

In summary, the flow data generated for the Saanich Peninsula municipalities was acceptable for qualifying I&I but is not currently accurate enough to quantify I&I rates for use in sewer modelling or capacity studies. Recommendations are provided in this document that, if implemented, would rectify the data quality issue so that accurate I&I quantification could be achieved.

I&I Management Plans

I&I Management Plans are an integral part of infrastructure asset management. Excessive I&I results in increased pumping and treatment costs, reduces available sewer capacity for growth, and lowers the return period of storms that can be conveyed without overflow. Climate change is expected to increase the frequency of large rainfall events and overflows, so it is imperative that I&I Management Plans be undertaken as part of responsible environmental stewardship. In general, the plans are long term and are updated at set intervals (i.e., five years). The plans generally contain actions in the following phases:

1. Collect sewer flow data:
    a. Divide municipality into catchments and collect sewer flow data;
    b. Assess I&I levels in municipal catchments;
    c. Establish an I&I baseline that can be tracked over time;
    d. Provide pre-rehabilitation data for assessing the effectiveness of sewer work; and
    e. This provides a foundation for phases 2 and 3.
2. Investigating the catchments found to have elevated I&I (i.e., smoke testing, CCTV);
3. Rehabilitate sewers based on priority with defined schedules and budgets; and
4. Conduct post-rehabilitation monitoring to verify the effectiveness of rehabilitation efforts.

Saanich Peninsula I&I Management Plans

From 2020 to 2022, the CRD allocated modest annual budgets to initiate I&I management plans for the Peninsula municipalities. The goal was to leverage the resources and expertise of the Core Area I&I program to help initiate I&I actions on the Peninsula. Based on need, the focus was on sewer flow data collection, which is the foundation of I&I management plans.

Sewer Flow Data

I&I Management Plans benefit from long term sewer flow data. The process of collecting sufficient data to identify and characterize the type of I&I, selection, and implementation of appropriate rehabilitation methods, followed by conducting post-rehabilitation monitoring is a multi-year effort. This has real impacts and considerations for cost and staff time, as well as data quality and consistency.

Options for collecting data can be generally classified into permanent metering sites, temporary portable meters, and leveraging municipal pump station data. Briefly:

- Permanent meters with telemetry (weirs, flumes, surface RADAR, magnetic flow meters) provide excellent, consistent long-term data. Apart from magmeters, they need moderate staff time for calibration and cleaning. They are expensive to install (typically $100K or more when factoring in electrical and kiosk). Due to the cost, they are typically set up for cost sharing or as permanent I&I baseline meters only;
- Temporary meters (of which there are various types) provide data of varying quality depending on site conditions and contractor skill. Typically, they are installed, and data is provided as a turn-key service from specialized contractors. Rough monthly cost per site is $2,000, meaning a typical winter monitoring season per site is around $10K. Due to the inherent inaccuracy in sewer flow monitoring, differentiating between I&I reduction and impacts caused by removing and reinstalling equipment in a site can be difficult and complicates analysis; and
- Leveraging municipal pump station data has an up-front setup time (a few hours) to assess and configure the algorithms to convert that data into useful flow data. Supervisory Control and Data Acquisition Systems (SCADA) are already implemented and maintained (hence no additional costs), and typically have many years of data already stored. Beyond ensuring that no changes are made to the operating set points of the station (which can be automated), the solution provides consistent, reliable, and very low-cost data.

The CRD I&I Program believes the benefits of leveraging municipal pump station data should be maximized first prior to other options.

Pump Station SCADA Derived Flow Data

At a very high level, the simplest method is to use pump start/stop data recorded by the SCADA system. The calculation is simply timing how long it takes ‘to fill a bucket’, where the bucket in this case is the volume of the wet well between the stop and start setpoints. However, the quality of the data can be impacted by the following:

- Inaccurate time stamps (i.e., polling frequency of the SCADA system);
- Inaccurate wet well pumped volume (storage tanks/upstream pipes provide an unknown additional storage during the fill cycle); and
- Complicated sites (multiple pumps running at once, overflow tanks, etc.).

As such, it is important to assess each site and such impacts to the quality of not only previously collected data, but the impact on future data collection as well.

Saanich Peninsula Sewer Flow Summary

Overview

Two categories of flow data were reviewed for this memorandum; newly generated flow data from municipal pump stations and long-term flow CRD cost sharing meters. Issues were observed with both types of data, currently limiting their usefulness for I&I analysis.

Flows Generated from Municipal Pump Stations

The Saanich Peninsula municipal pump stations are on the CRD SCADA system. SCADA data is available for these pump stations back to 2012. As part of a previous phase of this project, the data was used to generate flow data for the purpose of I&I analyses. The following bullets summarize how this flow data was developed:

- Wet well level and pump start/stop data spanning multiple years was downloaded for each of the municipal pump stations from the CRD's SCADA system;
- Metadata about each station (wet well shape and cross-sectional area, storage tanks, inlet sewer elevations) were also provided by each municipality; and
- The data was uploaded to www.Flowworks.com, and a purpose-built pump station inflow calculator was used to turn this data into usable flow data for I&I analyses. Flowworks is a subscription service utilized by the CRD that provides flow data analysis tools including graphing, reporting, rainfall event analysis, I&I analysis, and the pump station inflow calculator.

The accuracy of the resulting flow data for each site was then assessed based on a variety of criteria. Please refer to the attached Appendix for the supporting technical memo detailing the assessments previously conducted for each station. This step was important to clearly show the accuracy of the data for each pump station. There were three issues identified for some or all of the sites:

1. Time stamp issues related to the way data is collected by the SCADA system (all but two sites);
2. Unknown wet well fill cycle volumes, due to storage tanks or backwatering of the inlet pipe during each fill cycle (some sites); and
3. Complex sites (more than two pumps, long running pump cycles, complex storage tanks, etc.) (Rare).

In a separate exercise, the CRD used the resulting flow data to assess the pump station catchments for relative I&I severity (i.e., comparing relative response of winter storm flows to summer flows). The data shows that I&I is at levels that should be monitored going forward. However, the accuracy of the data as currently collected is not suitable for quantifying I&I rates (i.e., calculating L/ha/day), or for use in sewer models or capacity studies.

Flows from CRD Sewer Cost Sharing Sites

The CRD cost sharing sites each have permanent flow meters and have been used for years for cost sharing purposes. One of the meters is a weir and the rest are magnetic flow meters (magmeters). Confirming the data quality (assumed to be reliable) from these sites is not in the scope of this memo, however a brief analysis of how the SCADA polling frequency impacts how the data is stored in the SCADA system was conducted.

It is noted that the three cost sharing meters located in the inlet of the treatment plant are not impacted by polling issues as they are directly connected to the WWTP system. The data for these meters is believed to be excellent.

However, the remaining 8 cost sharing meters located away from the treatment plant are polled approximately every 10 seconds to 2 minutes, depending on location and communication quality. CRD SCADA only time stamps single data points at time of polling, which is not ideal for signals that have rapid changes in values (pump stations for example). Several example issues are highlighted in Figure 1.

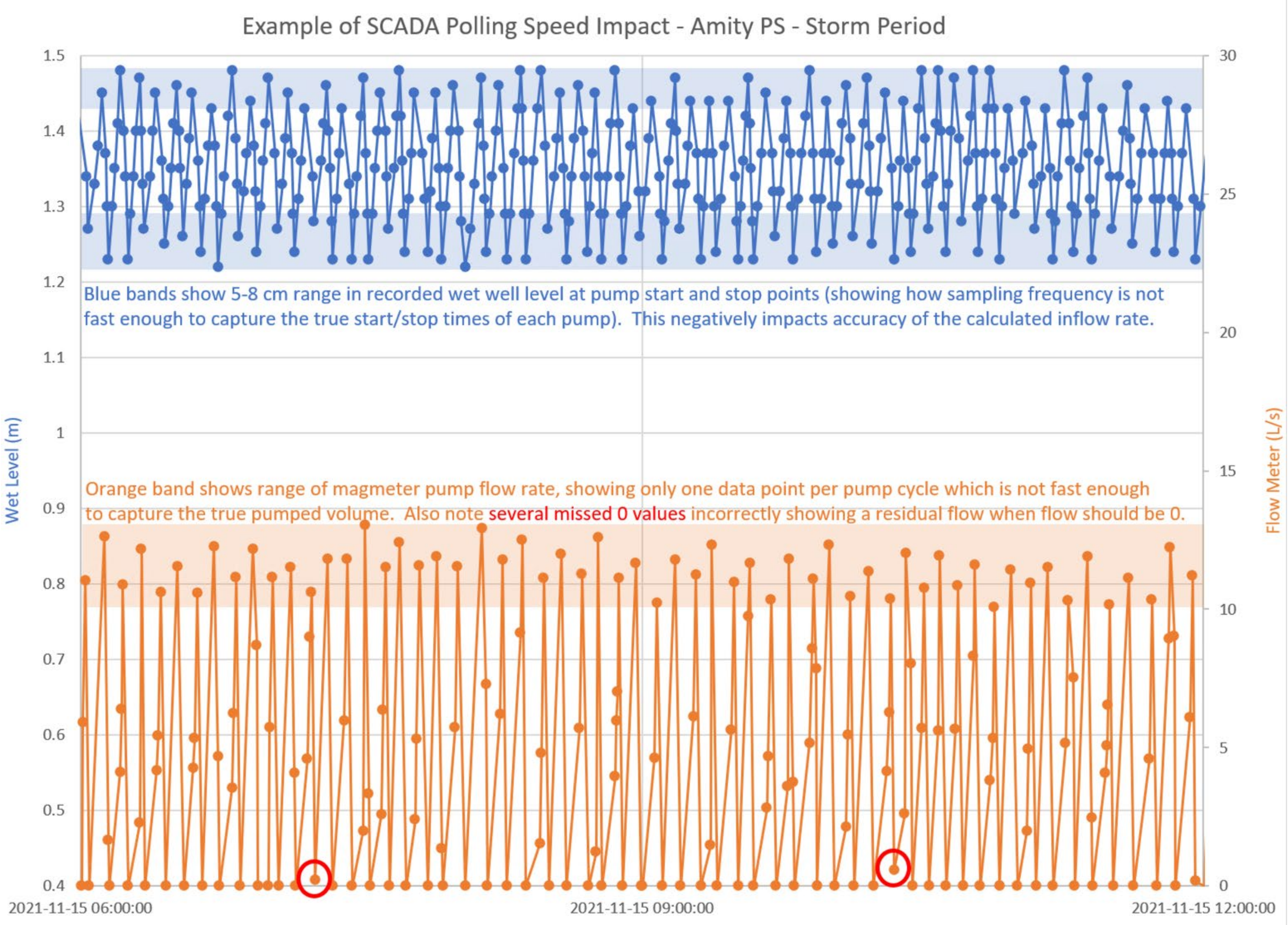

Figure 1: Amity PS – Issues Related to SCADA Polling Speed

In Figure 1, the blue bands show the variability in the reported wet well level highs/lows during a typical storm period, caused by the polling method and speed of the SCADA system. This is a good demonstration of the timing inaccuracy that prevents using the municipal pump station data (affected by the same issue) to produce accurate flow results.

The orange bands show the variability in the recorded magmeter flow from the Amity PS. The sampling rate (shown by the orange dots) is not high enough to accurately quantify the pumped volume from the data as provided. There are also two periods where the pumped flow is not recorded as returning to zero, also indicative of an insufficient sampling rate.

In our opinion and experience, the issues observed in Figure 1 are common in the industry and are typical of a SCADA system that was designed to prioritize limited bandwidth for important operational issues such as high wet well alarms, as opposed to the collection of data for planning use. One common improvement that can be implemented in new installations or retrofit programs is to implement the DNP3 protocol, which timestamps and stores events locally as they occur. Properly implemented, DNP3 significantly improves the accuracy of the collected data for use in planning and I&I analysis. Currently only two stations (North Saanich municipal pump stations Cromar and Towner) use DNP3.

Options for Improving Data Quality

The issues with current data quality, along with potential solutions, can be categorized into 3 separate issues, each described in the following sections.

SCADA Data Time Stamp Issue

By far the biggest issue is the current method that the CRD Peninsula SCADA system employs to collect data from the municipal pump stations. The system rotates through all stations, systematically polling each for data such as wet well level, pump status, flow rate, alarms, etc. The time assigned to each event is the time that the system polled the station, not the time that each event happened. While this approach is perfectly suitable for many uses, it is not accurate enough for calculating inflows using wet well fill timing methods and can easily result in errors of 100% or more. To fix this issue, the time must be recorded to the second at the station as each event occurs. The limited polling speed also affects the cost sharing sites as well.

The following are possible solutions:

SCADA System Upgrade

The Core Area SCADA was upgraded years ago, and the issue of time stamping and polling speed was addressed as part of that upgrade. The CRD proposed a similar upgrade for the Saanich Peninsula system in 2018, but this was option was turned down by the Peninsula Commission due to cost.

Temporary Dataloggers

This option involves the installation of a temporary datalogger in each pump station or cost sharing meter kiosk, with simple connections to the wet well level, pump start/stop signals and flow meter channels as available/appropriate. Units can include wireless cellular capabilities for extended monitoring over a winter season or can be downloaded locally and moved around as desired. Hardware cost for a datalogger with pump current clamps is approximately $2,500. Dataloggers of this type can record pump on/off events to within 1 second accuracy, sample flow meters at 1 Hz and provide an internally averaged flow volume on a specified interval (typically five minutes) suitable for I&I analysis.

A CRD electrician working with a datalogger specialist can typically install or move two to three temporary units per day. With suitable training and preparation, a CRD electrician can easily do the datalogger installation work unassisted. Labour costs for setup and installation benefit from economy of scale for mob/demobilization, which should be factored in when planning how many (and how long) deployments per season are expected.

Permanent Dataloggers

A datalogger system can be made 'permanent' by adding approximately $500 for a modem and budgeting $45/month for cellular and Flowworks.com data service. This provides ongoing telemetry without the need to provide a server to receive and host the data. The equipment can be left in place for an indeterminate length of time, and later can be moved just as easily as the temporary units. Installation time/costs are only nominally more than temporary sites, due to the need to mount the logger and install a small stub antenna.

Unknown Fill Volume

Developing flows using pump station data is effectively the same thing as timing how long it takes to fill a bucket, with the bucket in this case being the volume of the wet well between the start and stop points. However, for some pump stations, calculating fill volumes can be complicated if the upstream sewer backs up during the pump station fill cycle or if there is a storage tank. In these cases, a more detailed analysis is required to calculate the required storage curve and the behaviour of the incoming flow. For example, with clear record drawings of the station and incoming sewer, aided by GIS records of the upstream pipes if available, an engineer or technologist could typically do the analysis and calculate the required curve in four to eight hours. Armed with that curve, the rest of the analysis is the same as for 'normal' sites.

Complex Sites

Some sites are too complex to implement the simple inflow methodology. This can include sites that:

- run for extended periods of time during storm events using one or more pumps;
- utilize offline storage tanks to reduce/contain overflows; and
- have long, flat incoming sewers that are used for storage.

In these cases, the most likely solution is to investigate installation of a permanent flow meter (either a full-pipe magmeter or clamp-on ultrasonic or Doppler) on the station forcemain.

It is recommended that an experienced engineer conduct a site visit to review meter and installation options, assess how the meter would be connected to any existing SCADA, assess electrical needs, etc. Developing a workable design to retrofit a flow meter would depend heavily on the existing site conditions, with a design effort ranging from a few hours to a few days. Depending on the complexity of the site (i.e., excavation, pipe work), additional effort would be required to develop tender documents, administer contracts, commissioning, etc.

In general, one would only recommend this approach if the site represents an important catchment area with significant I&I issues, and/or if there are simple/inexpensive site conditions that would allow installation of a meter without incurring sizeable costs to excavate/expose the forcemain.

Site Summaries

The following tables summarize the sites from each municipality and categorize them by issue and proposed solution. Currently, most of the flow data is only suitable for qualifying I&I rates. By implementing the noted solutions, the accuracy of the data would be improved and the data from most sites would be suitable for uses including quantified I&I analyses, sewer modeling, and capacity studies.

Table 1: North Saanich Sites

Flow Data Issue	Metering Location/ Grouping	Notes/Discussion/Solution
These sites use DNP3 data collection and produce very good quality data		
No Issue	Cromar 43.6 ha	
	Towner 57.2 ha	
The accuracy of the data for these sites is impacted by the polling frequency of the SCADA system.		
SCADA Data Time Stamp Issue	Bazen Bay 11.9 ha	These sites would be suitable for temporary or permanent datalogger solutions to address the SCADA time stamp issue.
	(Deep Cove) Marina 20 ha	
	Munro 74.2 ha	
	West Saanich 15.8 ha	
The magnitude of the calculated flow data for these sites is substantially incorrect because the fill volume is unknown due to the presence of storage tanks or inlet pipes that back up during wet well fill cycles.		
Unknown Fill Volume + SCADA Data Time Stamp Issue	Mills 84.5 ha	These sites have storage tanks that complicate flow calculations. The size of the catchments warrants a small desktop assessment of how the tanks are utilized to determine if the effects of the tanks can be incorporated into the flow calculations.
	Trincomali 99.2 ha	
These catchments are very small and are less useful for I&I studies, sewer modelling, capacity studies, etc.		
	Parkland 1.6 ha	Too small for most applications.

Table 2: Central Saanich Sites

Flow Data Issue	Metering Location/ Grouping	Notes/Discussion/Solution
The accuracy of the data for these sites is impacted by the polling frequency of the SCADA system.		
SCADA Data Time Stamp Issue	Butler 10.6 ha	These sites would be suitable for temporary or permanent datalogger solutions to address the SCADA time stamp issue.
	Central 11.5 ha	
	Holm 8.0 ha	
	Keating 328.7 ha	
	Kirkpatrick 13.7 ha	
	Lancelot 6.1 ha	
The magnitude of the calculated flow data for these sites is substantially incorrect because the fill volume is unknown due to the presence of storage tanks or inlet pipes that back up during wetwell fill cycles.		
Unknown Fill Volume + SCADA Data Time Stamp Issue	Arthur 7.8 ha	These sites have storage tanks that complicate flow calculations. The size of the catchments warrants a small desktop assessment of how the tanks are utilized to determine if the effects of the tanks can be incorporated into the flow calculations.
	Brentwood 113.6 ha	
	Butchart 23.6 ha	
	Delemere 8.8 ha	
	Silverdale 6.2 ha	
These catchments are very small and are less useful for I&I studies, sewer modeling, capacity studies, etc.		
	Cultra 2.3 ha	Too small for most applications.
	Newton 3.8 ha	

Table 3: Sidney Sites

Flow Data Issue	Metering Location/ Grouping	Notes/Discussion/Solution
The accuracy of the data for these sites is impacted by the polling frequency of the SCADA system.		
SCADA Data Time Stamp Issue	Amelia 97.6 ha	These sites would be suitable for temporary or permanent datalogger solutions to address the SCADA time stamp issue.
	Ardwell 26.6 ha	
	Harbour 59.8 ha	
	Rothesay 23.8 ha	
	Summergate 11.3 ha	
	Butchart 23.6 ha	
	Delemere 8.8 ha	
	Silverdale 6.2 ha	
These catchments are very small and are less useful for I&I studies, sewer modeling, capacity studies, etc.		
	Beacon 0.1 ha	Too small for most applications.
	Frost 3.4 ha	
	Latch 2.6 ha	
	Lochside 4.5 ha	
	Seaport 1.2 ha	
	Surfside 1.3 ha	

Table 4: CRD Cost Sharing Sites

These dedicated flow metering sites are used for CRD sewer cost sharing, with high sampling rates as they are located at SPWWTP		
No Issue	North Saanich Mag Meter 82.8 ha	These sites are sampled with high frequency (1-4 seconds) and data is considered to be excellent.
	Central Saanich Mag Meter 919.3 ha	
	Sidney Mag Meter 685.9 ha	
The accuracy of the data for these sites is impacted by the polling frequency of the SCADA system.		
SCADA Data Time Stamp Issues at Sites with Flow Meters	Airport PS Mag Meter 71.0 ha	These sites would be suitable for temporary or permanent datalogger solutions to address the SCADA time stamp issue.
	Amity Mag Meter 40.3 ha	
	Ebor Flume 169.3 ha (influenced by upstream PS's)	
	IOS PS Mag Meter 7.1 ha	
	McDonald Mag Meter 48.5 ha	
	Pauquachin Mag Meter 24.2 ha	
	Reay Creek Mag Meter 161.5 ha	
	Tseycum Mag Meter 10.1 ha	

KERR WOOD LEIDAL ASSOCIATES LTD.

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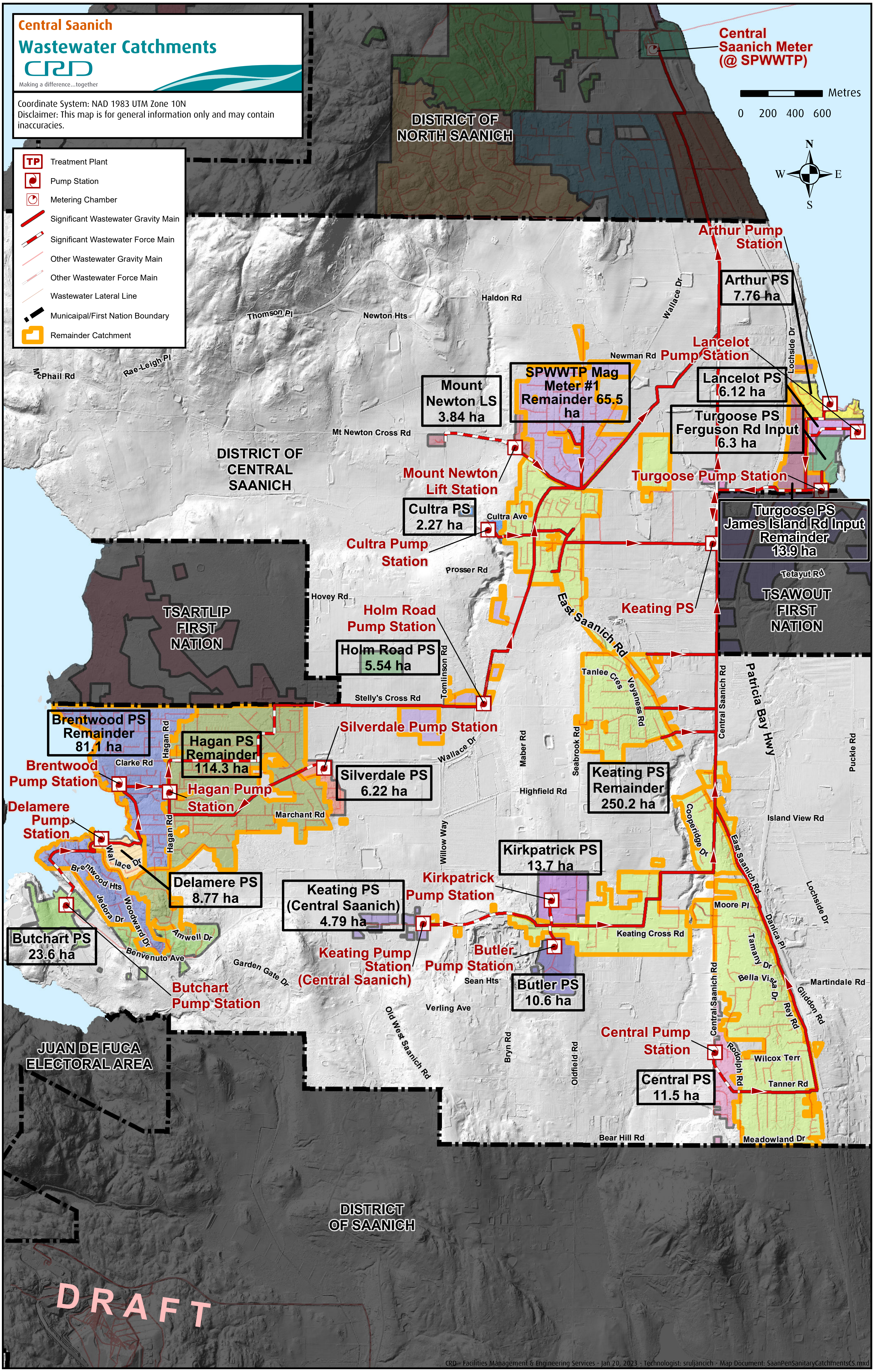
Revision History

Revision #	Date	Status	Revision Description	Author
0	March 14, 2023	Final		JV
B	February 28, 2023	Draft	Second draft for client comment/review	JV
A	November 28, 2022	Draft	First draft for client comment	JV

Appendix D:

Central Saanich: Sewer Map, Catchment Stats, Catchments Maps and Flow Charts



Central Saanich
Wastewater Catchments

CRD
Making a difference...together

Coordinate System: NAD 1983 UTM Zone 10N
Disclaimer: This map is for general information only and may contain inaccuracies.

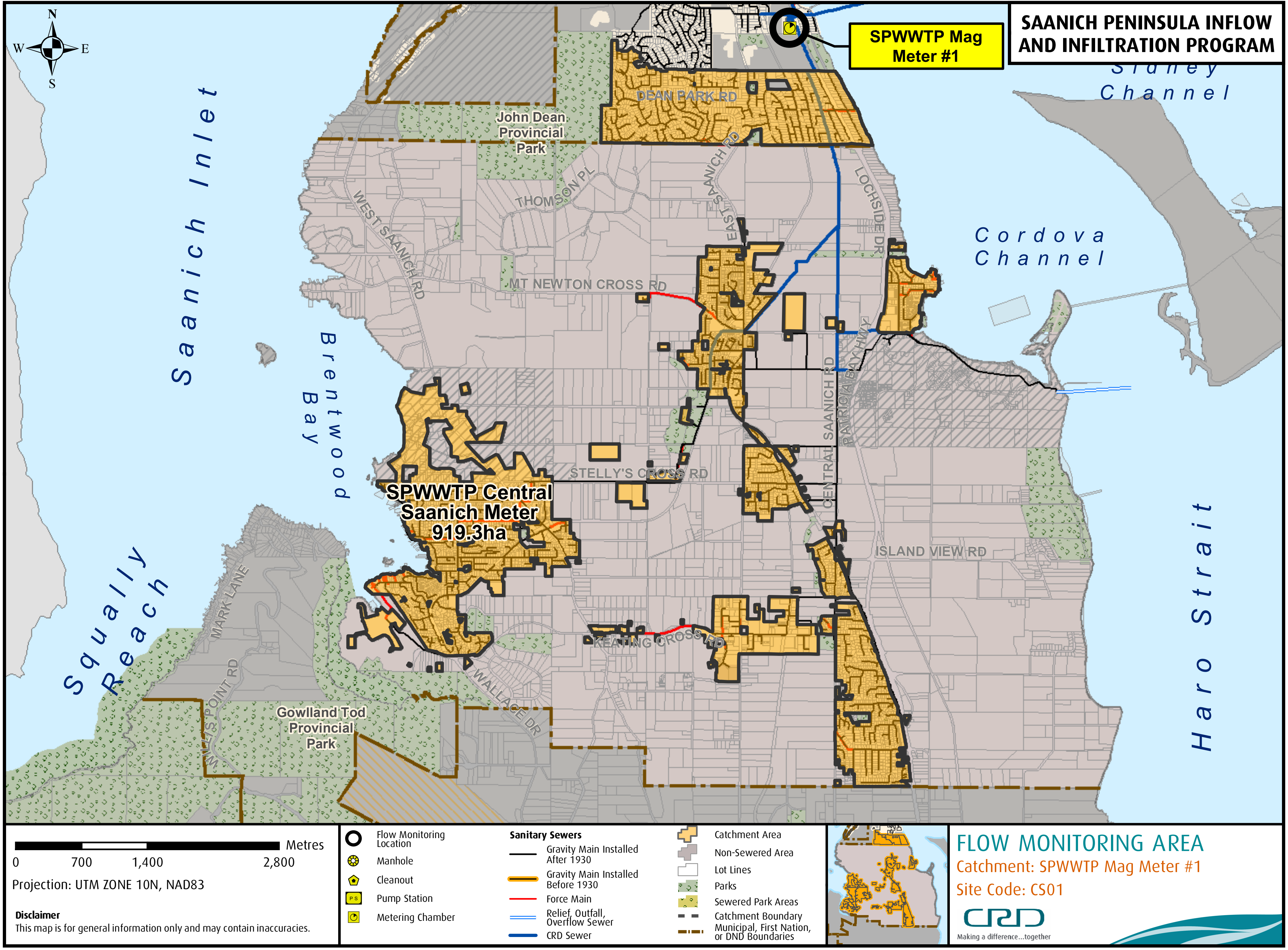
CRD - Facilities Management & Engineering Services - Jan 20, 2023 - Technologist: sruljancich - Map Document: SaanPenSanitaryCatchmentsCS.mxd

Central Saanich Catchment Summary Stats

Pump Station	**Site Code**	**Catchment Stats**							**Gravity Sewer Pipe Type** *(approximate %)*					**Catchment Makeup** *(approximate %)*				
		Size (ha)	**Ave Age (yrs)**	**Gravity Sewers (m)**	**Force Mains (m)**	**PS's (#)**	**MH's (#)**	**Sewered Properties (#)**	**PVC**	**Concrete**	**Clay**	**Rehabbed**	**Other/Unk**	**Single Family**	**Multi Family**	**Commercial**	**Industrial**	**Institutional**
CRD Keating PS	CS2	328.7	1979	46,696	3,577	13	507	2497	68.6	21.5	4.0	0.0	5.9	63.9	7.9	19.0	2.3	6.8
CRD Turgoose PS	CS3	34.1	NA	3,856	866	6	44	410	35.5	16.2	26.3	0.0	22.0	51.0	43.0	5.5	0.0	0.5
Authur PS	CS4	7.8	n/a	893	191	4	9	44	0	33.4	38.1	0.0	28.4	100.0	0.0	0.0	0.0	0.0
Brentwood PS	CS5	113.6	n/a	15,857	1,109	13	190	917	15.8	25.7	38.5	0.0	20.0	76.4	7.5	15.1	0.0	0.9
Butchart PS	CS6	23.6	n/a	2,234	0	1	27	87	32	19.8	47.0	0.0	1.2	43.4	0.0	55.8	0.0	0.7
Butler PS	CS7	10.6	n/a	419	0	1	4	115	94	0.0	0.0	0.0	6.0	0.0	0.0	78.7	21.1	0.2
Central PS	CS8	11.5	n/a	2,035	0	1	23	90	100	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Cultra PS	CS9	2.3	n/a	326	0	1	3	15	100	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Delemere PS	CS10	8.8	n/a	575	0	1	10	147	81	7.9	0.0	0.0	11.1	25.5	73.2	0.0	0.0	1.2
Hagan PS	CS11	234.0	n/a	33,236	1,712	16	384	2136	21.2	25.0	39.8	0.0	14.0	78.0	9.8	9.7	0.0	2.6
Holm PS	CS12	8.0	n/a	332	0	1	4	9	100	0.0	0.0	0.0	0.0	33.7	0.0	0.0	0.0	66.3
Keating PS	CS13	4.8	n/a	476	0	1	6	22	100	0.0	0.0	0.0	0.0	51.7	5.2	23.7	0.0	19.4
Kirkpatrick PS	CS14	13.7	n/a	985	0	1	7	48	50	48.9	0.0	0.0	1.1	0.0	0.0	97.8	1.9	0.3
Lancelot PS	CS15	6.1	n/a	834	0	1	9	60	83.6	0.0	0.0	0.0	16.4	73.2	26.8	0.0	0.0	0.0
Newton PS	CS16	3.8	n/a	664	598	1	10	26	16	80.9	0.0	0.0	3.1	68.3	0.0	0.0	0.0	31.7
Silverdale PS	CS17	6.2	n/a	926	0	1	12	41	0	87.9	0.0	0.0	12.1	77.4	0.0	22.6	0.0	0.0

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 700 1,400 2,800

Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○	Flow Monitoring Location
✲	Manhole
⬟	Cleanout
PS	Pump Station
◔	Metering Chamber

Sanitary Sewers

—	Gravity Main Installed After 1930
—	Gravity Main Installed Before 1930
—	Force Main
=	Relief, Outfall, Overflow Sewer
—	CRD Sewer

▨	Catchment Area
▨	Non-Sewered Area
☐	Lot Lines
▨	Parks
▨	Sewered Park Areas
- -	Catchment Boundary
-·-	Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

Catchment: SPWWTP Mag Meter #1

Site Code: CS01

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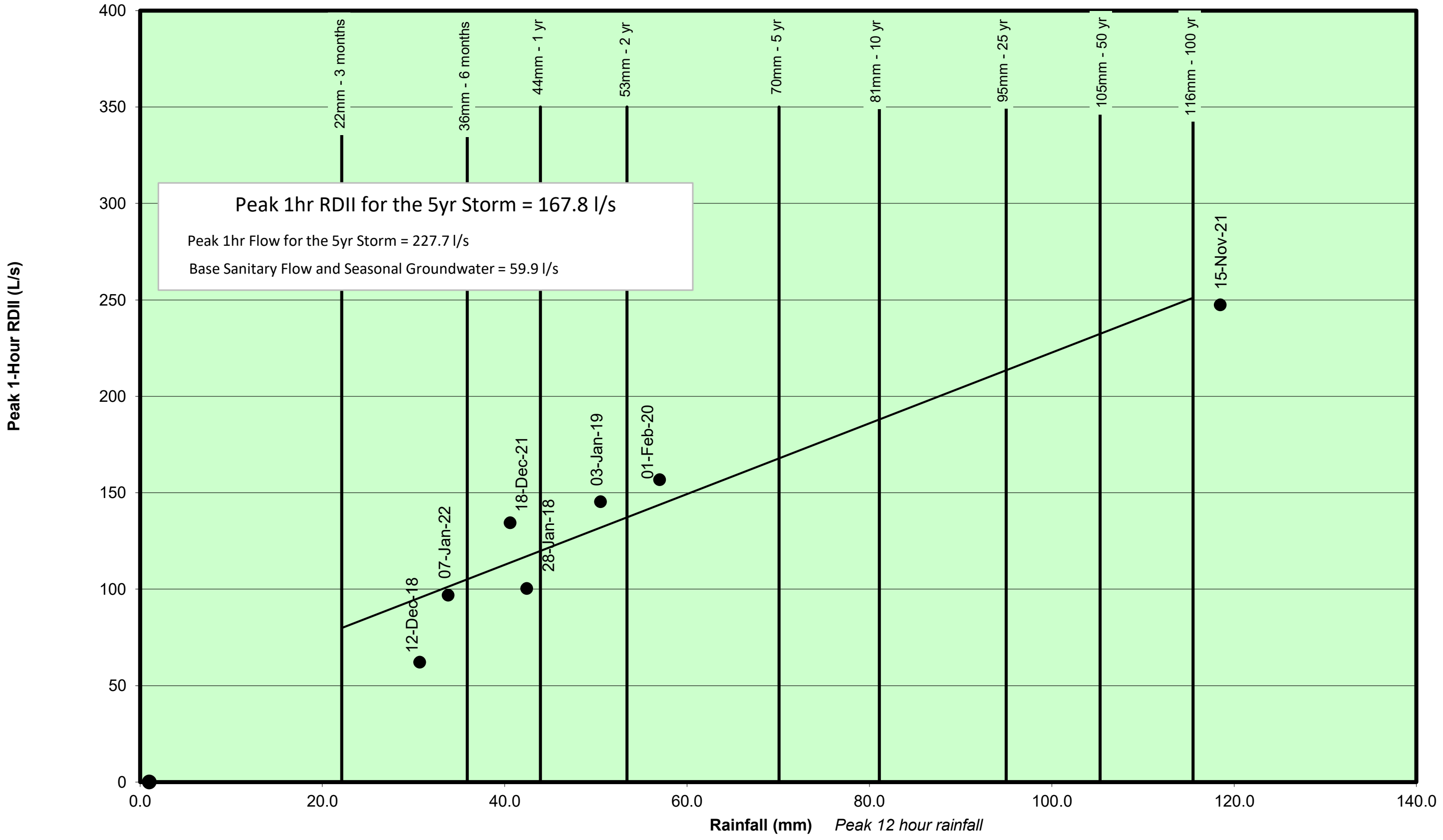
SPWWTP Mag Meter #1 (CS01)

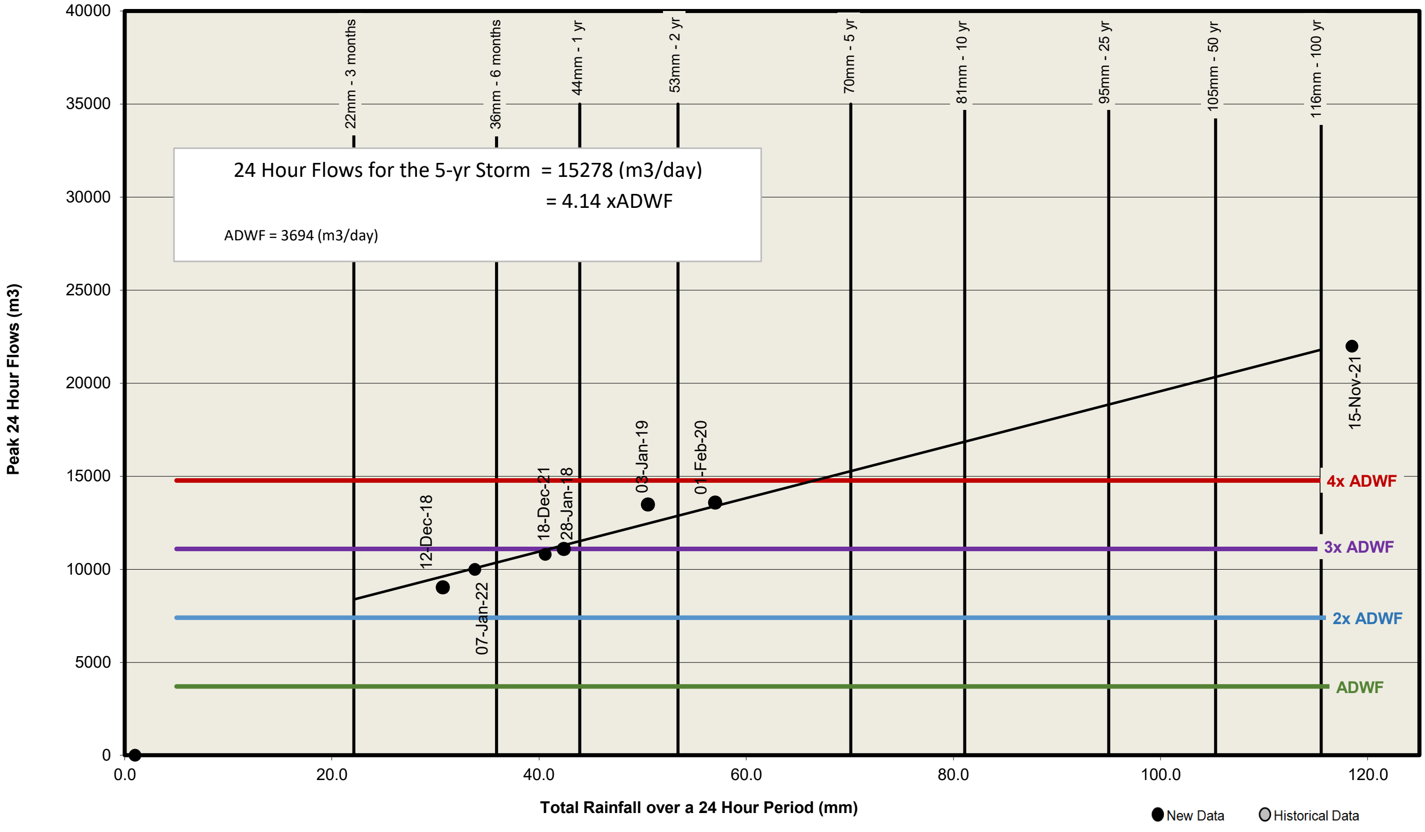


Peak 1hr RDII for the 5yr Storm = 167.8 l/s

Peak 1hr Flow for the 5yr Storm = 227.7 l/s

Base Sanitary Flow and Seasonal Groundwater = 59.9 l/s

Peak 24-Hour Flows by Storm Event



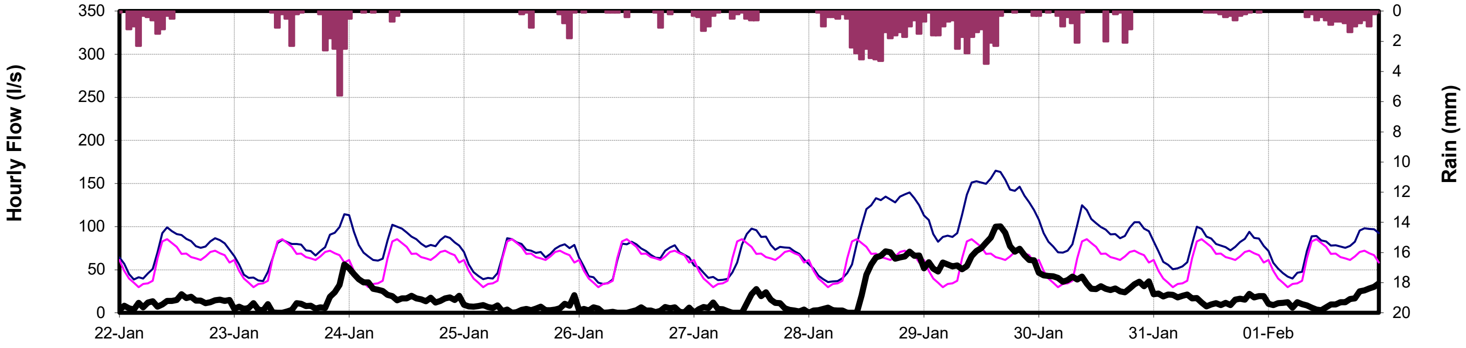
24 Hour Flows for the 5-yr Storm = 15278 (m3/day)

= 4.14 xADWF

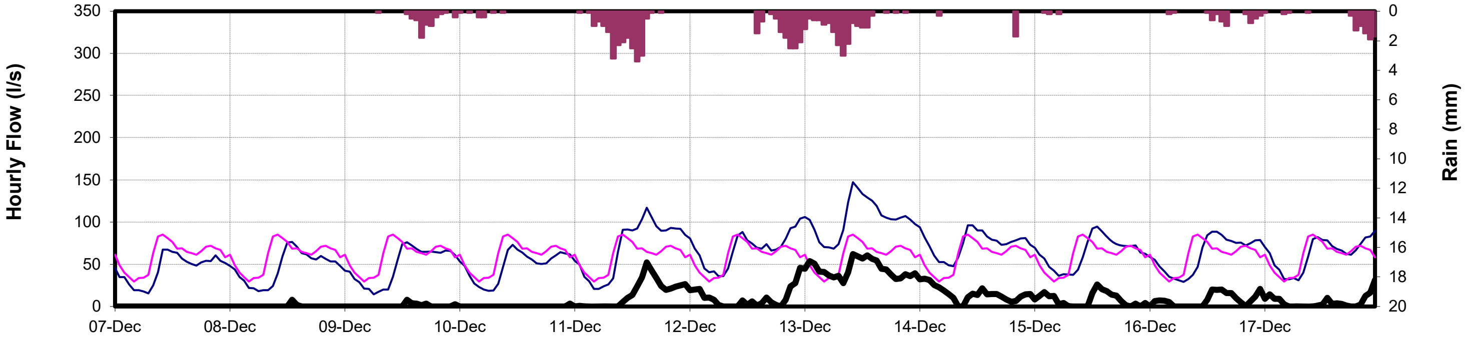
ADWF = 3694 (m3/day)

SPWWTP Mag Meter #1 (CS01)

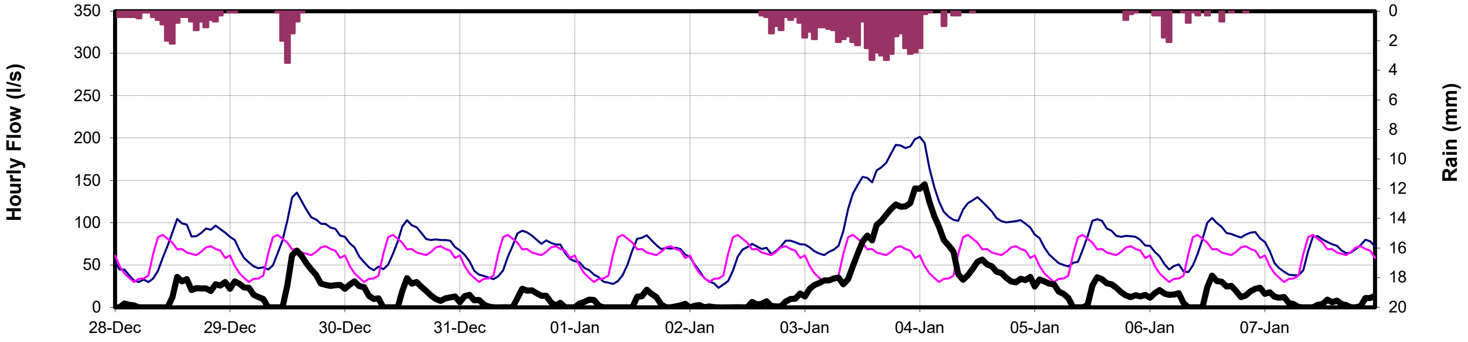
January 22 to February 1, 2018 Storm Events



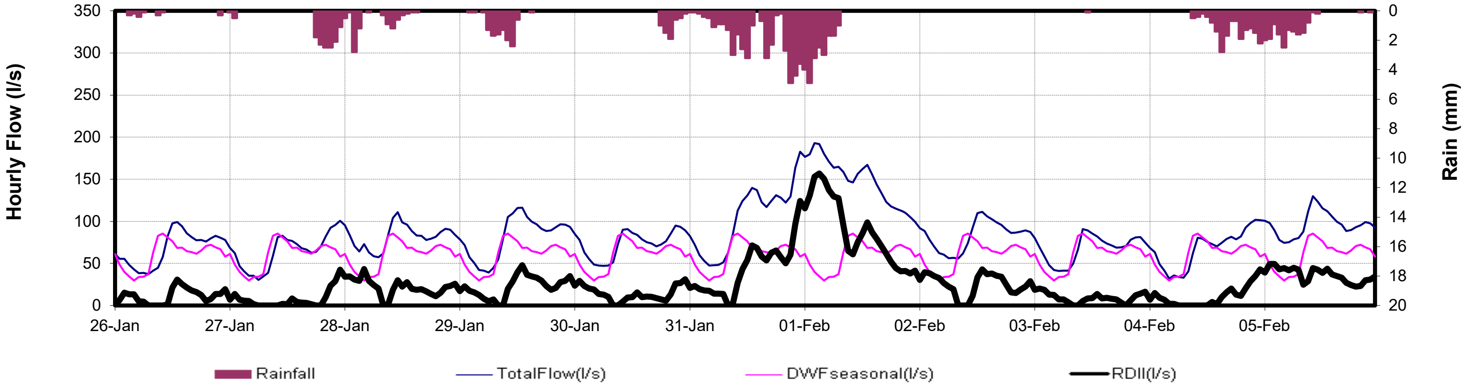
December 7 to December 17, 2018 Storm Events



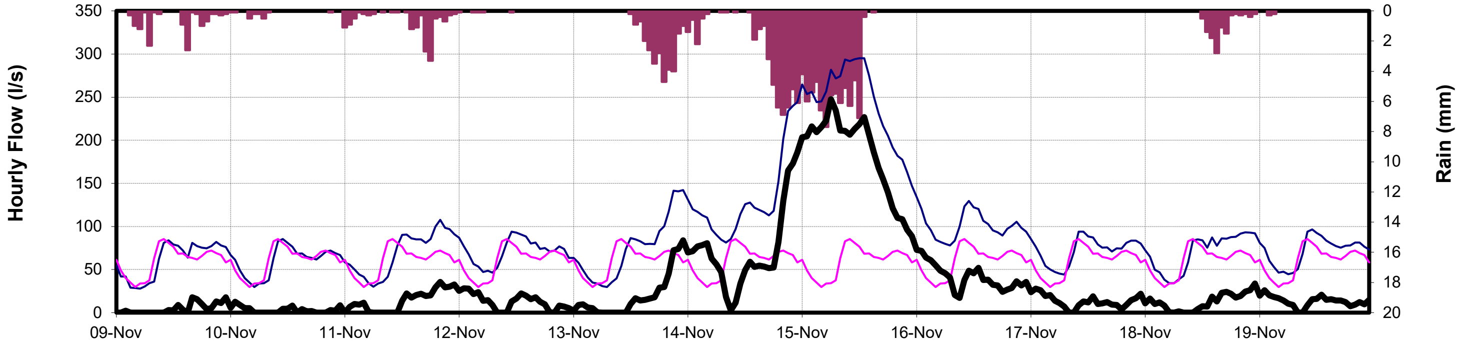
December 28 to January 7, 2019 Storm Events

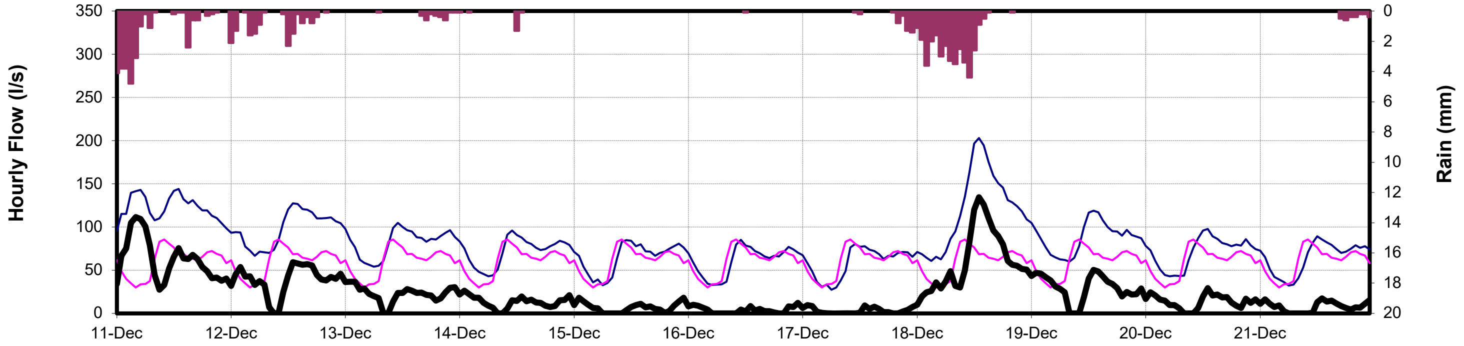


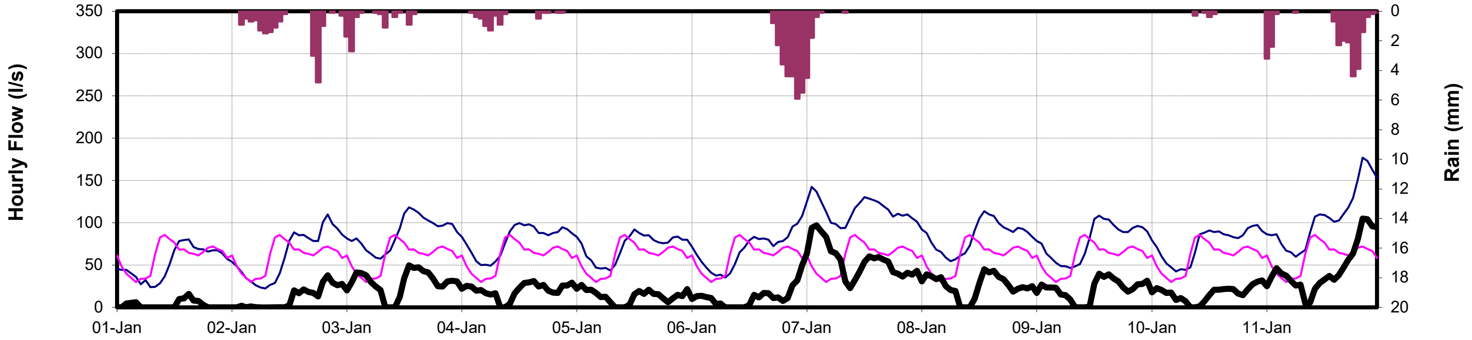
January 26 to February 5, 2020 Storm Events

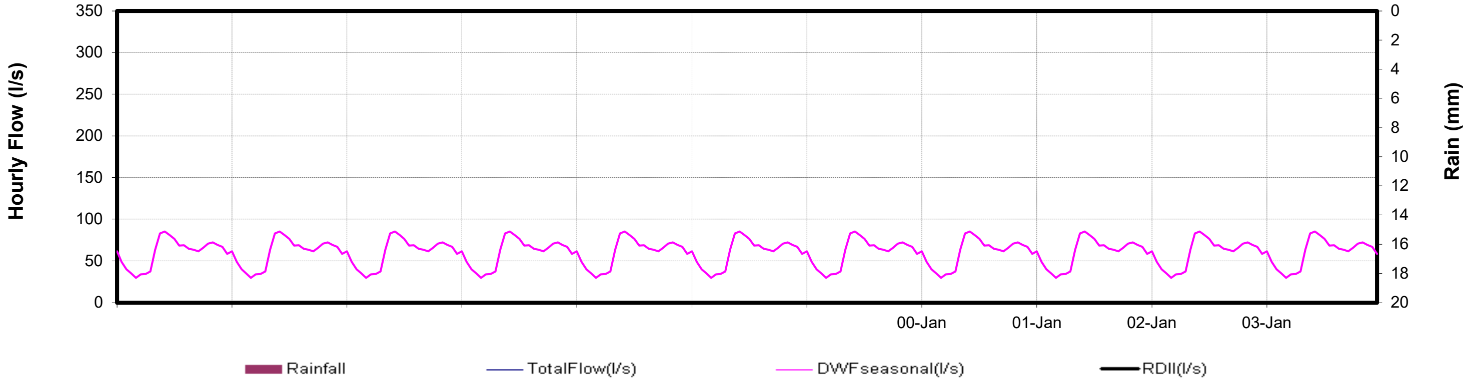


SPWWTP Mag Meter #1 (CS01)


November 9 to November 19, 2021 Storm Events

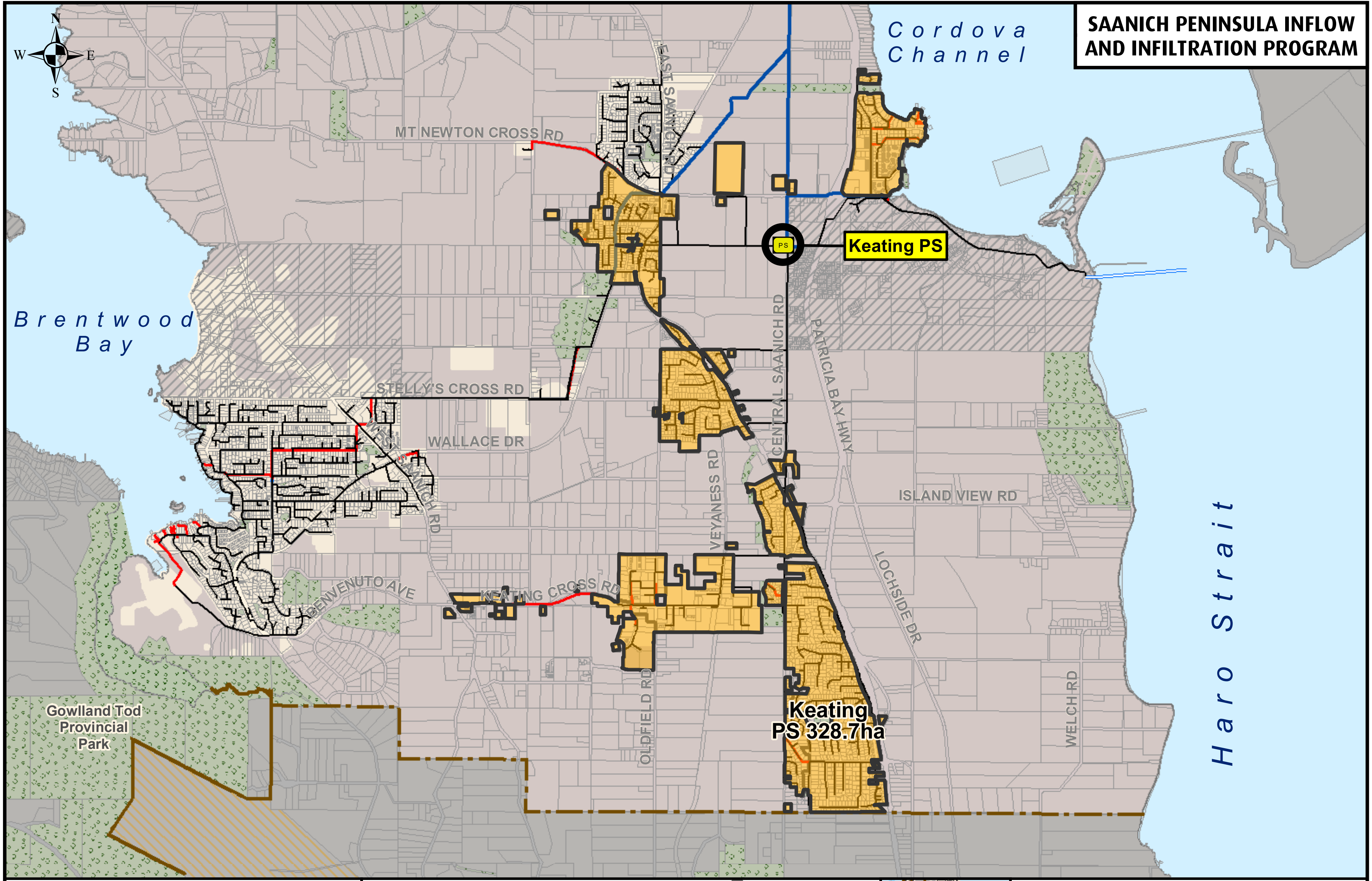

December 11 to December 21, 2021 Storm Events


January 1 to January 11, 2022 Storm Events


#VALUE!

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 550 1,100 2,200

Projection: UTM ZONE 10N, NAD83

Disclaimer

This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location

⊛ Manhole

⬟ Cleanout

PS Pump Station

◔ Metering Chamber

Sanitary Sewers

— Gravity Main Installed After 1930

— Gravity Main Installed Before 1930

— Force Main

═ Relief, Outfall, Overflow Sewer

— CRD Sewer

▨ Catchment Area

▨ Non-Sewered Area

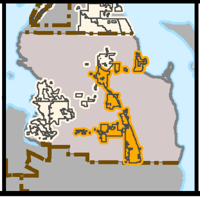
☐ Lot Lines

▨ Parks

▨ Sewered Park Areas

- - Catchment Boundary

-·- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Keating PS

Site Code: CS02

CRD

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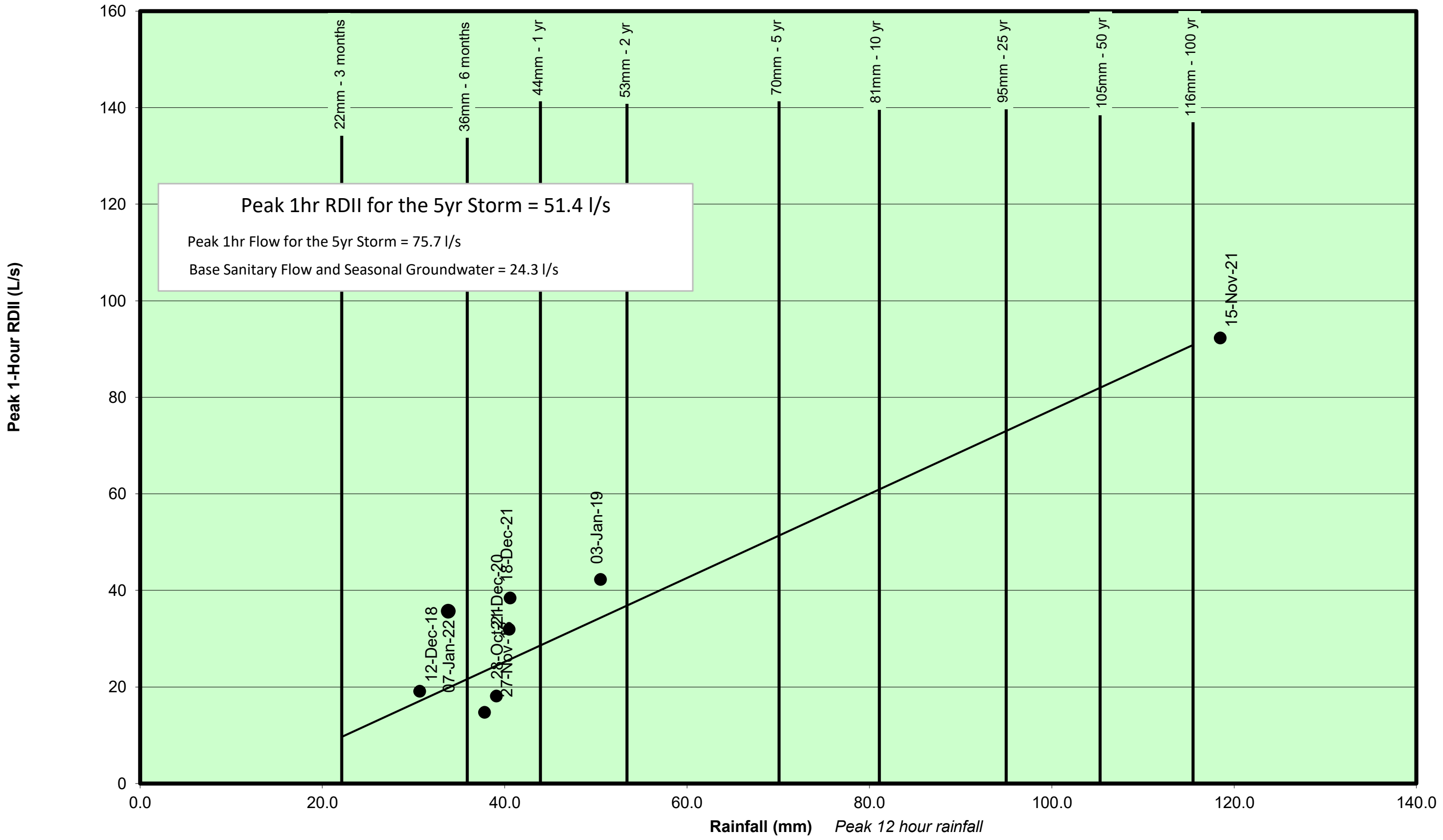
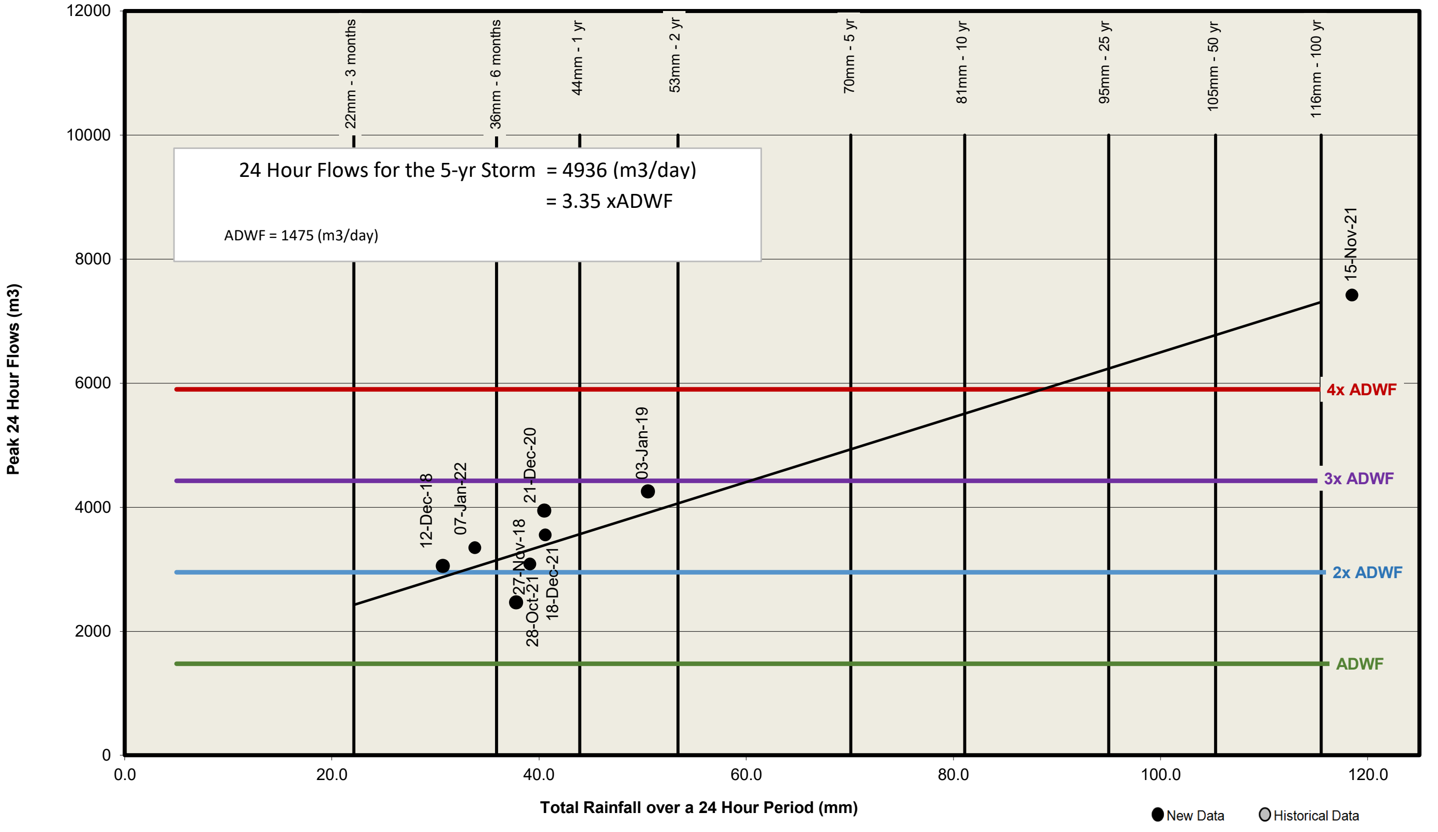
CRD Keating

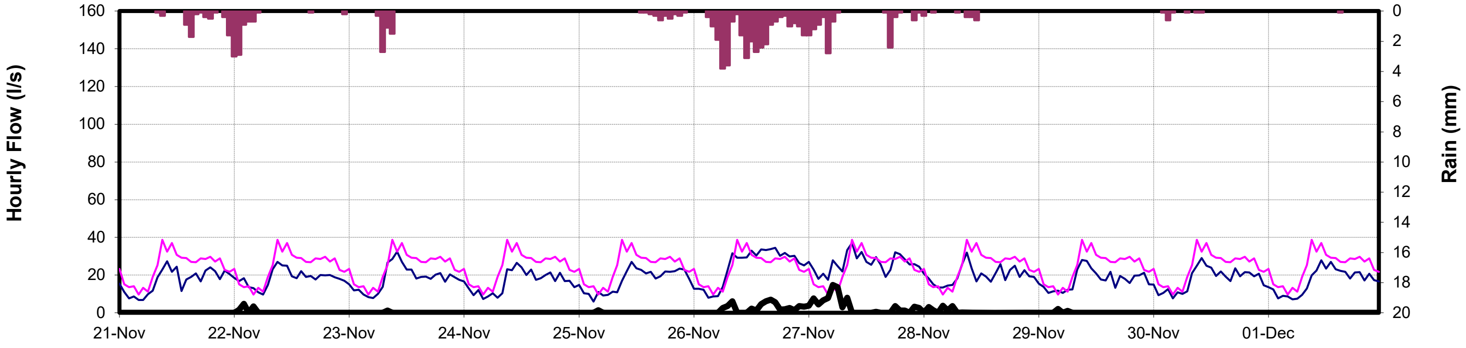


Peak 24-Hour Flows by Storm Event

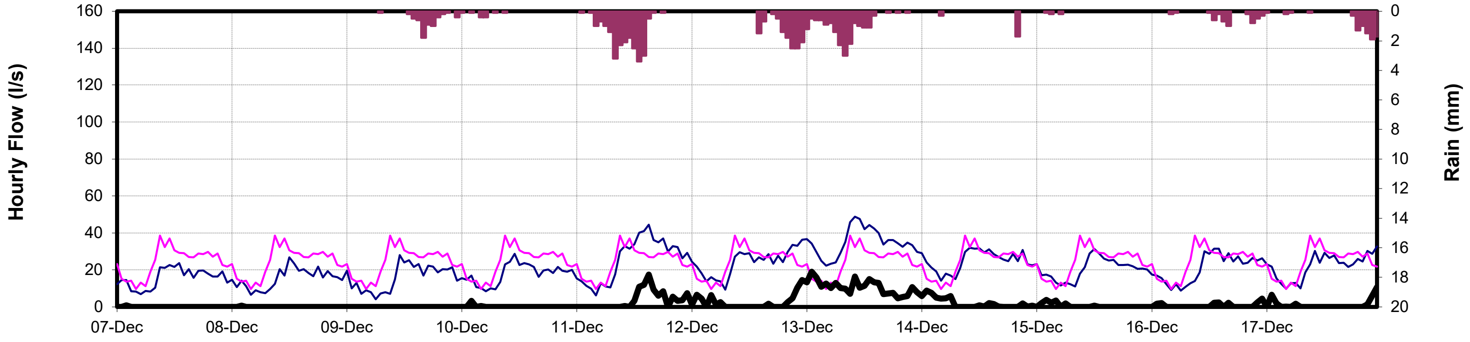


CRD Keating (CS02)

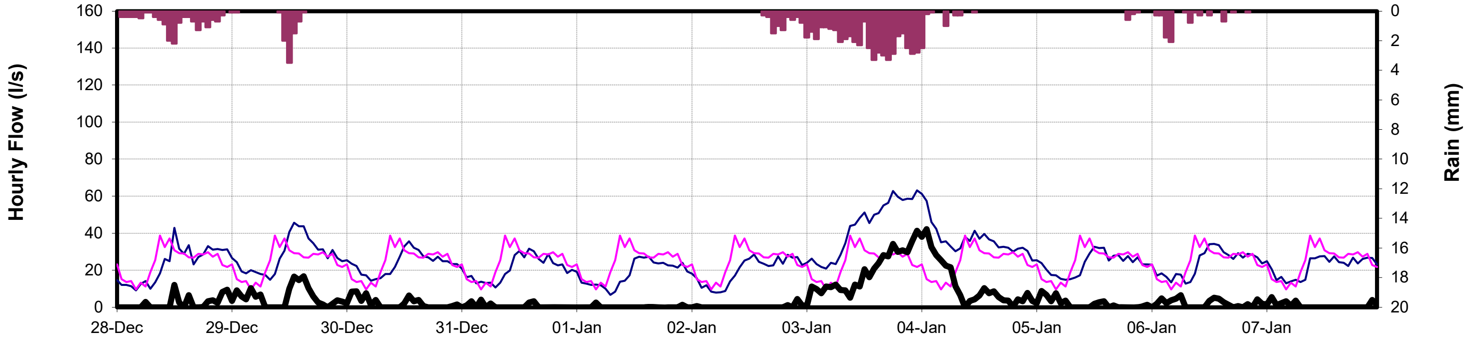
November 21 to December 1, 2018 Storm Events



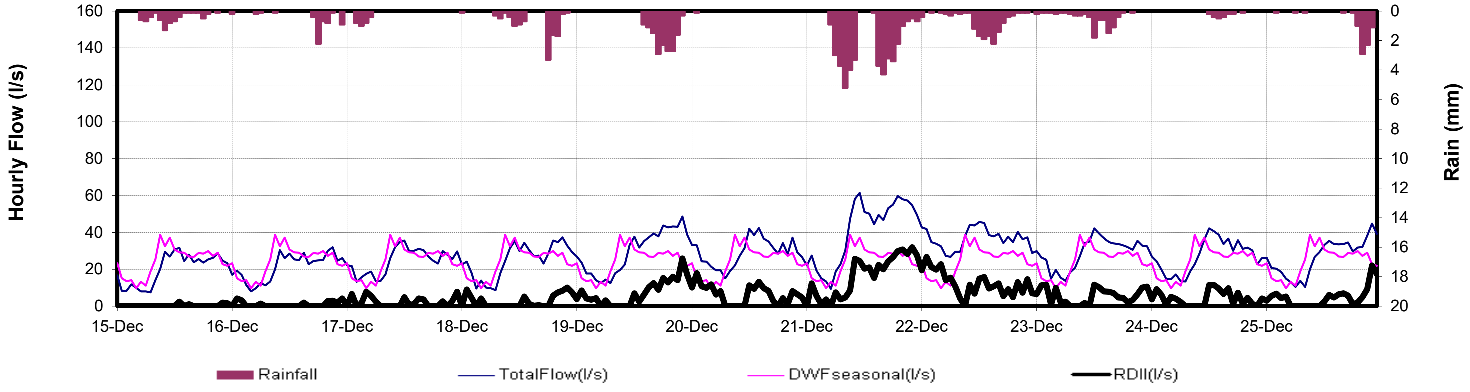
December 7 to December 17, 2018 Storm Events



December 28 to January 7, 2019 Storm Events

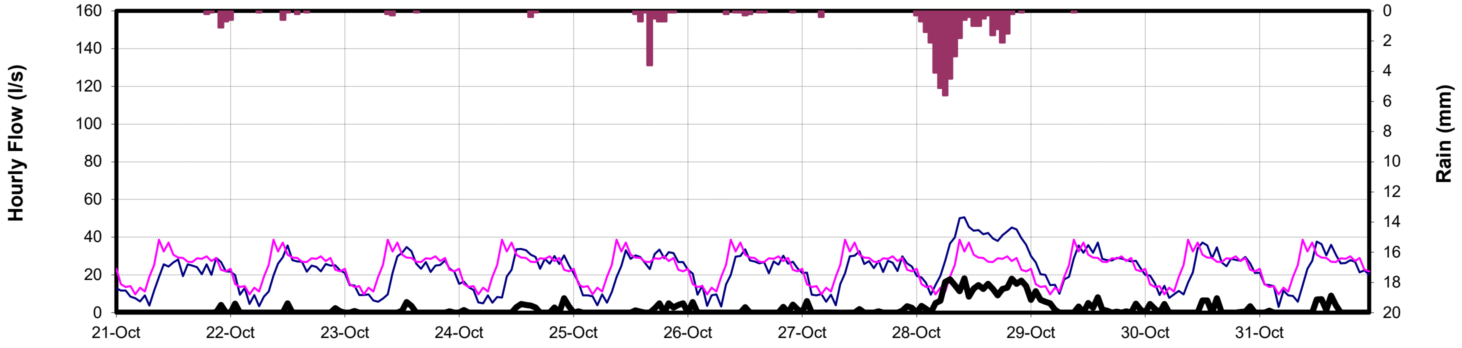


December 15 to December 25, 2020 Storm Events

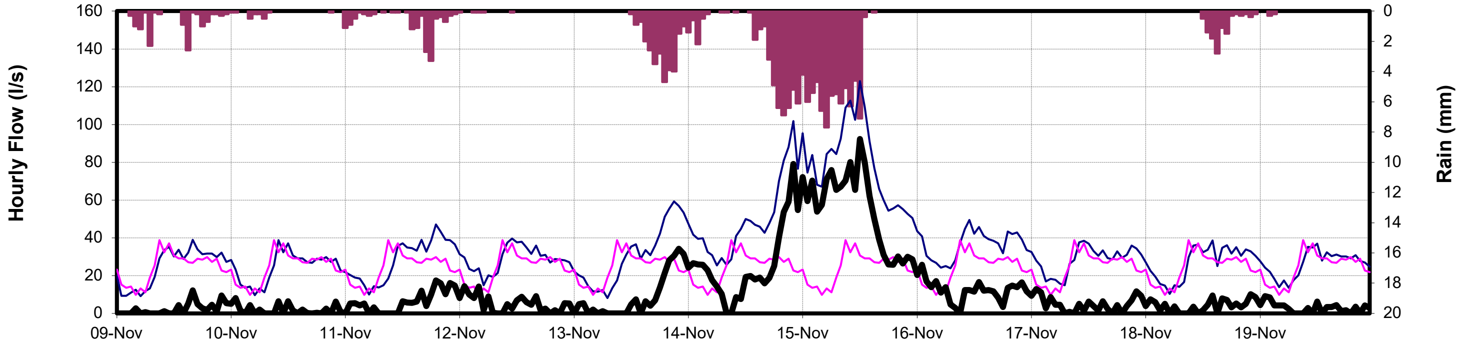


CRD Keating (CS02)

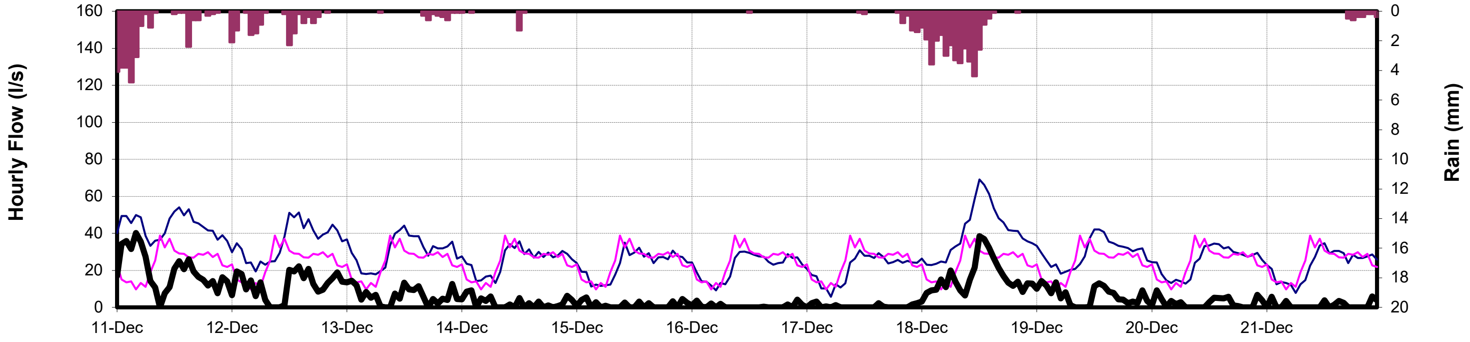
October 21 to October 31, 2021 Storm Events



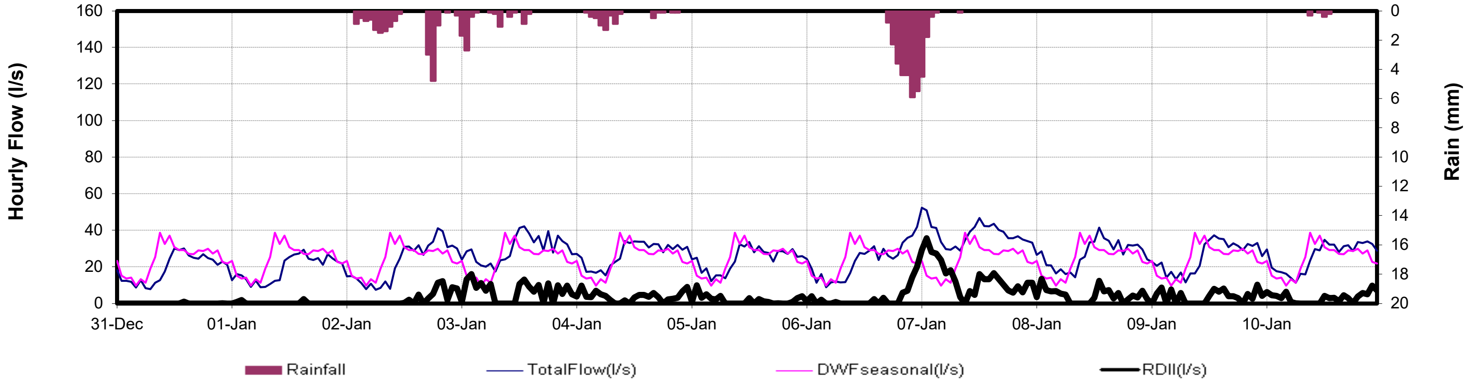
November 9 to November 19, 2021 Storm Events



December 11 to December 21, 2021 Storm Events

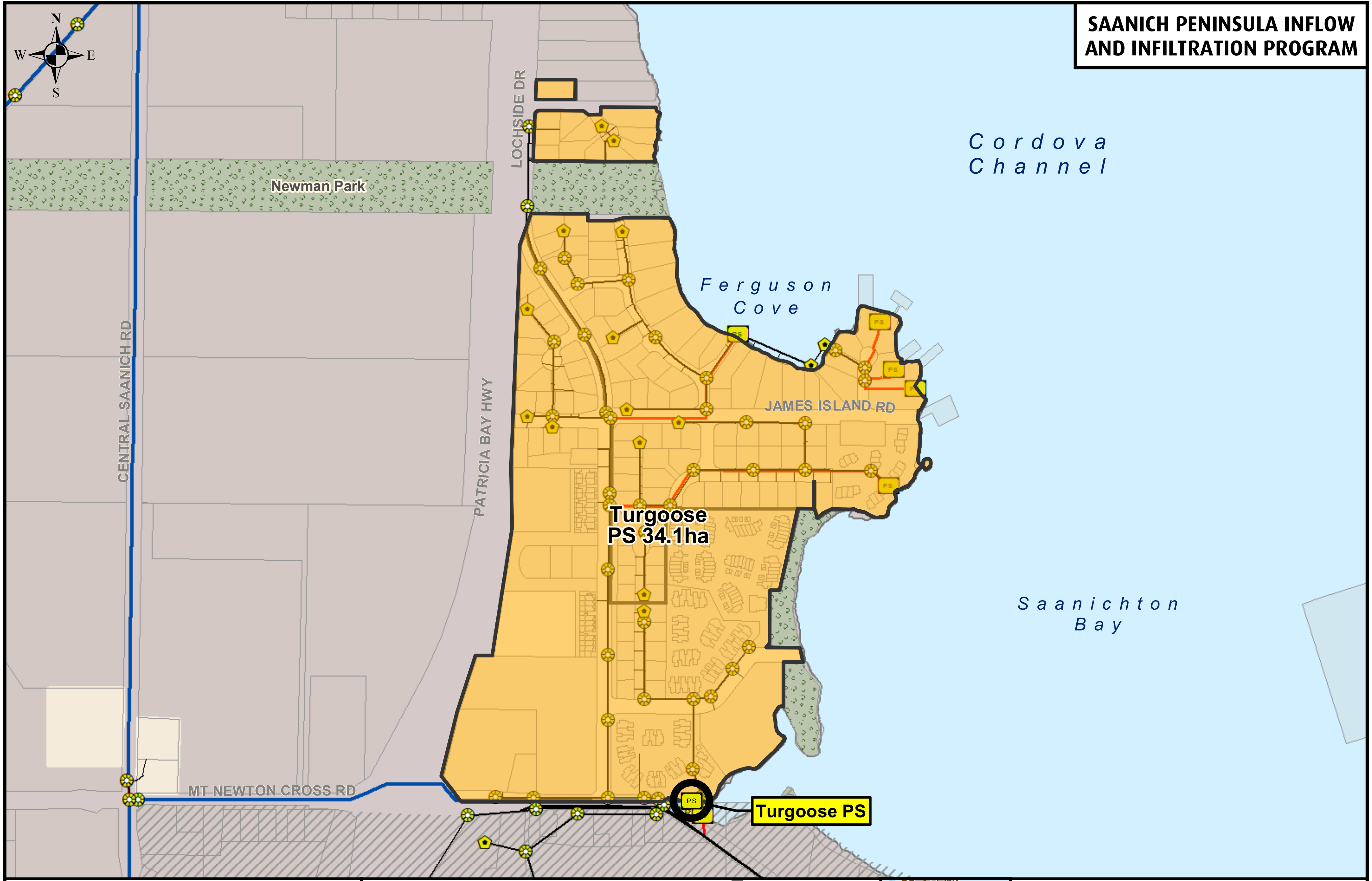


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 100 200 400

Projection: UTM ZONE 10N, NAD83

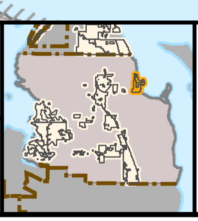
Disclaimer
This map is for general information only and may contain inaccuracies.

- ○ Flow Monitoring Location
- ✲ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◔ Metering Chamber

Sanitary Sewers

- — Gravity Main Installed After 1930
- — Gravity Main Installed Before 1930
- — Force Main
- ═ Relief, Outfall, Overflow Sewer
- — CRD Sewer

- ▨ Catchment Area
- ▨ Non-Sewered Area
- ☐ Lot Lines
- ▨ Parks
- ▨ Sewered Park Areas
- - - Catchment Boundary
- -·- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Turgoose PS

Site Code: CS03

CRD
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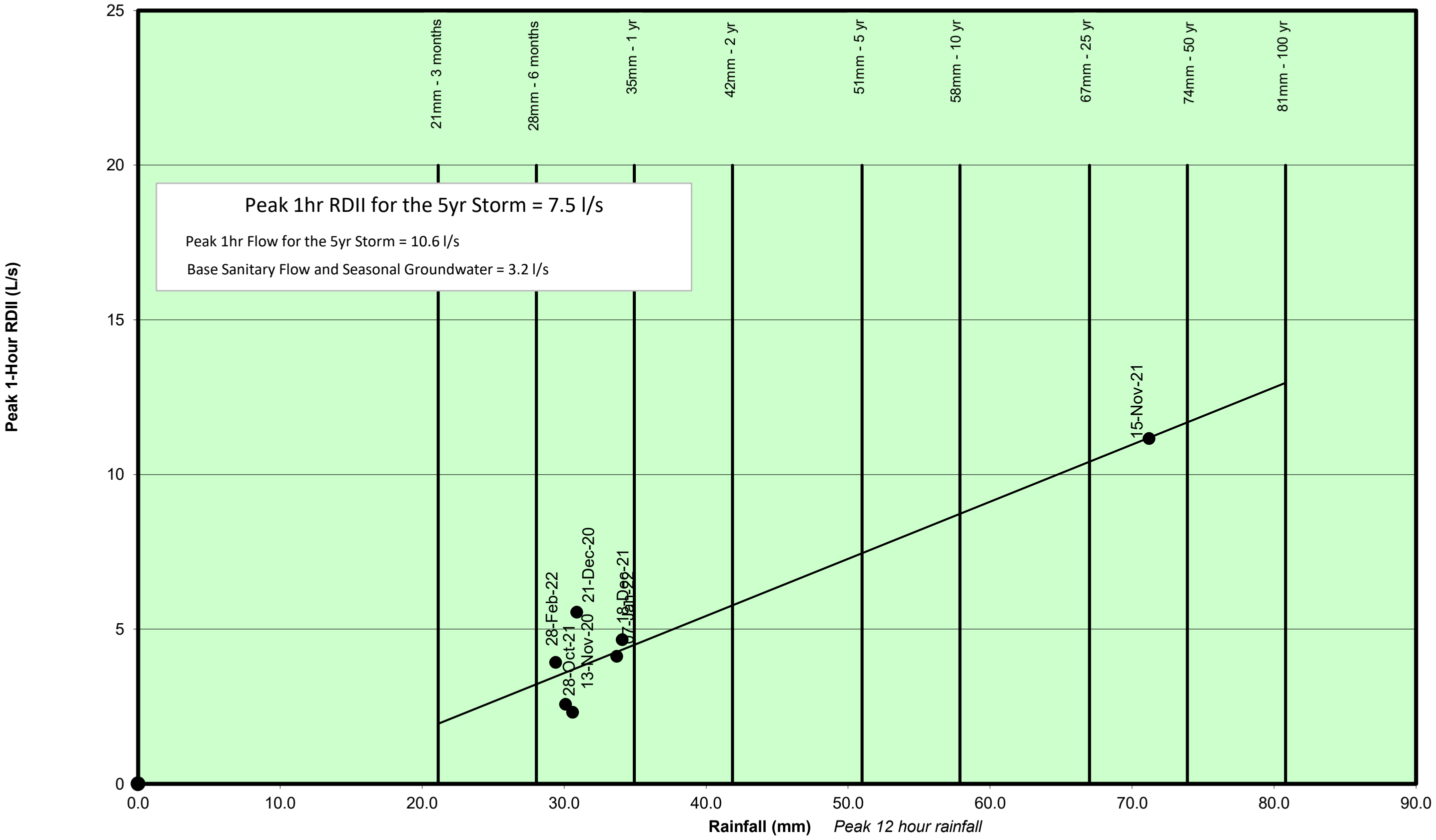
CRD Turgoose PS (CS03)

Peak 1-hr RDII by Storm Event

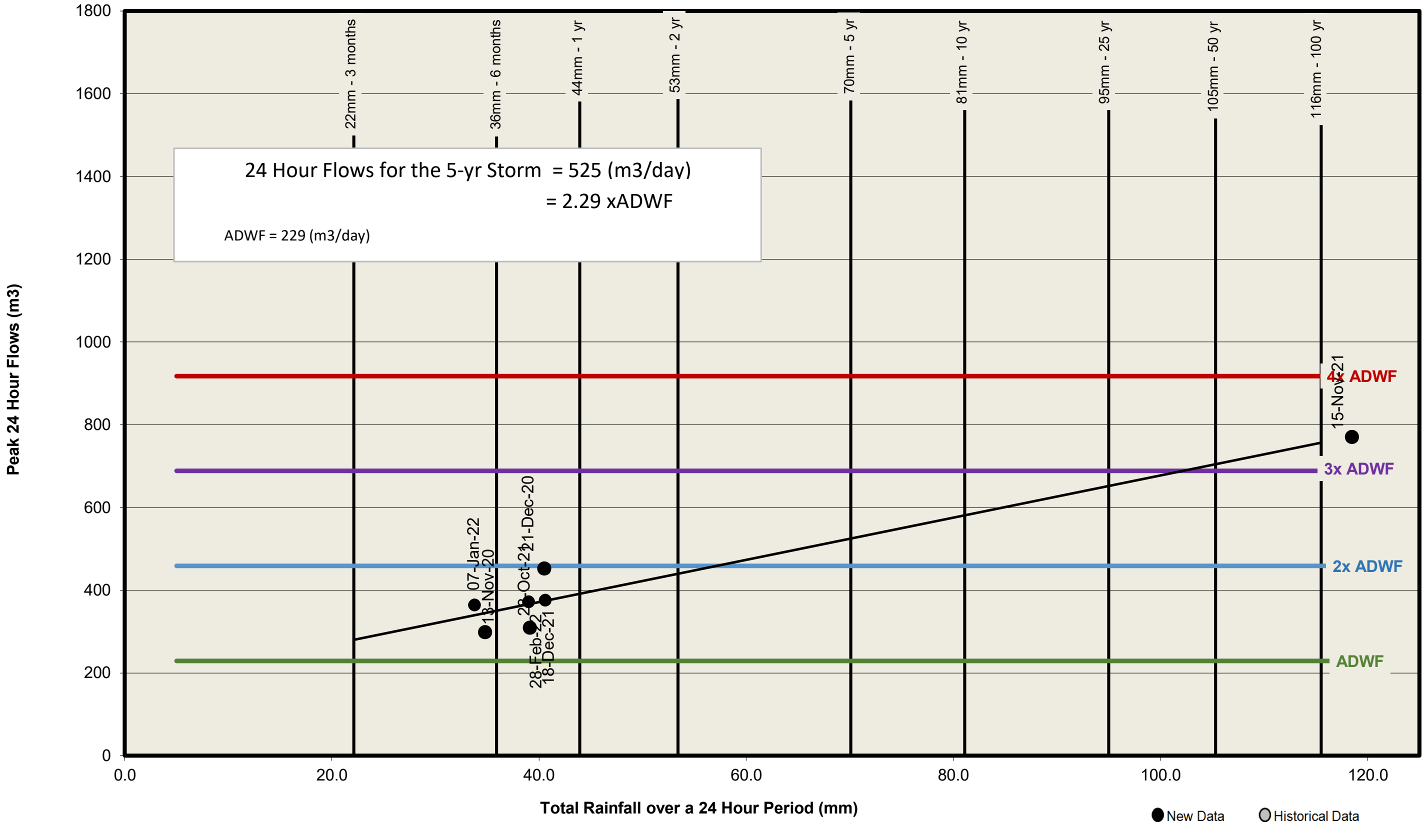


Peak 1hr RDII for the 5yr Storm = 7.5 l/s

Peak 1hr Flow for the 5yr Storm = 10.6 l/s

Base Sanitary Flow and Seasonal Groundwater = 3.2 l/s

Peak 24-Hour Flows by Storm Event

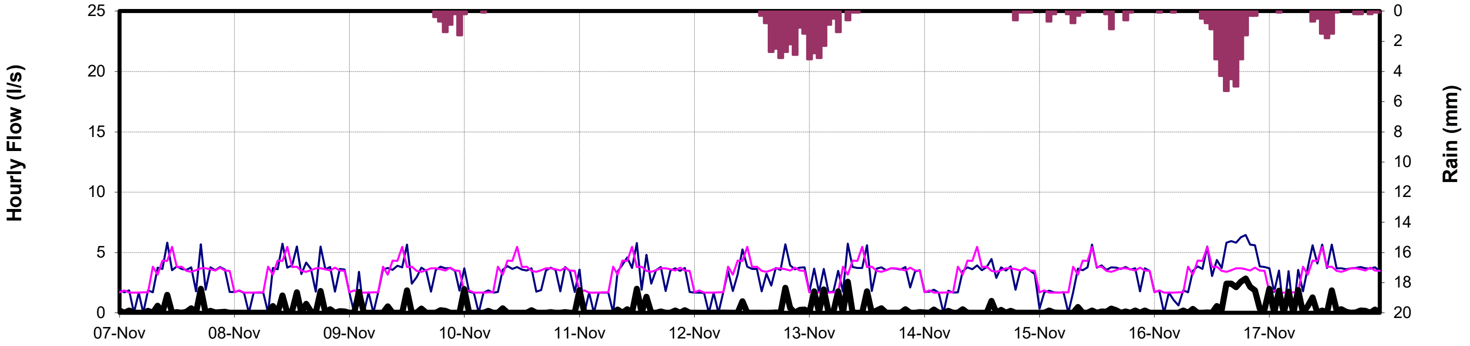


24 Hour Flows for the 5-yr Storm = 525 (m3/day)
= 2.29 xADWF

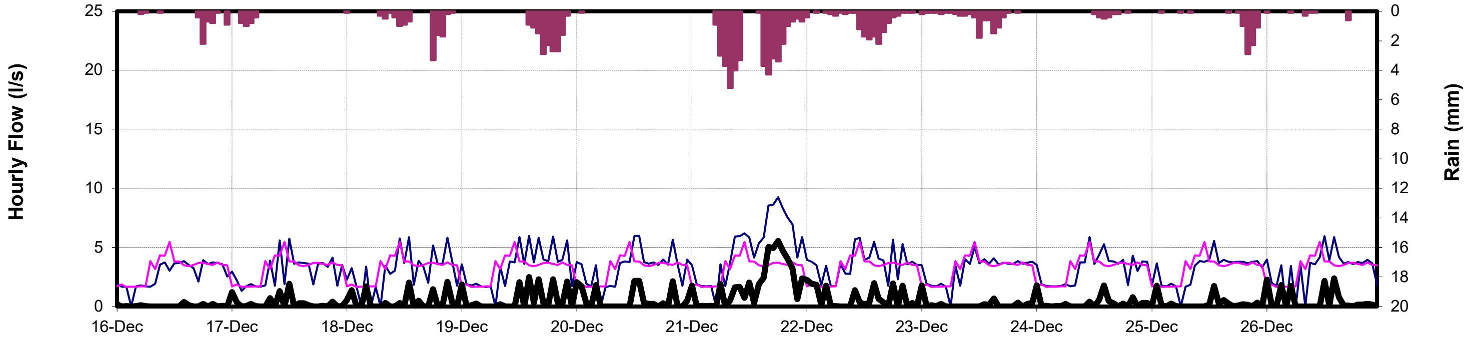
ADWF = 229 (m3/day)

CRD Turgoose PS (CS03)

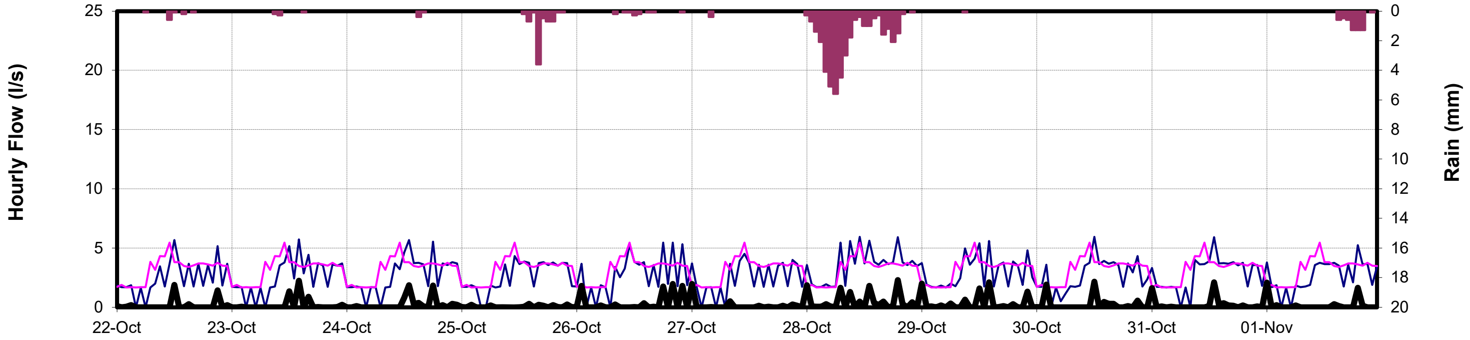
November 7 to November 17, 2020 Storm Events



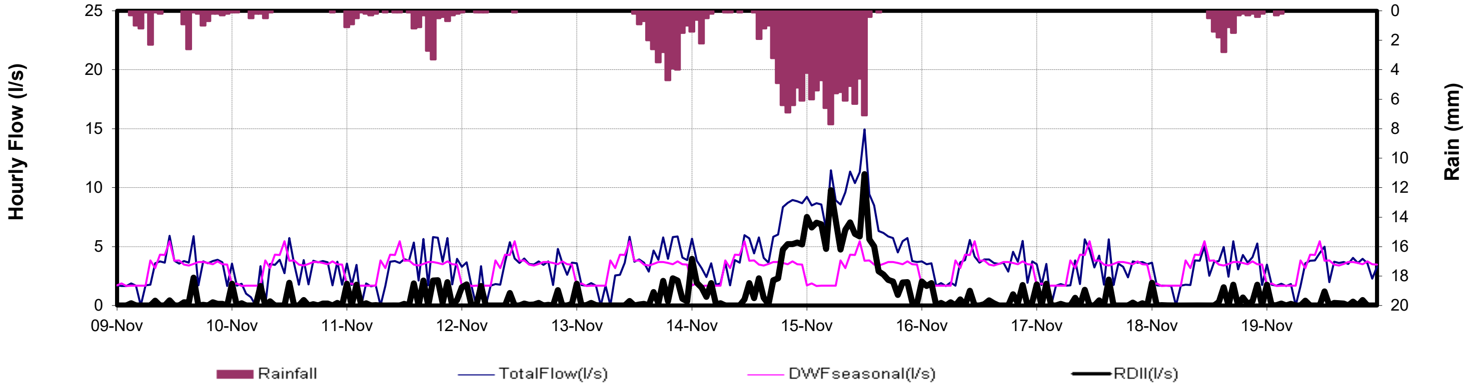
December 16 to December 26, 2020 Storm Events



October 22 to November 1, 2021 Storm Events

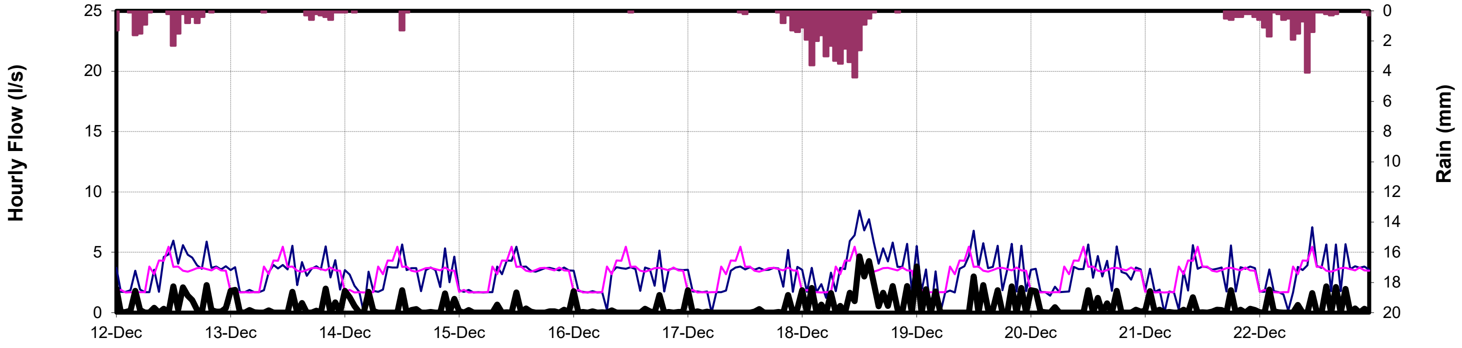


November 9 to November 19, 2021 Storm Events

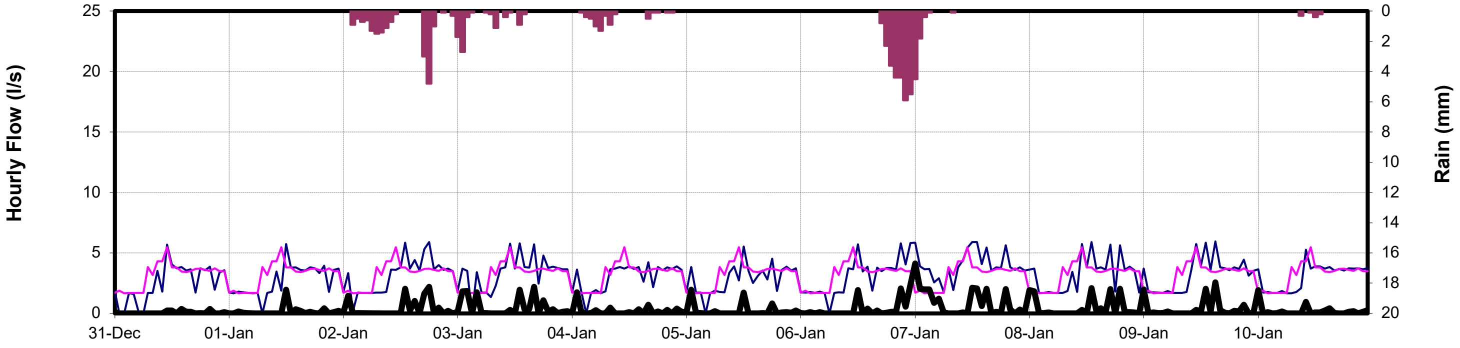


CRD Turgoose PS (CS03)

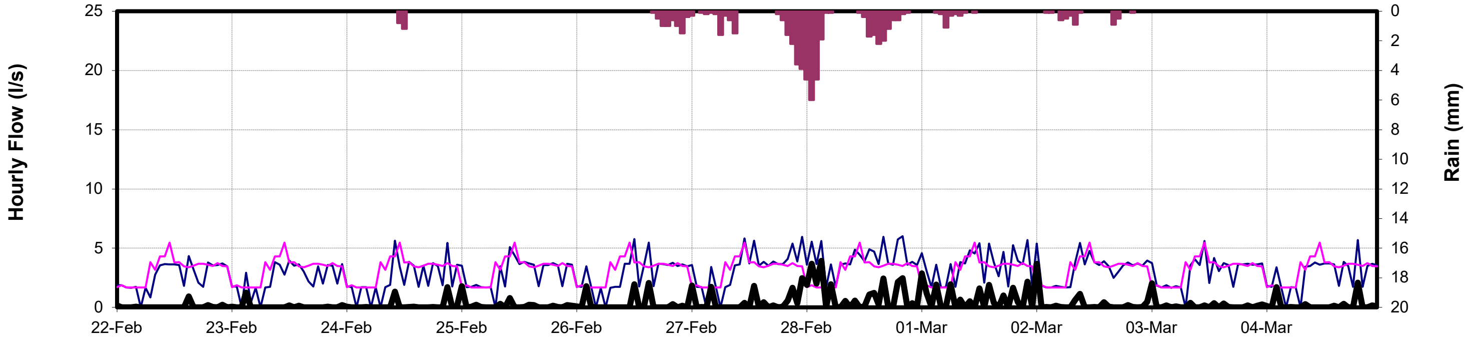
December 12 to December 22, 2021 Storm Events



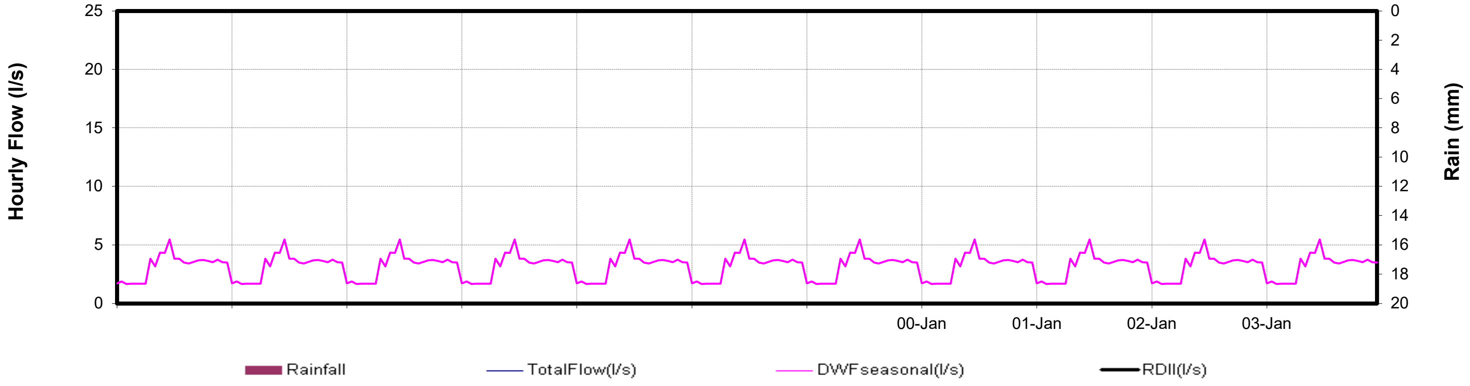
December 31 to January 10, 2022 Storm Events



February 22 to March 4, 2022 Storm Events

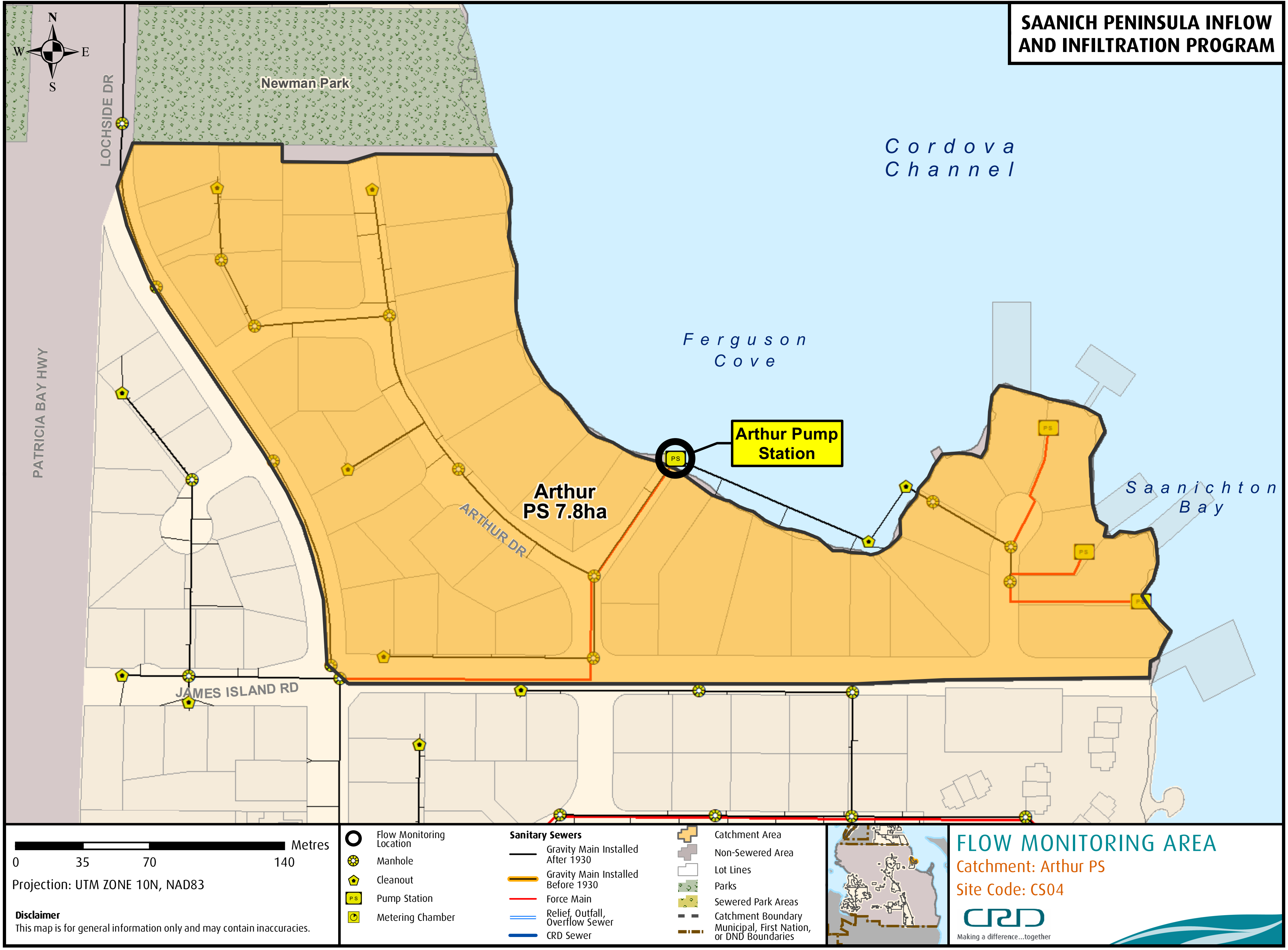


#VALUE!



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Projection: UTM ZONE 10N, NAD83

Disclaimer
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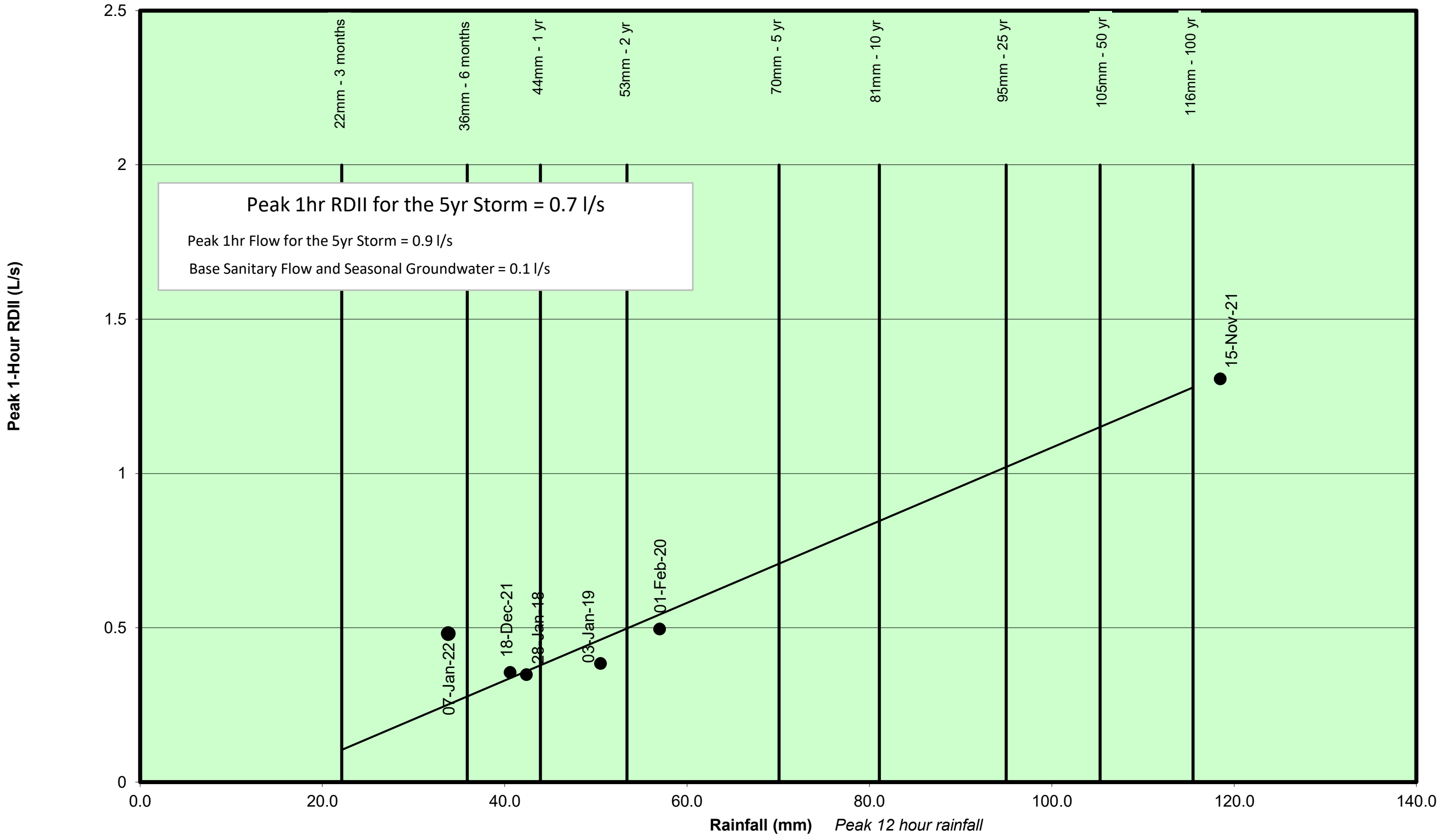
FLOW MONITORING AREA

Catchment: Arthur PS

Site Code: CS04

Arthur PS (CS04)

Peak 1-Hour RDII by Storm Event

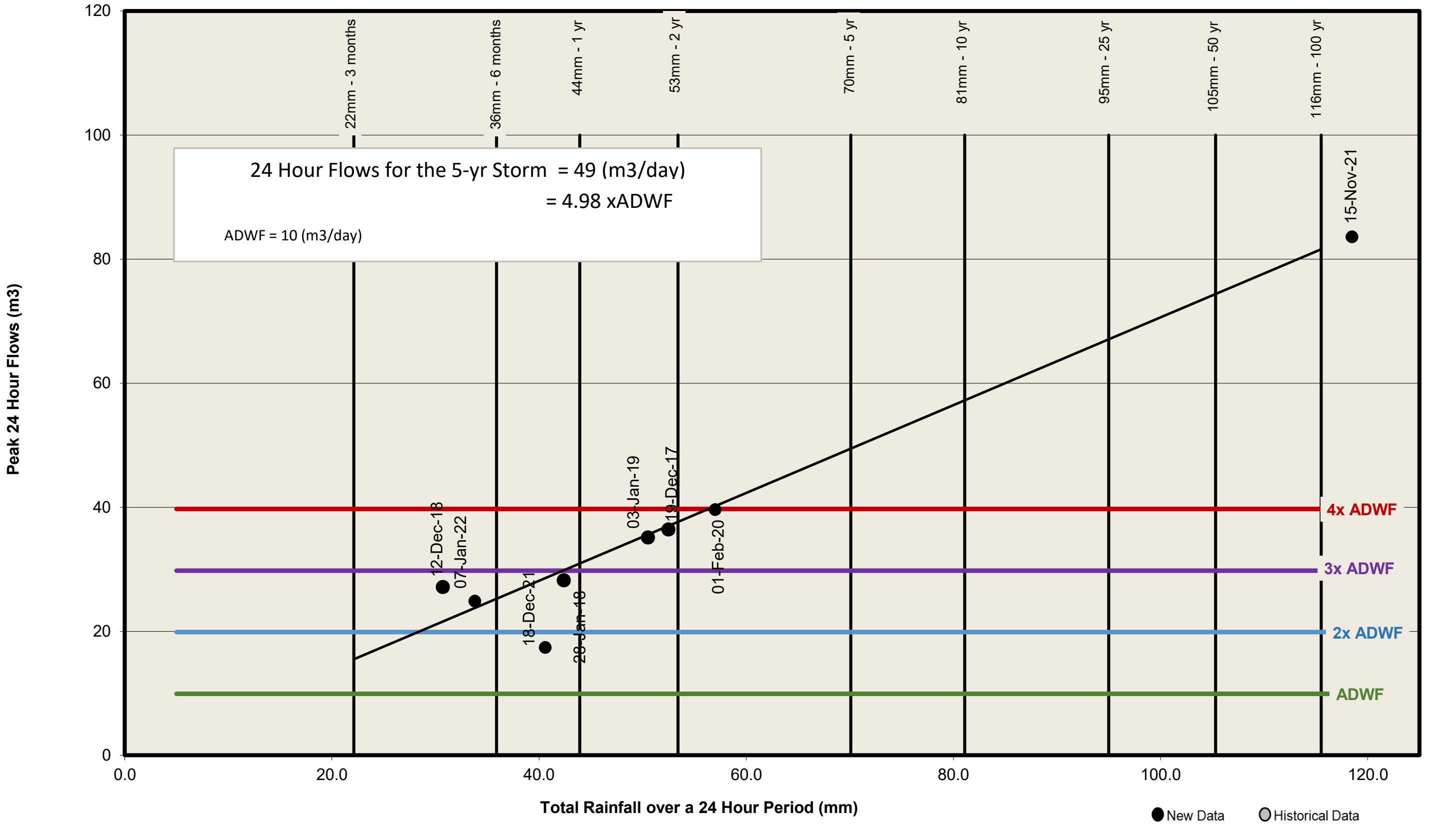


Peak 1hr RDII for the 5yr Storm = 0.7 l/s

Peak 1hr Flow for the 5yr Storm = 0.9 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.1 l/s

Peak 24-Hour Flows by Storm Event



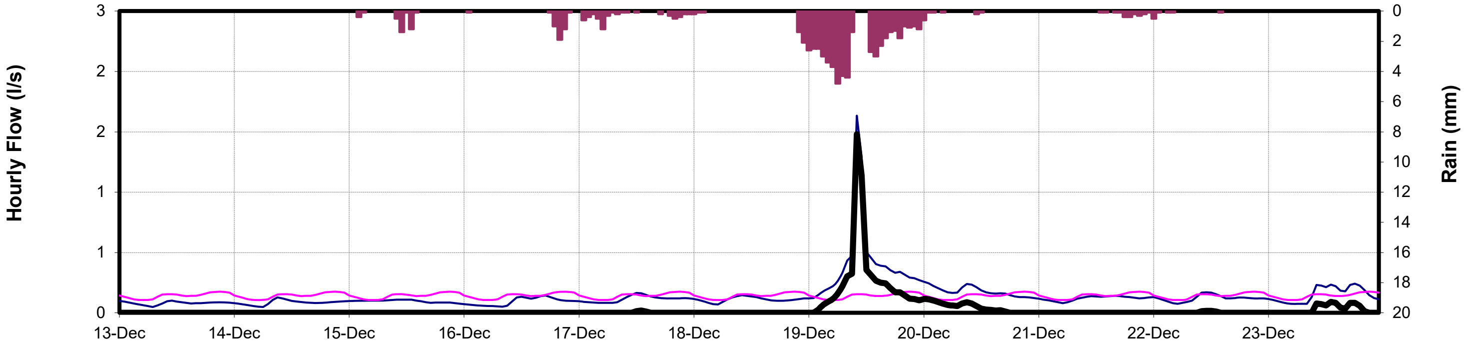
24 Hour Flows for the 5-yr Storm = 49 (m3/day)

= 4.98 xADWF

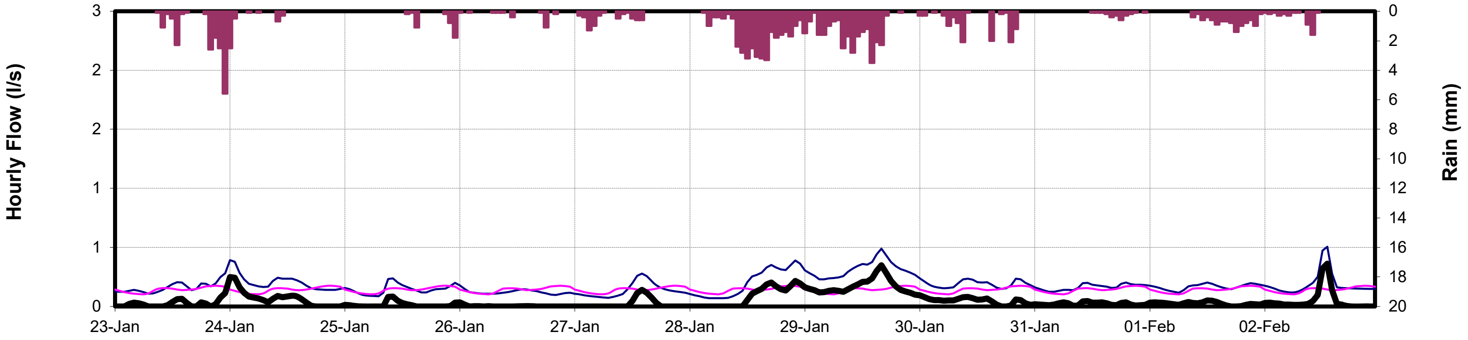
ADWF = 10 (m3/day)

Arthur PS (CS04)

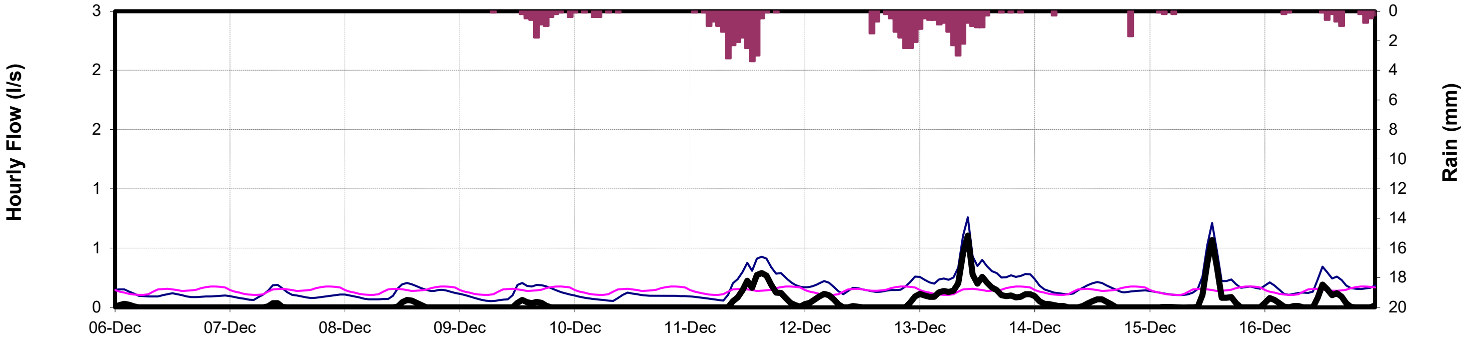
December 13 to December 23, 2017 Storm Events



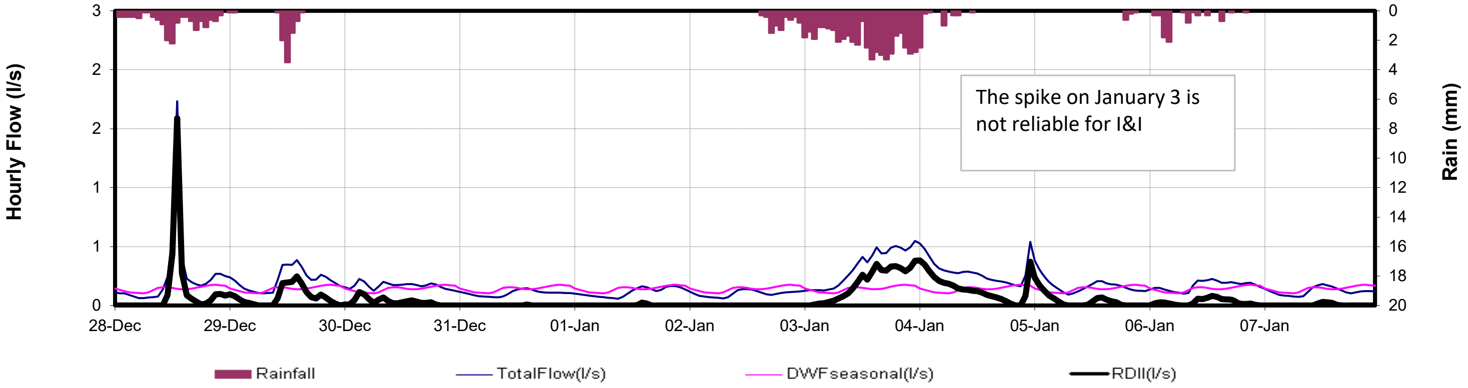
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events



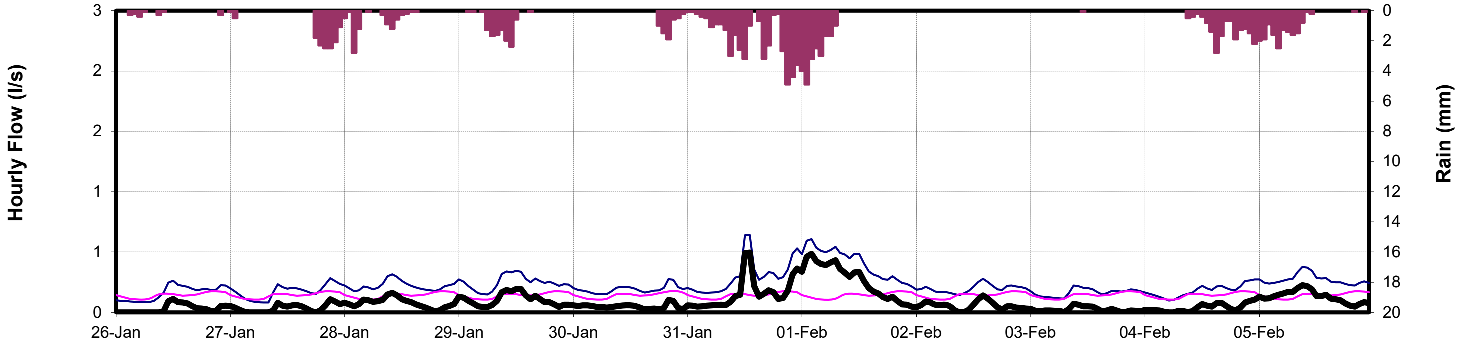
December 28 to January 7, 2019 Storm Events



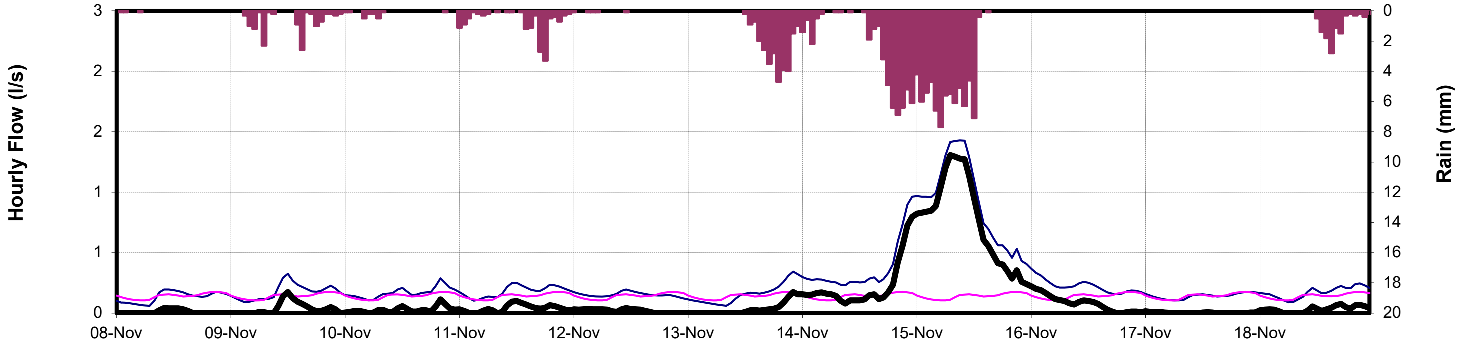
The spike on January 3 is not reliable for I&I

Arthur PS (CS04)

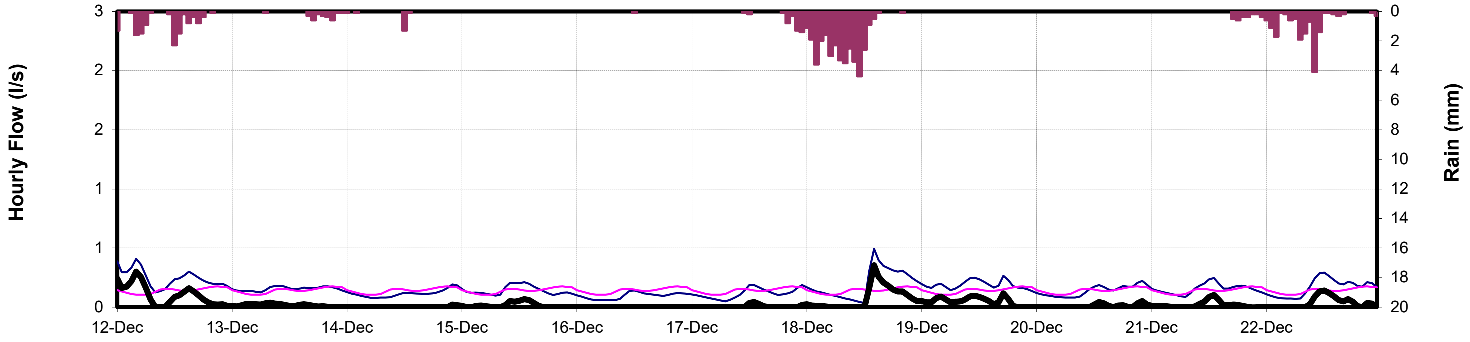
January 26 to February 5, 2020 Storm Events



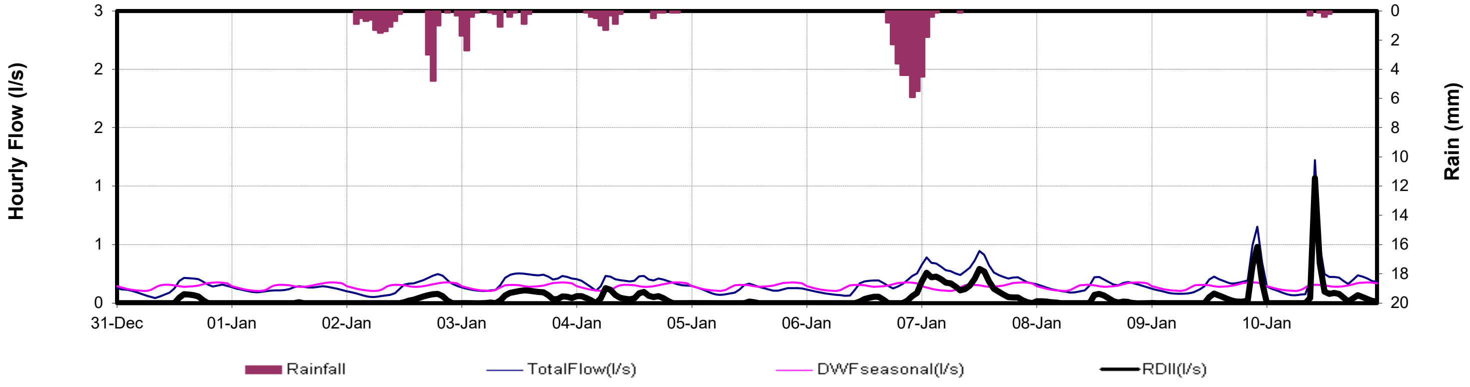
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

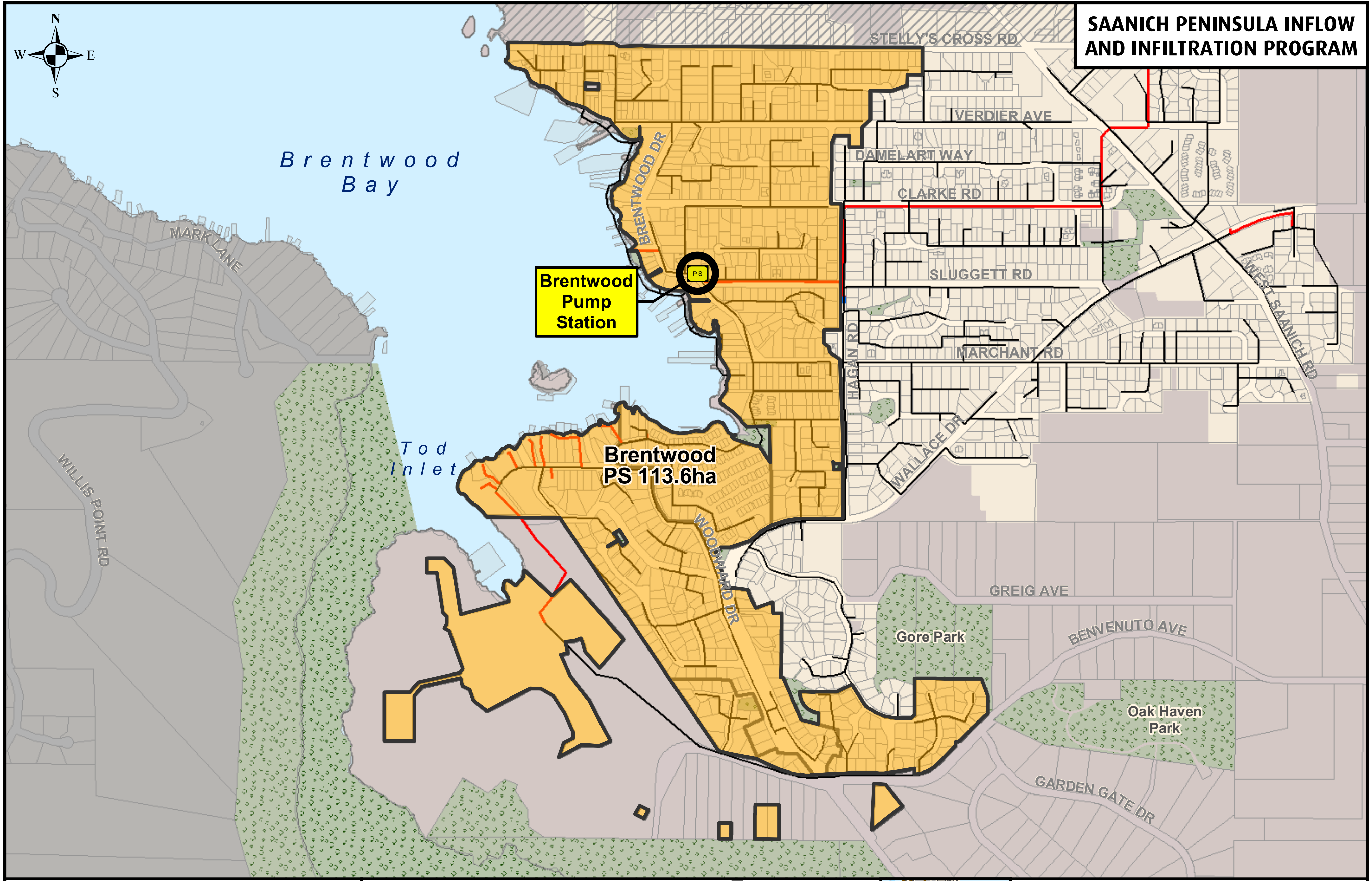


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 185 370 740

Projection: UTM ZONE 10N, NAD83

Disclaimer
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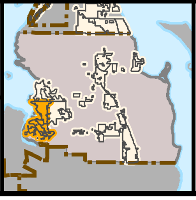
○ Flow Monitoring Location
⊛ Manhole
⬟ Cleanout
PS Pump Station
◙ Metering Chamber

Sanitary Sewers
— Gravity Main Installed After 1930
— Gravity Main Installed Before 1930
— Force Main
═ Relief, Outfall, Overflow Sewer
— CRD Sewer

▨ Catchment Area
▨ Non-Sewered Area
☐ Lot Lines
▨ Parks
▨ Sewered Park Areas
- - Catchment Boundary
-·- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Brentwood PS

Site Code: CS05

CRD
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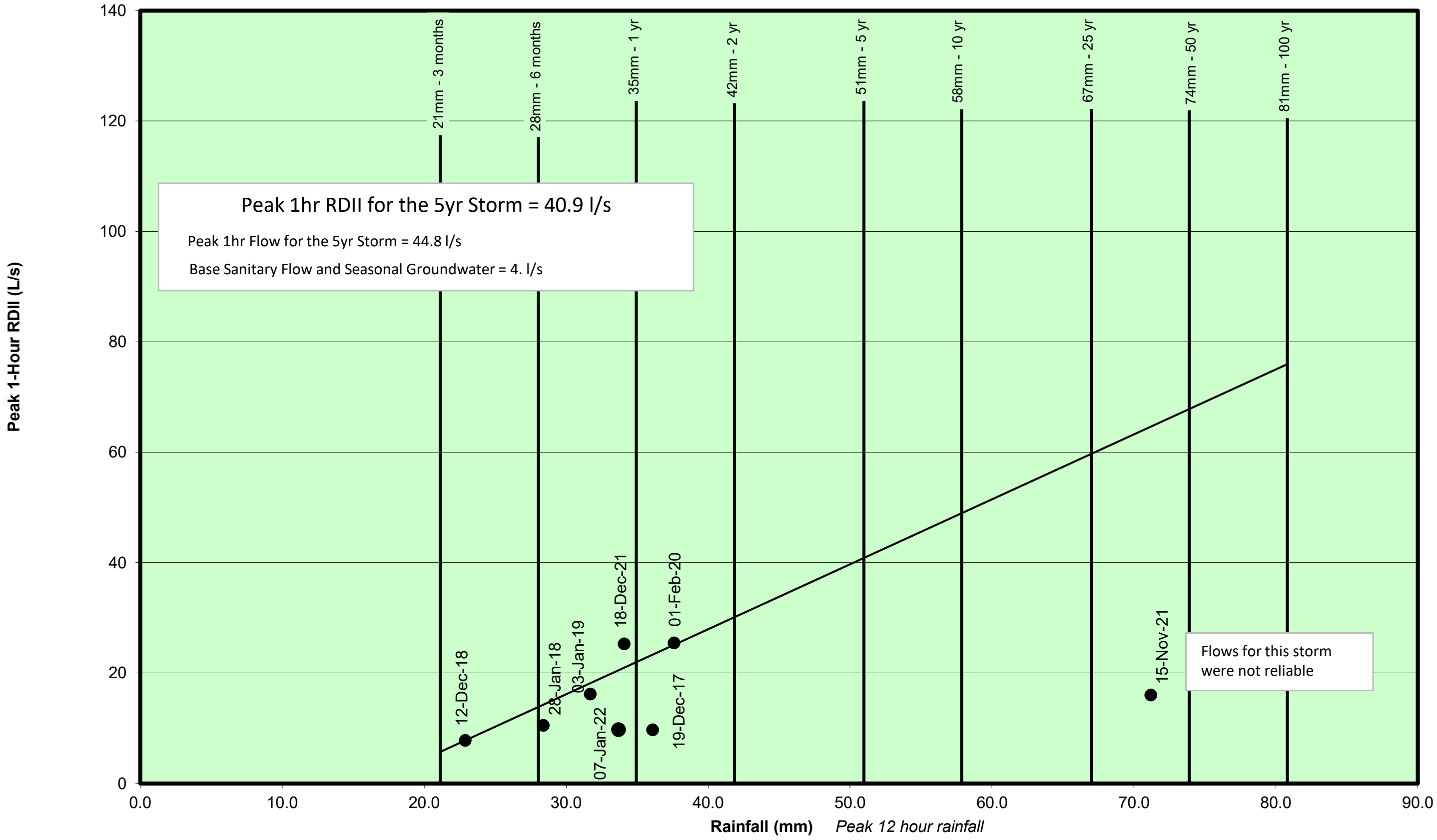
Brentwood PS (CS05)

Peak 1hr RDII by Storm Event

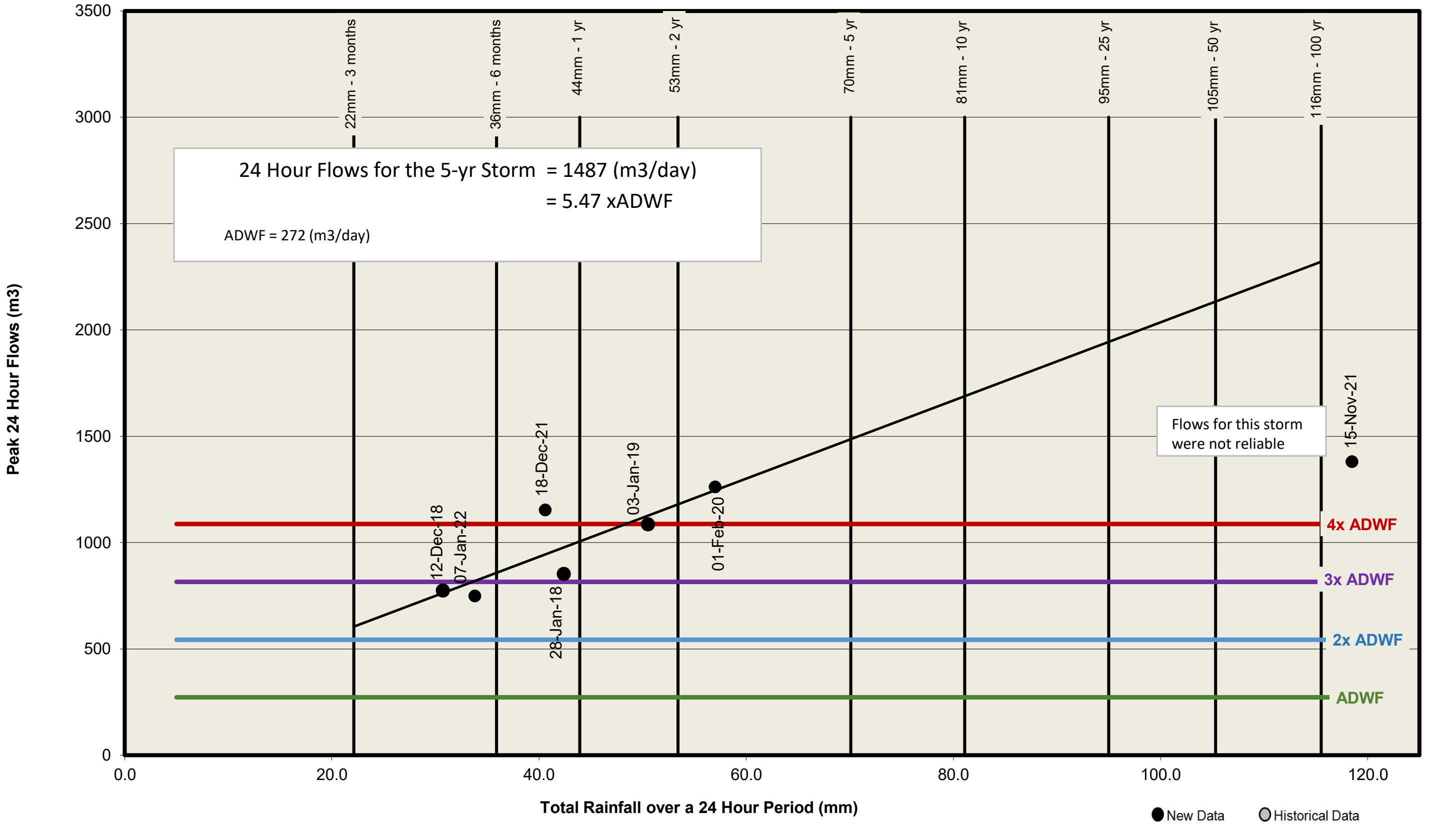

Peak 1hr RDII for the 5yr Storm = 40.9 l/s

Peak 1hr Flow for the 5yr Storm = 44.8 l/s

Base Sanitary Flow and Seasonal Groundwater = 4. l/s

Flows for this storm were not reliable

Peak 24-Hour Flows by Storm Event

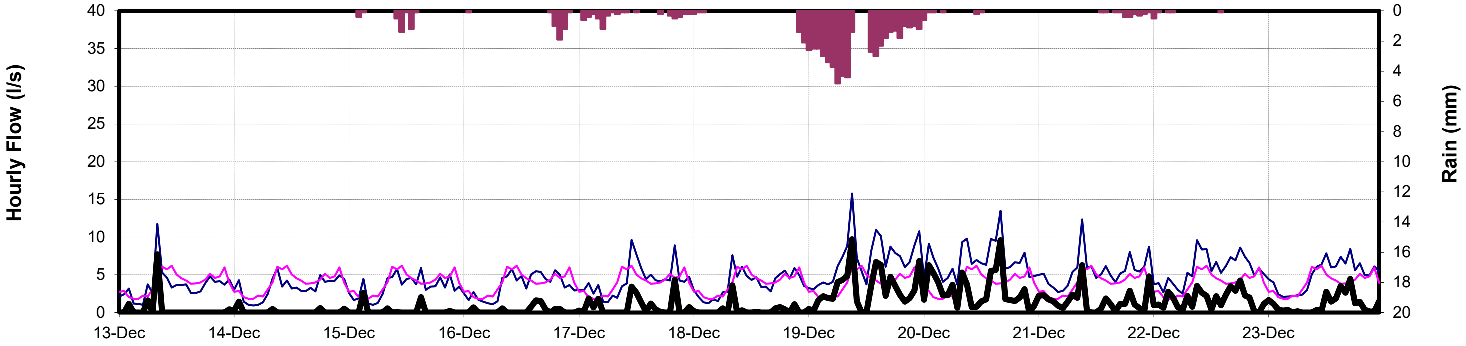

24 Hour Flows for the 5-yr Storm = 1487 (m3/day)
= 5.47 xADWF

ADWF = 272 (m3/day)

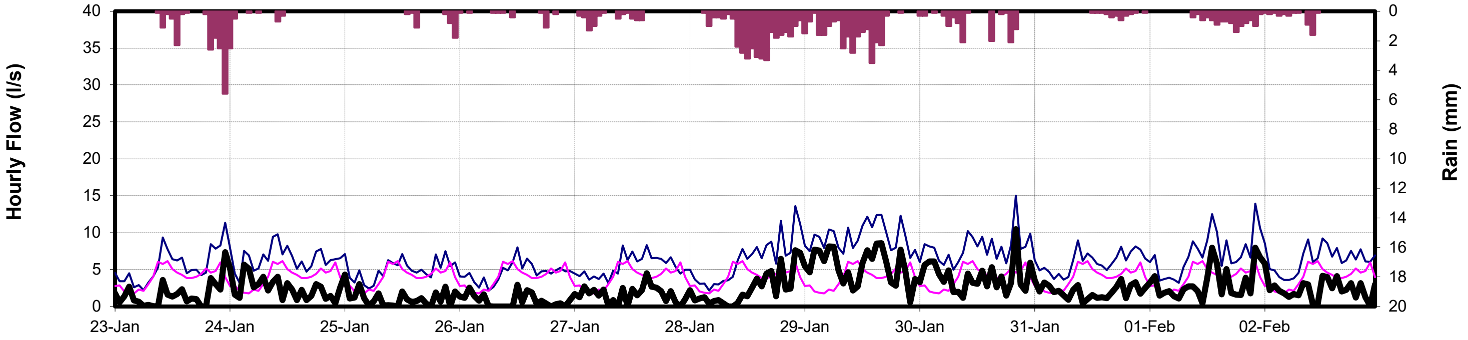
Flows for this storm were not reliable

Brentwood PS (CS05)

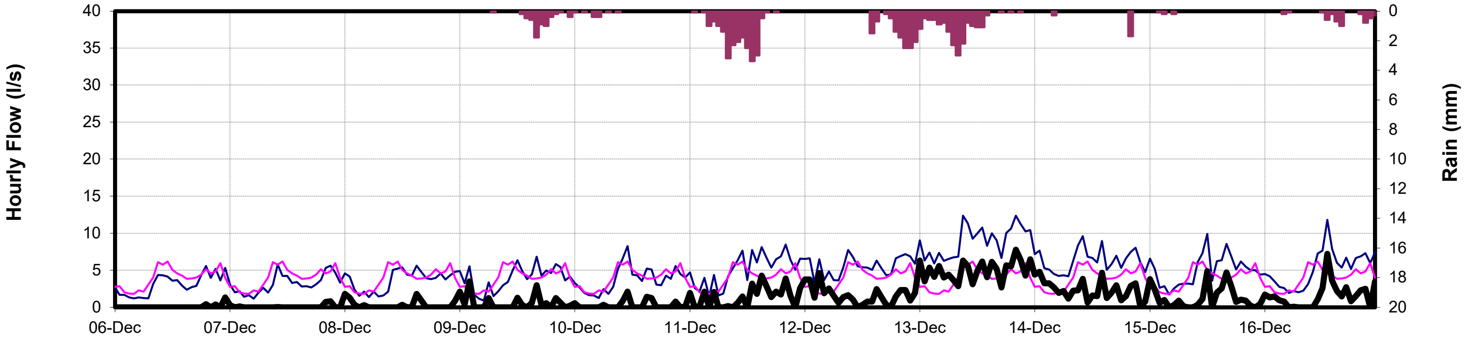
December 13 to December 23, 2017 Storm Events



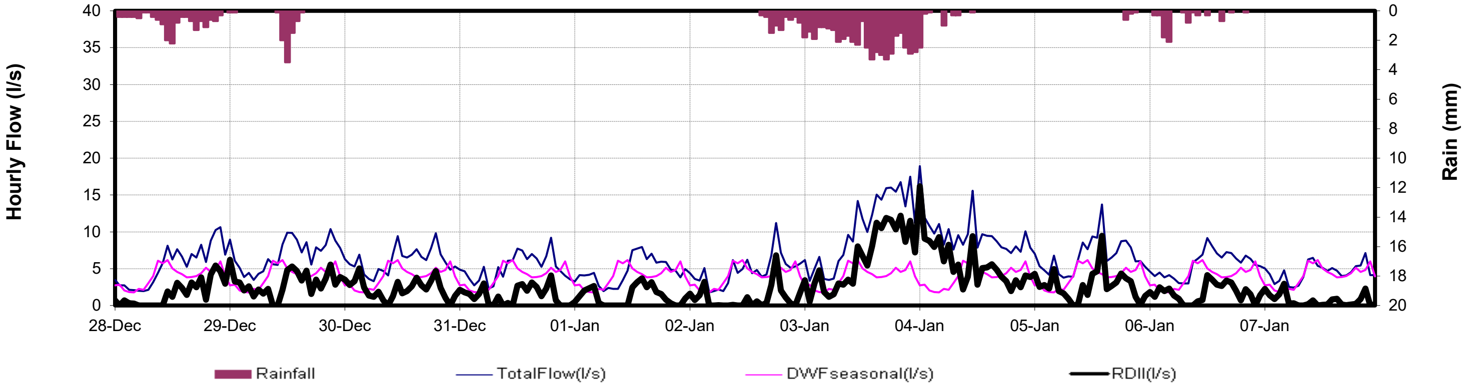
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

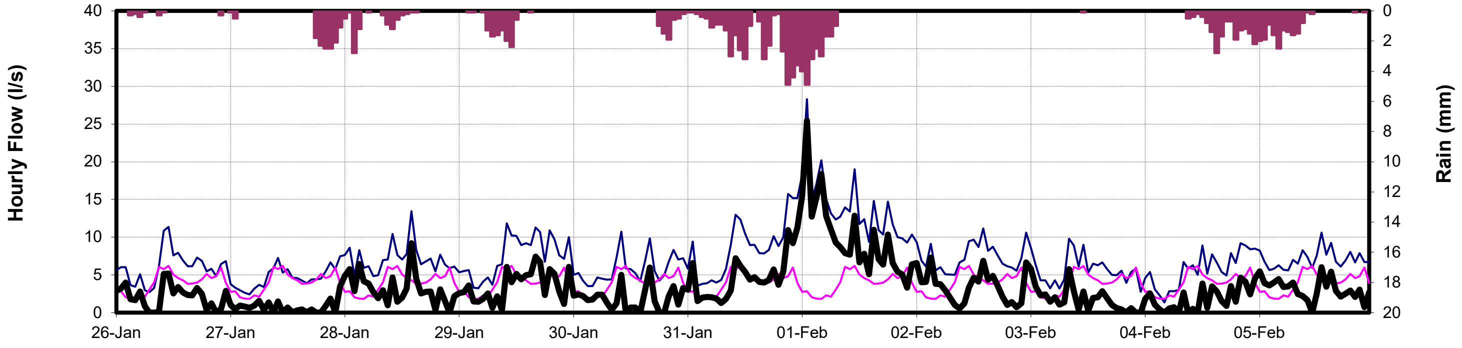


December 28 to January 7, 2019 Storm Events

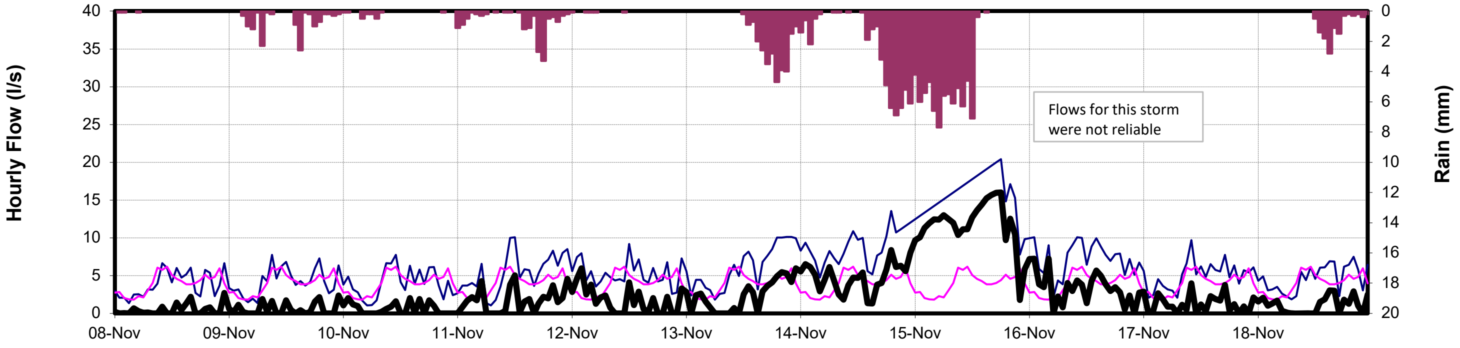


Brentwood PS (CS05)

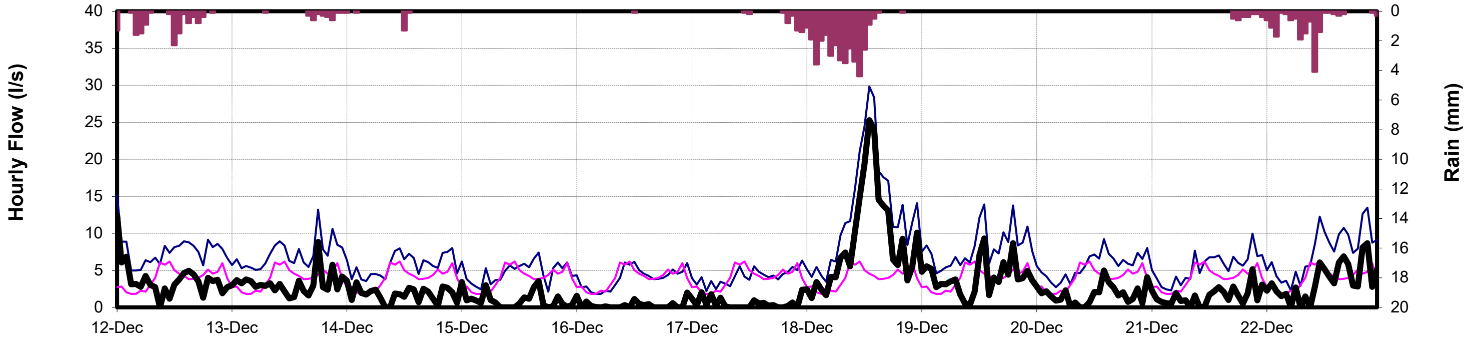
January 26 to February 5, 2020 Storm Events



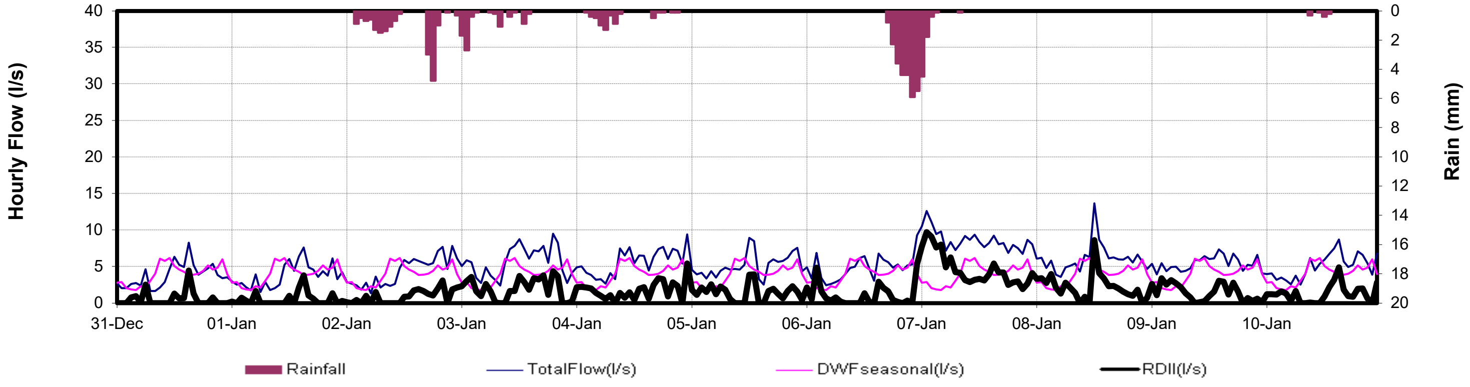
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

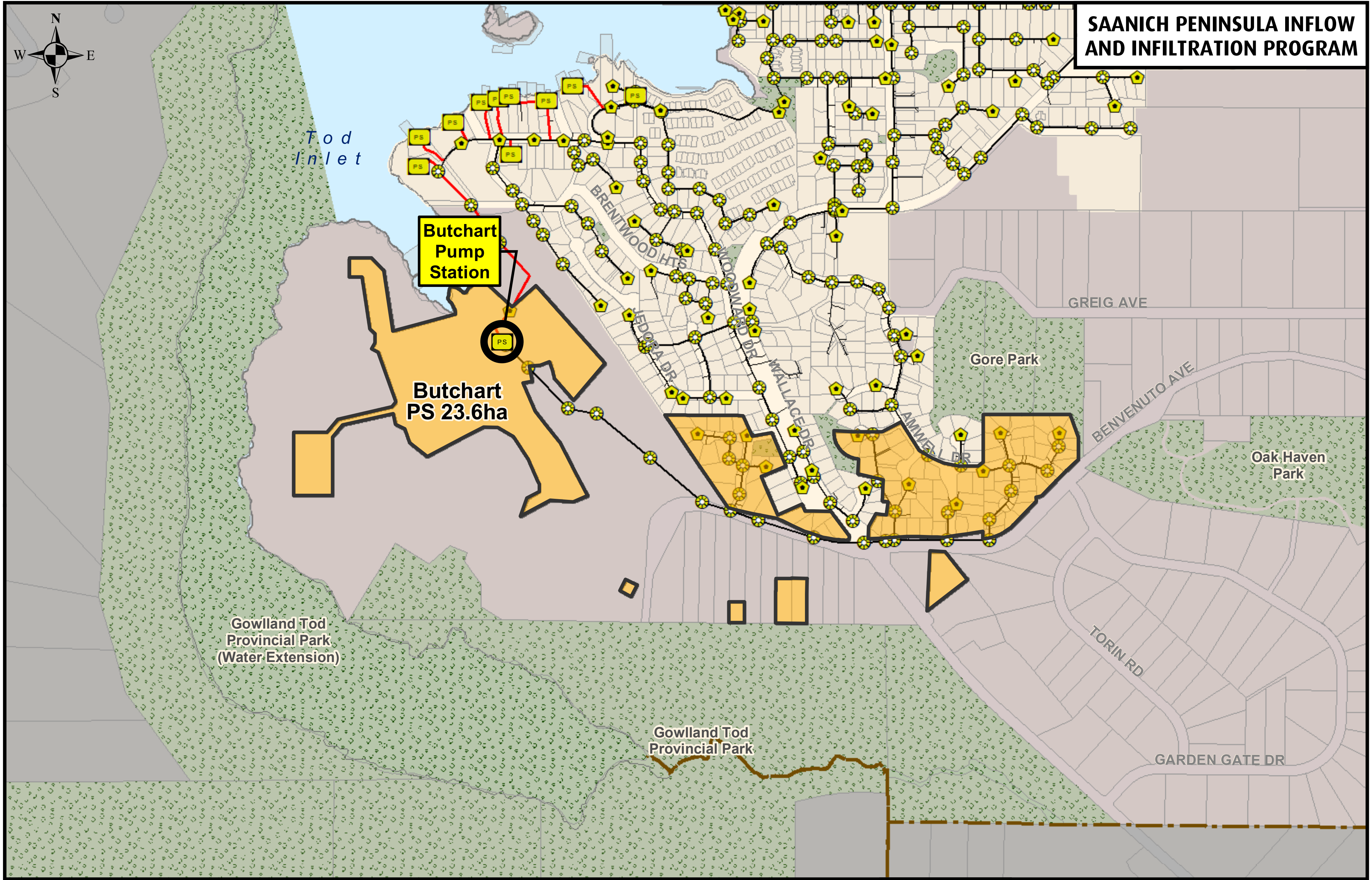


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 140 280 560

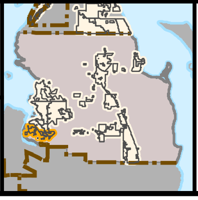
Projection: UTM ZONE 10N, NAD83

Disclaimer

- ○ Flow Monitoring Location
- ✳ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◔ Metering Chamber

Sanitary Sewers
- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- Catchment Area
- Non-Sewered Area
- Lot Lines
- Parks
- Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

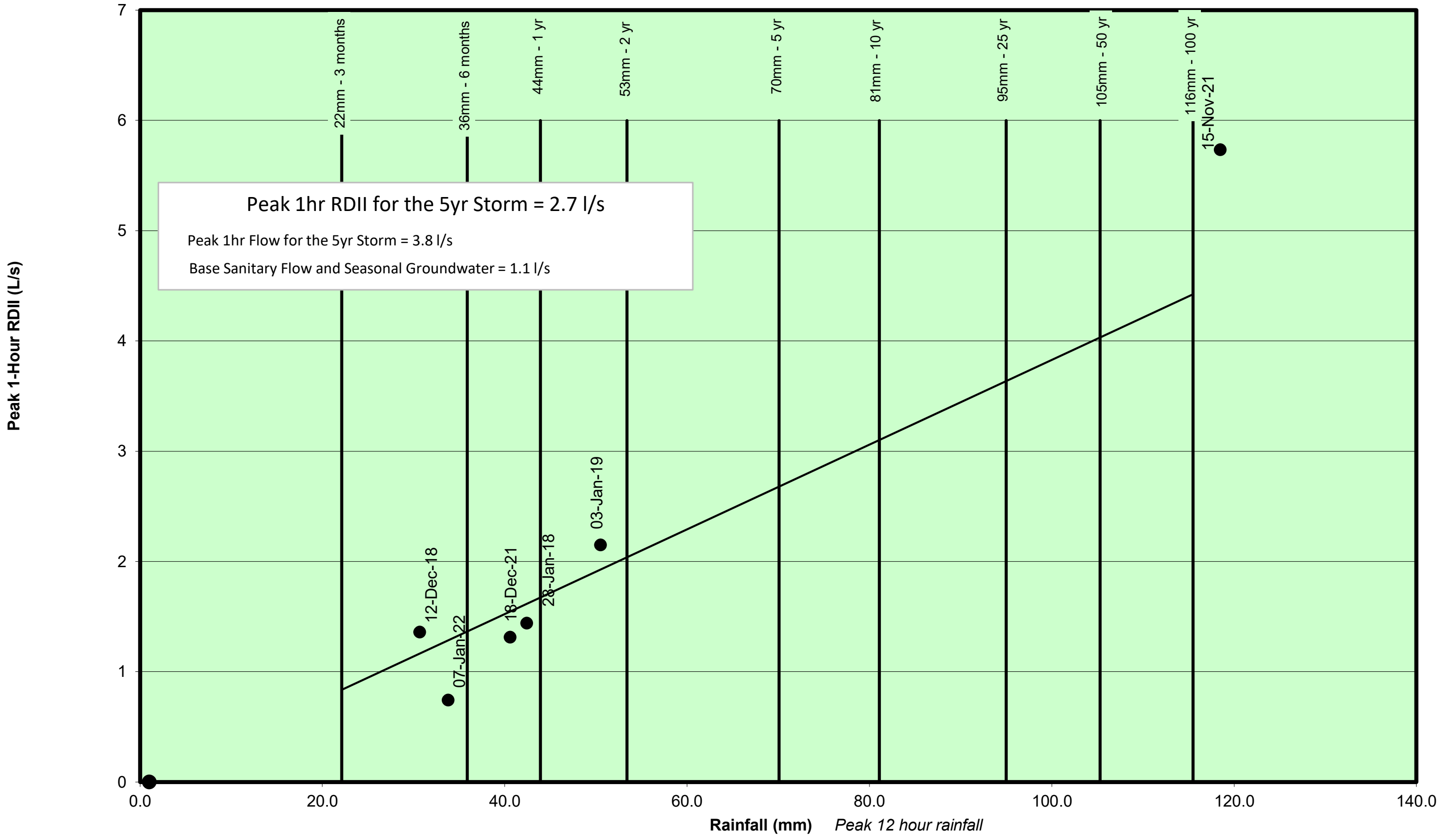
Catchment: Butchart PS

Site Code: CS06

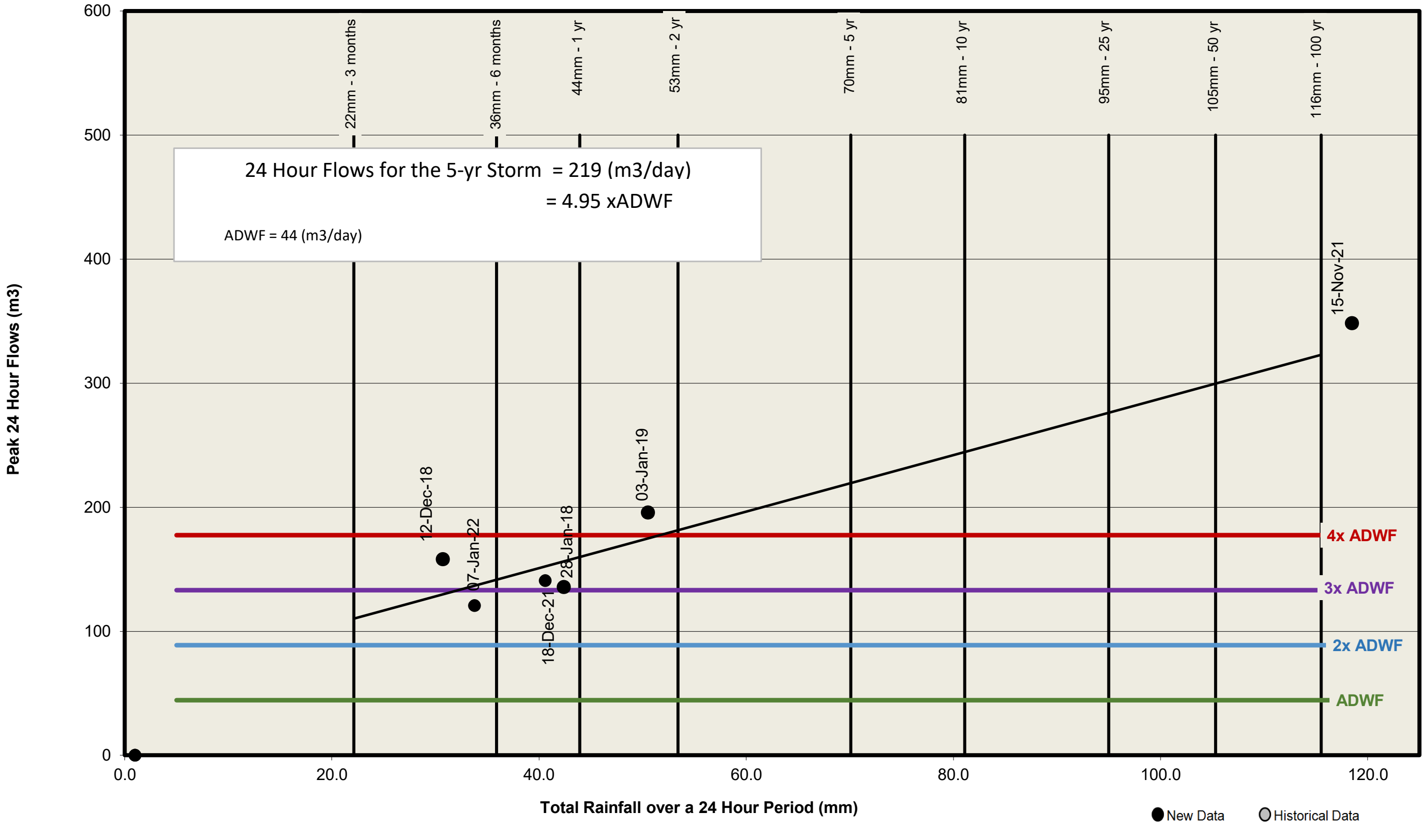
CRD
Making a difference...together

Butchart PS (CS06)

Peak 1-hr RDII by Storm Event

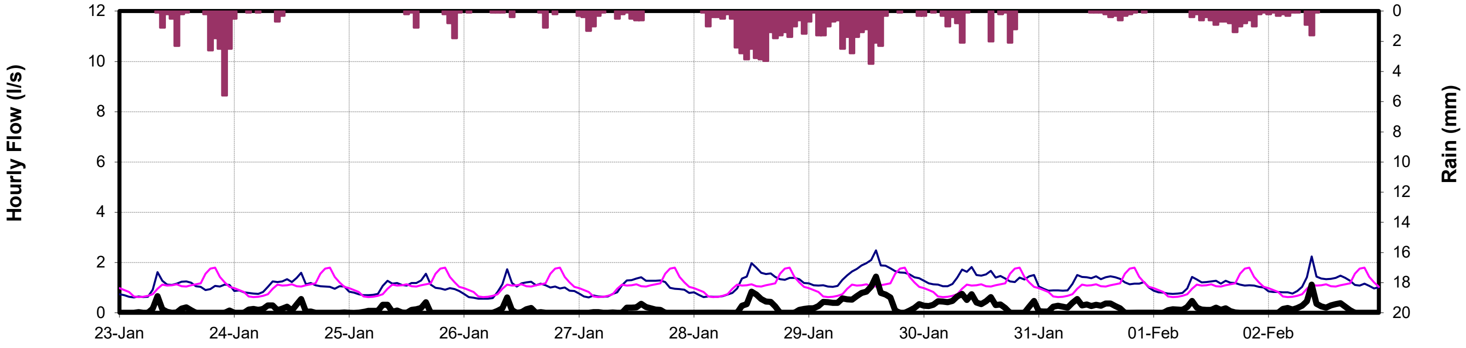


Peak 24-Hour Flows by Storm Event

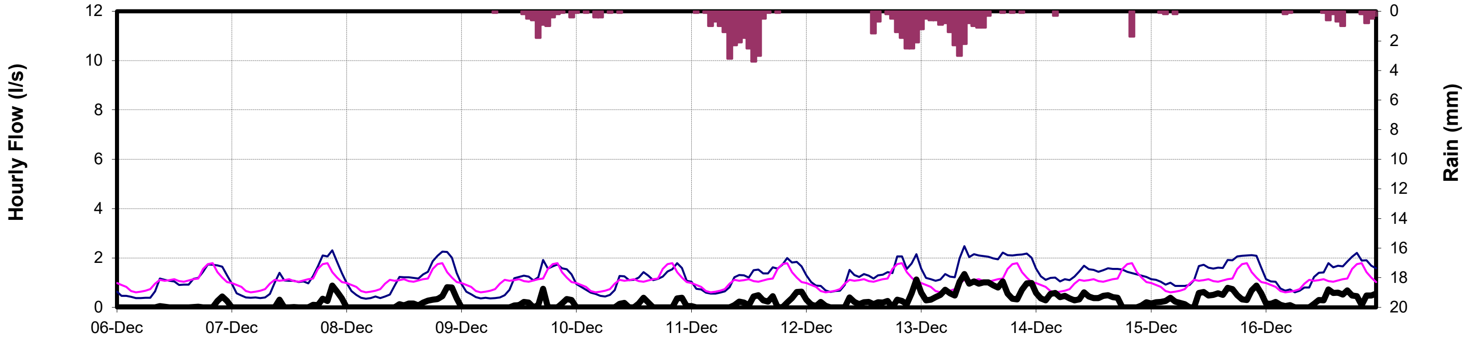


Butchart PS (CS06)

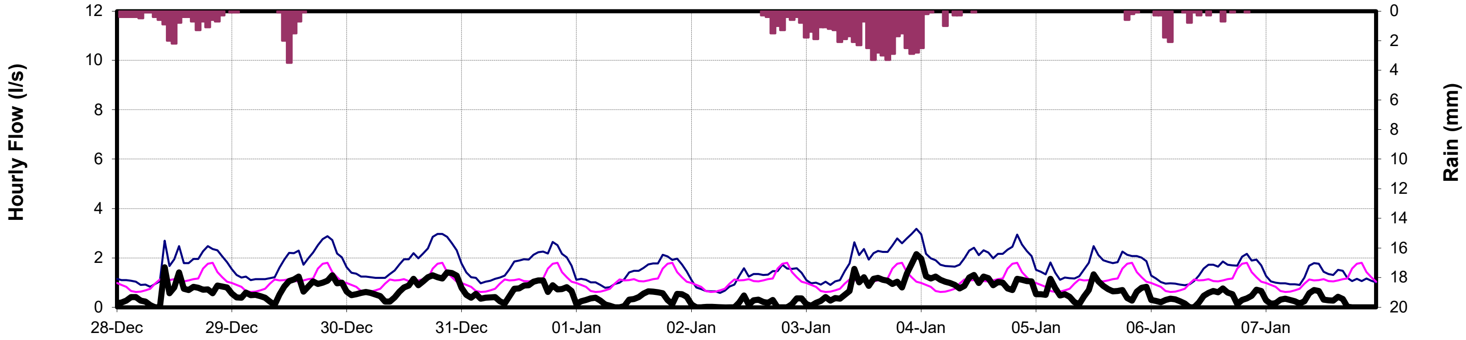
January 23 to February 2, 2018 Storm Events



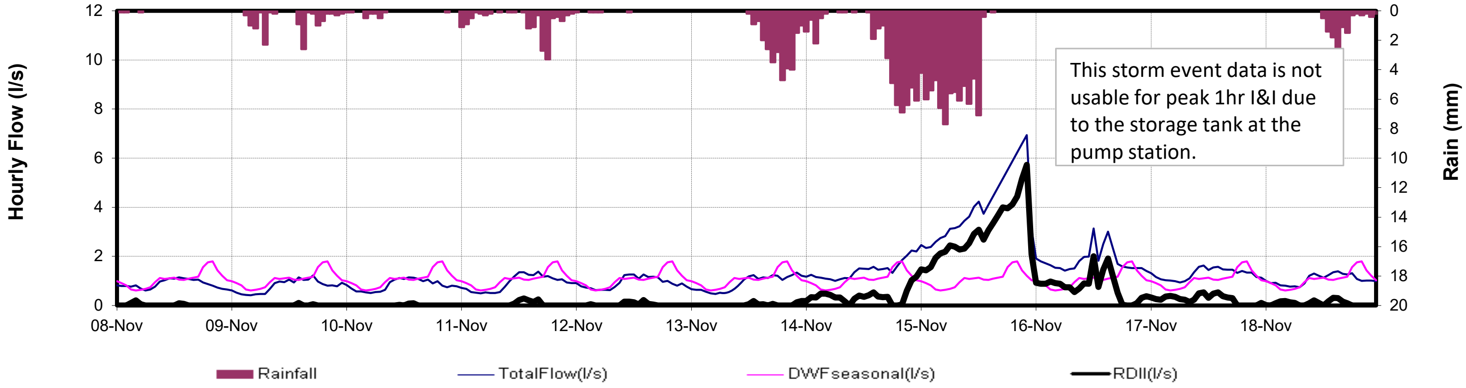
December 6 to December 16, 2018 Storm Events



December 28 to January 7, 2019 Storm Events



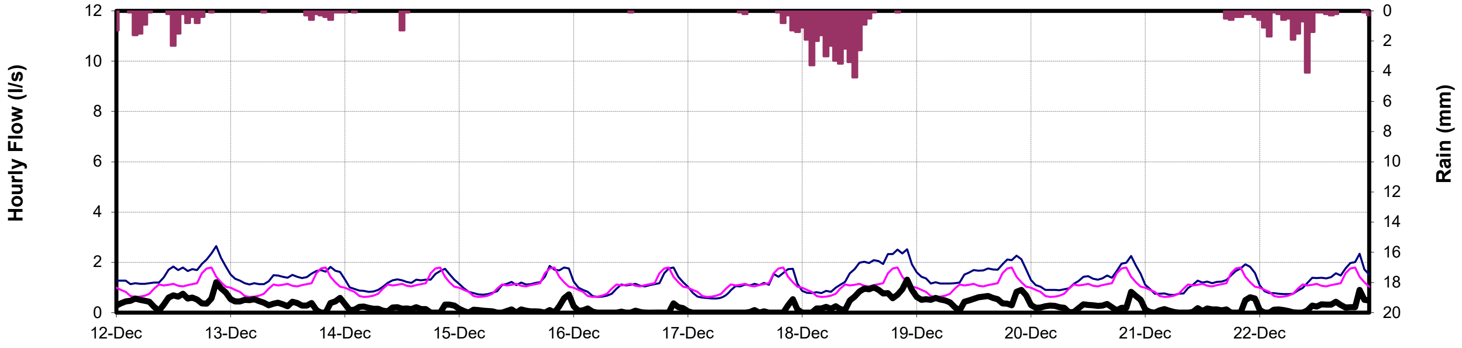
November 8 to November 18, 2021 Storm Events



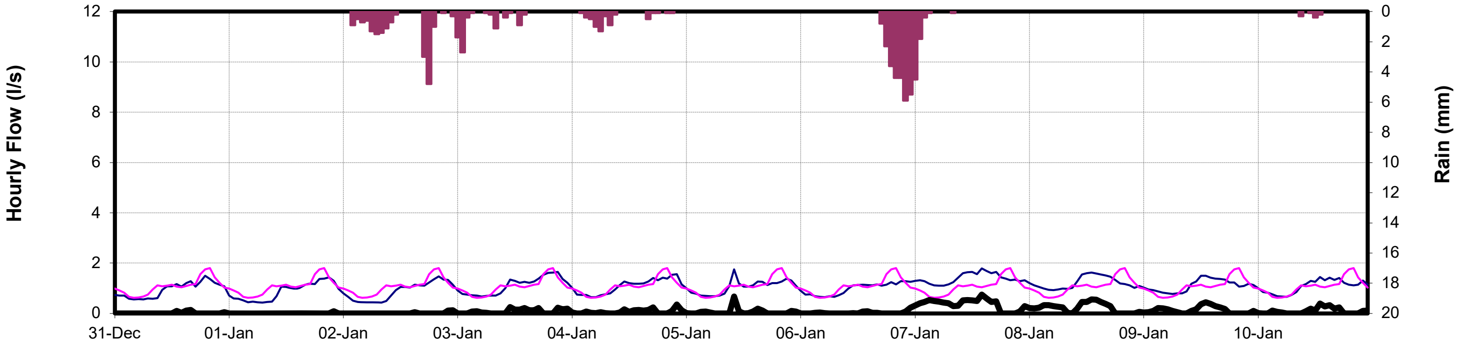
This storm event data is not usable for peak 1hr I&I due to the storage tank at the pump station.

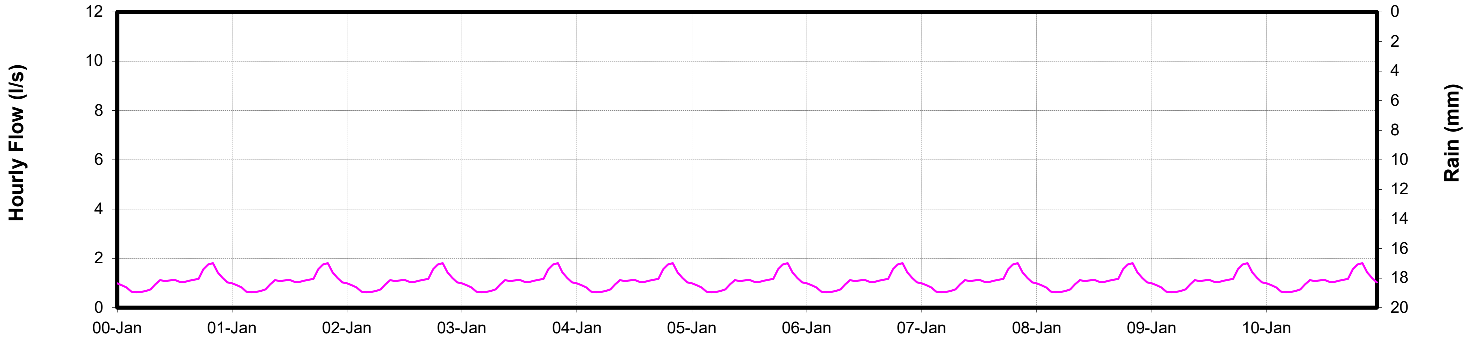
Butchart PS (CS06)

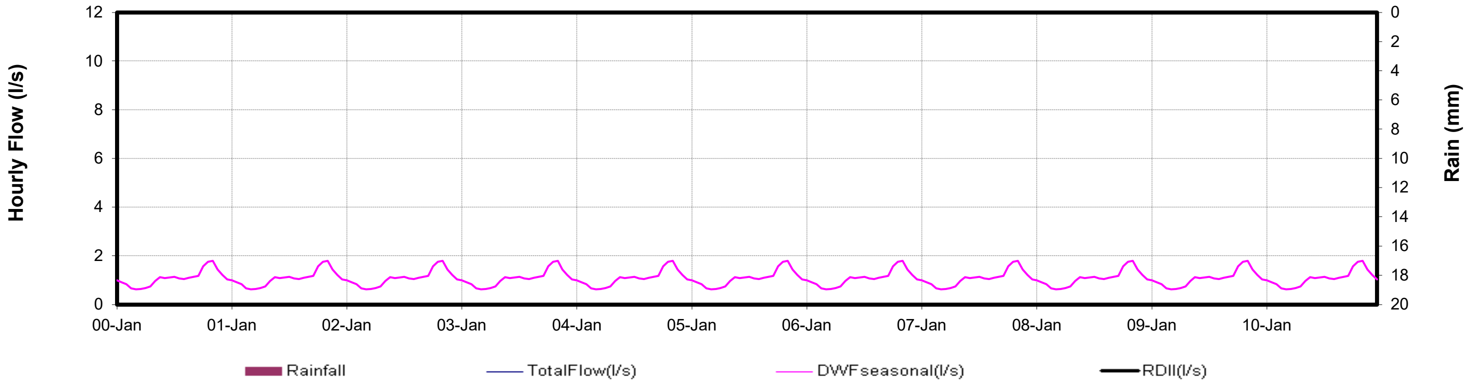
December 12 to December 22, 2021 Storm Events



December 31 to January 10, 2022 Storm Events







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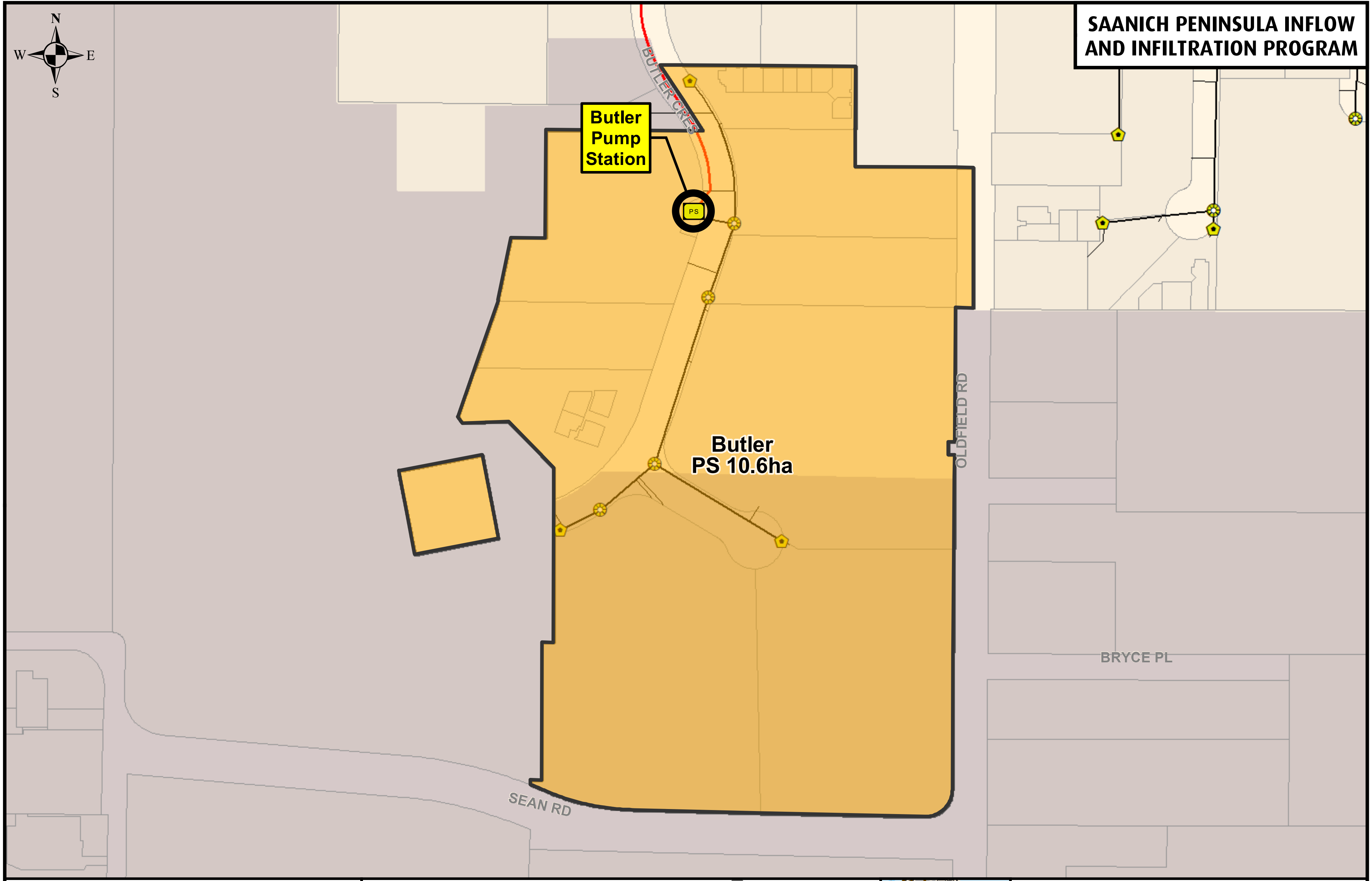
SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 40 80 160

Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
⊛ Manhole
⬟ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

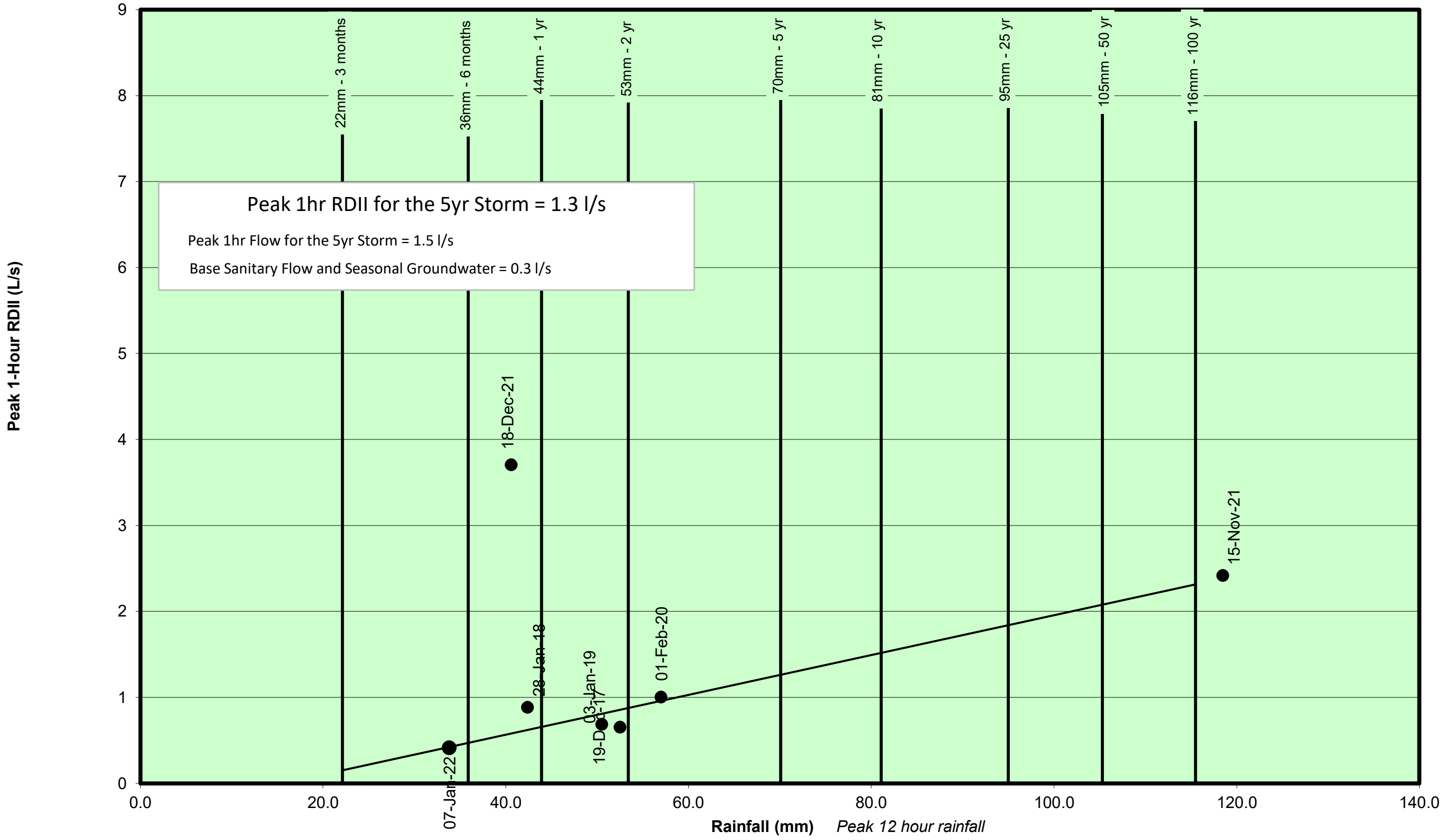
Catchment: Butler PS

Site Code: CS07

CRD
Making a difference...together

Butler PS (CS07)

Peak 1-hr RDII by Storm Event

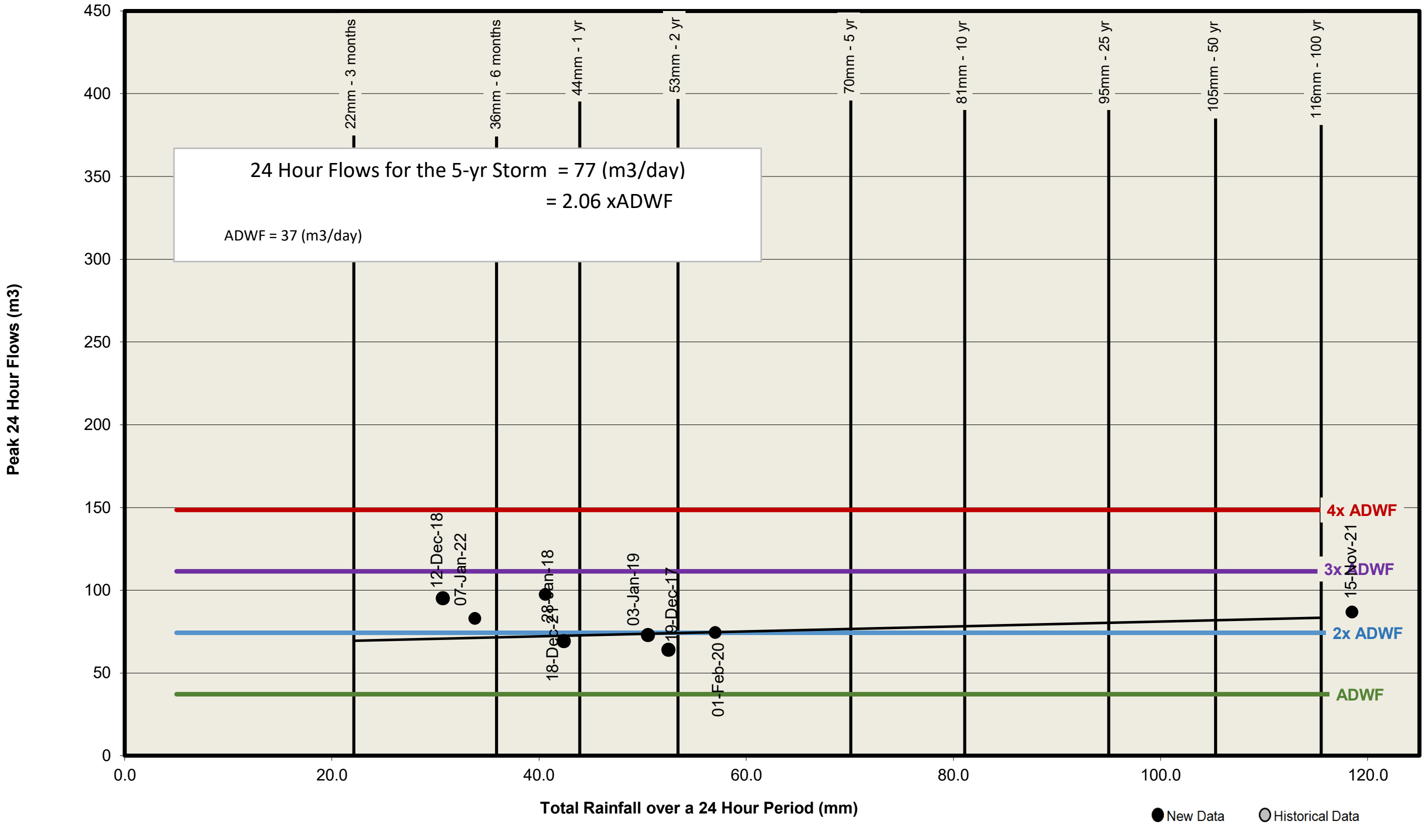


Peak 1hr RDII for the 5yr Storm = 1.3 l/s

Peak 1hr Flow for the 5yr Storm = 1.5 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.3 l/s

Peak 24-Hour Flows by Storm Event



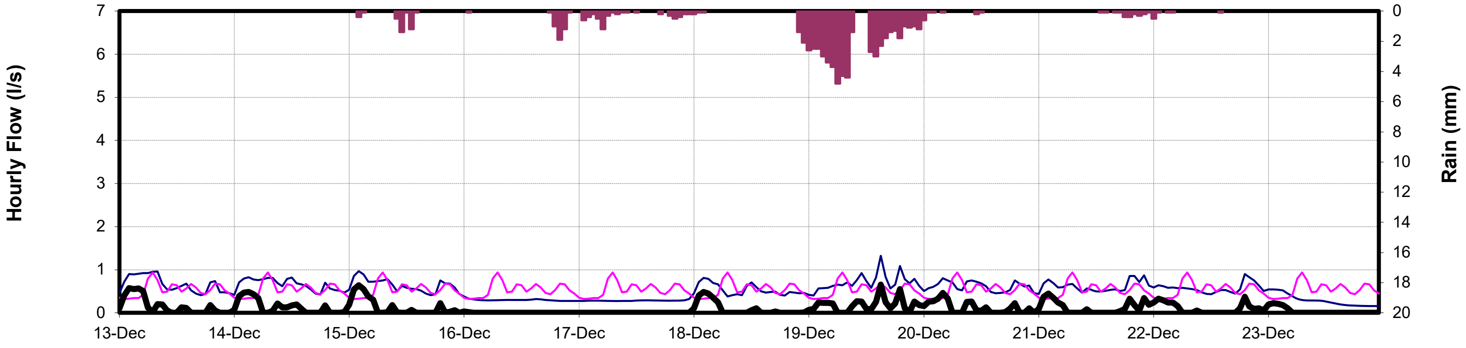
24 Hour Flows for the 5-yr Storm = 77 (m3/day)

= 2.06 xADWF

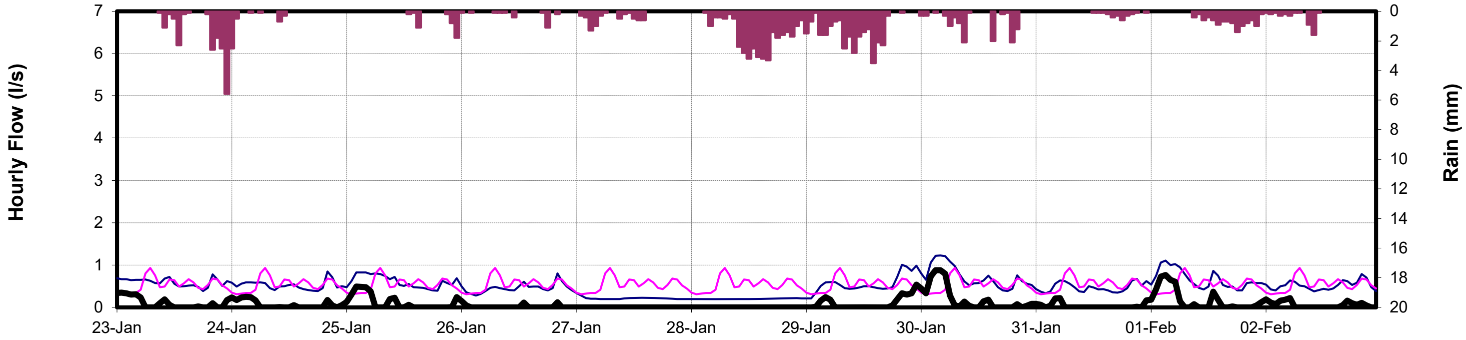
ADWF = 37 (m3/day)

Butler PS (CS07)

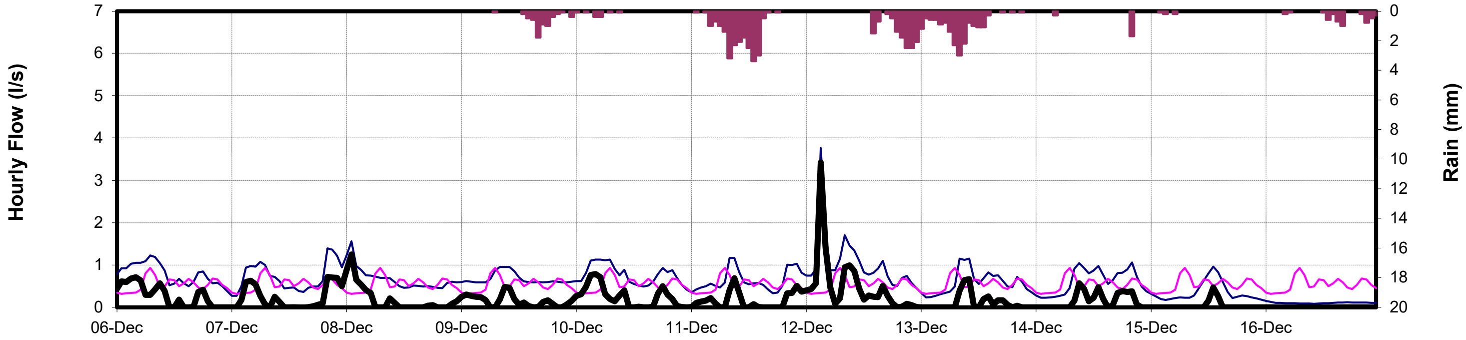
December 13 to December 23, 2017 Storm Events



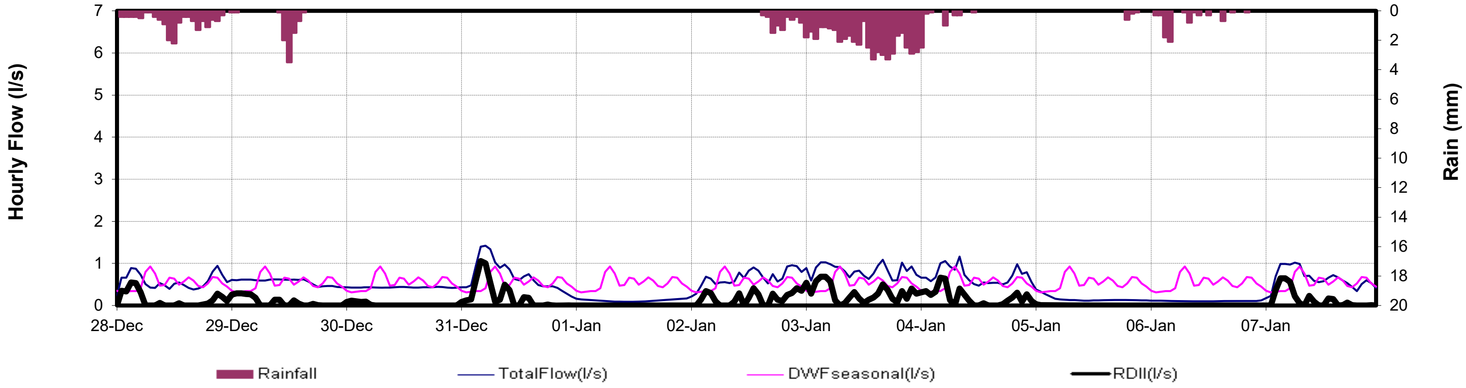
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

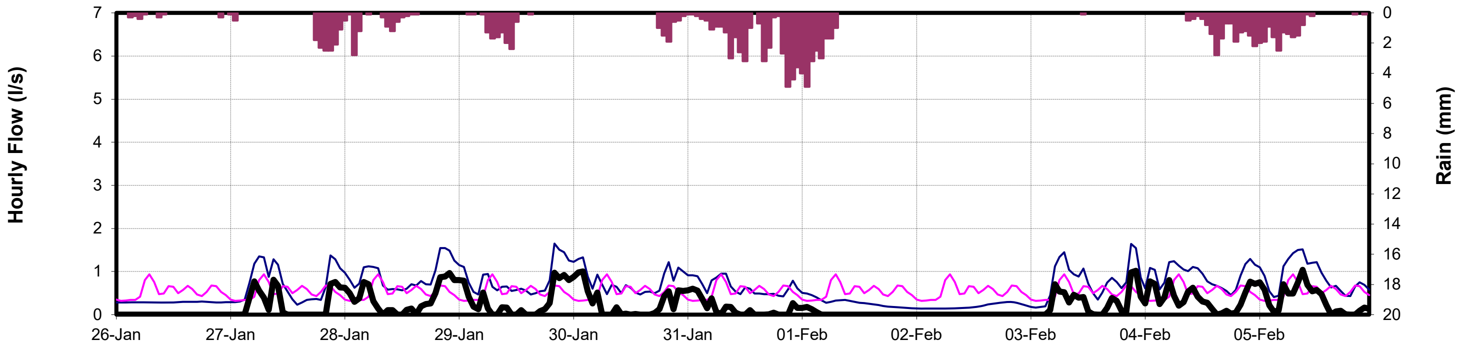


December 28 to January 7, 2019 Storm Events

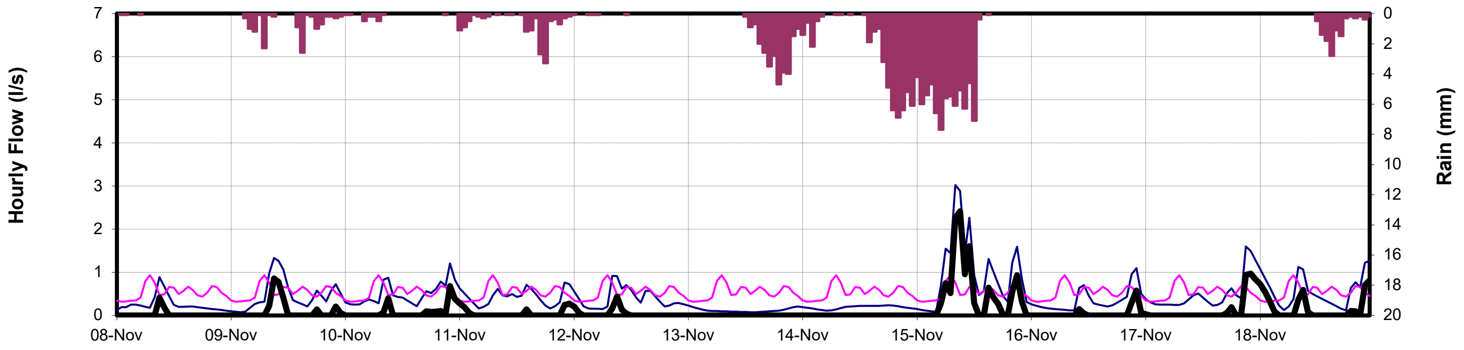


Butler PS (CS07)

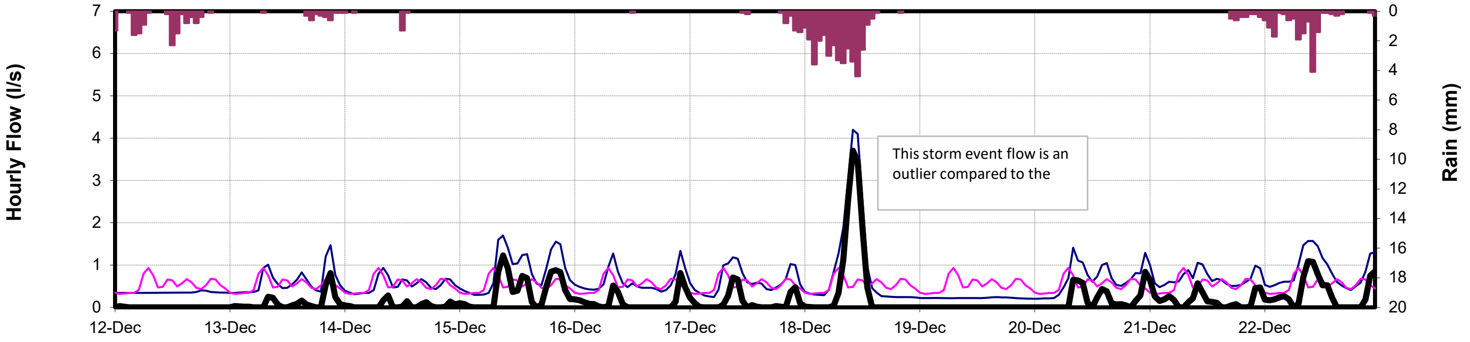
January 26 to February 5, 2020 Storm Events



November 8 to November 18, 2021 Storm Events

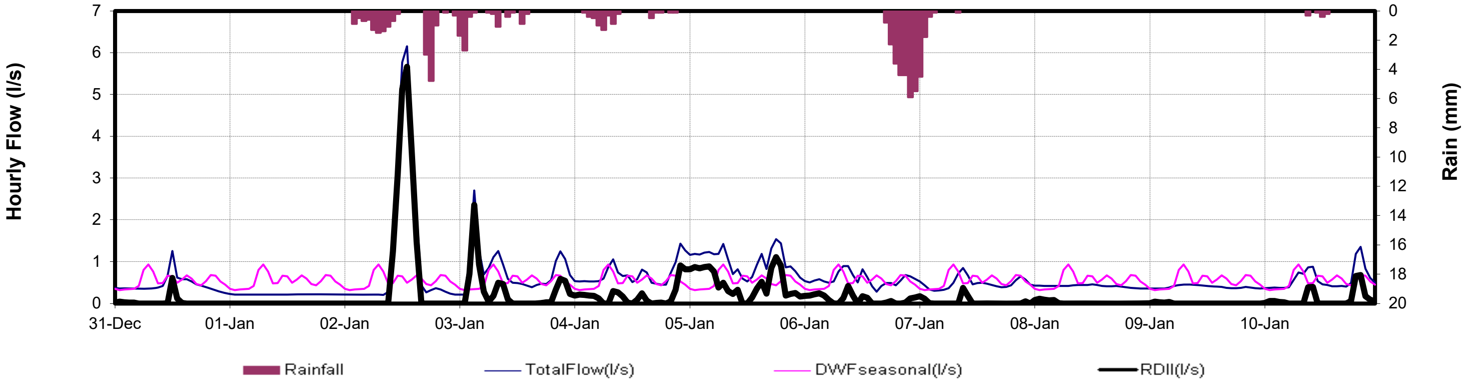


December 12 to December 22, 2021 Storm Events



This storm event flow is an outlier compared to the

December 31 to January 10, 2022 Storm Events



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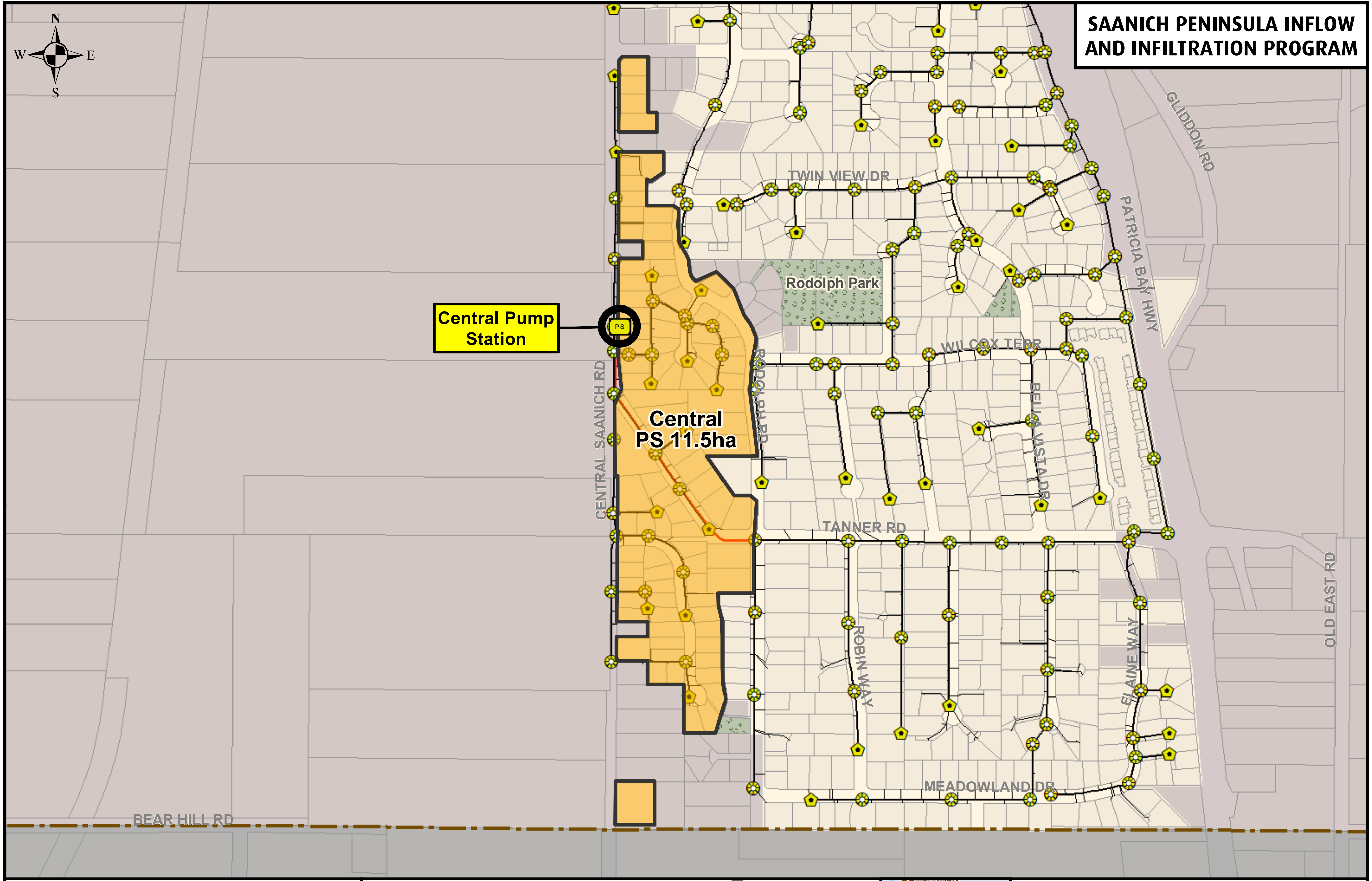
SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 100 200 400

Projection: UTM ZONE 10N, NAD83

Disclaimer

○ Flow Monitoring Location

✺ Manhole

⬟ Cleanout

PS Pump Station

◔ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

Catchment Area

Non-Sewered Area

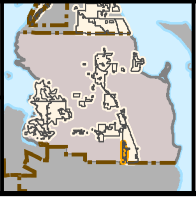
Lot Lines

Parks

Sewered Park Areas

Catchment Boundary

Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Central PS

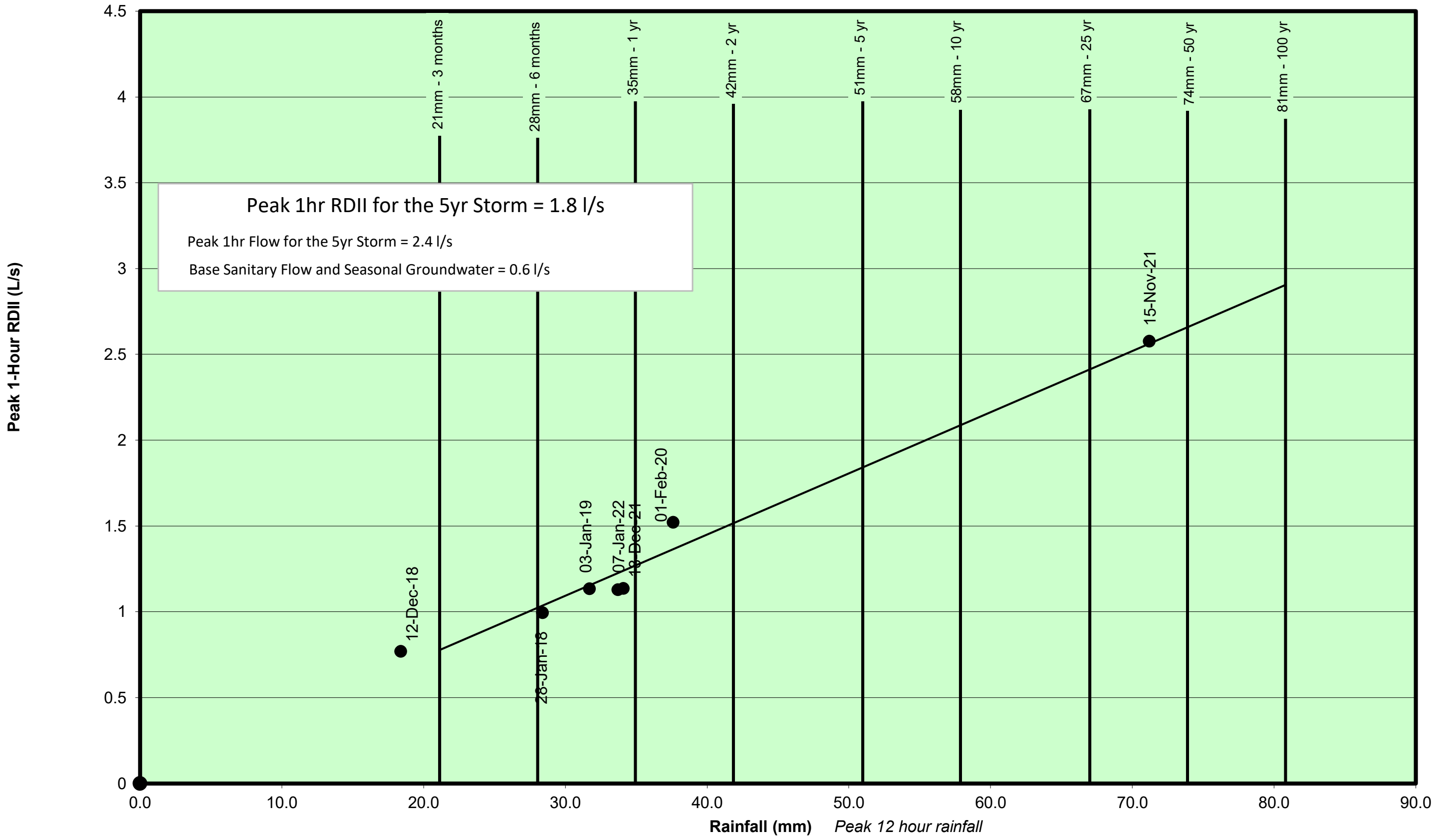
Site Code: CS08

CRD

Making a difference...together

Central PS (CS08)

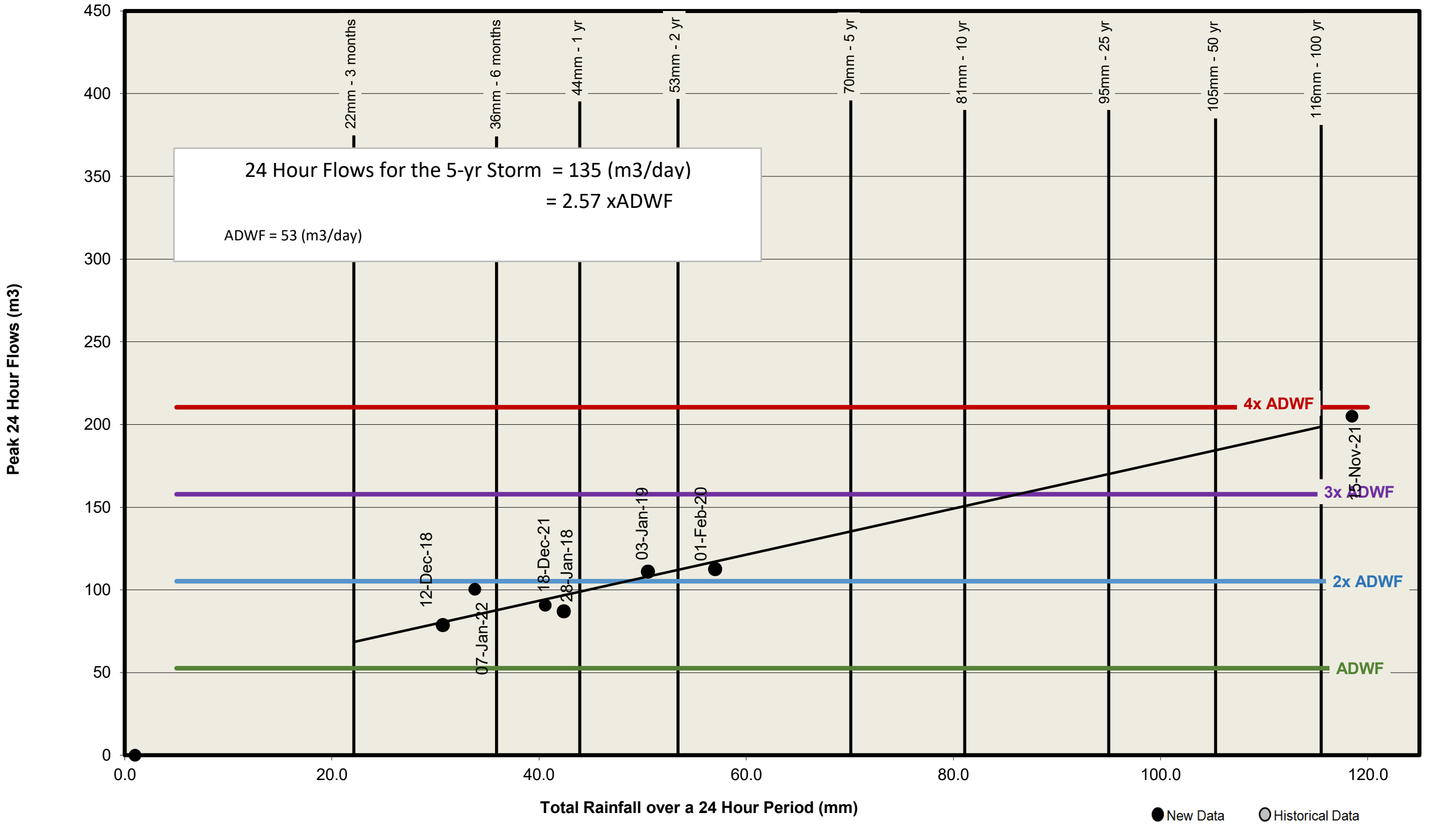
Peak 1-hr RDII by Storm Event


Peak 1hr RDII for the 5yr Storm = 1.8 l/s

Peak 1hr Flow for the 5yr Storm = 2.4 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.6 l/s

Peak 24-Hour Flows by Storm Event

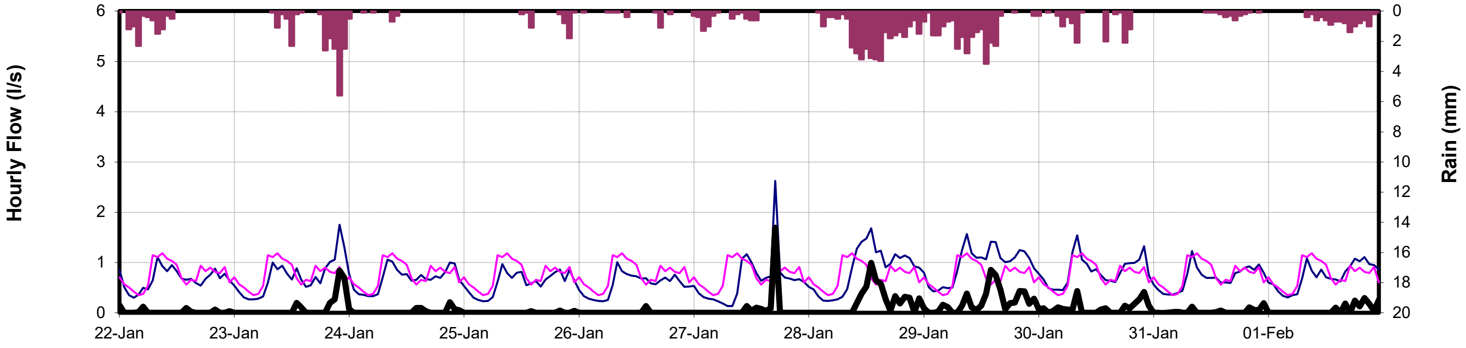

24 Hour Flows for the 5-yr Storm = 135 (m3/day)

= 2.57 xADWF

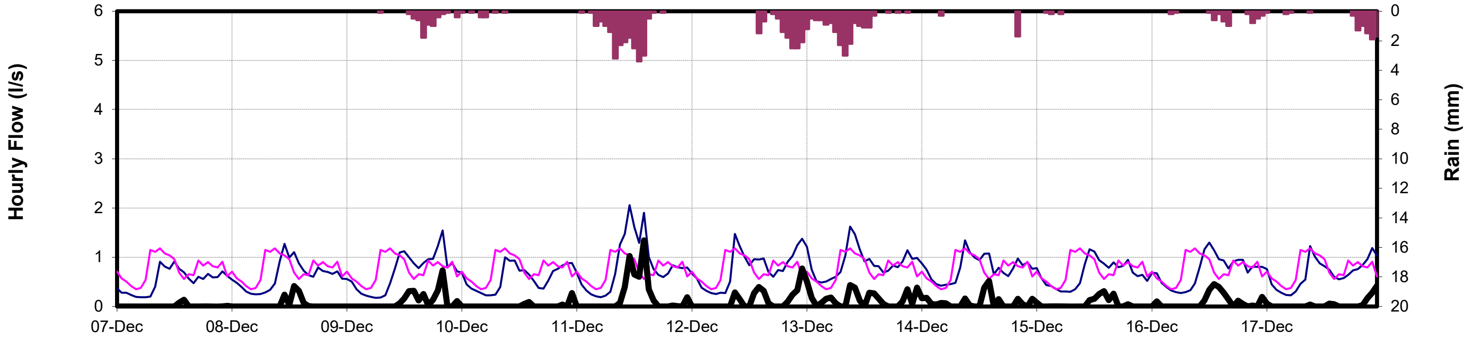
ADWF = 53 (m3/day)

Central PS (CS08)

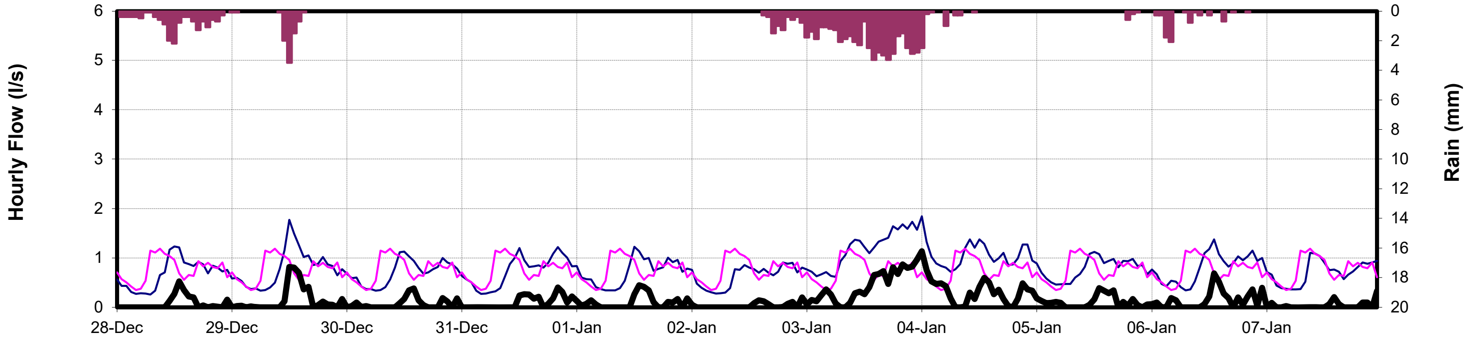
January 22 to February 1, 2018 Storm Events



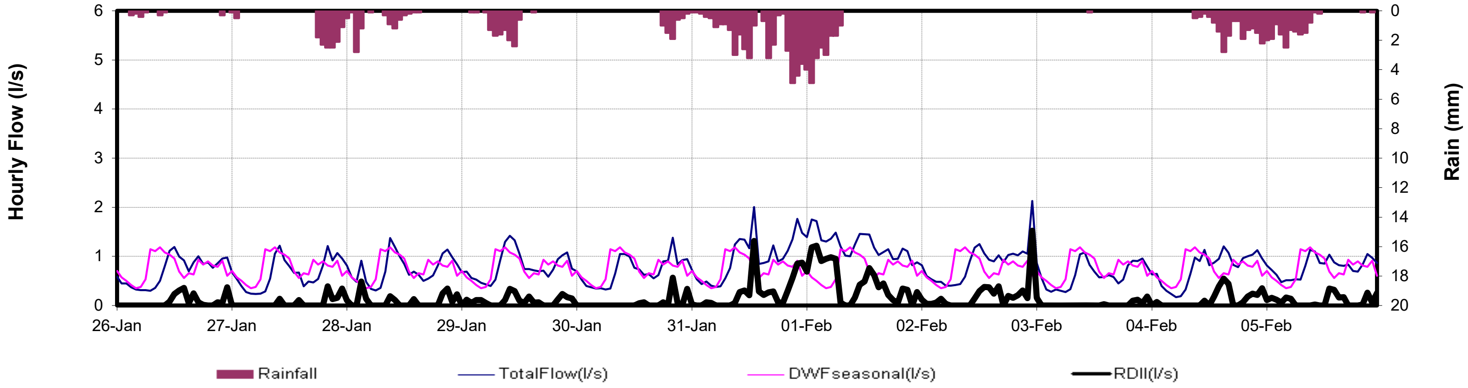
December 7 to December 17, 2018 Storm Events



December 28 to January 7, 2019 Storm Events

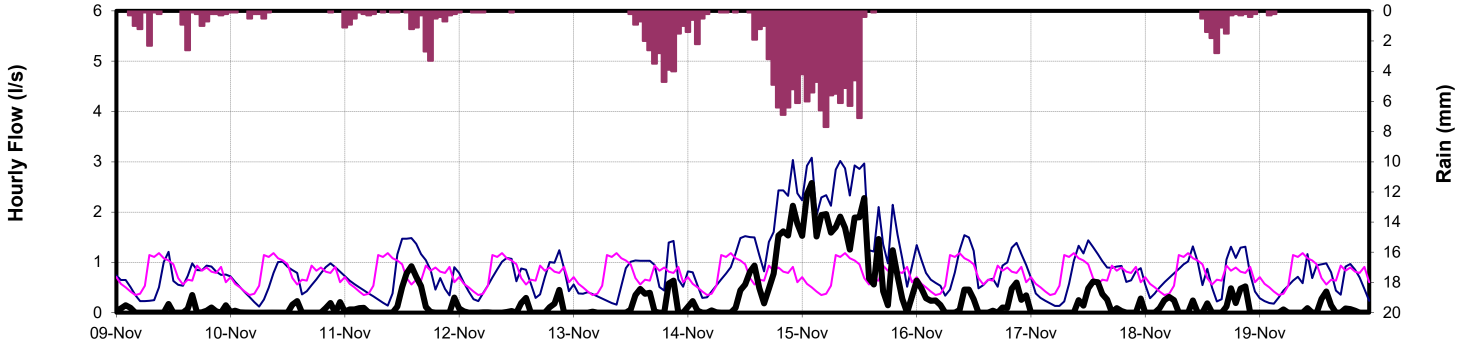


January 26 to February 5, 2020 Storm Events

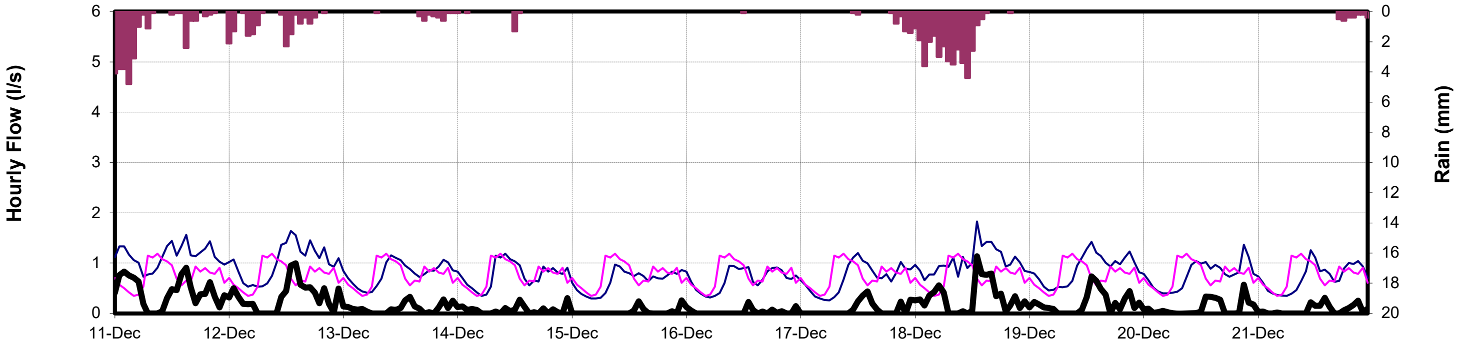


Central PS (CS08)

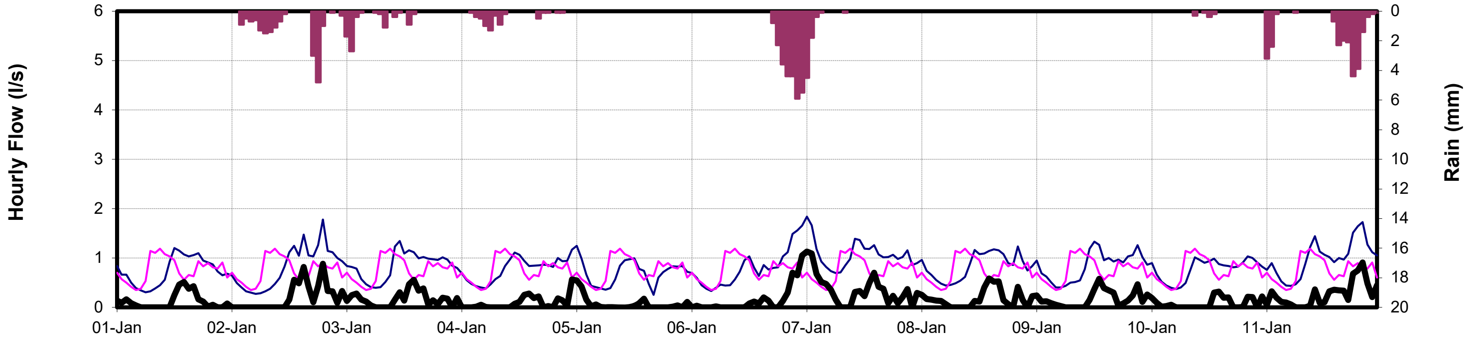
November 9 to November 19, 2021 Storm Events



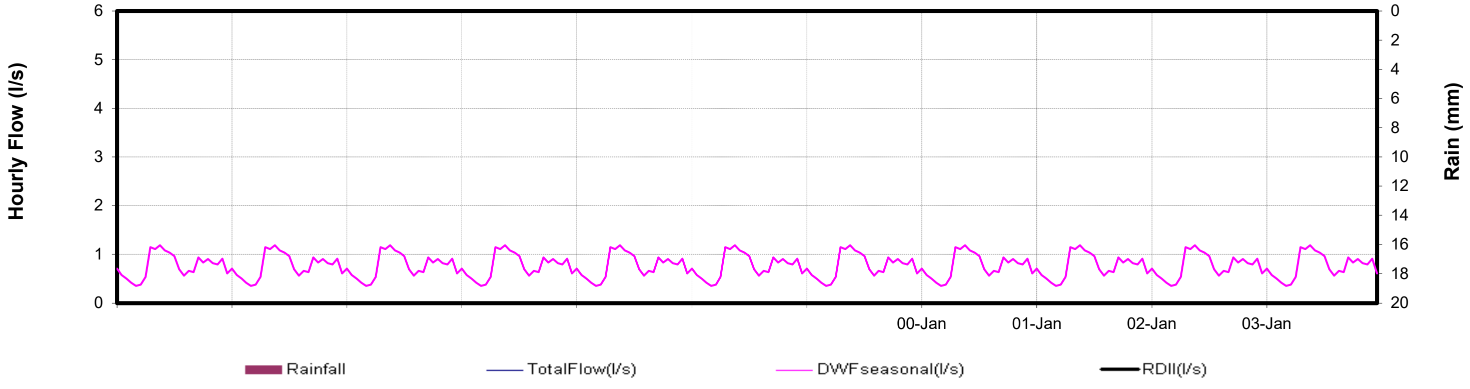
December 11 to December 21, 2021 Storm Events



January 1 to January 11, 2022 Storm Events

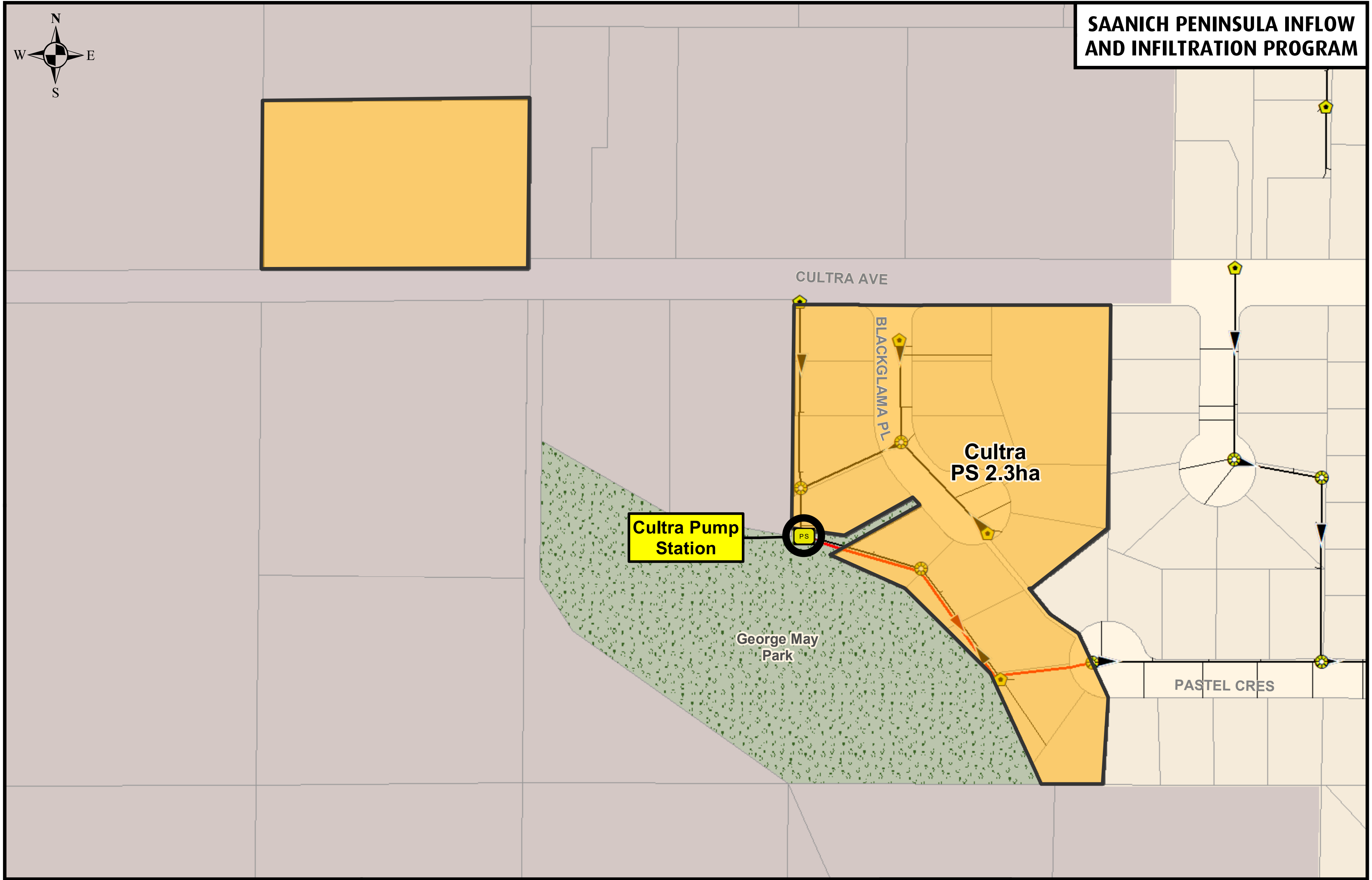


#VALUE!



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 25 50 100

Projection: UTM ZONE 10N, NAD83

Disclaimer
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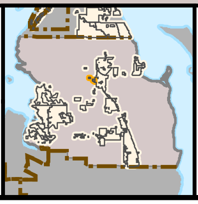
○ Flow Monitoring Location
Manhole
Cleanout
PS Pump Station
Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

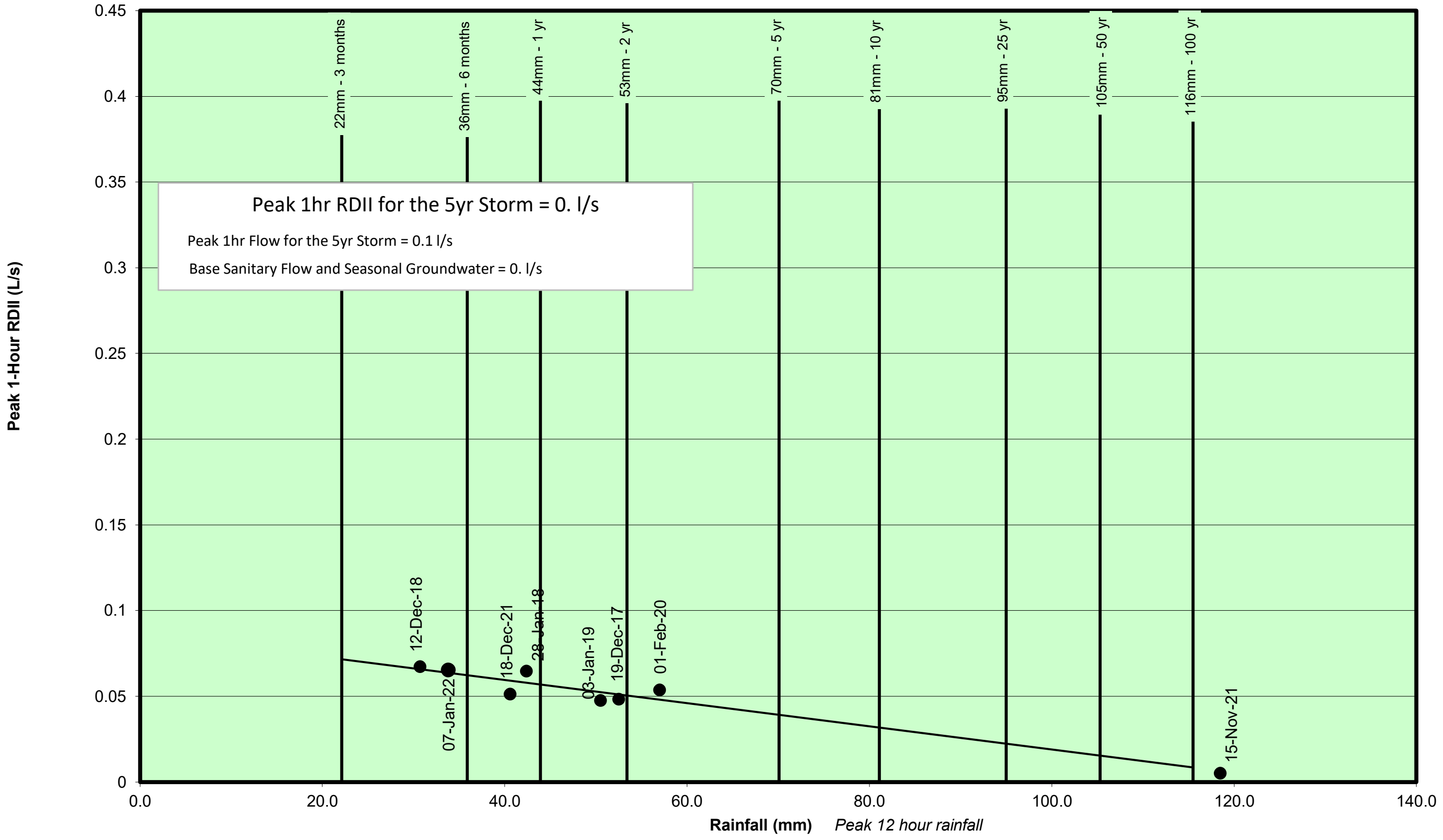
Catchment: Cultra PS

Site Code: CS09

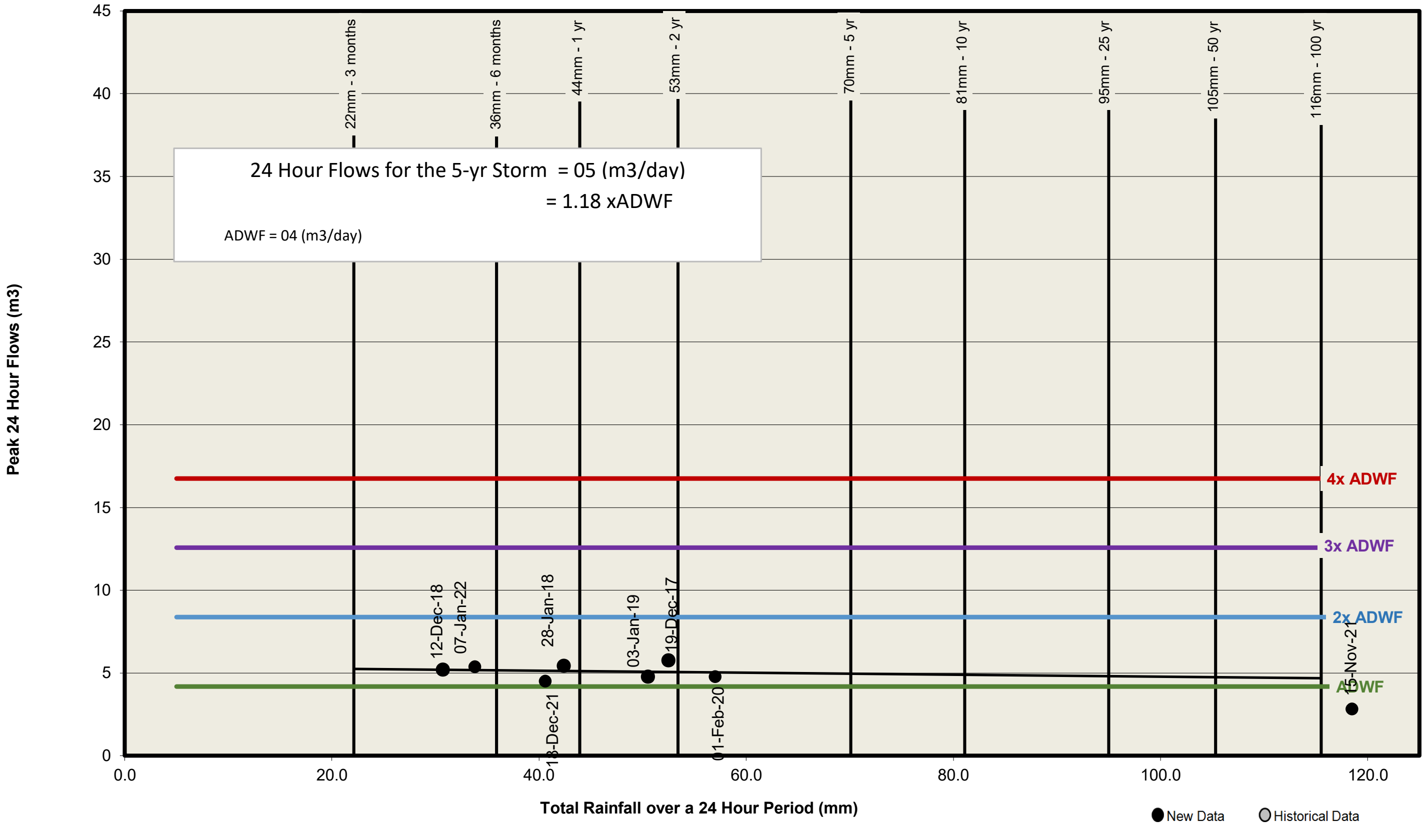
Making a difference...together

Cultra PS (CS09)

Peak 1-hr RDII by Storm Event

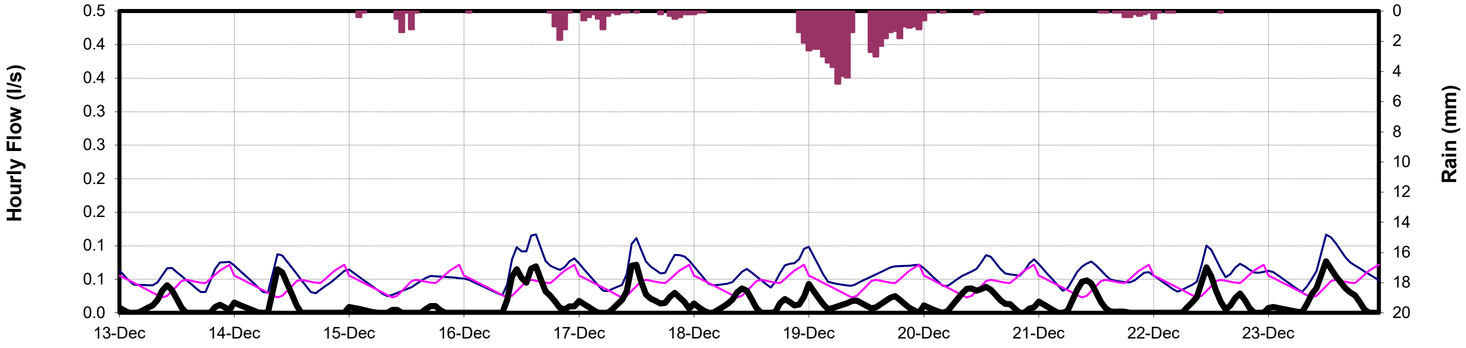


Peak 24-Hour Flows by Storm Event

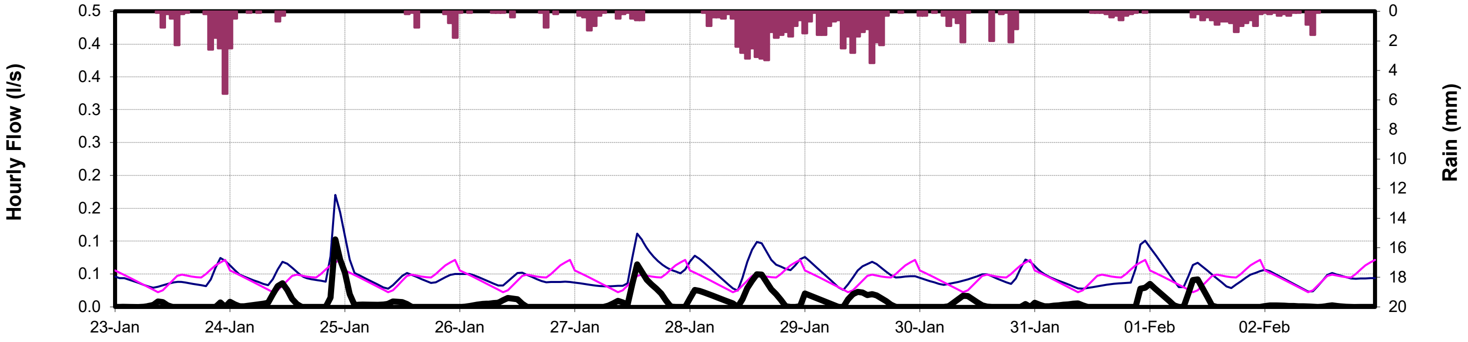


Cultra PS (CS09)

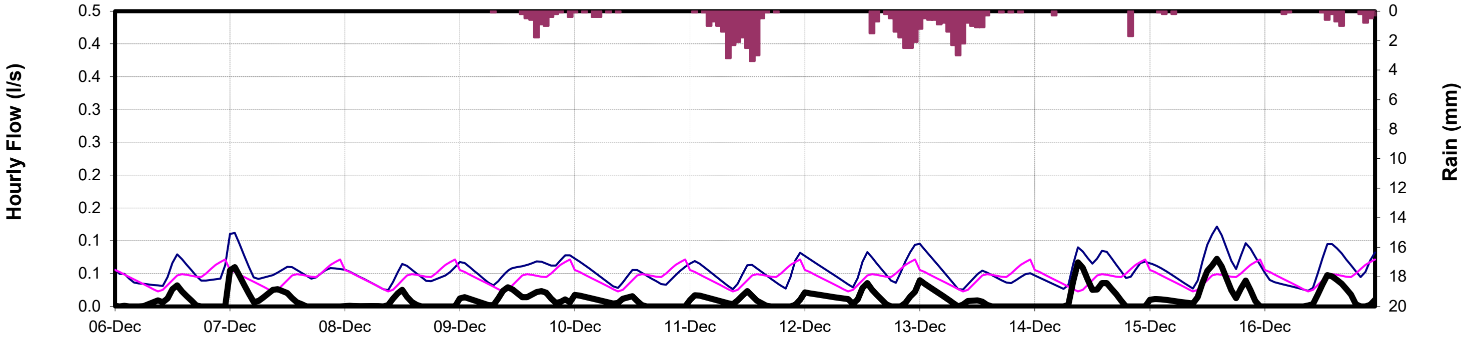
December 13 to December 23, 2017 Storm Events



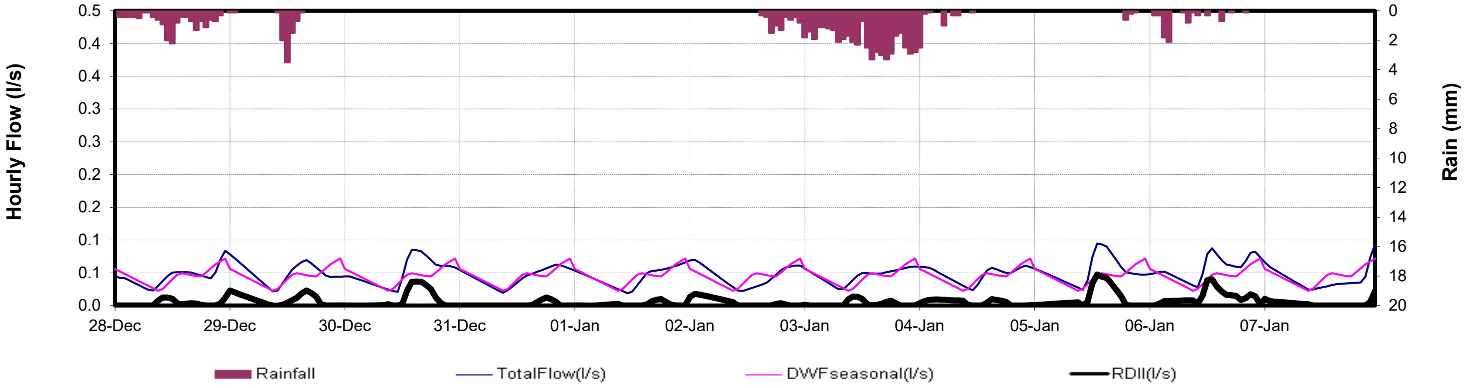
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

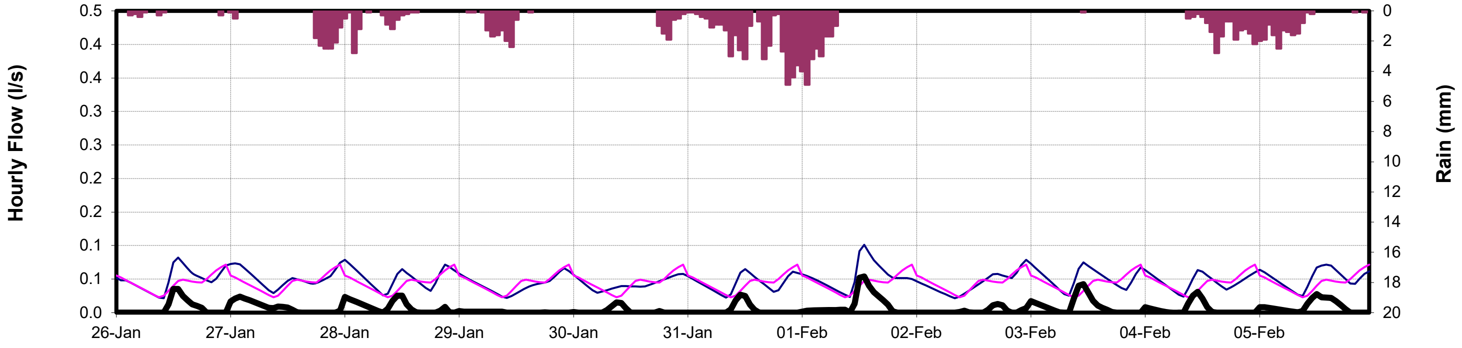


December 28 to January 7, 2019 Storm Events

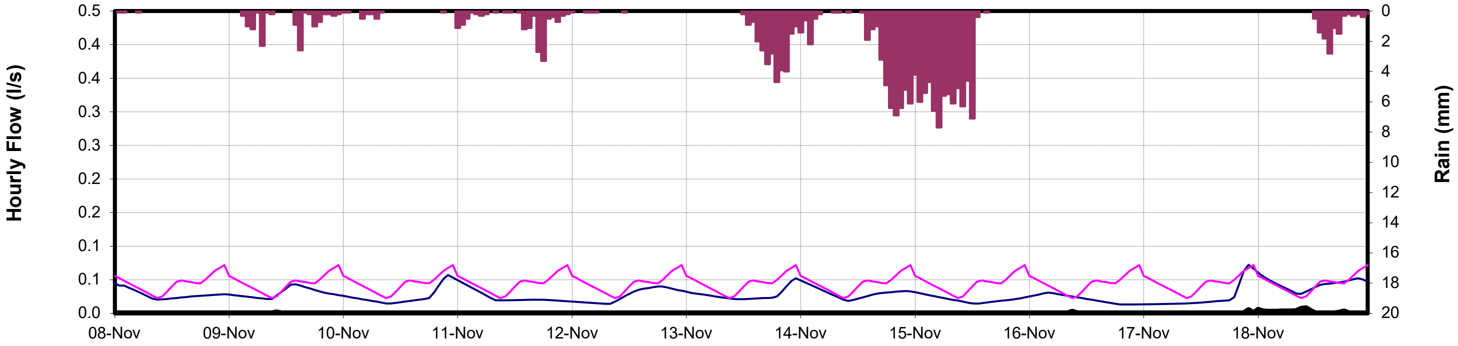


Cultra PS (CS09)

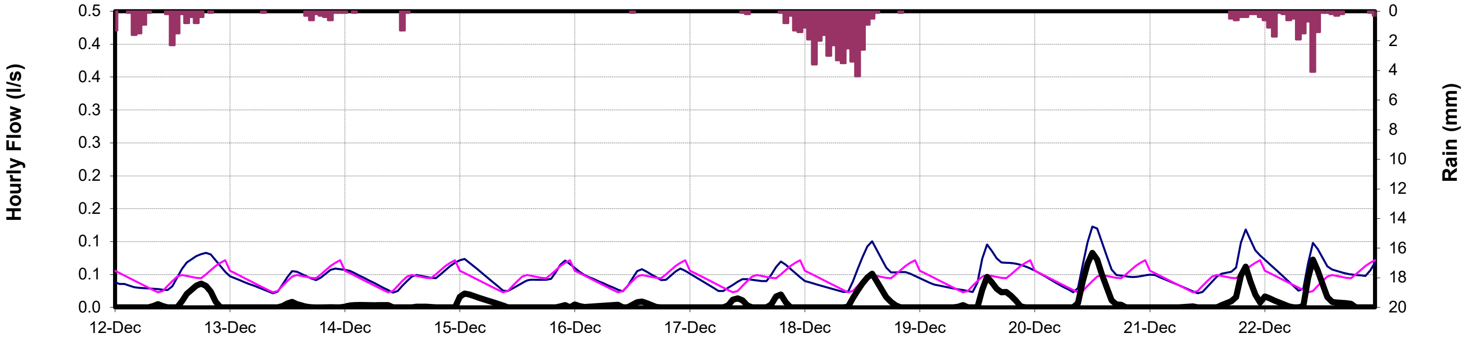
January 26 to February 5, 2020 Storm Events



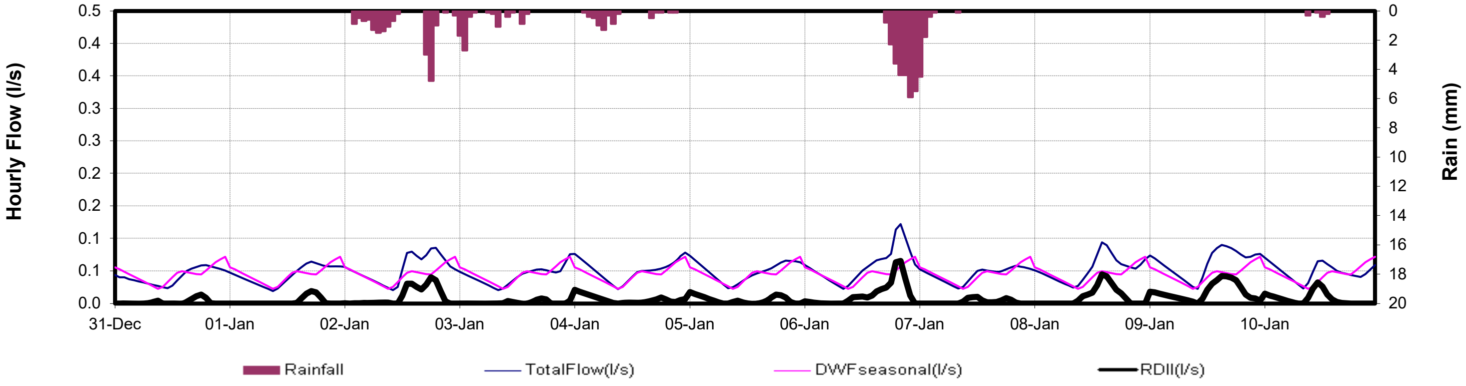
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

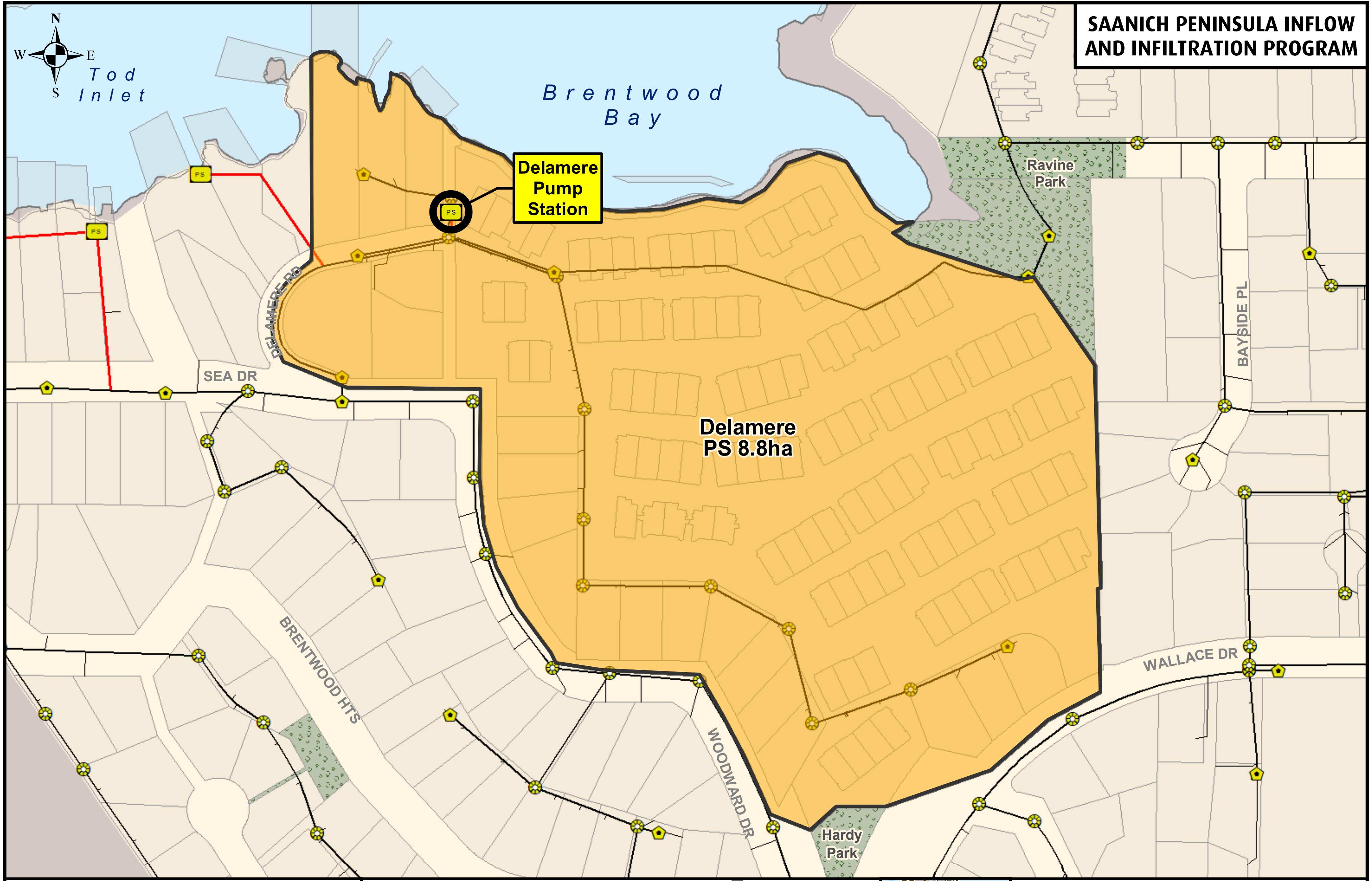


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



0 35 70 140 Metres

Projection: UTM ZONE 10N, NAD83

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- ○ Flow Monitoring Location
- ✱ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◔ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
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- Non-Sewered Area
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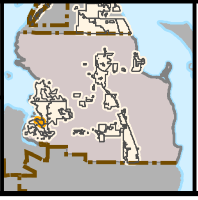


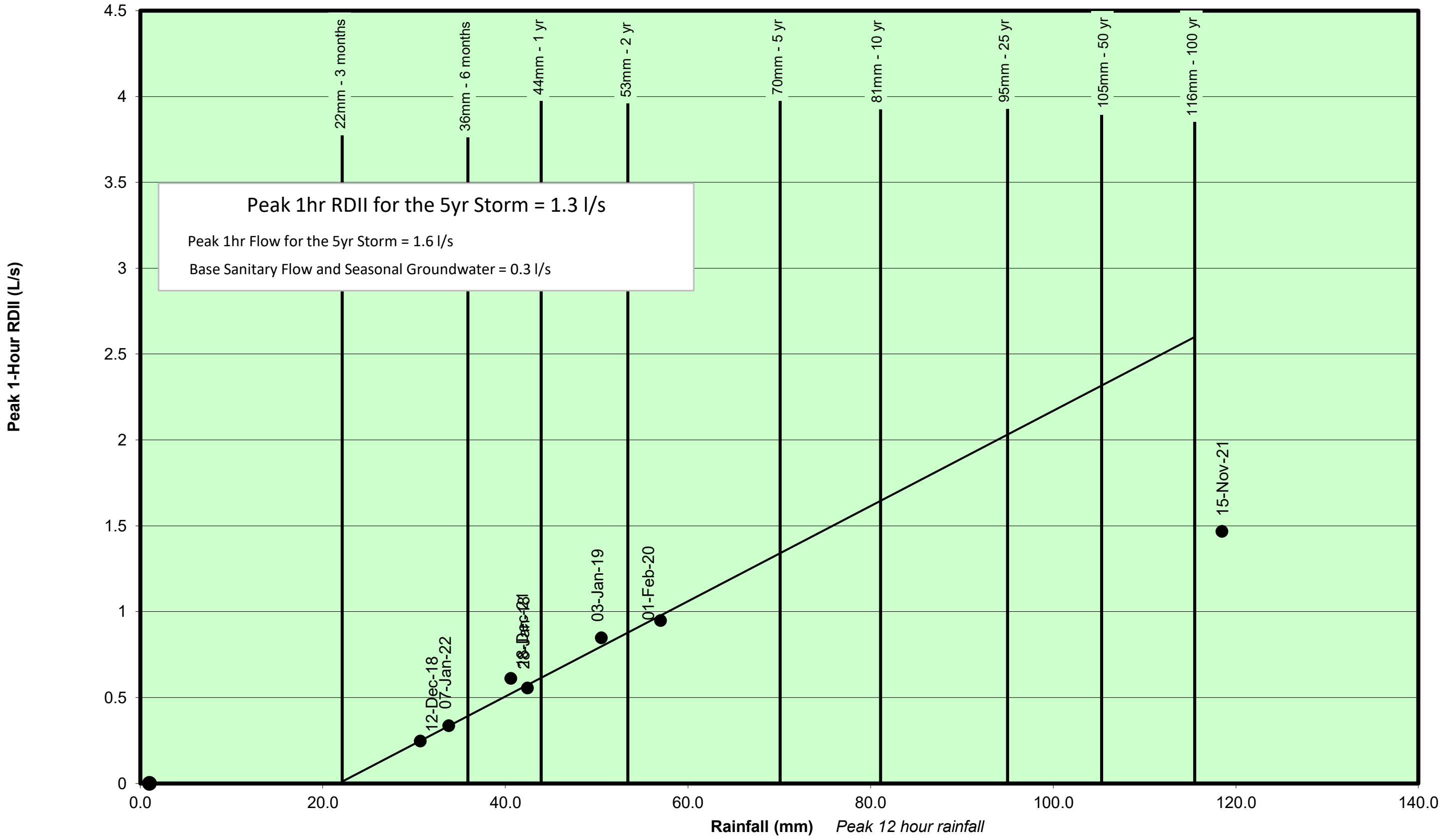
FLOW MONITORING AREA

Catchment: Delamere PS

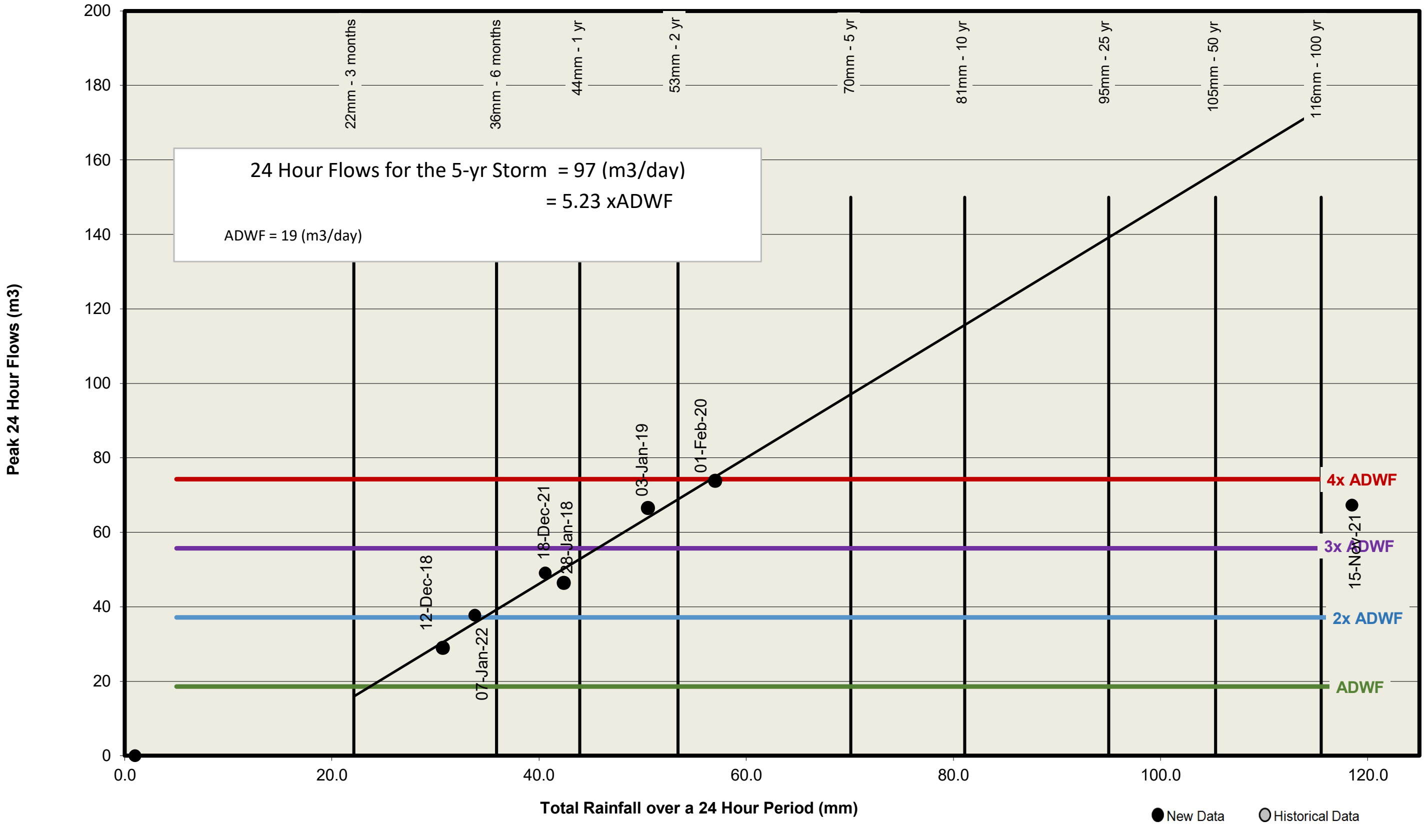
Site Code: CS10

Making a difference...together

Delamere PS (CS10)



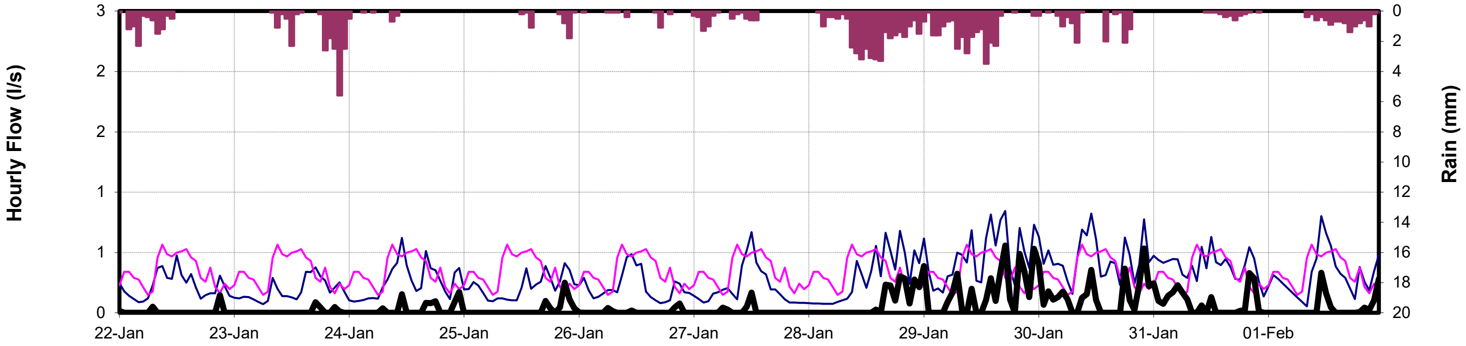
Peak 1-hr RDII by Storm Event



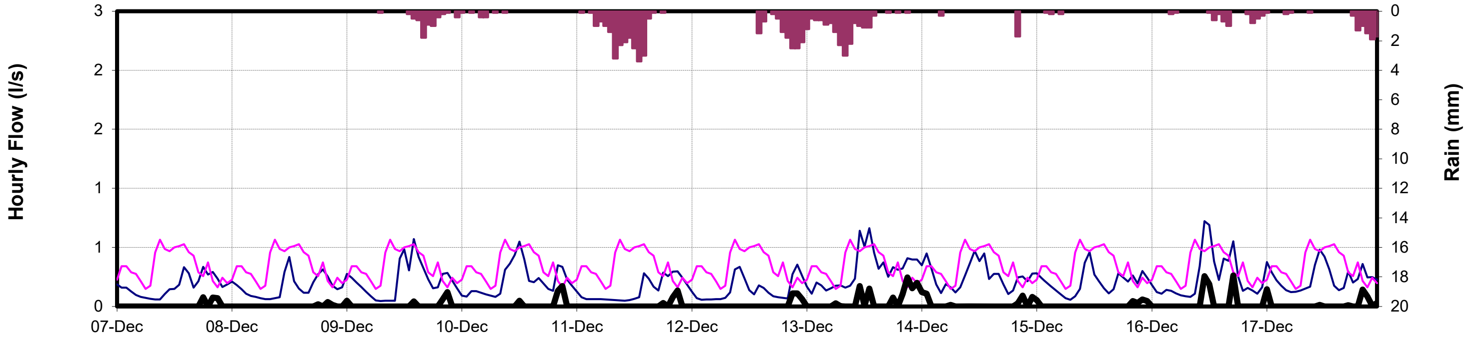
Peak 24-Hour Flows by Storm Event

Delamere PS (CS10)

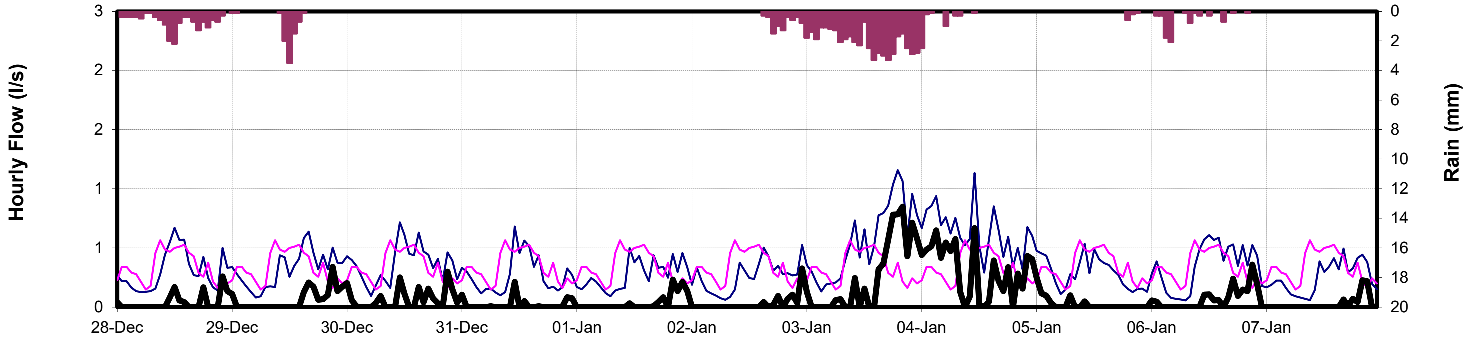
January 22 to February 1, 2018 Storm Events



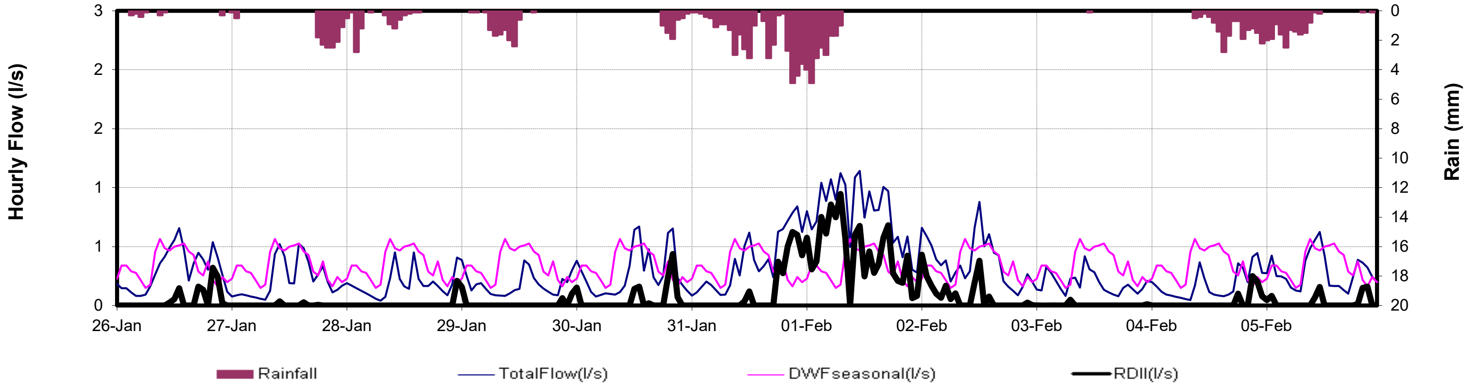
December 7 to December 17, 2018 Storm Events



December 28 to January 7, 2019 Storm Events

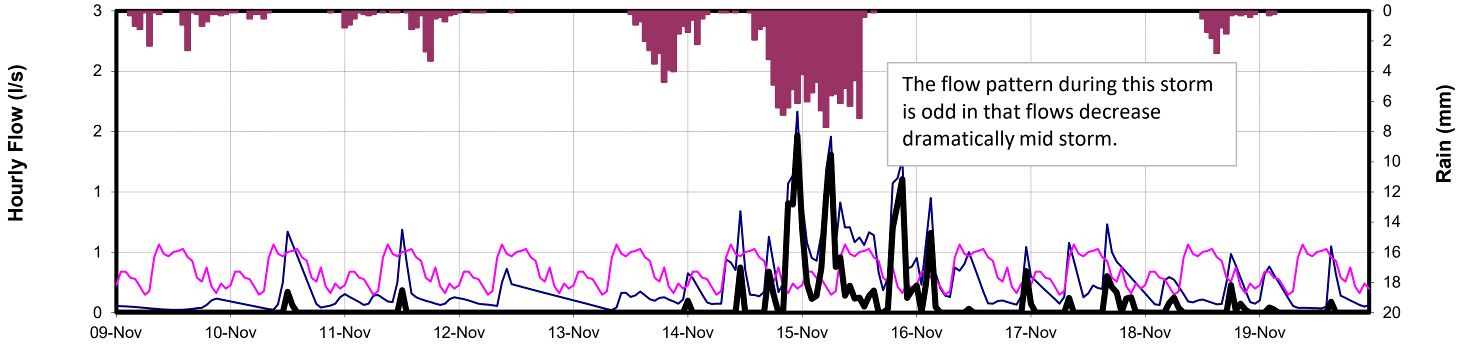


January 26 to February 5, 2020 Storm Events



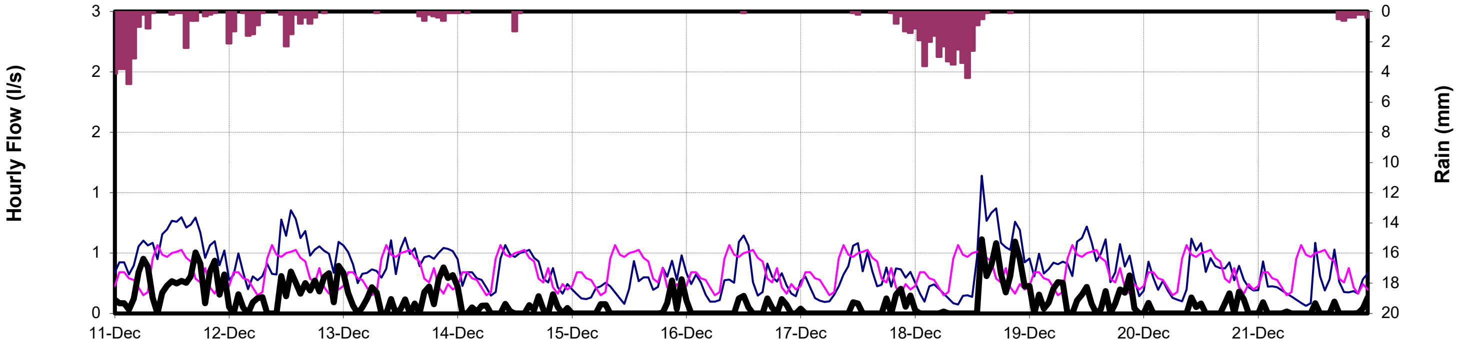
Delamere PS (CS10)

November 9 to November 19, 2021 Storm Events

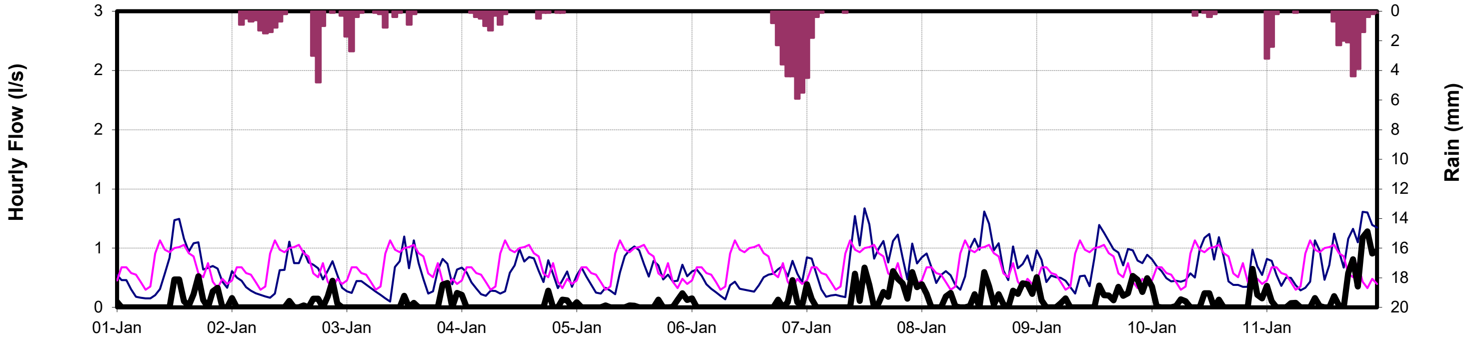


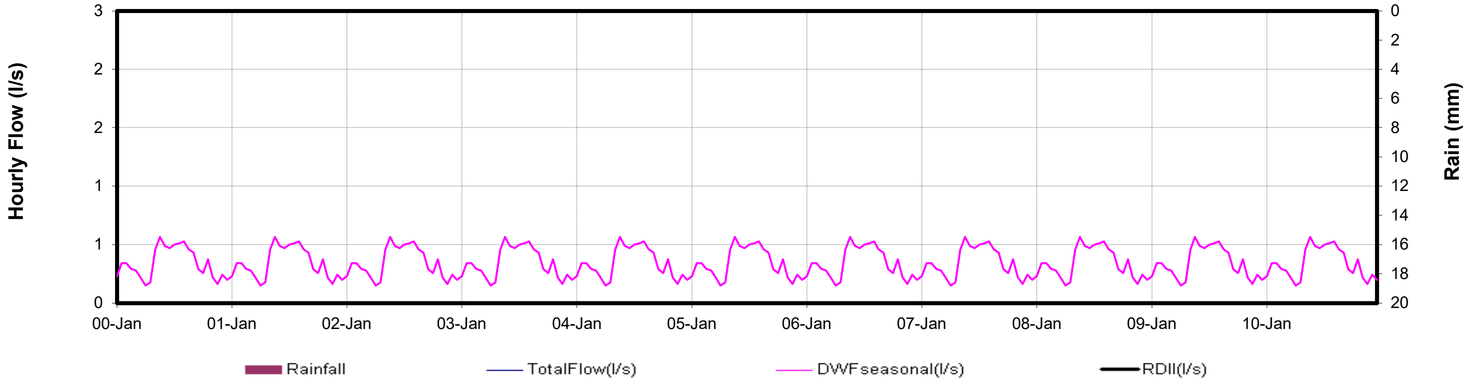
The flow pattern during this storm is odd in that flows decrease dramatically mid storm.

December 11 to December 21, 2021 Storm Events

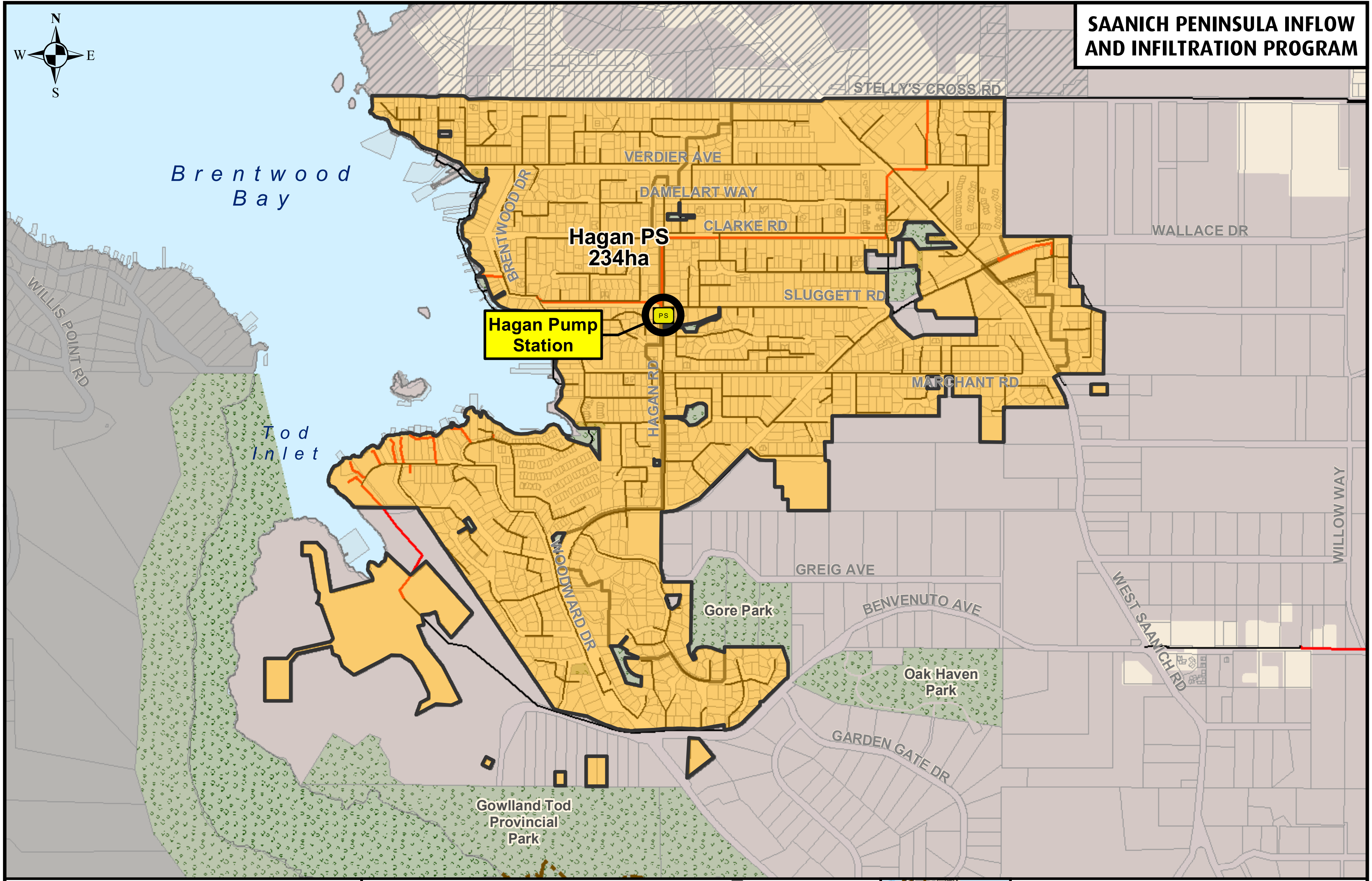


January 1 to January 11, 2022 Storm Events





SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



0 212.5 425 850 Metres

Projection: UTM ZONE 10N, NAD83

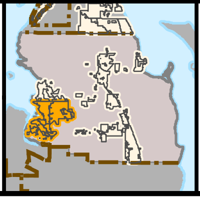
Disclaimer
This map is for general information only and may contain inaccuracies.

- ○ Flow Monitoring Location
- ✺ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◉ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- 🟧 Catchment Area
- ▨ Non-Sewered Area
- ☐ Lot Lines
- 🟩 Parks
- 🟨 Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



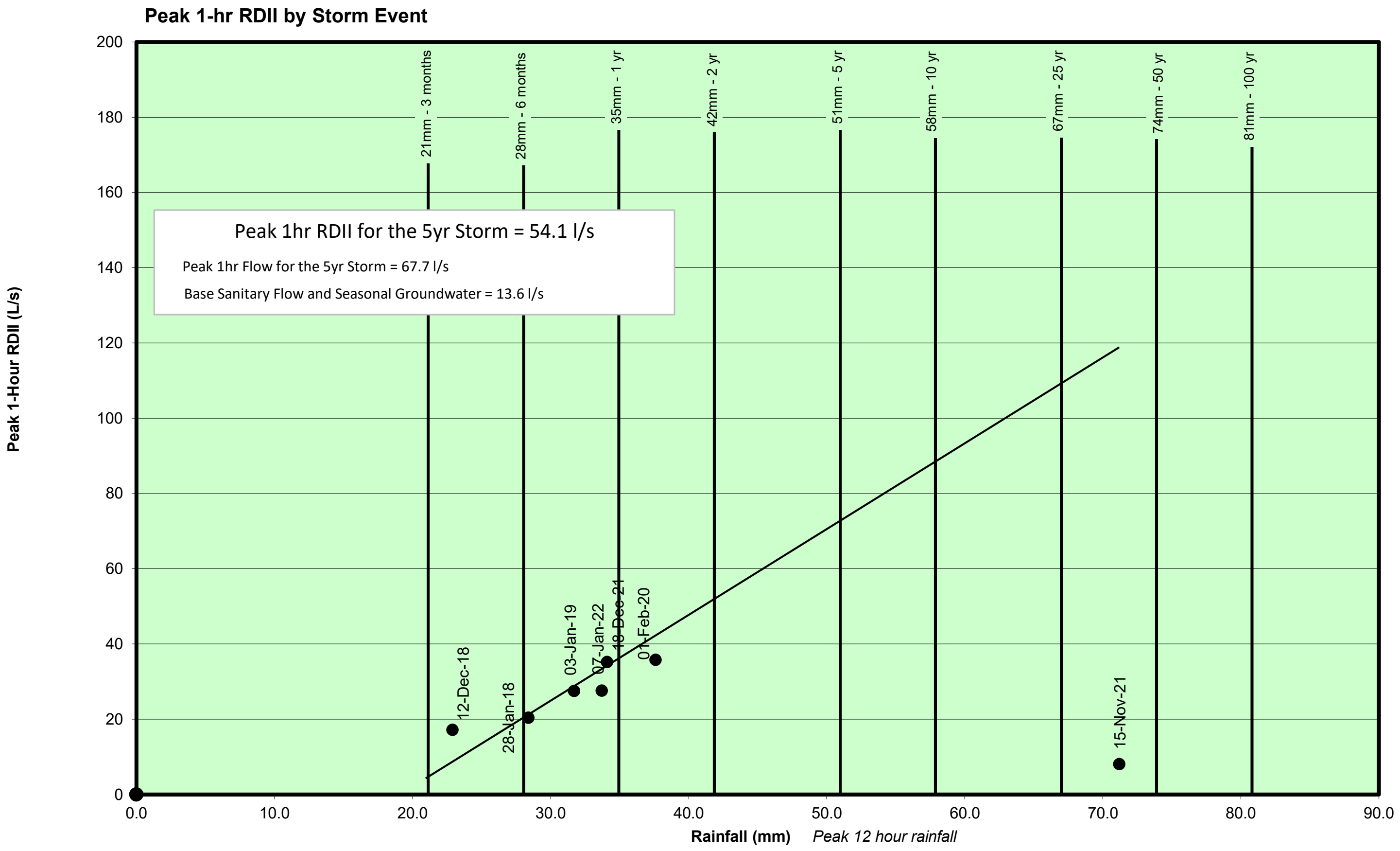
FLOW MONITORING AREA

Catchment: Hagan PS

Site Code: CS11

CRD
Making a difference...together

Hagan PS (CS11)

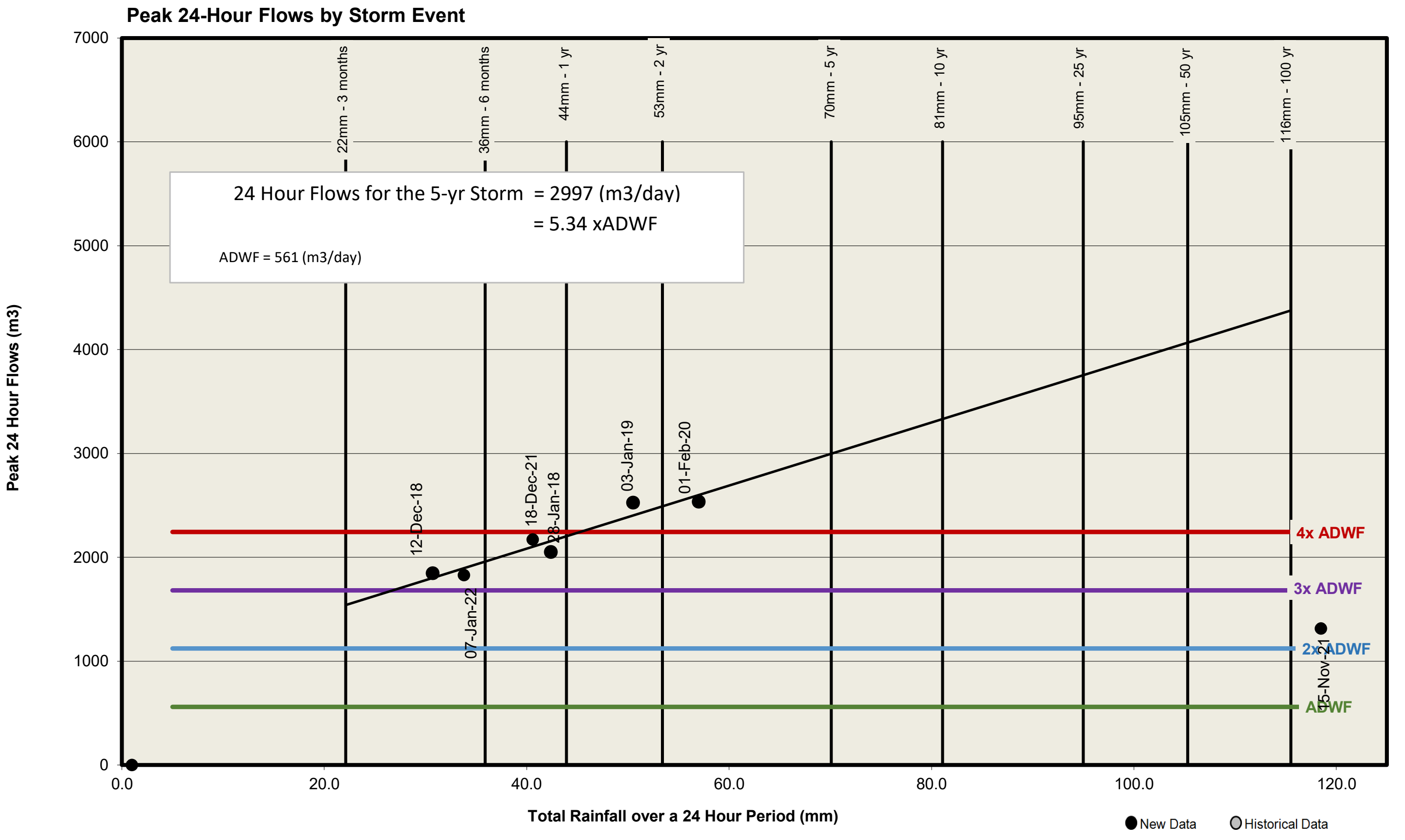


Peak 1-hr RDII by Storm Event

Peak 1hr RDII for the 5yr Storm = 54.1 l/s

Peak 1hr Flow for the 5yr Storm = 67.7 l/s

Base Sanitary Flow and Seasonal Groundwater = 13.6 l/s

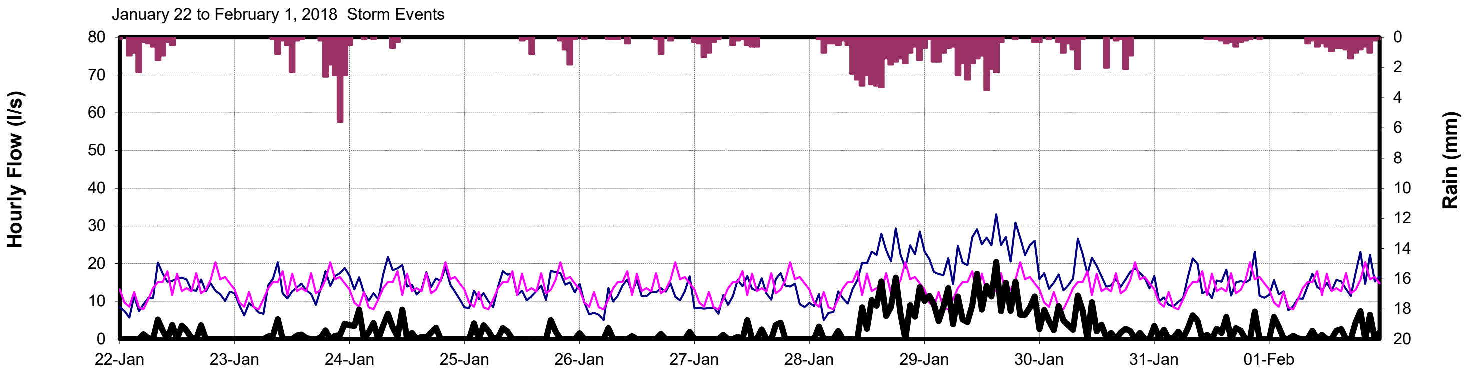


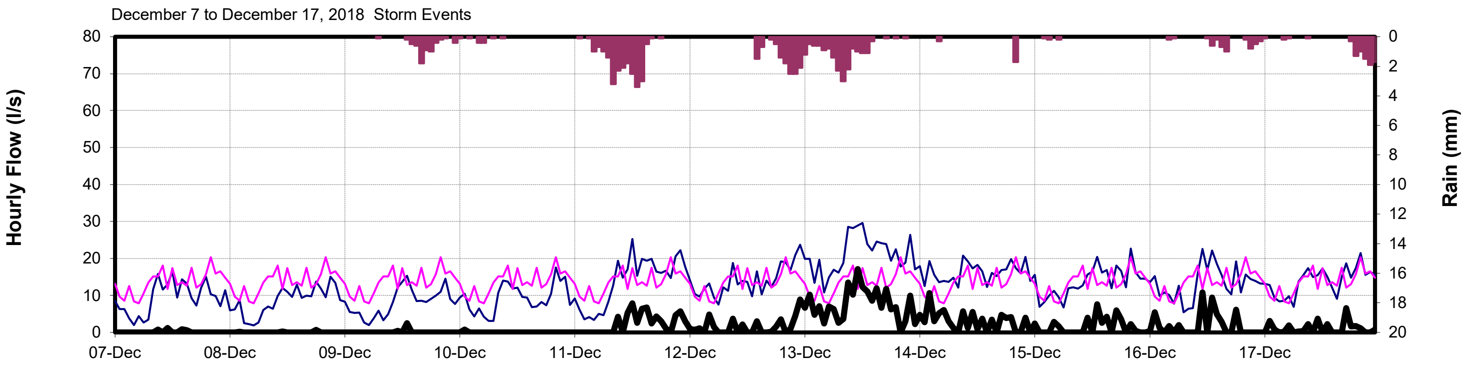
Peak 24-Hour Flows by Storm Event

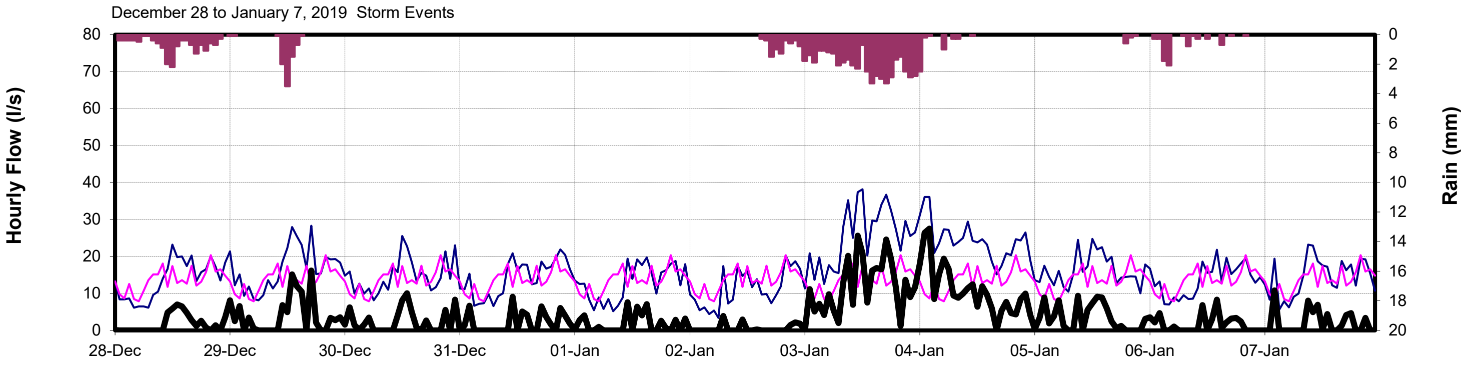
24 Hour Flows for the 5-yr Storm = 2997 (m3/day)
= 5.34 xADWF

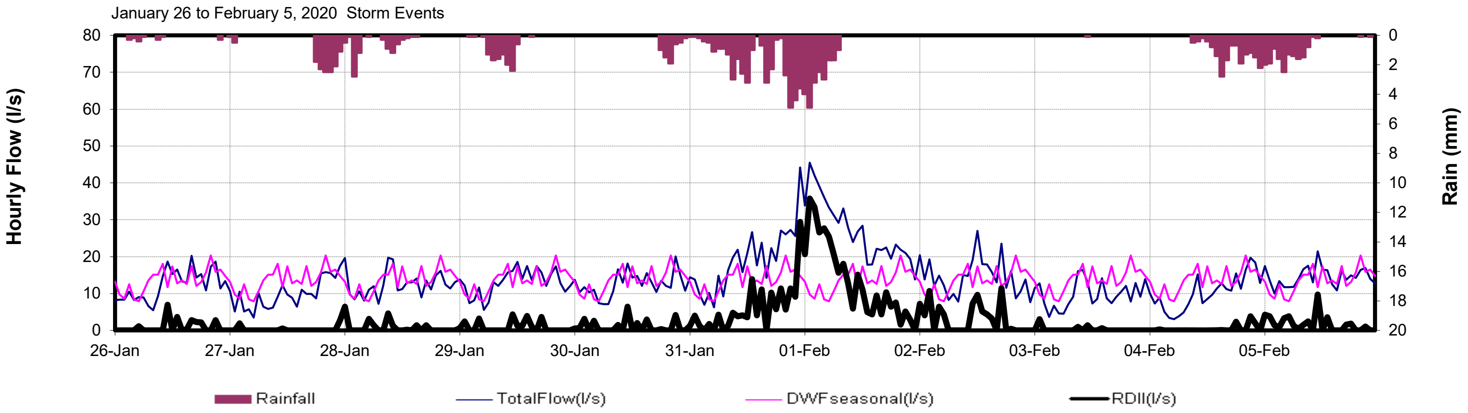
ADWF = 561 (m3/day)

Hagan PS (CS11)



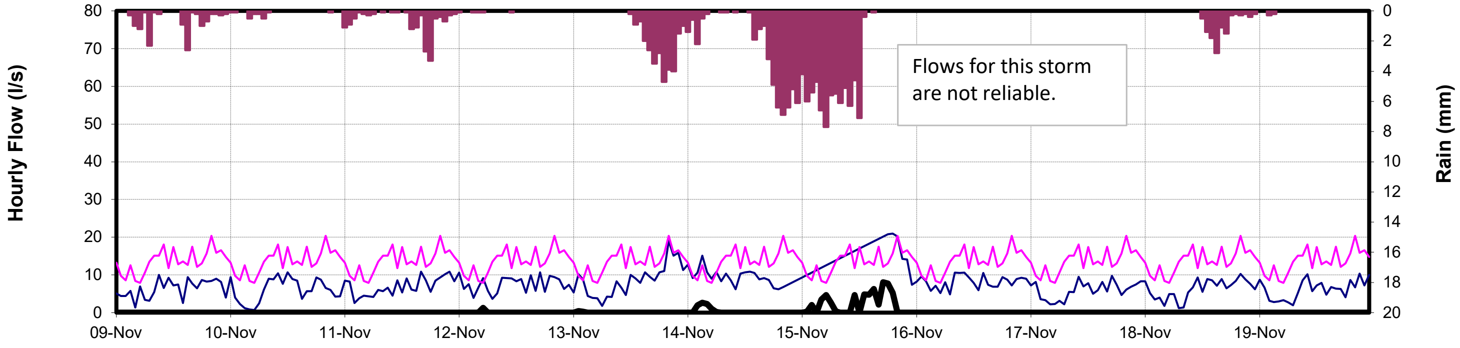




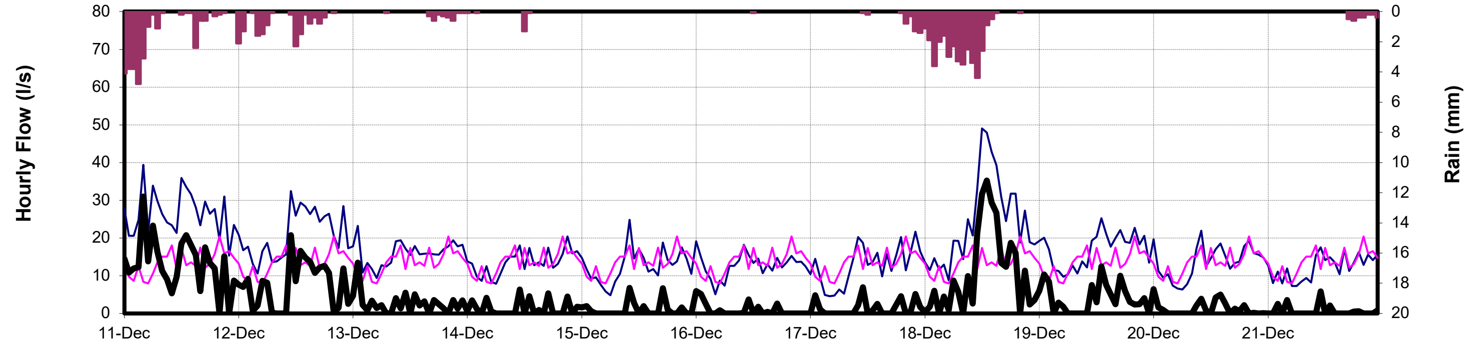


Hagan PS (CS11)

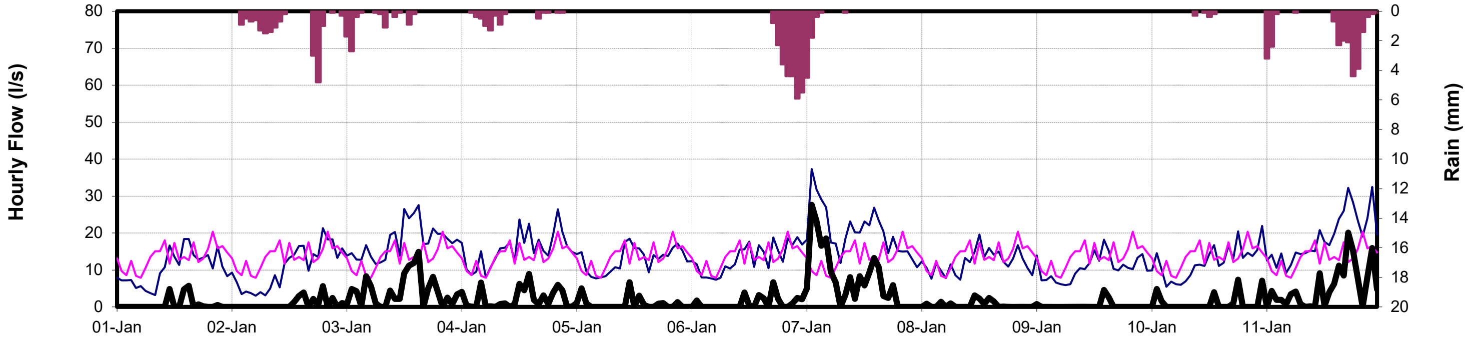
November 9 to November 19, 2021 Storm Events


Flows for this storm are not reliable.

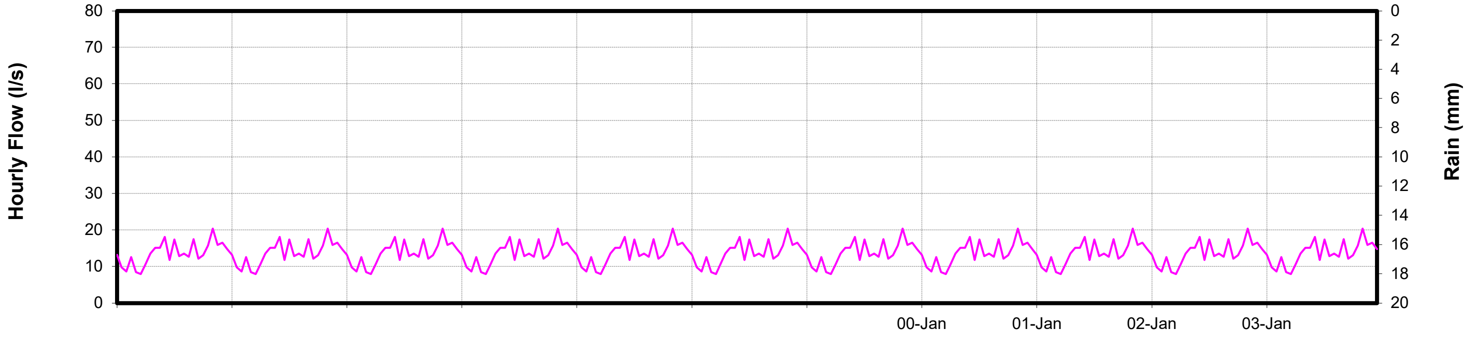
December 11 to December 21, 2021 Storm Events



January 1 to January 11, 2022 Storm Events



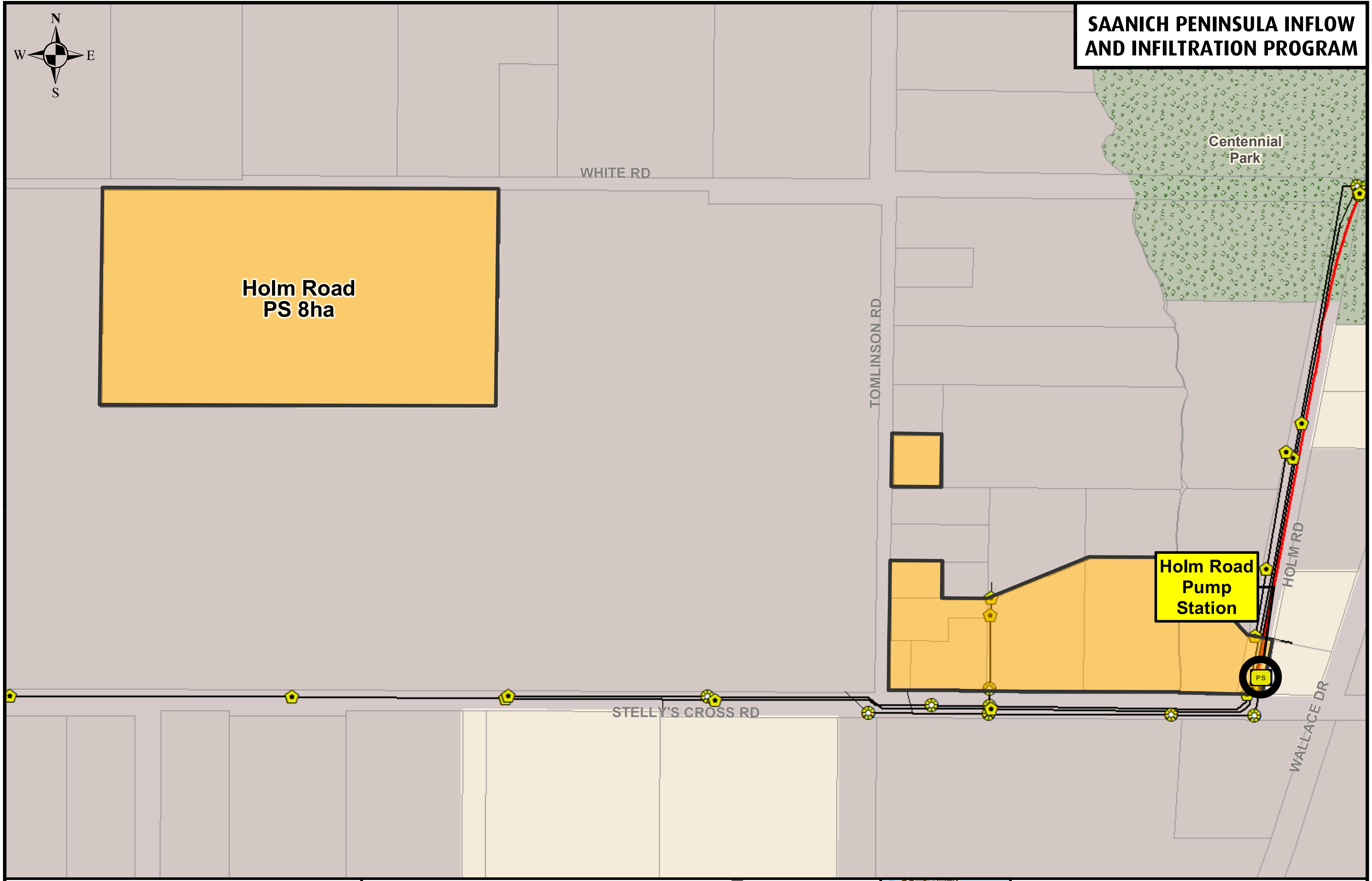
#VALUE!



▬ Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 55 110 220

Projection: UTM ZONE 10N, NAD83

Disclaimer
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○ Flow Monitoring Location
⊛ Manhole
⬟ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
— Gravity Main Installed After 1930
— Gravity Main Installed Before 1930
— Force Main
═ Relief, Outfall, Overflow Sewer
— CRD Sewer

▨ Catchment Area
▨ Non-Sewered Area
☐ Lot Lines
▨ Parks
▨ Sewered Park Areas
- - Catchment Boundary
-·- Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

Catchment: Holm Road PS

Site Code: CS12

CRD
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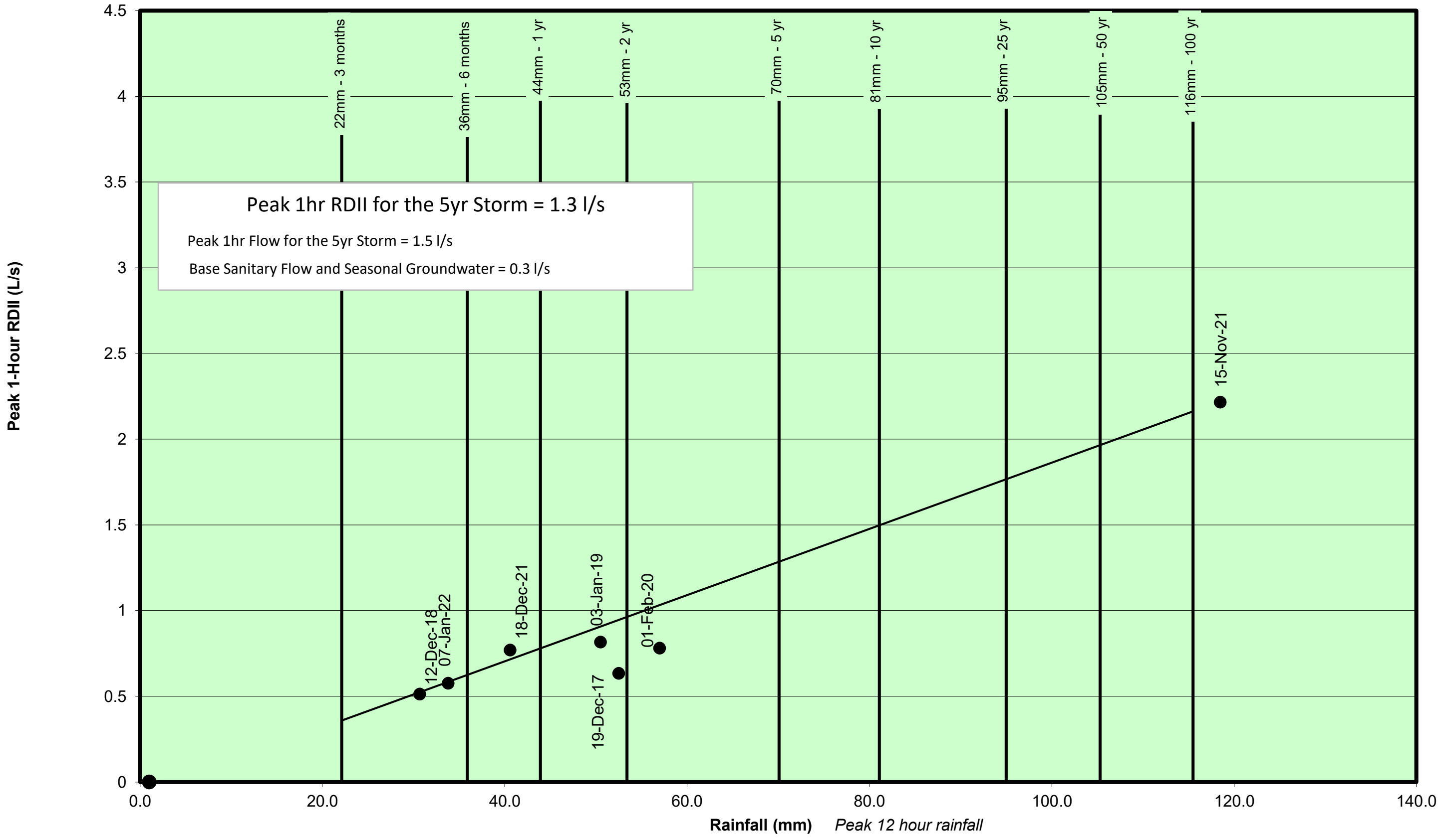
Holm Road PS (CS12)

Peak 1-hr RDII by Storm Event

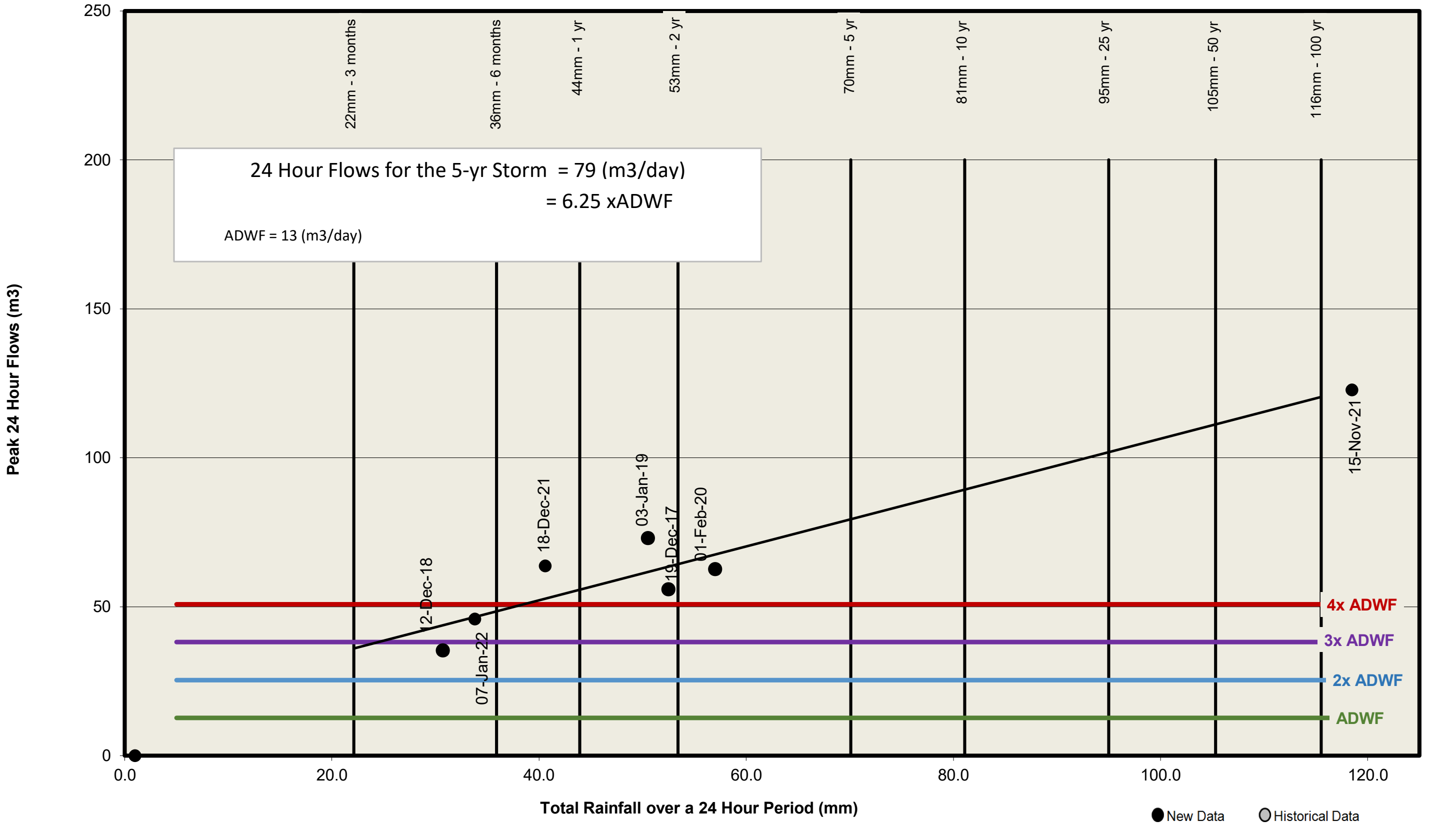


Peak 1hr RDII for the 5yr Storm = 1.3 l/s

Peak 1hr Flow for the 5yr Storm = 1.5 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.3 l/s

Peak 24-Hour Flows by Storm Event

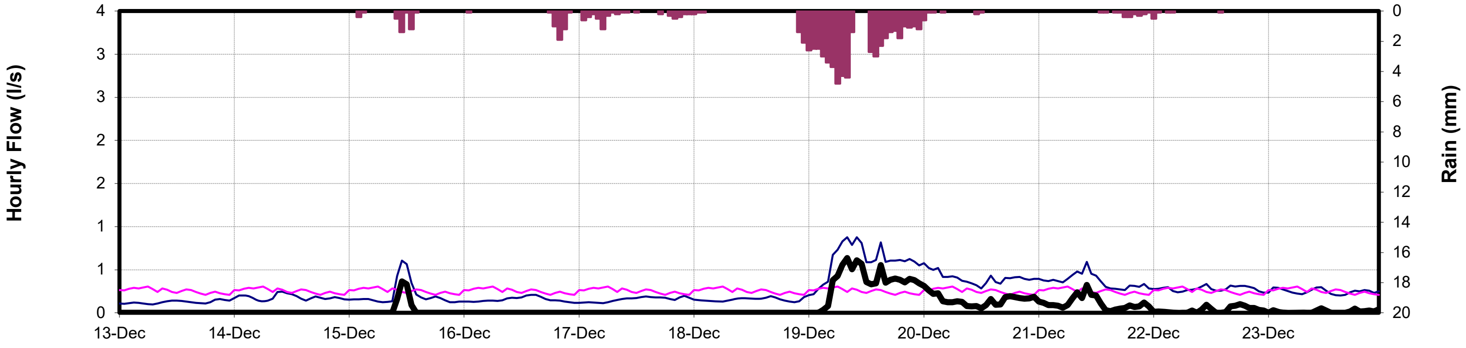


24 Hour Flows for the 5-yr Storm = 79 (m3/day)
= 6.25 xADWF

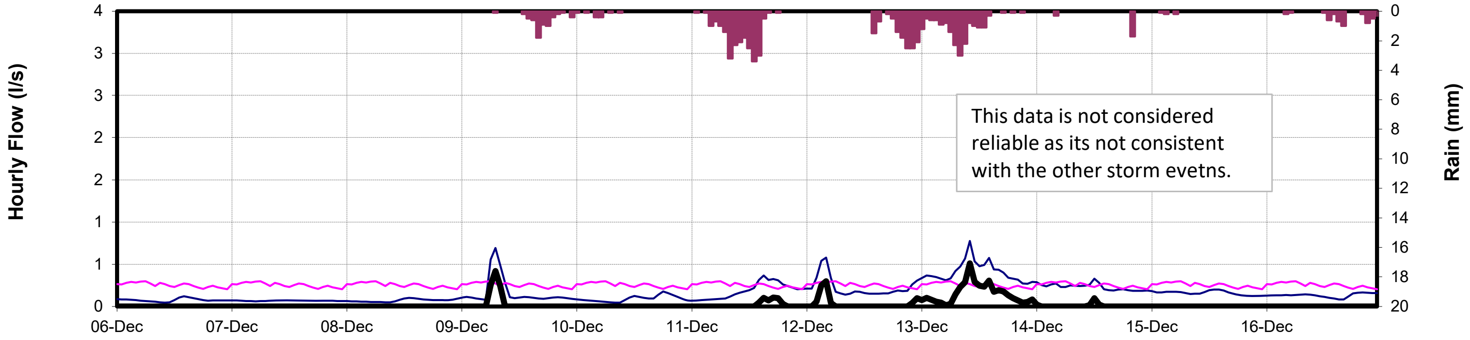
ADWF = 13 (m3/day)

Holm Road PS (CS12)

December 13 to December 23, 2017 Storm Events

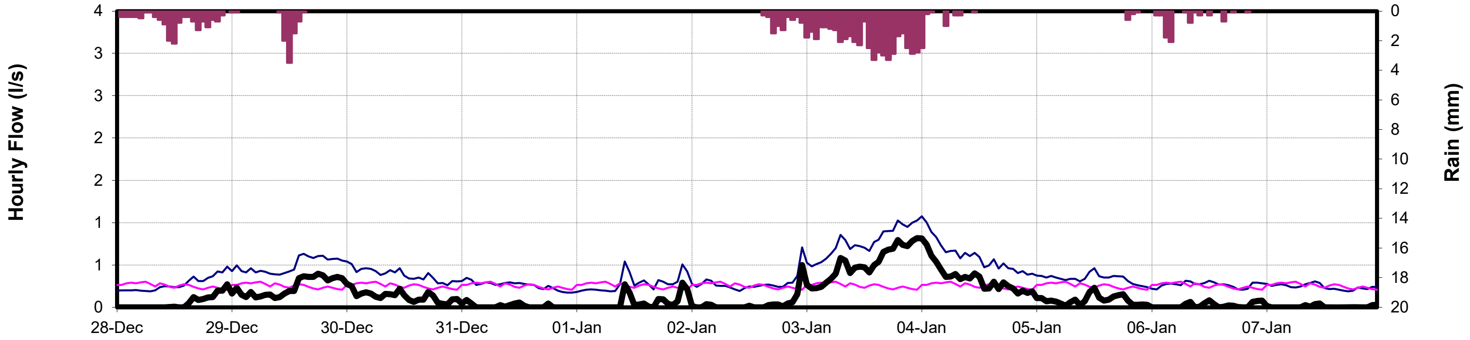


December 6 to December 16, 2018 Storm Events

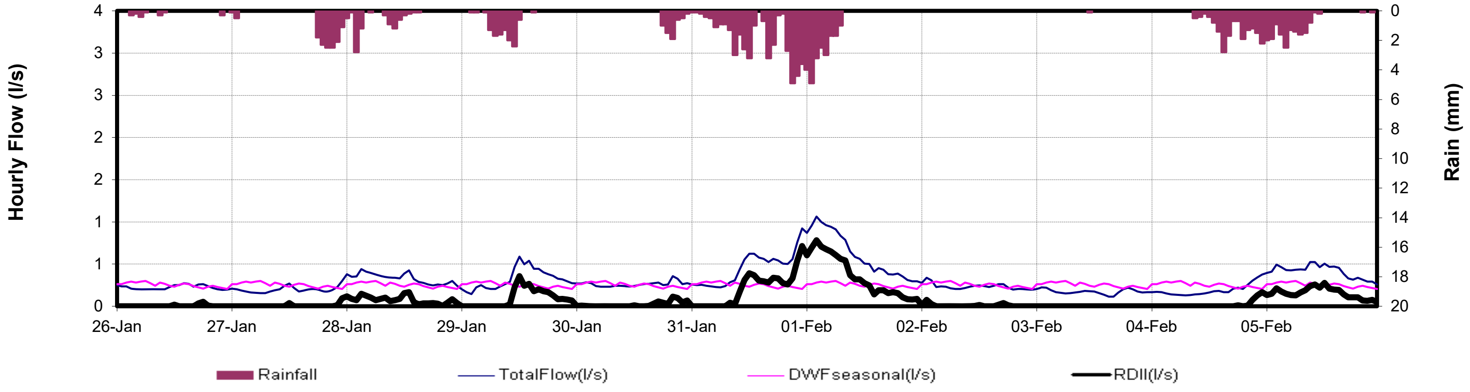


This data is not considered reliable as its not consistent with the other storm evetns.

December 28 to January 7, 2019 Storm Events

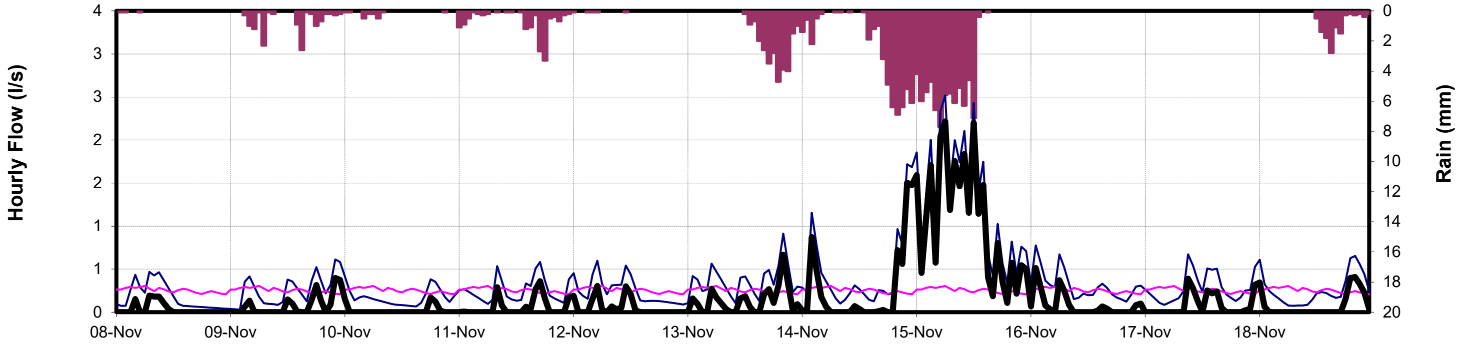


January 26 to February 5, 2020 Storm Events

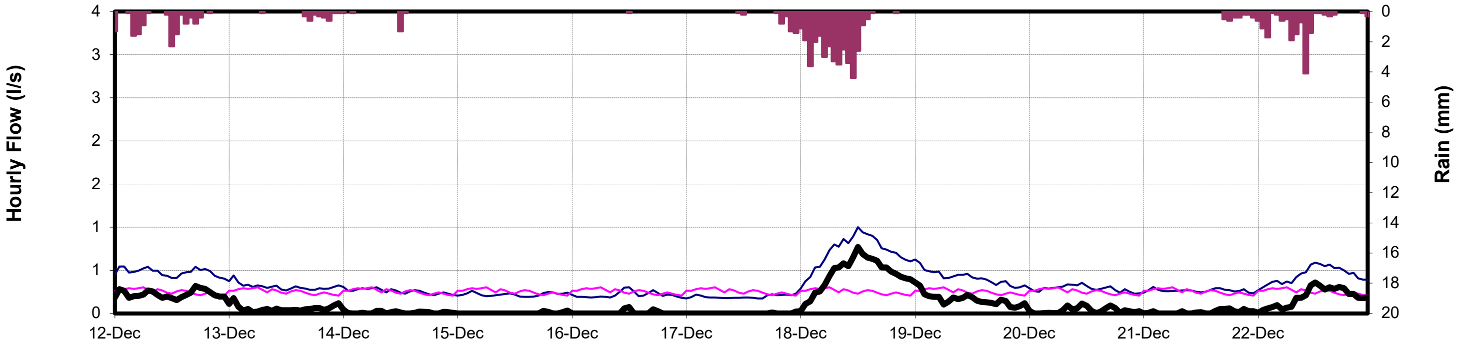


Holm Road PS (CS12)

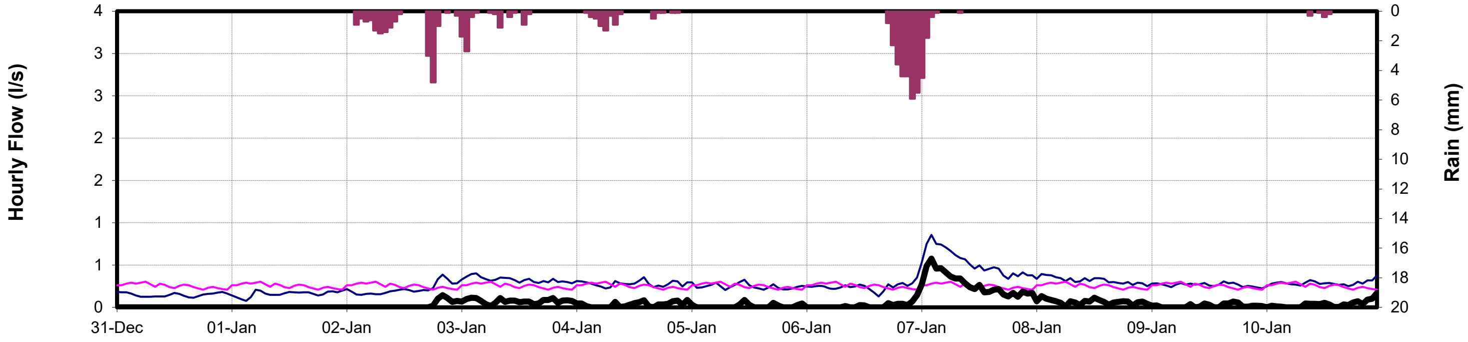
November 8 to November 18, 2021 Storm Events

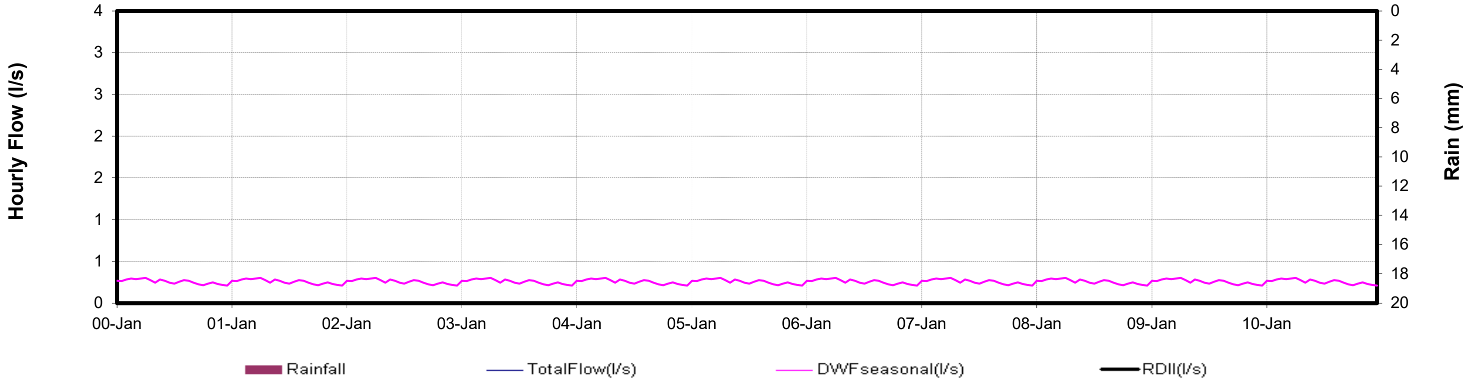


December 12 to December 22, 2021 Storm Events



December 31 to January 10, 2022 Storm Events





SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM

Metres
0 35 70 140

Projection: UTM ZONE 10N, NAD83

Disclaimer
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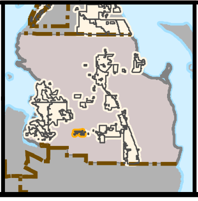
○ Flow Monitoring Location
⊛ Manhole
⬟ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
— Gravity Main Installed After 1930
— Gravity Main Installed Before 1930
— Force Main
═ Relief, Outfall, Overflow Sewer
— CRD Sewer

▨ Catchment Area
▨ Non-Sewered Area
☐ Lot Lines
▨ Parks
▨ Sewered Park Areas
- - Catchment Boundary
-·- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

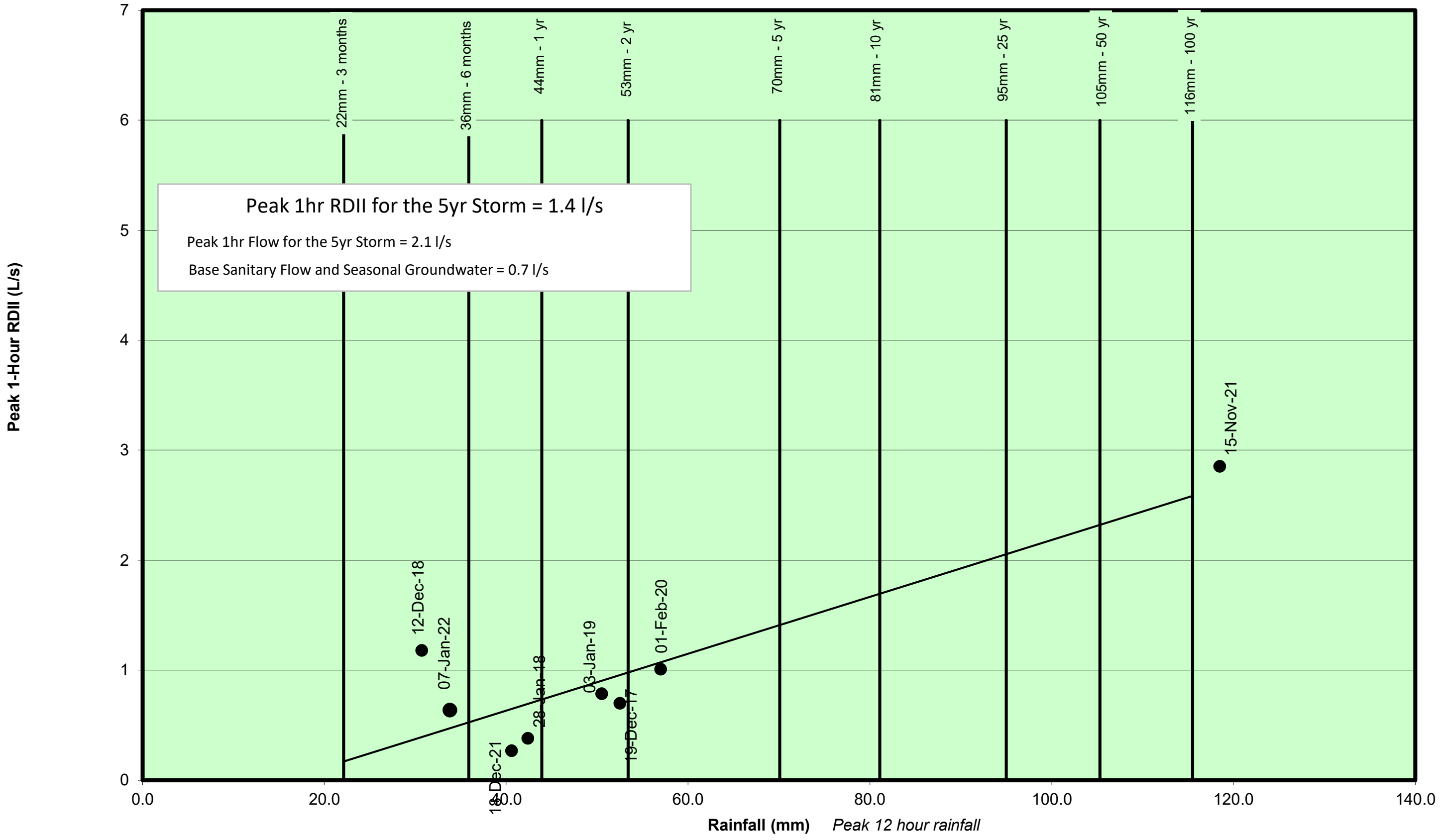
Catchment: Keating PS Central Saanich

Site Code: CS13

Making a difference...together

Keating PS (CS13)

Peak 1-hr RDII by Storm Event

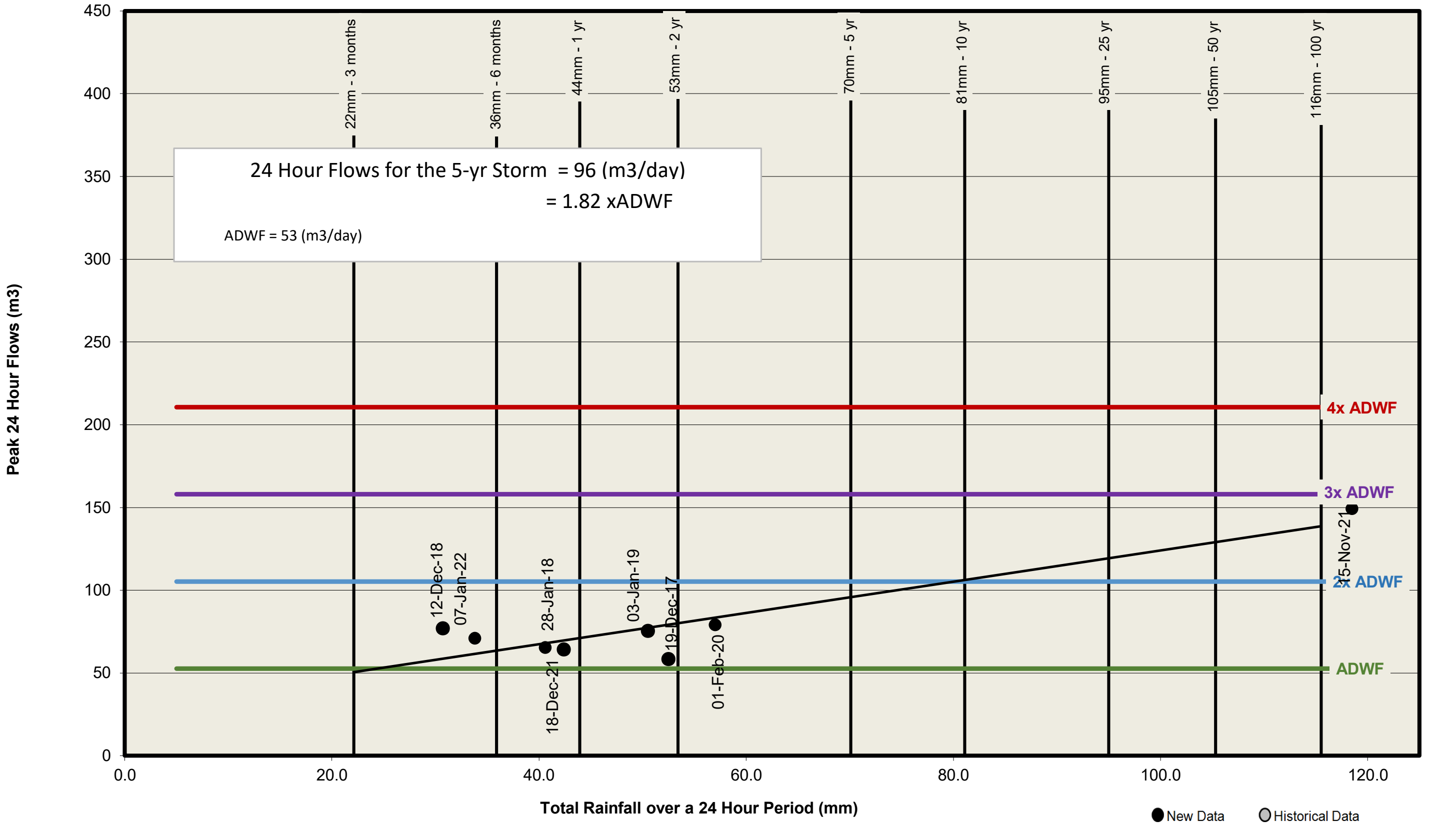


Peak 1hr RDII for the 5yr Storm = 1.4 l/s

Peak 1hr Flow for the 5yr Storm = 2.1 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.7 l/s

Peak 24-Hour Flows by Storm Event

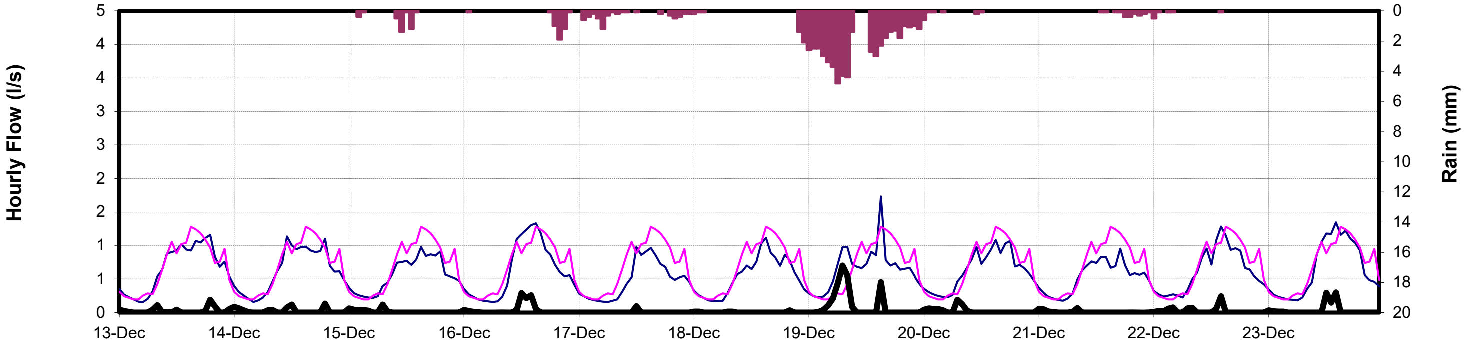


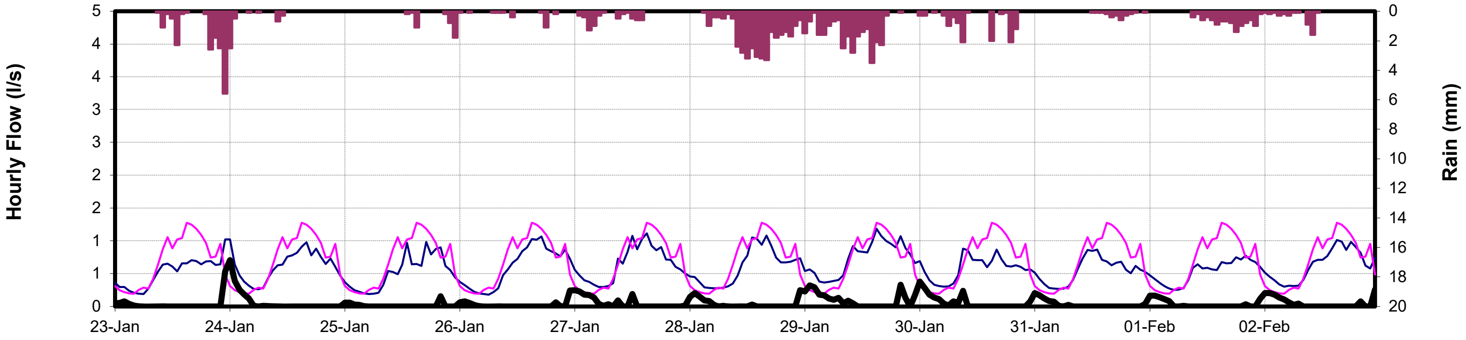
24 Hour Flows for the 5-yr Storm = 96 (m3/day)

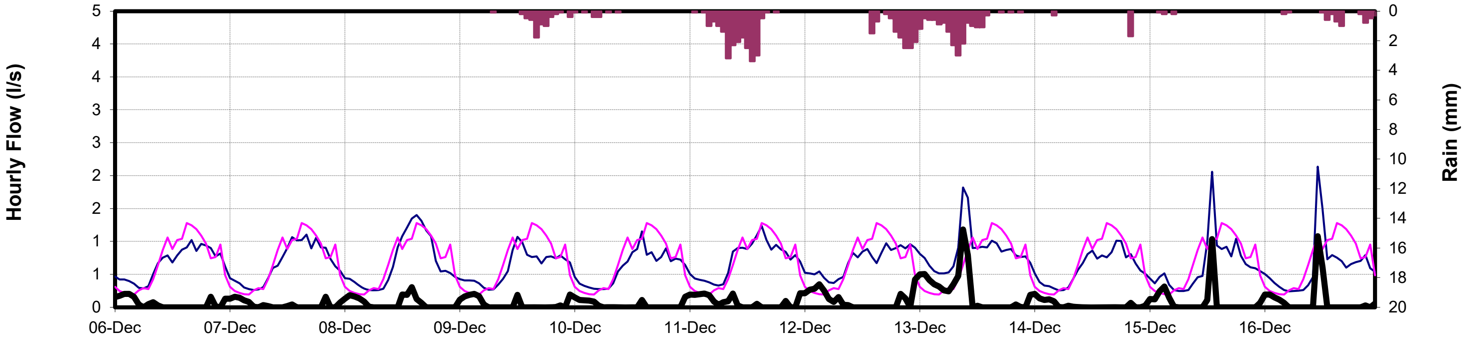
= 1.82 xADWF

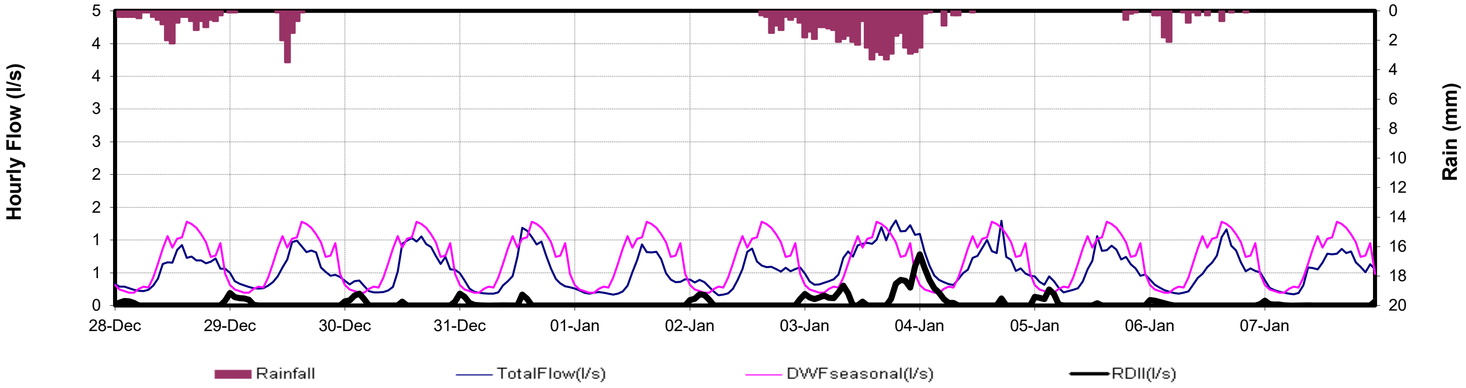
ADWF = 53 (m3/day)

Keating PS (CS13)

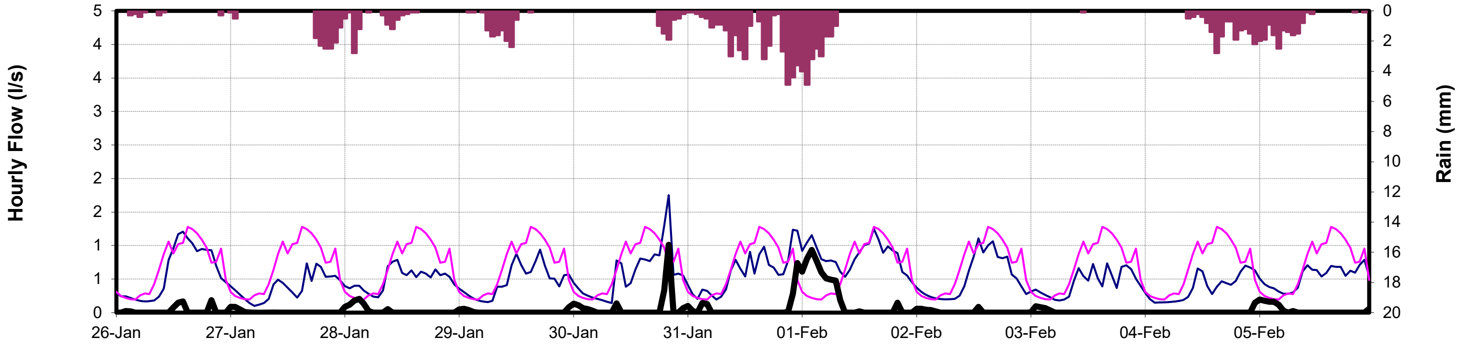

December 13 to December 23, 2017 Storm Events

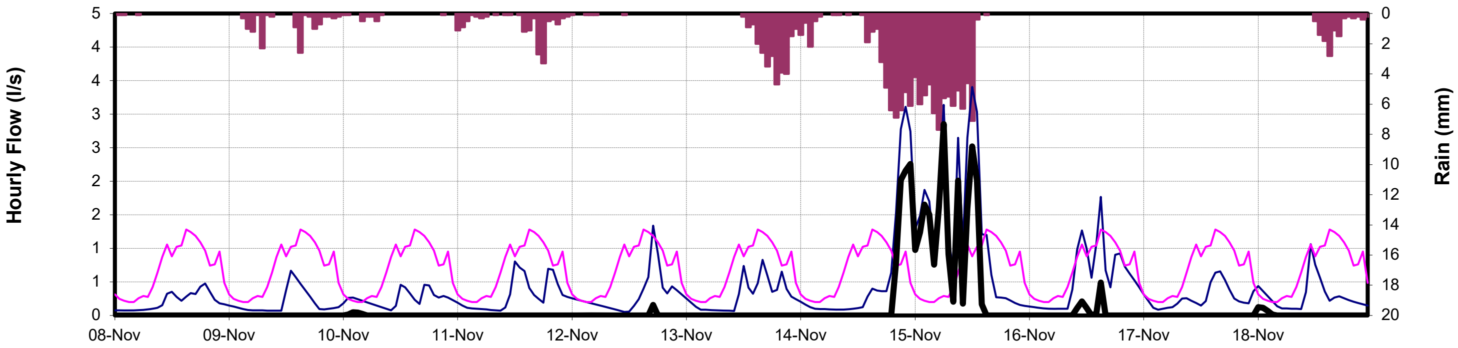

January 23 to February 2, 2018 Storm Events

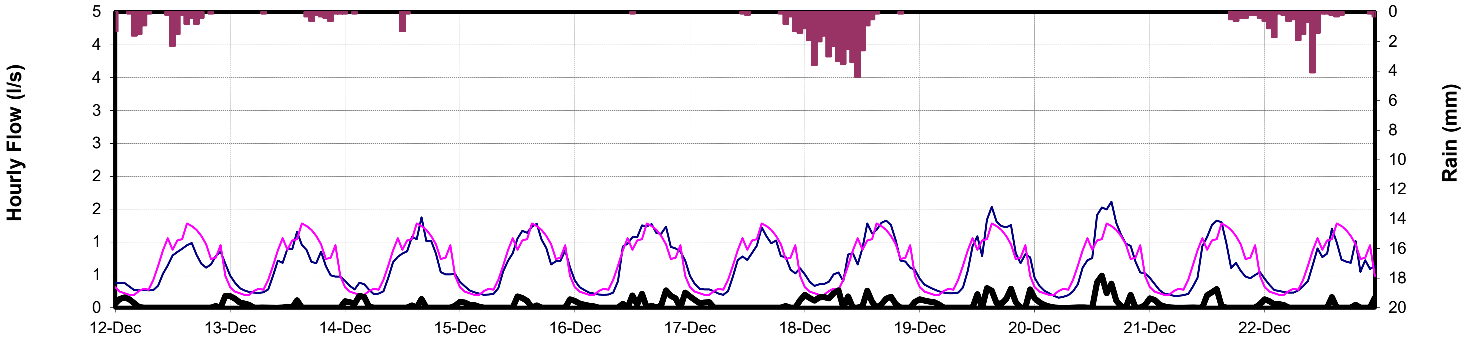

December 6 to December 16, 2018 Storm Events

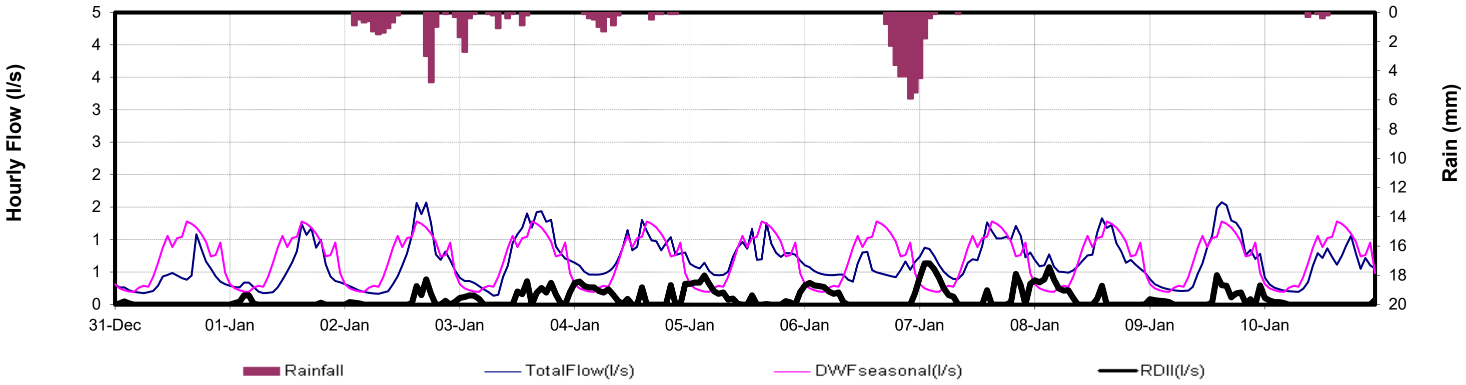

December 28 to January 7, 2019 Storm Events

Keating PS (CS13)


January 26 to February 5, 2020 Storm Events

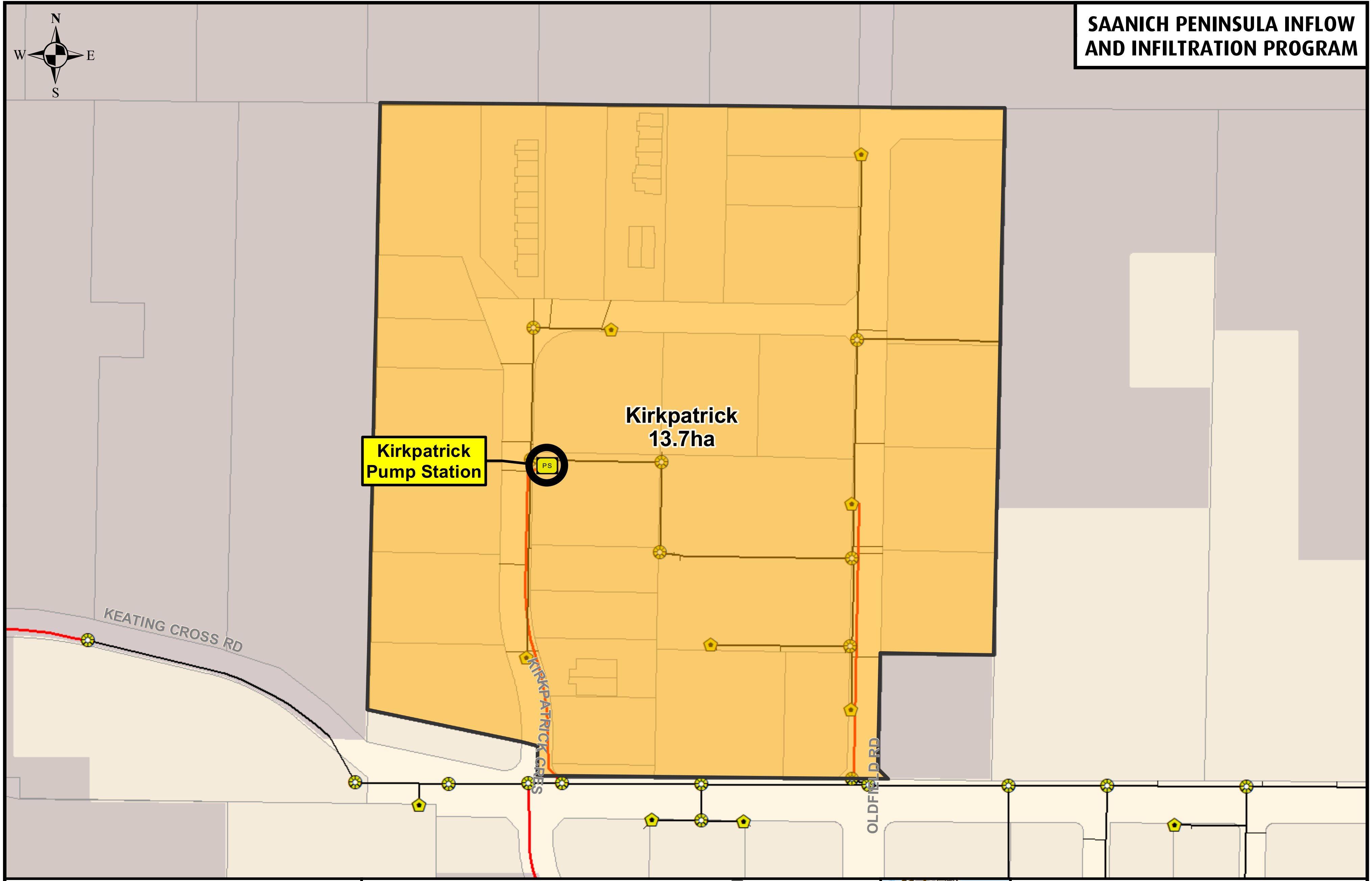

November 8 to November 18, 2021 Storm Events


December 12 to December 22, 2021 Storm Events


December 31 to January 10, 2022 Storm Events

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 40 80 160

Projection: UTM ZONE 10N, NAD83

Disclaimer
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- ○ Flow Monitoring Location
- ✺ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◔ Metering Chamber

Sanitary Sewers
- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- 🟧 Catchment Area
- ▨ Non-Sewered Area
- ☐ Lot Lines
- ▨ Parks
- ▨ Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

Catchment: Kirkpatrick

Site Code: CS14

CRD
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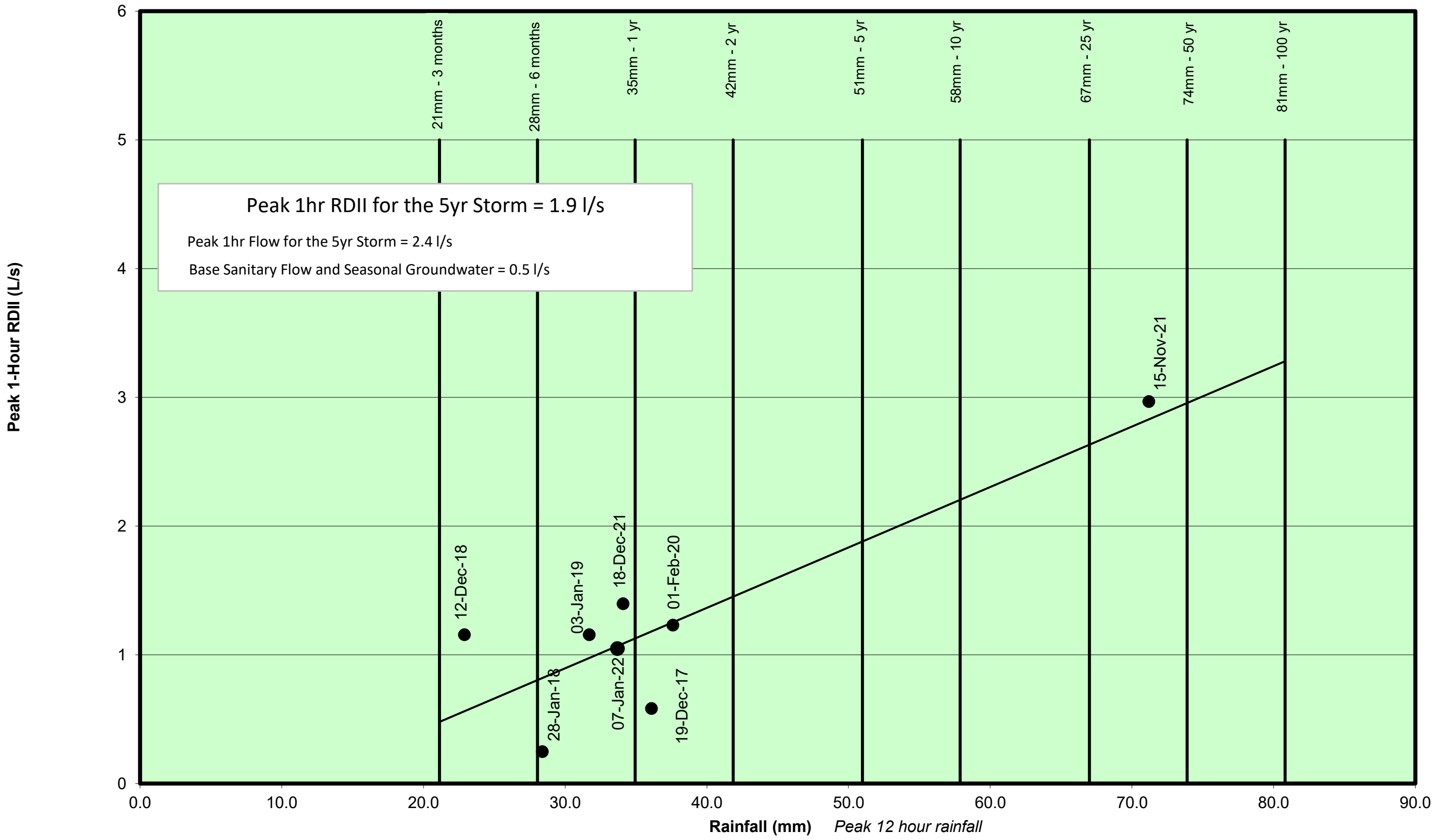
Kirkpatrick PS (CS14)

Peak 1-hr RDII by Storm Event

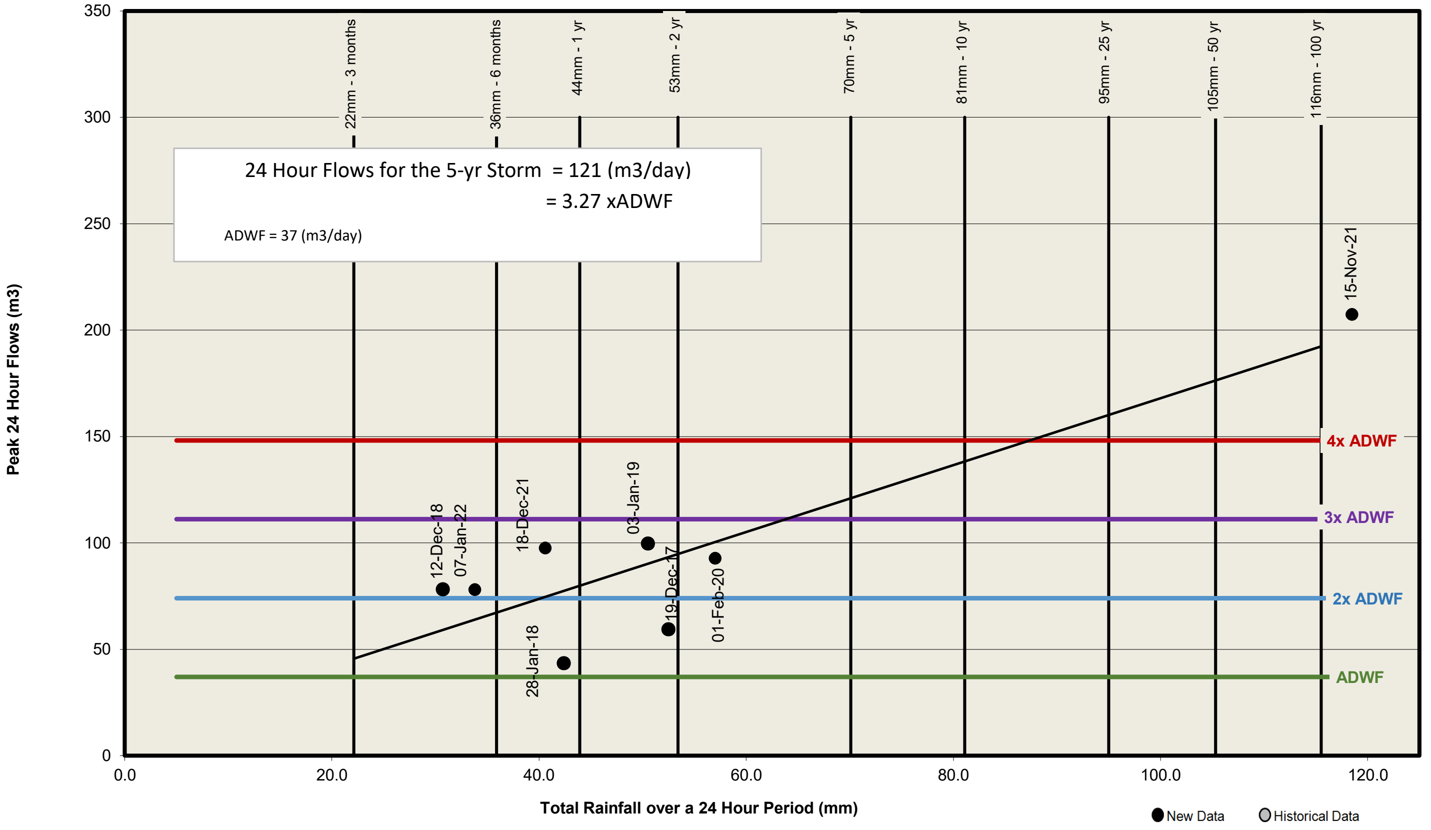


Peak 1hr RDII for the 5yr Storm = 1.9 l/s

Peak 1hr Flow for the 5yr Storm = 2.4 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.5 l/s

Peak 24-Hour Flows by Storm Event



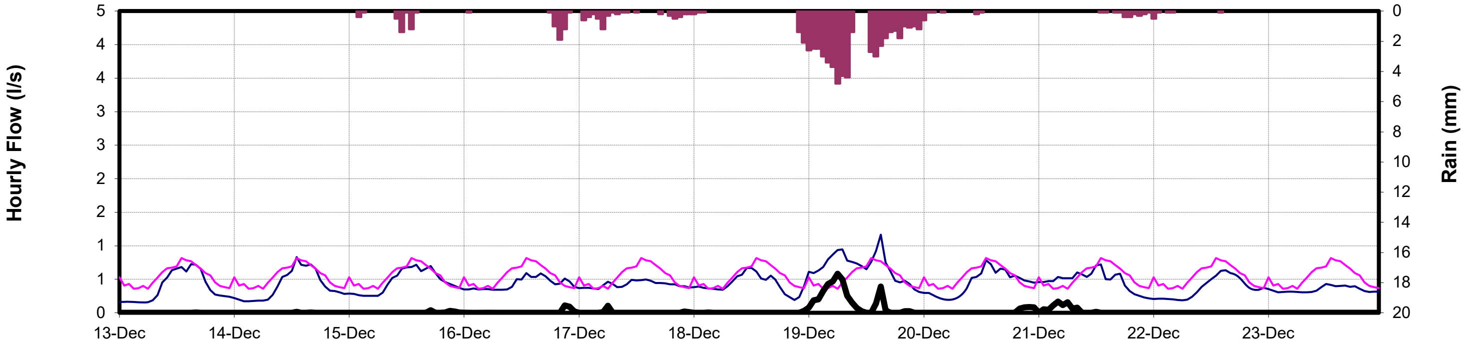
24 Hour Flows for the 5-yr Storm = 121 (m3/day)

= 3.27 xADWF

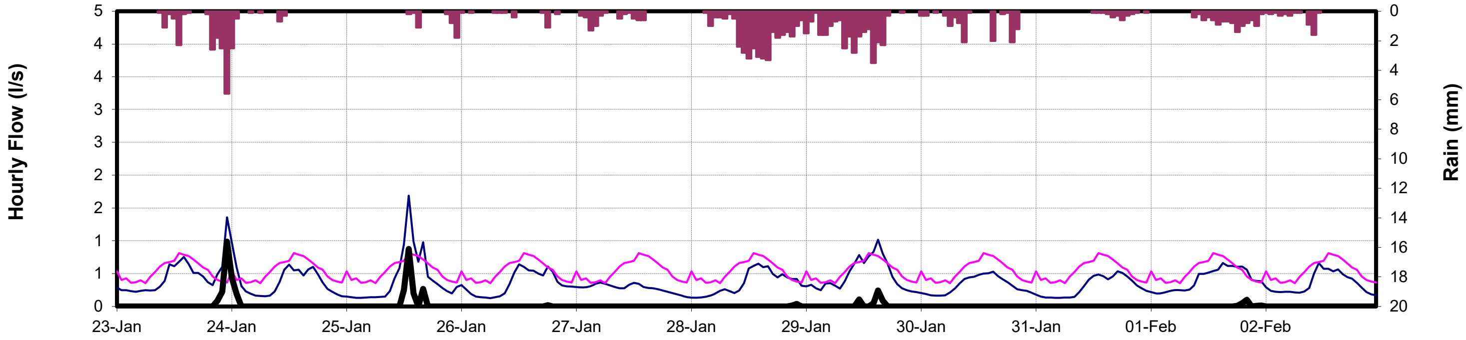
ADWF = 37 (m3/day)

Kirkpatrick PS (CS14)

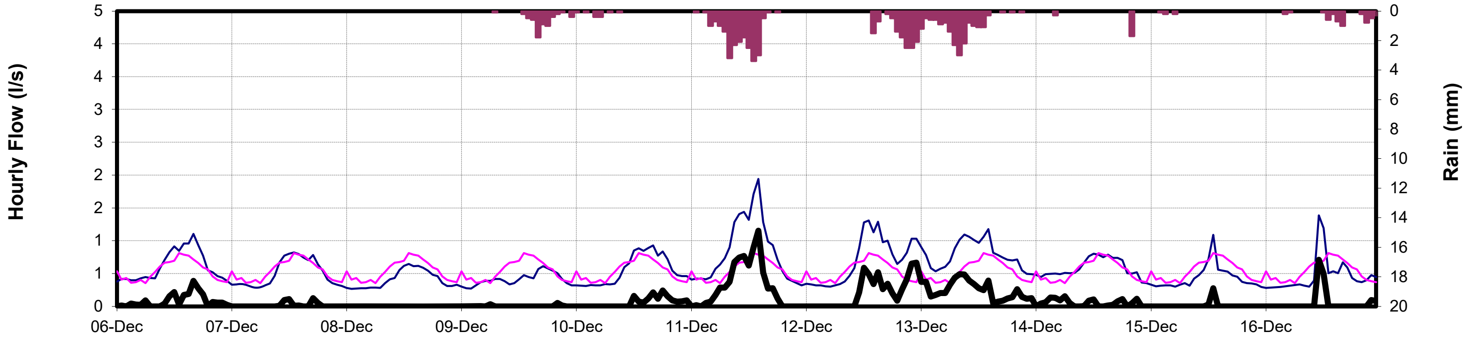
December 13 to December 23, 2017 Storm Events



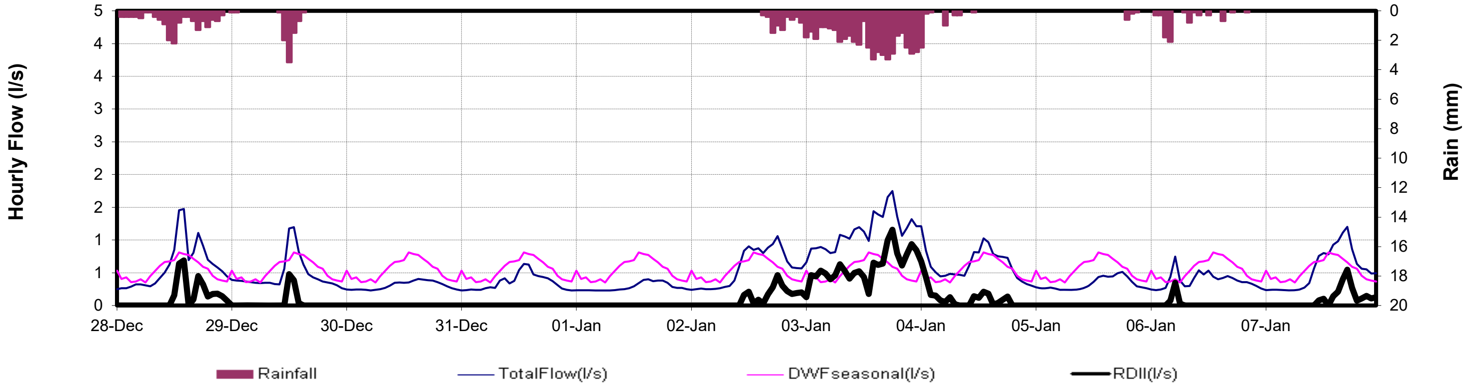
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

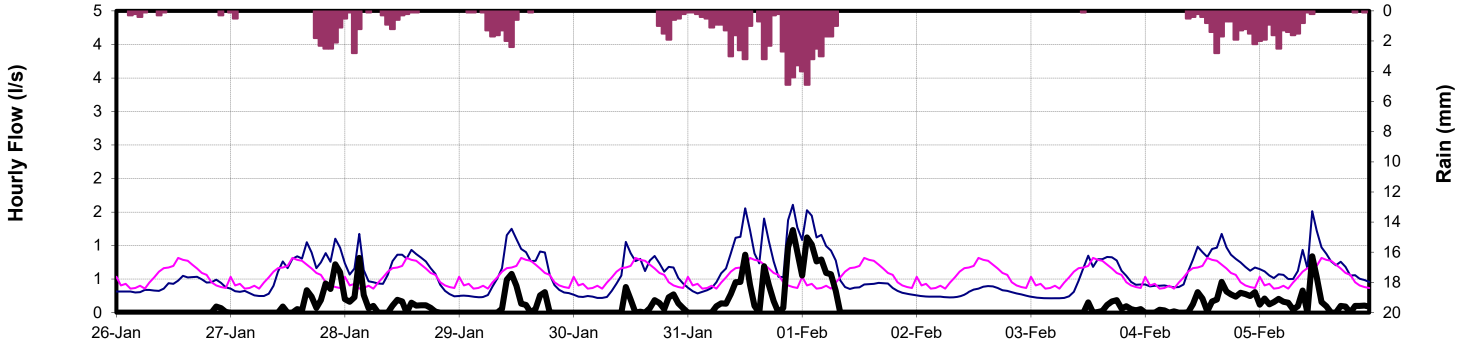


December 28 to January 7, 2019 Storm Events

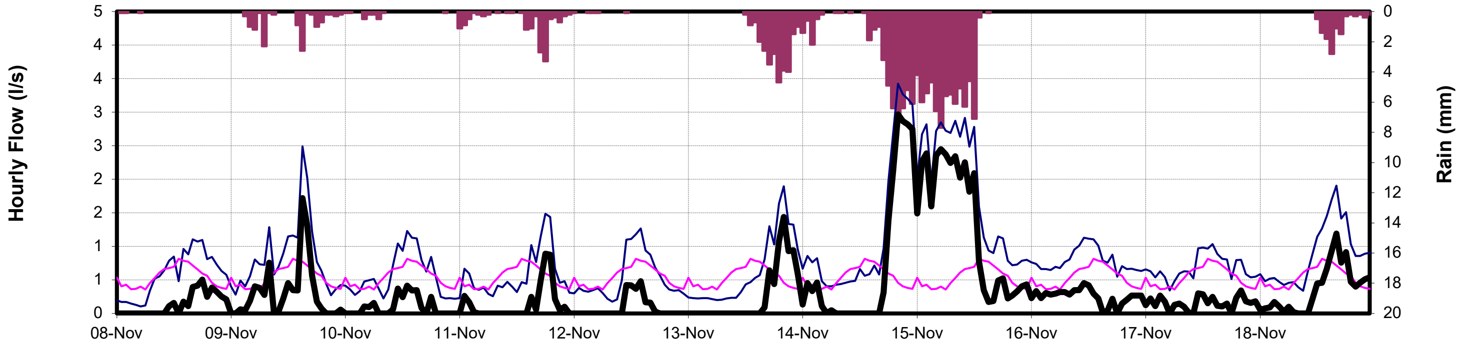


Kirkpatrick PS (CS14)

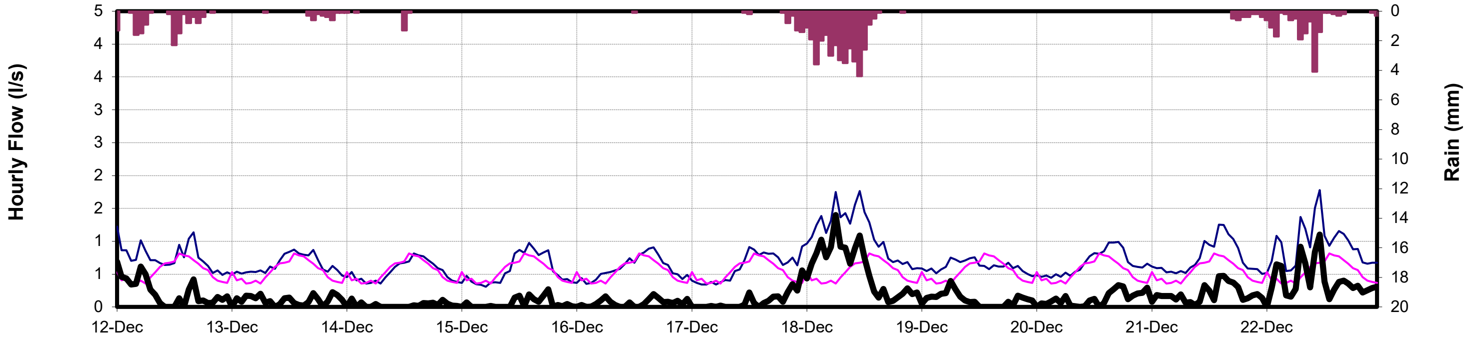
January 26 to February 5, 2020 Storm Events



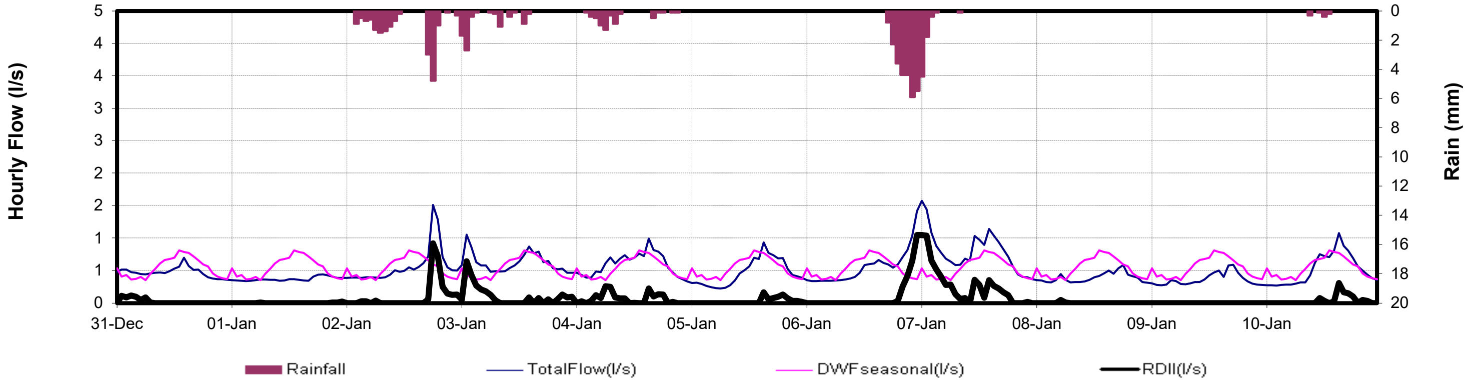
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

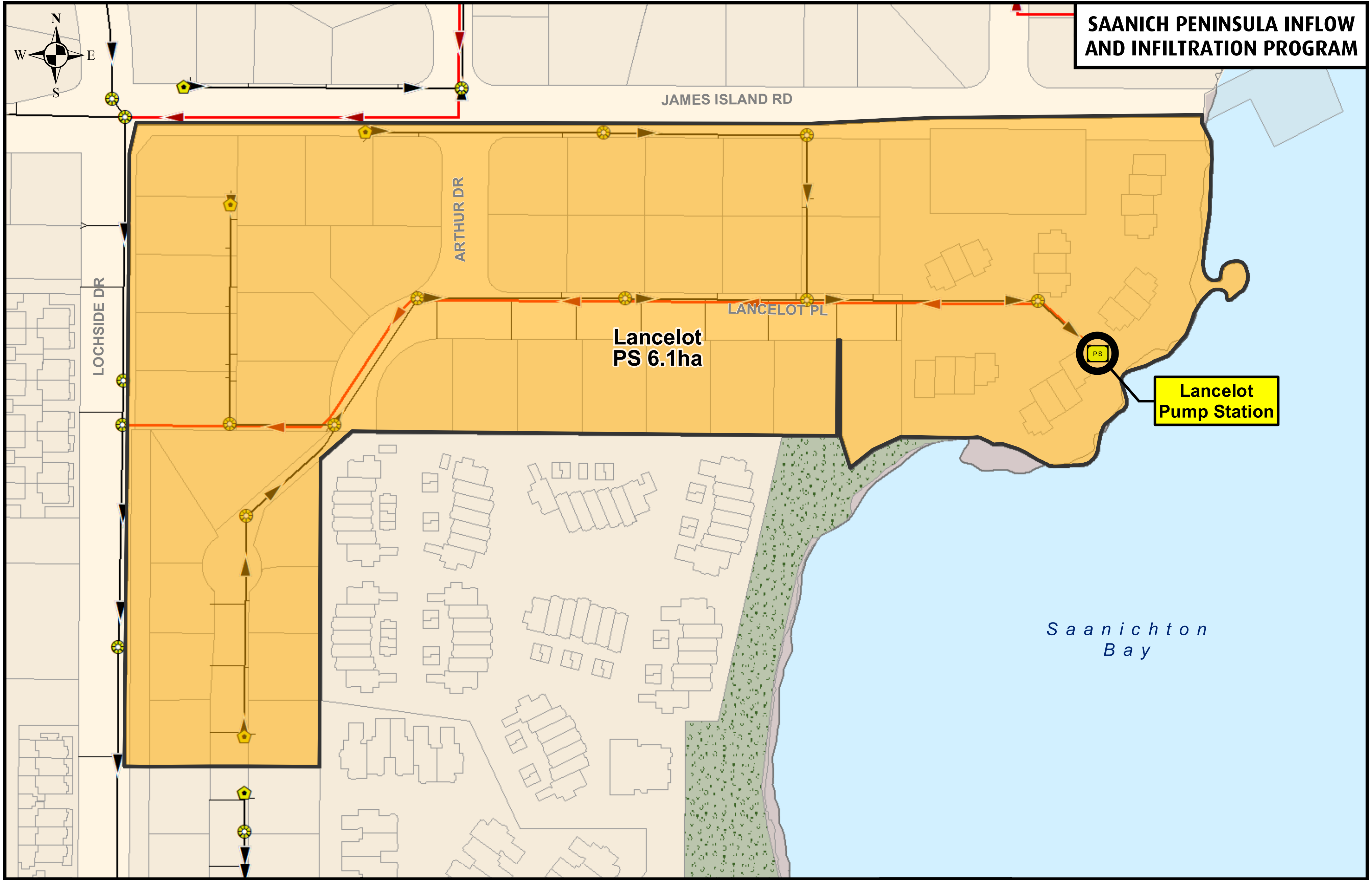


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Projection: UTM ZONE 10N, NAD83

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○ Flow Monitoring Location
Manhole
Cleanout
PS Pump Station
Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

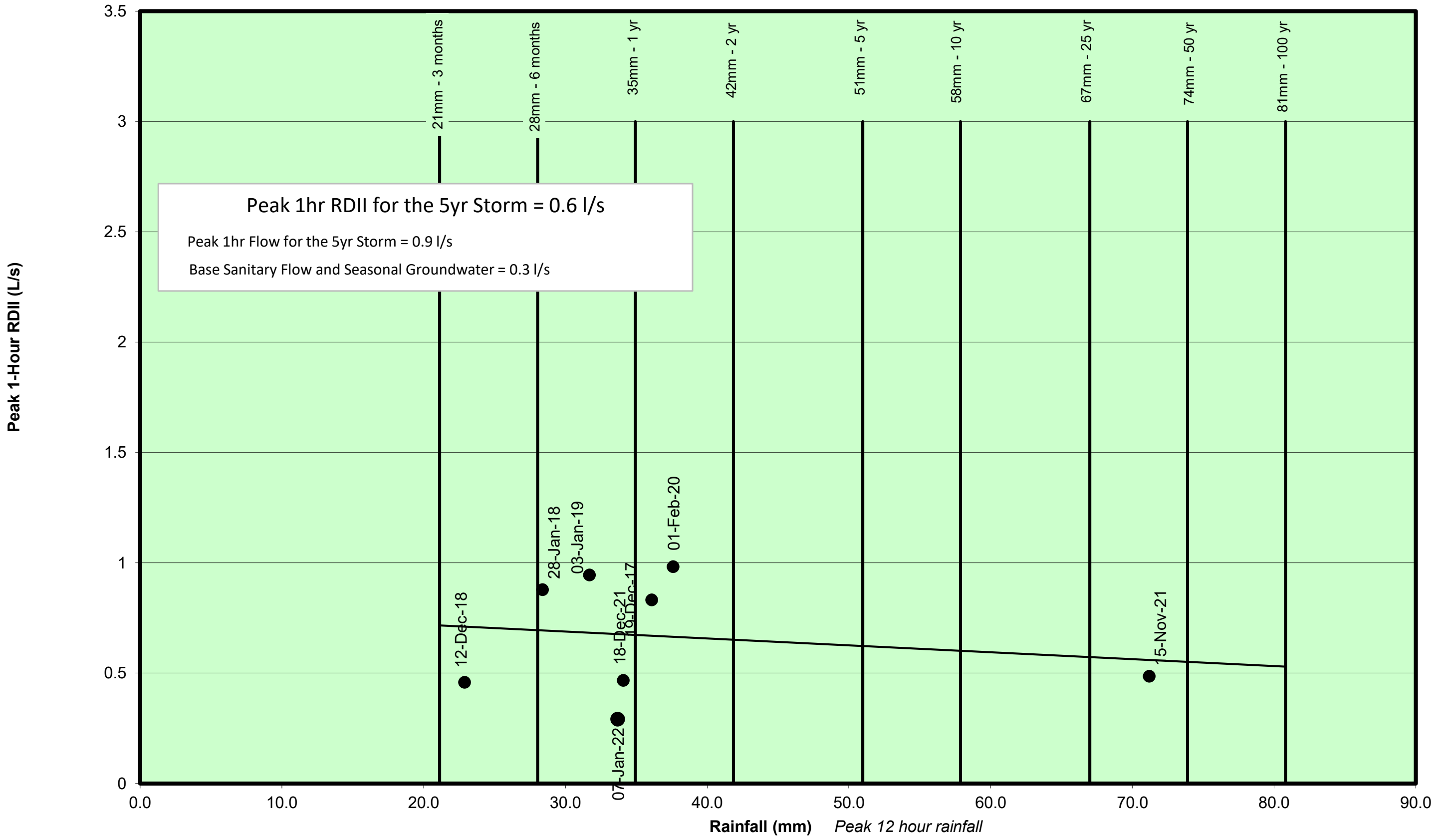
Catchment: Lancelot PS

Site Code: CS15

Making a difference...together

Lancelot PS (CS15)

Peak 1-hr RDII by Storm Event

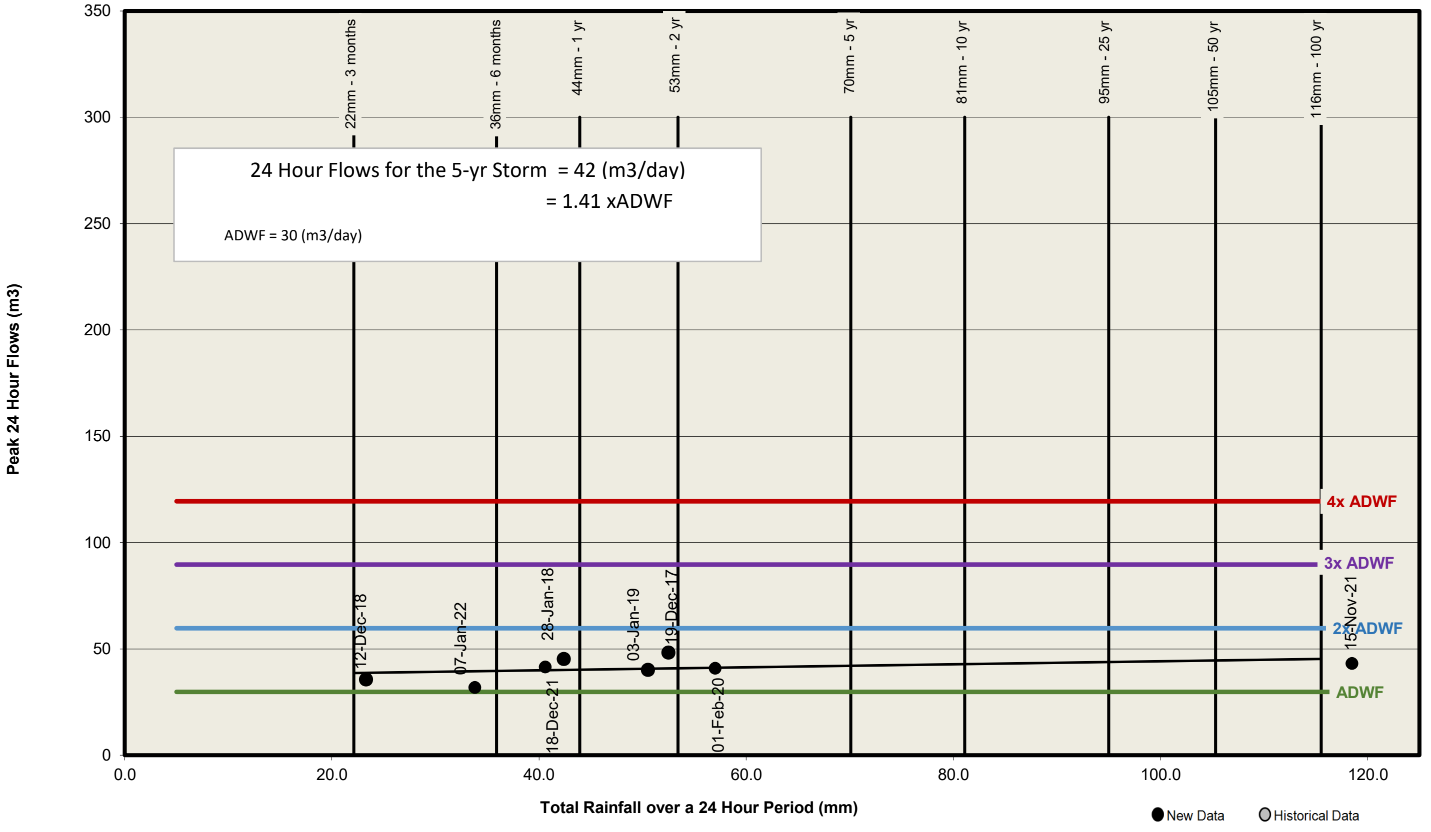


Peak 1hr RDII for the 5yr Storm = 0.6 l/s

Peak 1hr Flow for the 5yr Storm = 0.9 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.3 l/s

Peak 24-Hour Flows by Storm Event



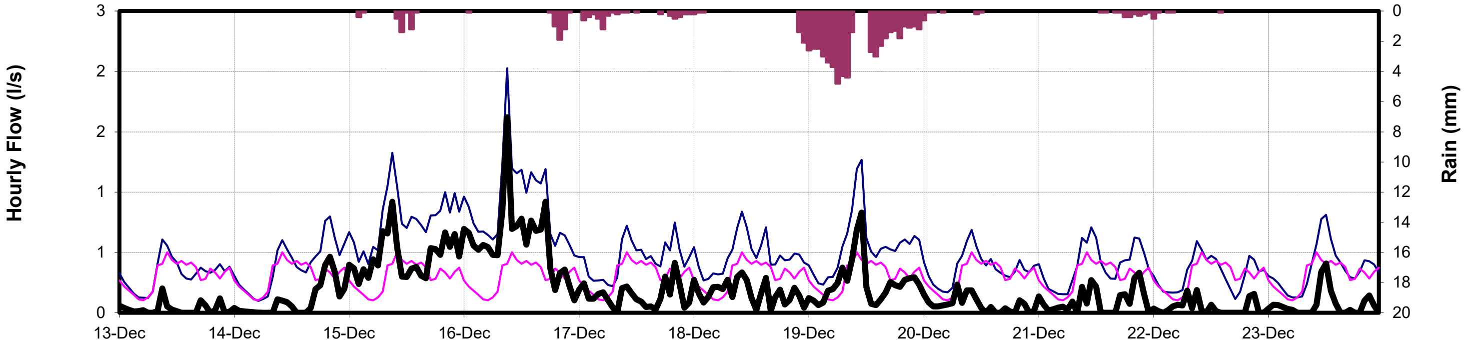
24 Hour Flows for the 5-yr Storm = 42 (m3/day)

= 1.41 xADWF

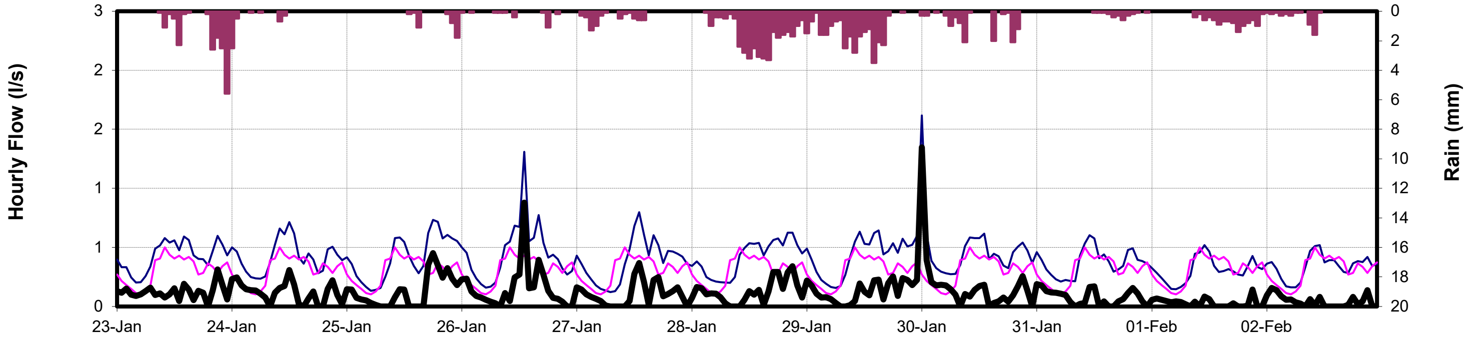
ADWF = 30 (m3/day)

Lancelot PS (CS15)

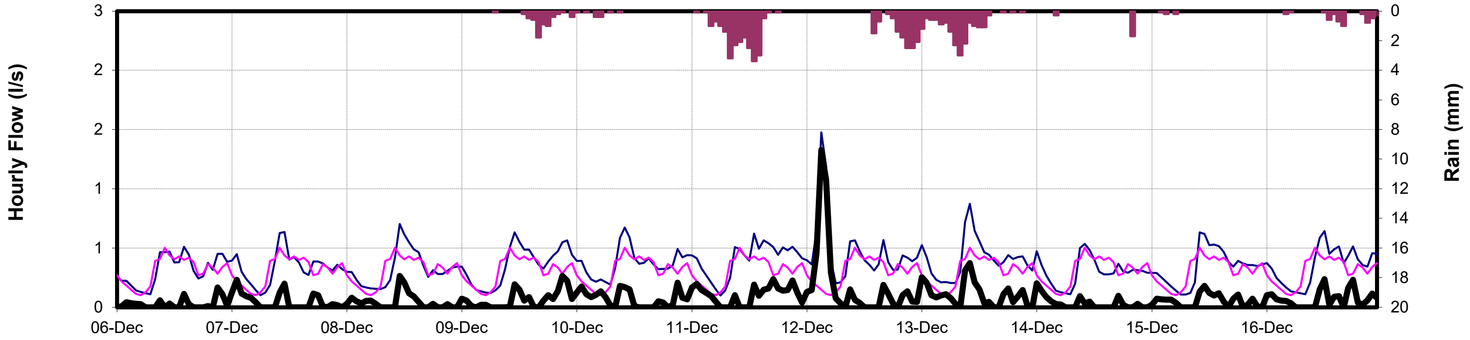
December 13 to December 23, 2017 Storm Events



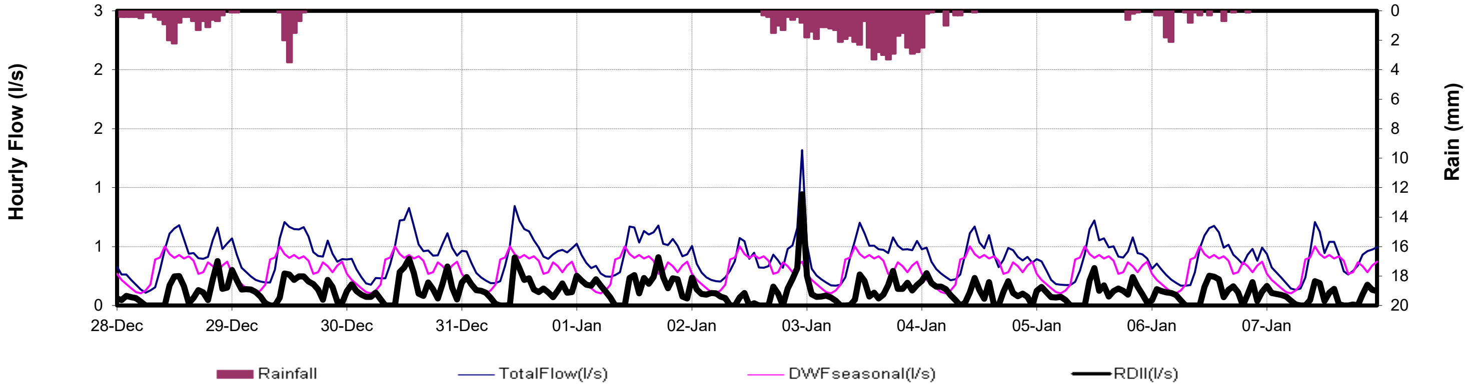
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

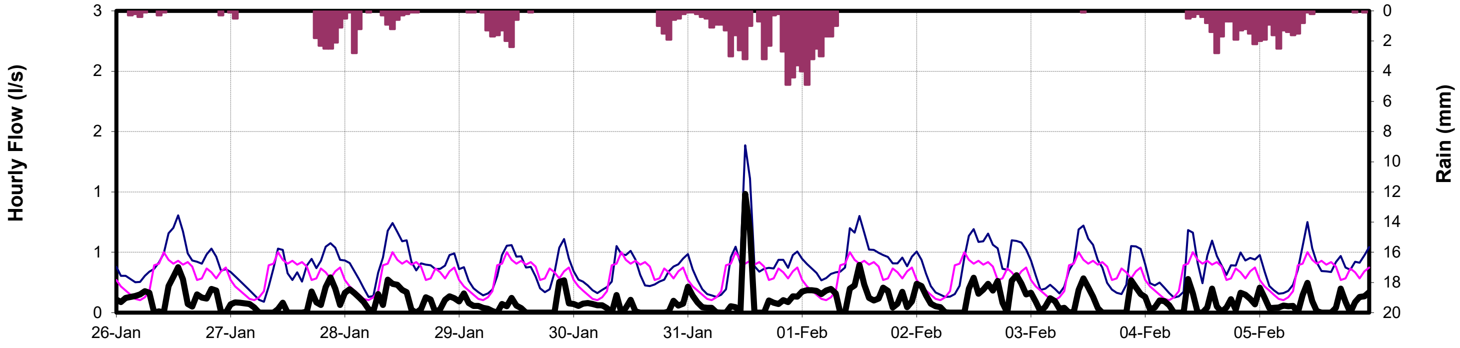


December 28 to January 7, 2019 Storm Events

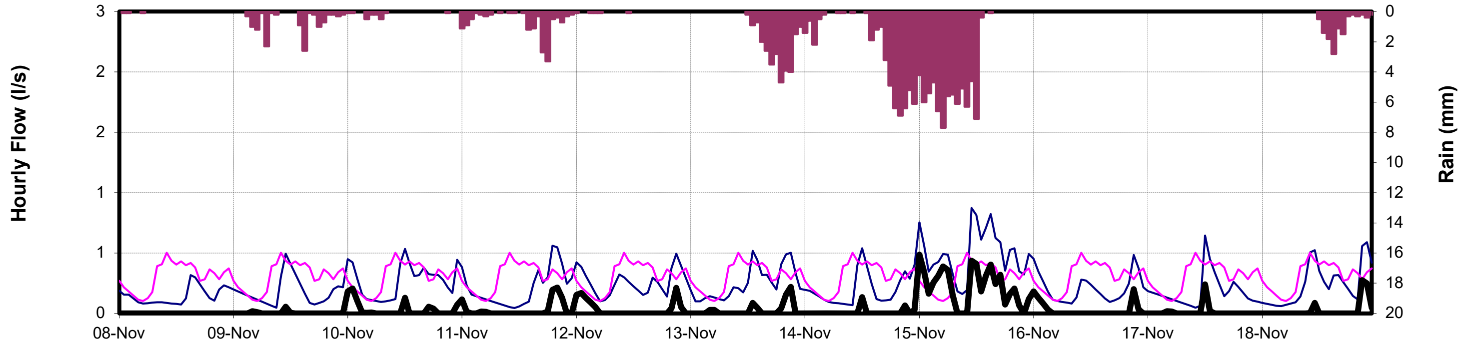


Lancelot PS (CS15)

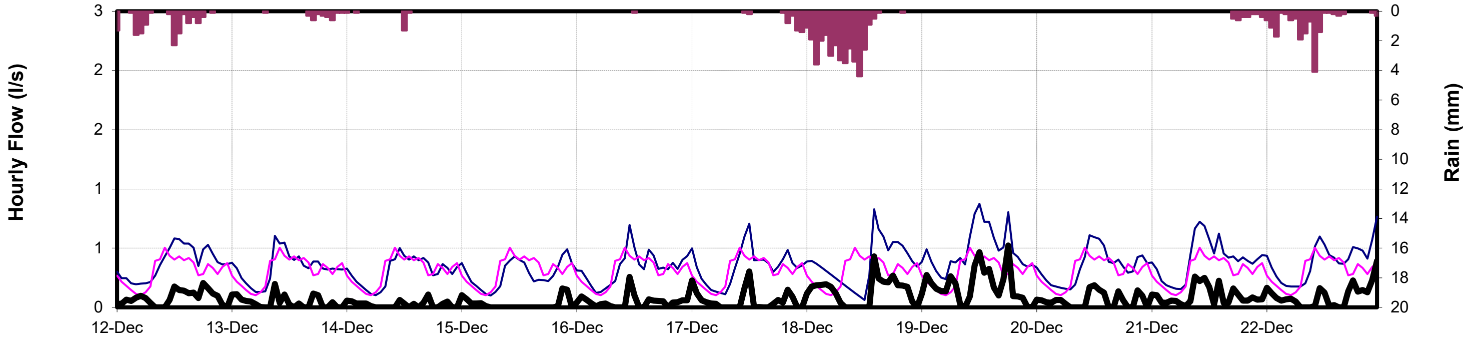
January 26 to February 5, 2020 Storm Events



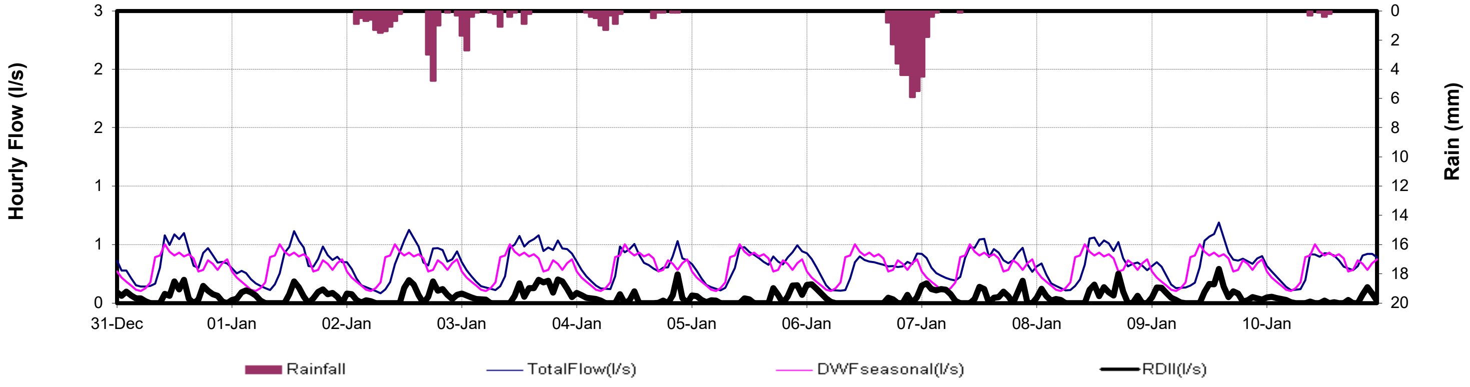
November 8 to November 18, 2021 Storm Events



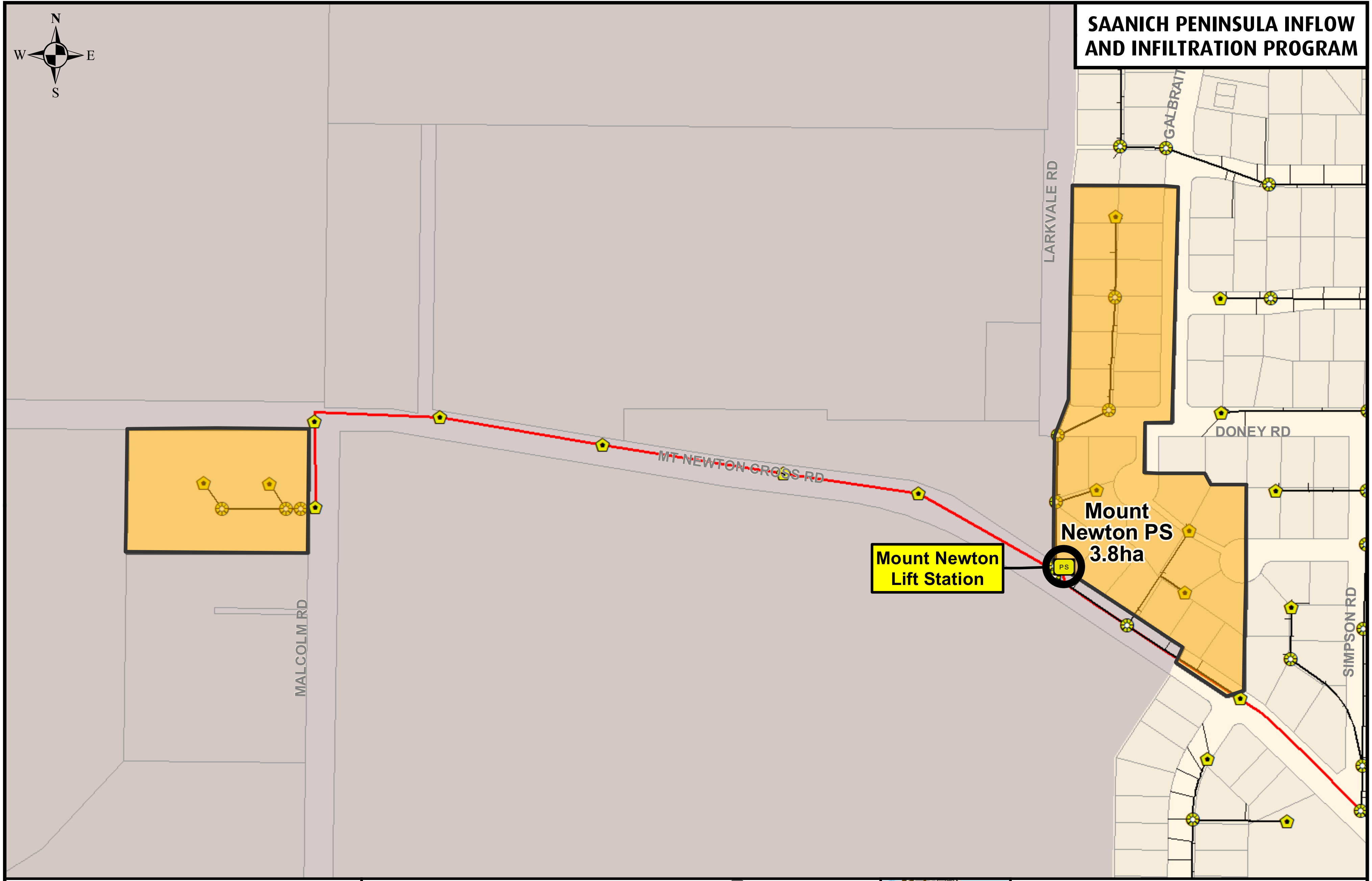
December 12 to December 22, 2021 Storm Events



December 31 to January 10, 2022 Storm Events



SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



0 50 100 200 Metres

Projection: UTM ZONE 10N, NAD83

Disclaimer

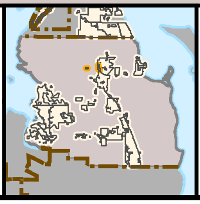
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
Manhole
Cleanout
PS Pump Station
Metering Chamber

Sanitary Sewers

Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Mount Newton PS

Site Code: CS16

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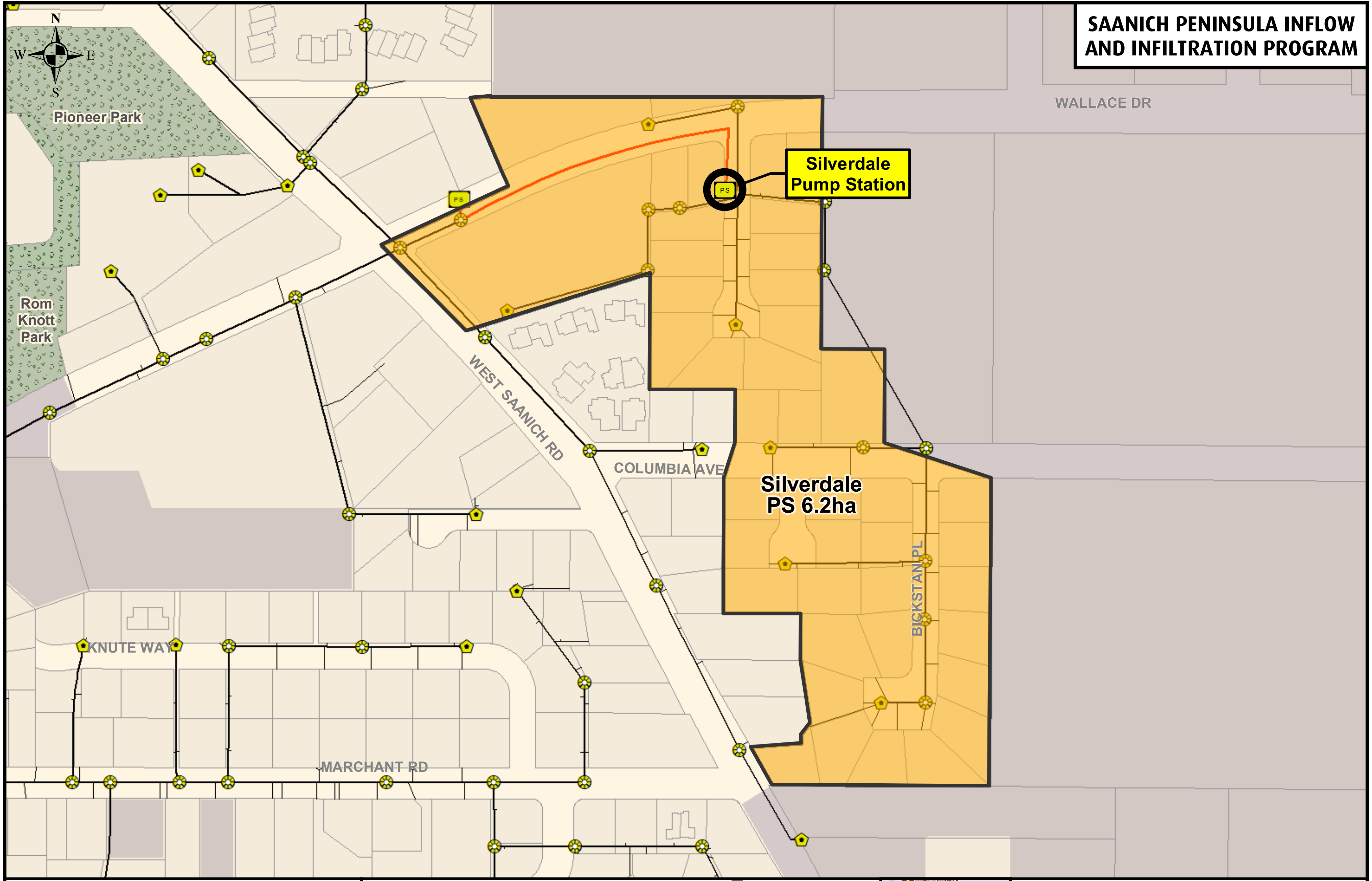
CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_CS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



0 40 80 160 Metres

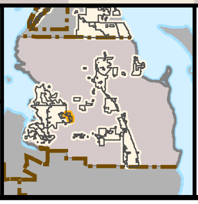
Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
Manhole
Cleanout
PS Pump Station
Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

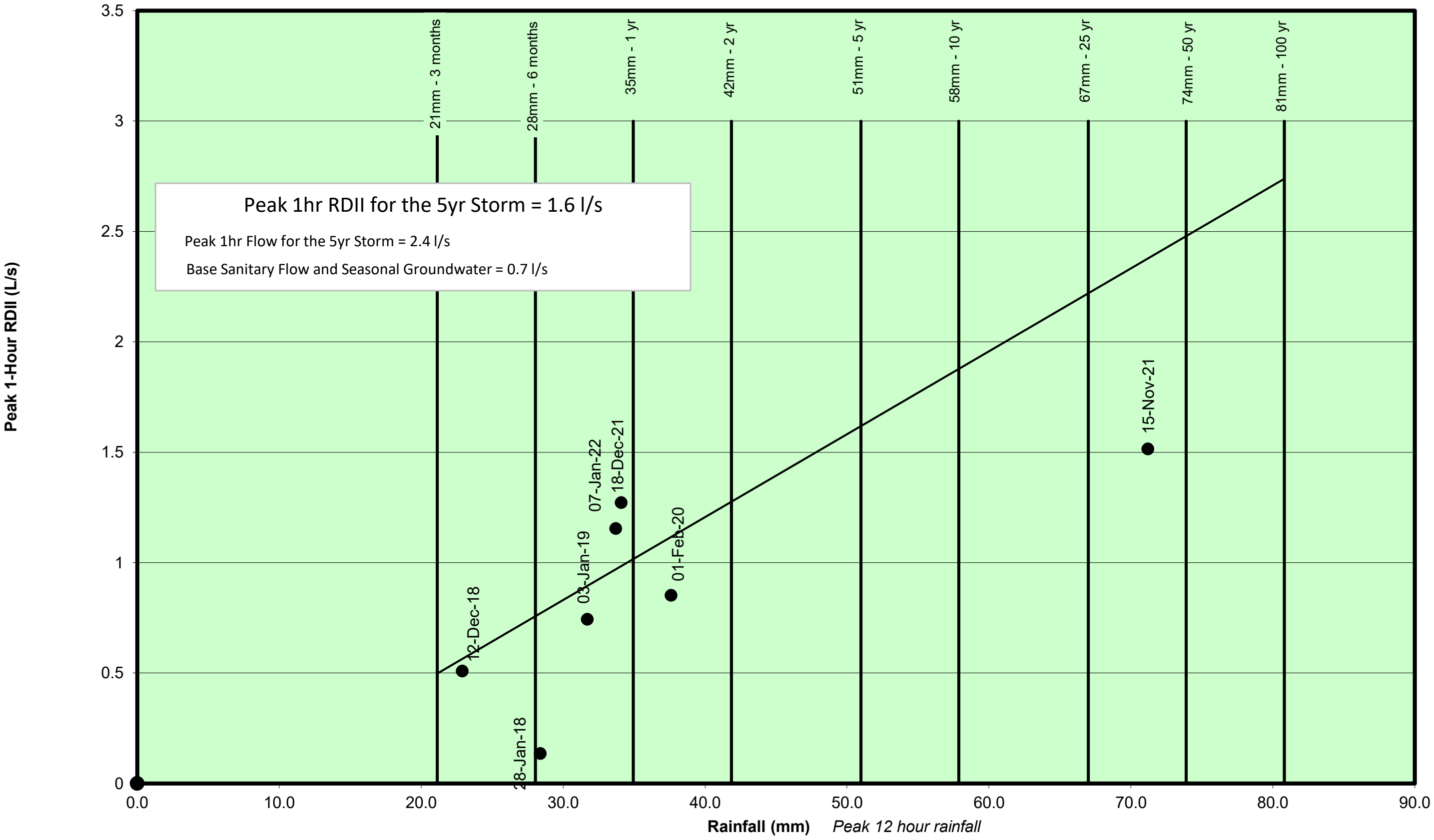
Catchment: Silverdale PS

Site Code: CS17

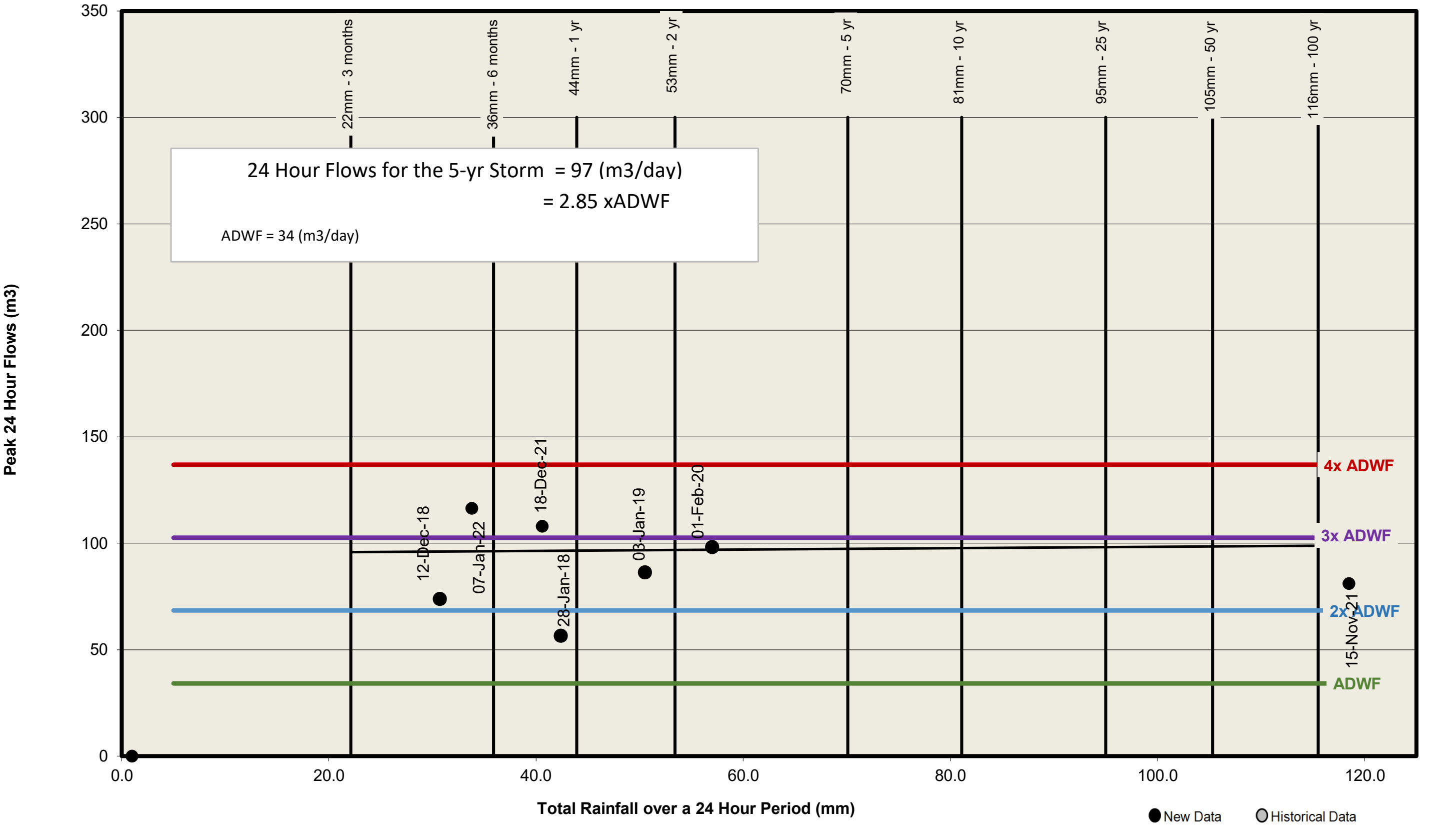
Making a difference...together

Silverdale PS (CS17)

Peak 1-hr RDII by Storm Event

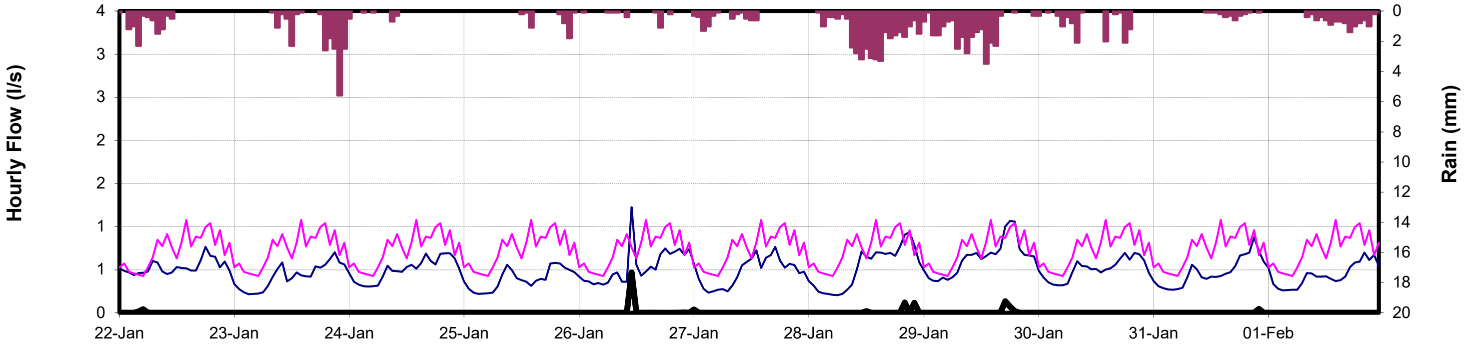


Peak 24-Hour Flows by Storm Event

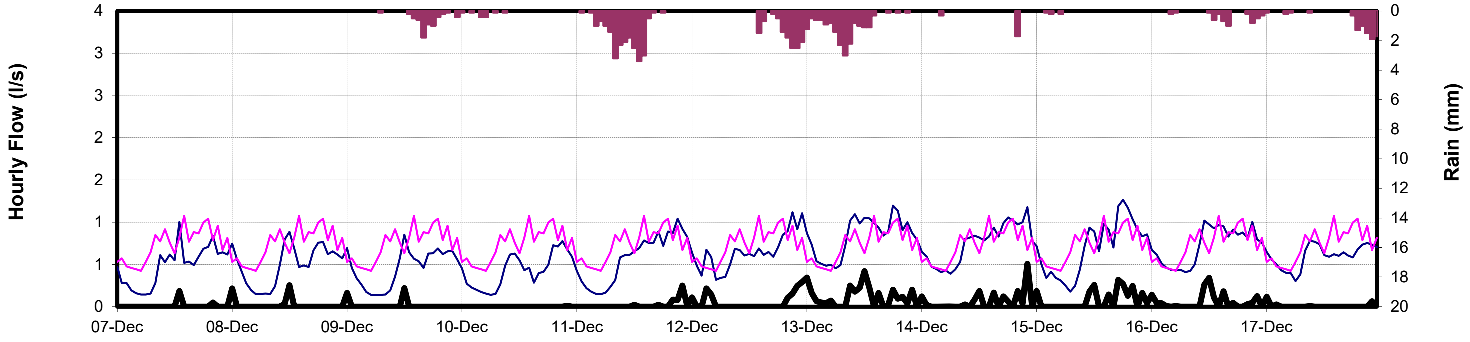


Silverdale PS (CS17)

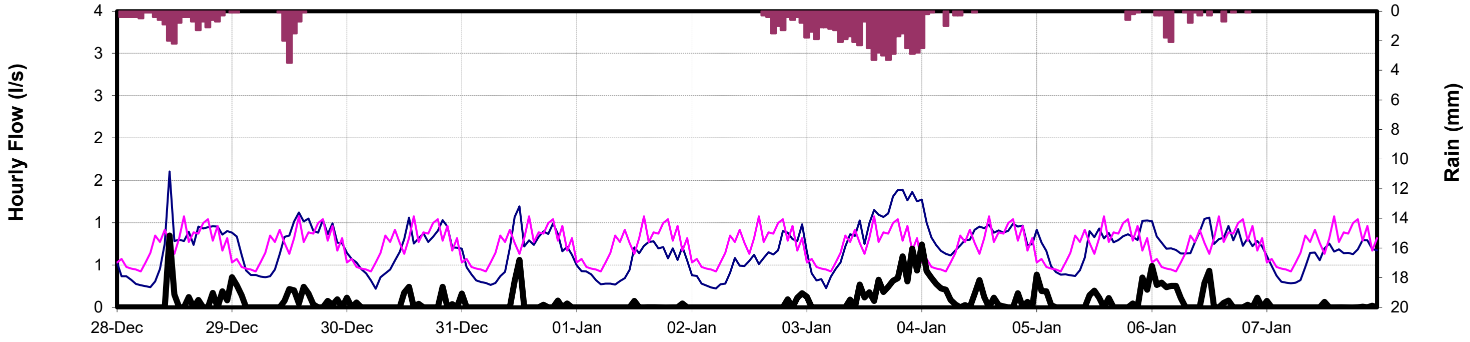
January 22 to February 1, 2018 Storm Events



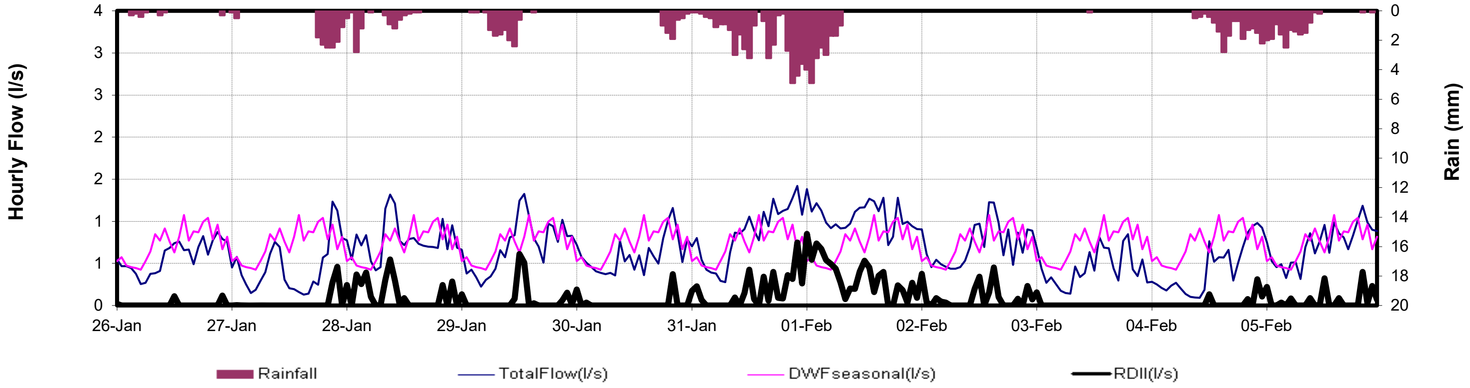
December 7 to December 17, 2018 Storm Events



December 28 to January 7, 2019 Storm Events

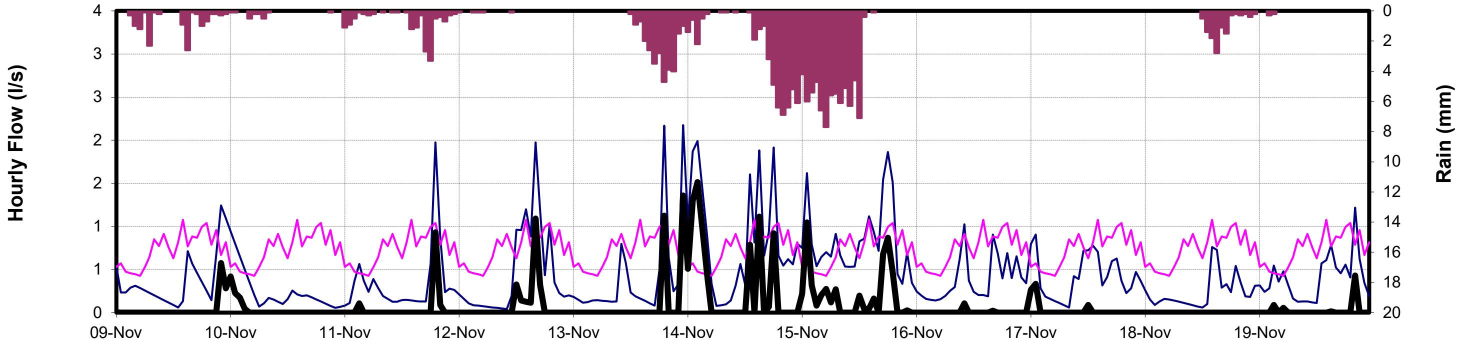


January 26 to February 5, 2020 Storm Events

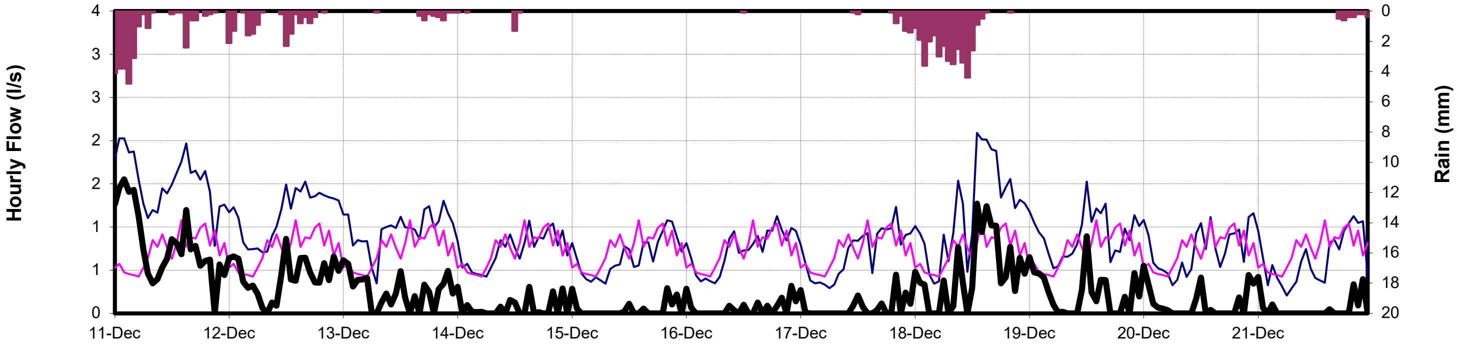


Silverdale PS (CS17)

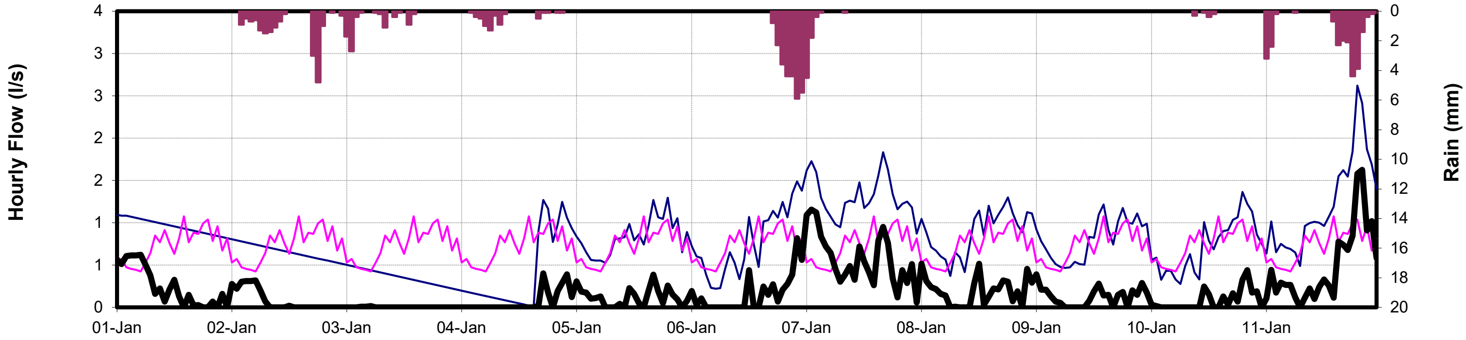
November 9 to November 19, 2021 Storm Events

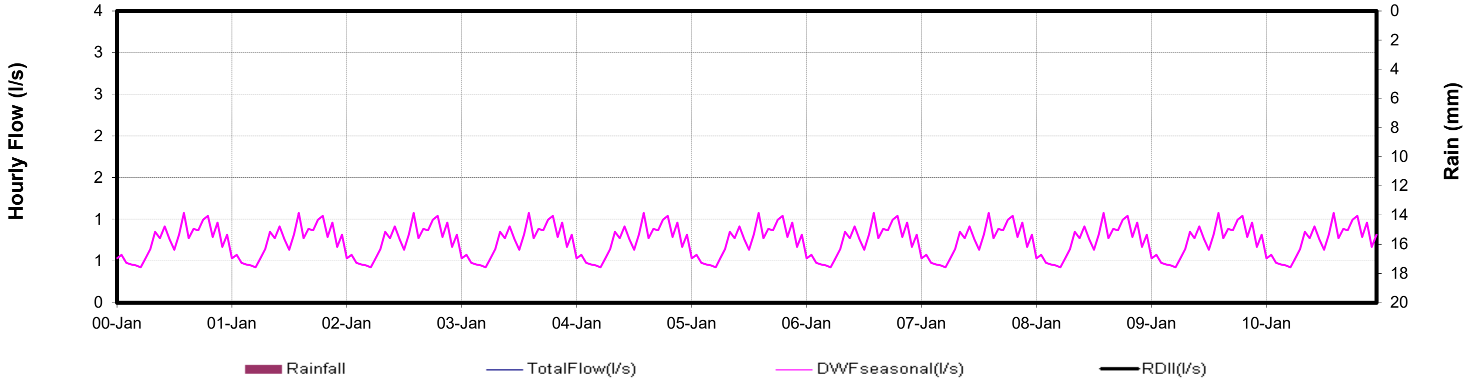


December 11 to December 21, 2021 Storm Events



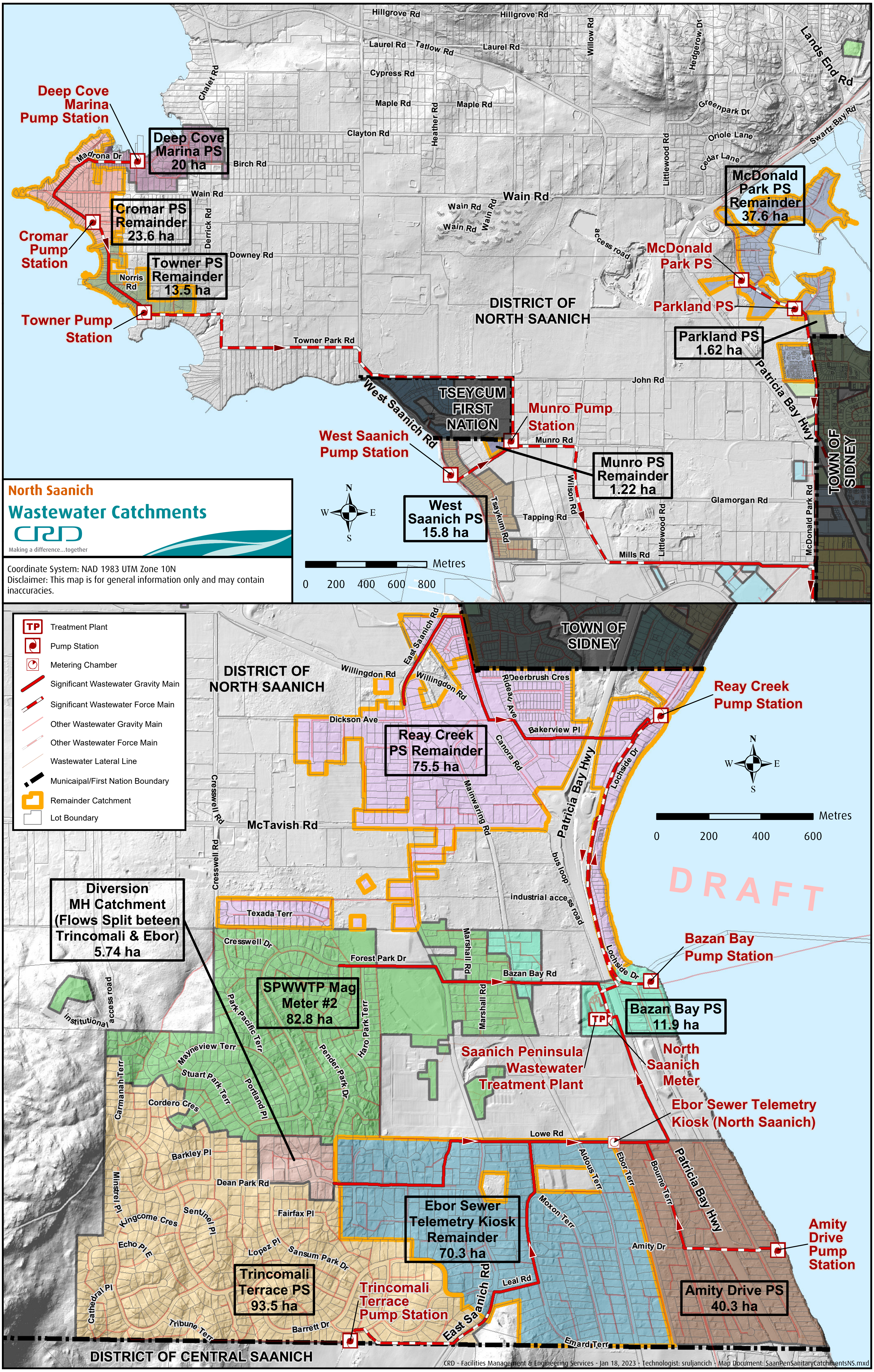
January 1 to January 11, 2022 Storm Events





Appendix E:

North Saanich: Sewer Map, Catchment Stats, Catchments Maps and Flow Charts



North Saanich

Wastewater Catchments

CRD
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Coordinate System: NAD 1983 UTM Zone 10N
Disclaimer: This map is for general information only and may contain inaccuracies.

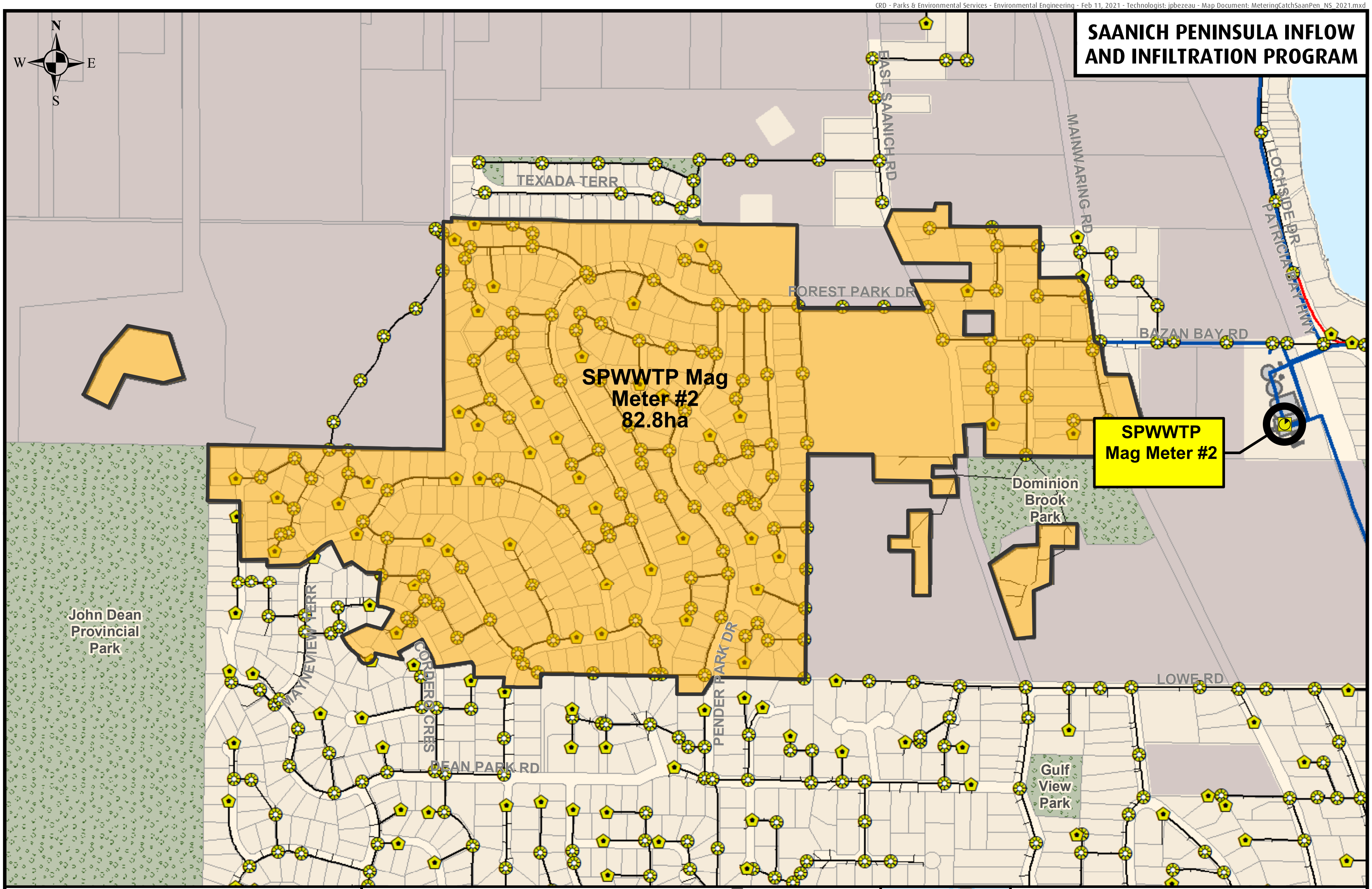
CRD - Facilities Management & Engineering Services - Jan 18, 2023 - Technologist: sruljancich - Map Document: SaanPenSanitaryCatchmentsNS.mxd

North Saanich Catchment Summary Stats

Pump Station	Site Code	Catchment Stats							Gravity Sewer Pipe Type *(approximate %)*					Catchment Makeup *(approximate %)*				
		Size (ha)	Ave Age (yrs)	Gravity Sewers (m)	Force Mains (m)	PS's (#)	MH's (#)	Sewered Properties (#)	PVC	Concrete	Clay	Rehabbed	Other/Unk	Single Family	Multi Family	Commercial	Industrial	Institutional
Amity	NS2	40.3	2002	4,352	0	1	43	143	99.0	0.0	0.0	0.0	1.0	98.9	0.0	1.0	0.0	0.2
Bazen Bay	NS3	11.9	1998	1,348	0	1	17	24	65.7	34.3	0.0	0.0	0.0	65.2	0.0	0.0	0.0	34.8
Cromar	NS4	43.6	2007	3,390	741	2	48	230	97.9	0.0	0.0	0.0	2.1	99.3	0.0	0.5	0.0	0.2
Ebor	NS5	170	1989	23,129	626	1	272	778	97.1	1.2	0.0	0.0	1.7	99.5	0.0	0.0	0.0	0.5
Marina	NS6	20	2007	1,810	183	1	25	117	100.0	0.0	0.0	0.0	0.0	98.9	0.0	1.1	0.0	0.0
McDonald	NS7	48.5	2005	1,902	3,856	2	23	201	97.1	2.1	0.0	0.0	0.9	49.7	13.4	11.3	0.0	25.6
Mills	NS8	84.5	2008	10,117	6,388	7	140	395	97.4	0.8	0.0	0.0	1.8	85.5	0.0	1.7	0.0	12.7
Munro	NS9	74.2	2007	7,191	4,362	5	101	389	99.0	0.0	0.0	0.0	1.0	99.6	0.0	0.3	0.0	0.1
Reay Creek	NS10	162	2006	21,594	8,356	9	279	794	95.6	2.5	0.0	0.0	1.9	93.3	0.7	0.8	0.0	5.1
Towner	NS11	57.2	2007	4,762	914	3	69	285	98.5	0.0	0.0	0.0	1.5	99.4	0.0	0.4	0.0	0.2
Trincomali	NS12	99.2	1981	13,940	626	1	170	522	97.4	2.0	0.0	0.0	0.6	99.6	0.0	0.0	0.0	0.4
West Saanich	NS13	15.8	2007	2,064	58	1	24	102	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Parkland	NS14	1.62	NA	NA	NA	1	0	1	NA	NA	NA	NA	NA	0.0	100.0	0.0	0.0	0.0

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 125 250 500

Projection: UTM ZONE 10N, NAD83

Disclaimer

- ○ Flow Monitoring Location
- ✪ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◘ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- Catchment Area
- Non-Sewered Area
- Lot Lines
- Parks
- Sewered Park Areas
- Catchment Boundary
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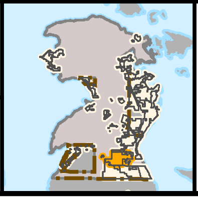

FLOW MONITORING AREA

Catchment: SPWWTP Mag Meter #2

Site Code: NS01

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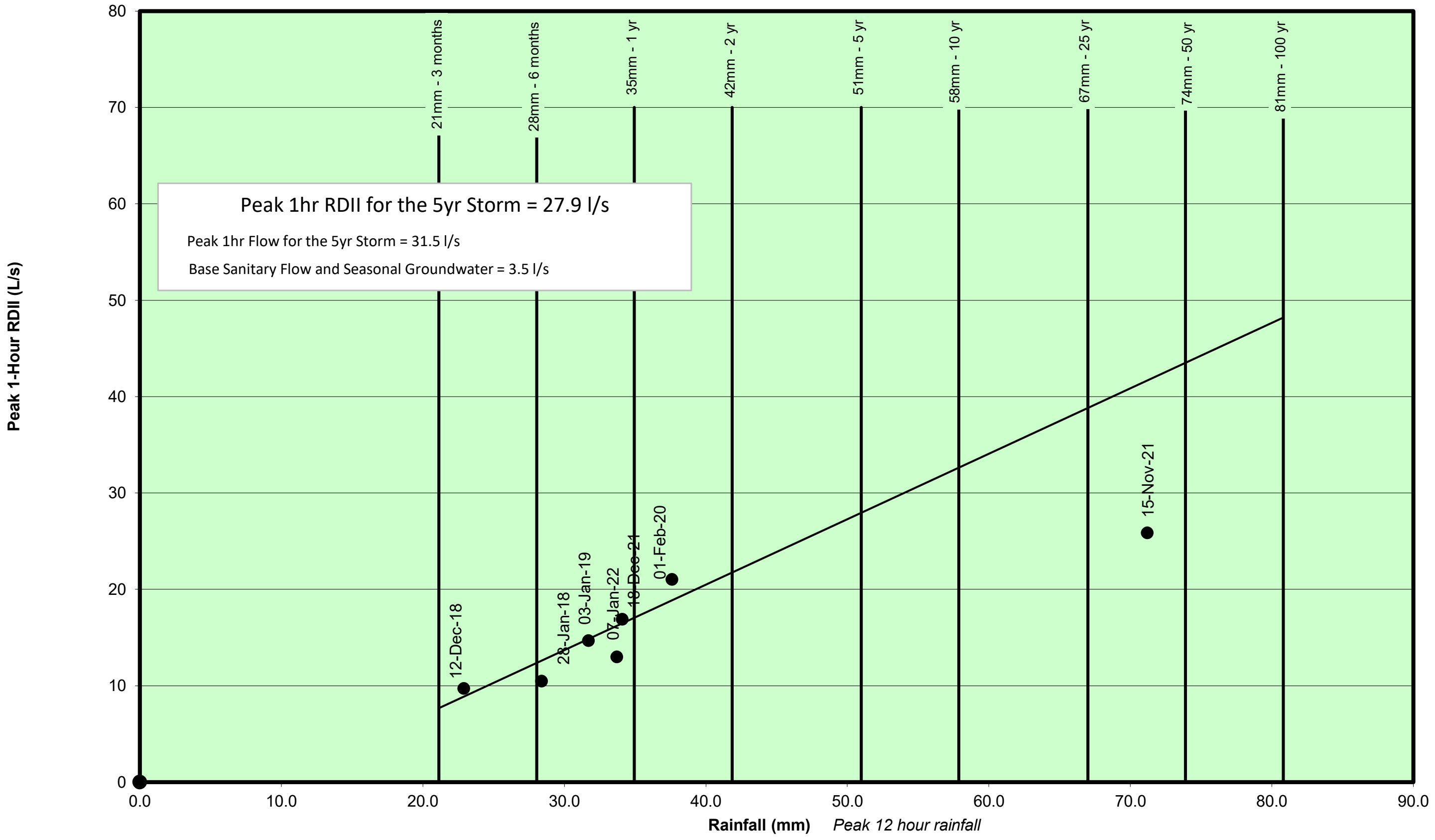
SPWWTP Mag Meter #2 (NS1)

Peak 1-hr RDII by Storm Event

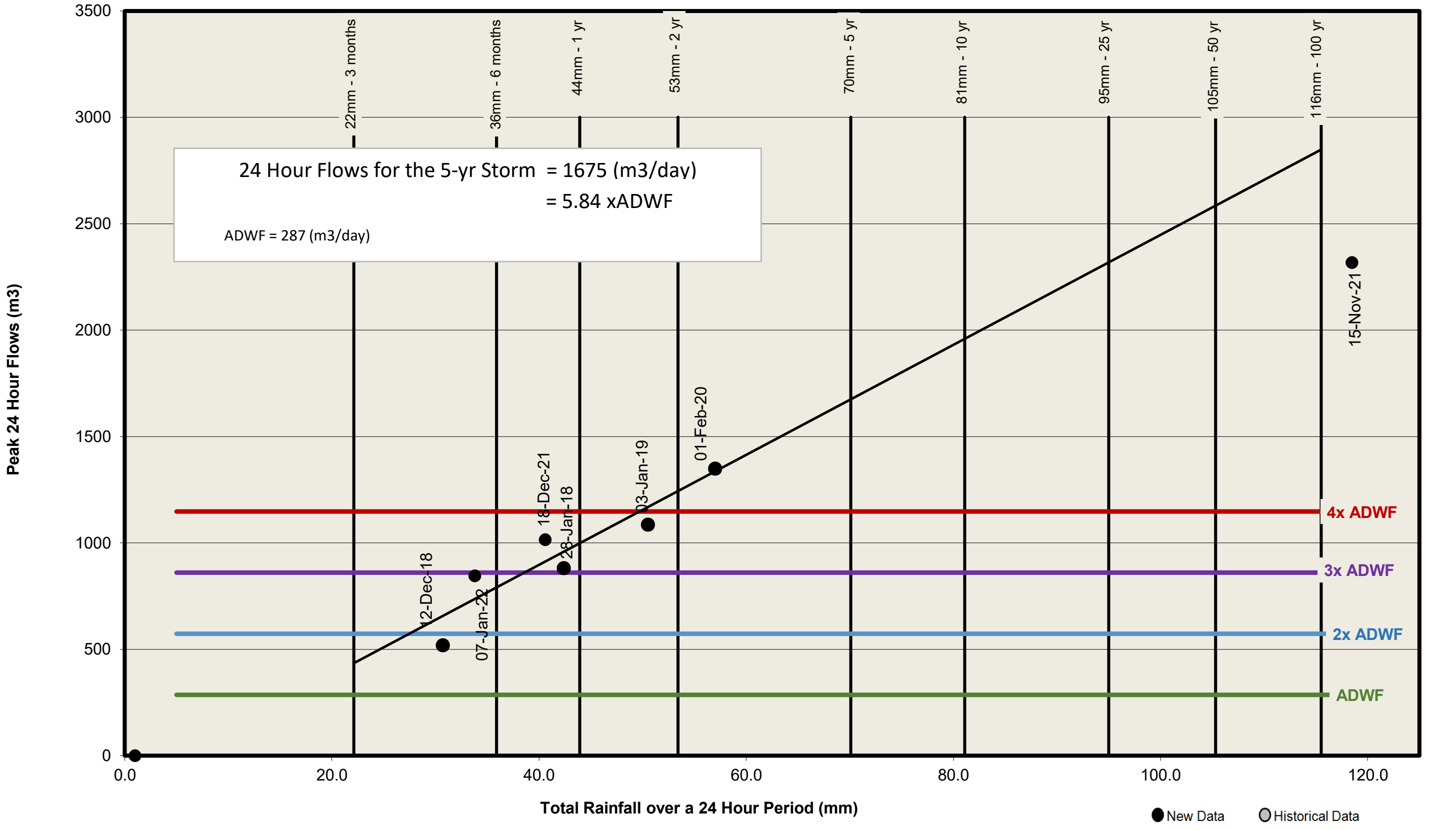


Peak 1hr RDII for the 5yr Storm = 27.9 l/s

Peak 1hr Flow for the 5yr Storm = 31.5 l/s

Base Sanitary Flow and Seasonal Groundwater = 3.5 l/s

Peak 24-Hour Flows by Storm Event



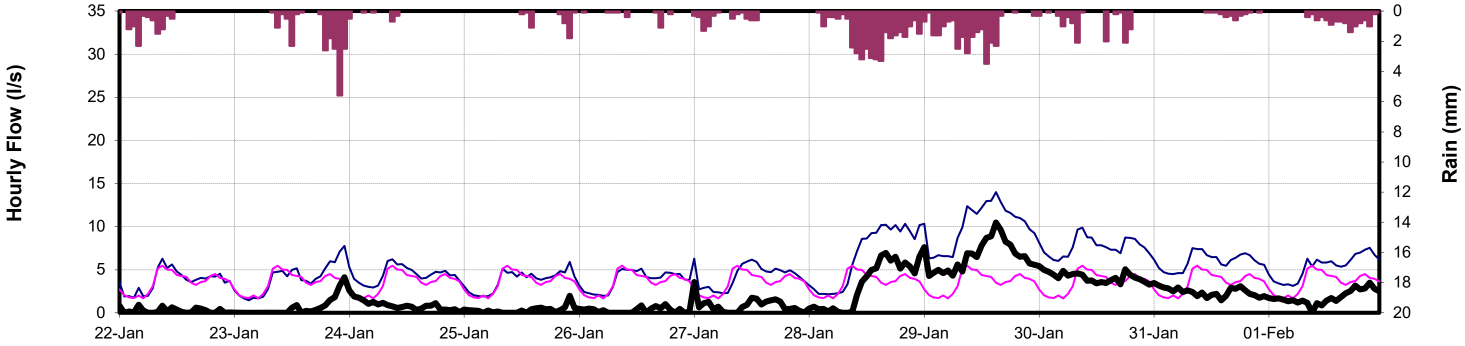
24 Hour Flows for the 5-yr Storm = 1675 (m3/day)

= 5.84 xADWF

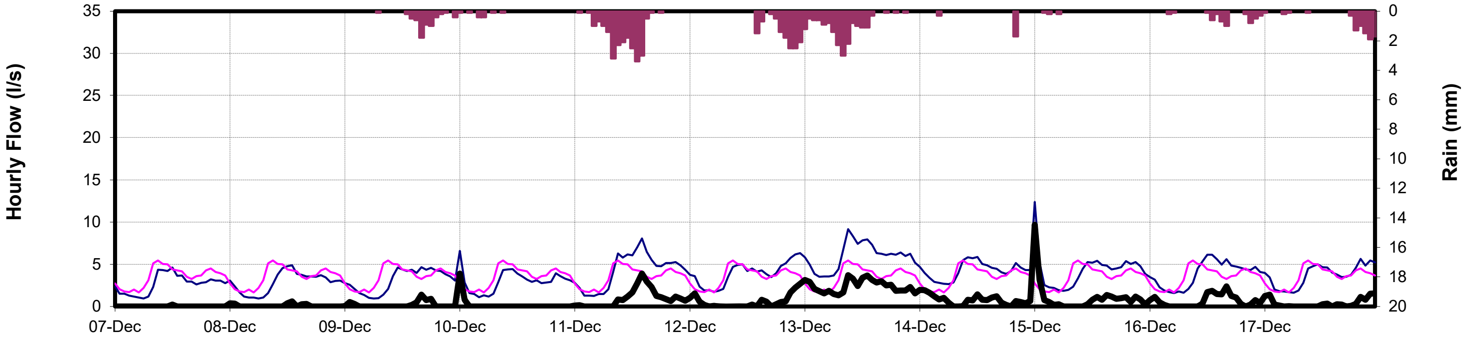
ADWF = 287 (m3/day)

SPWWTP Mag Meter #2 (NS1)

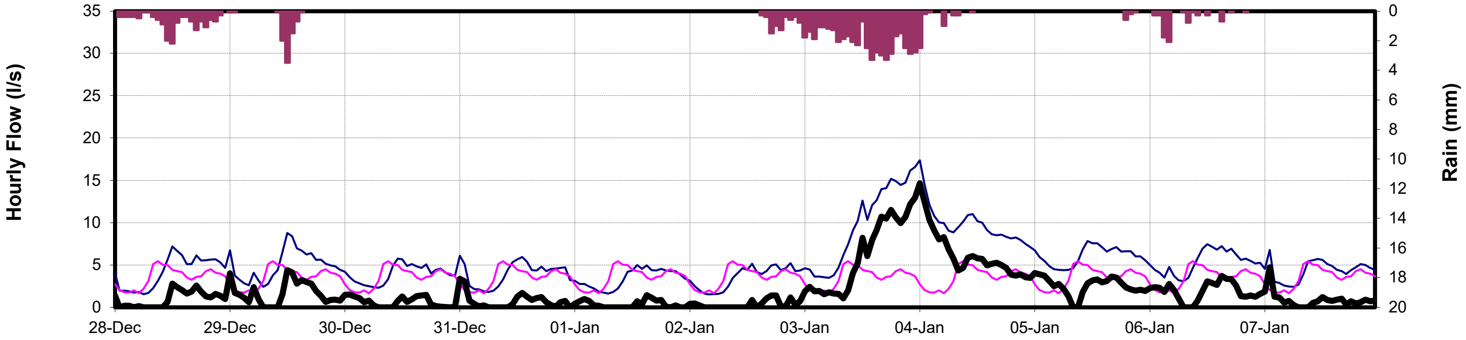
January 22 to February 1, 2018 Storm Events



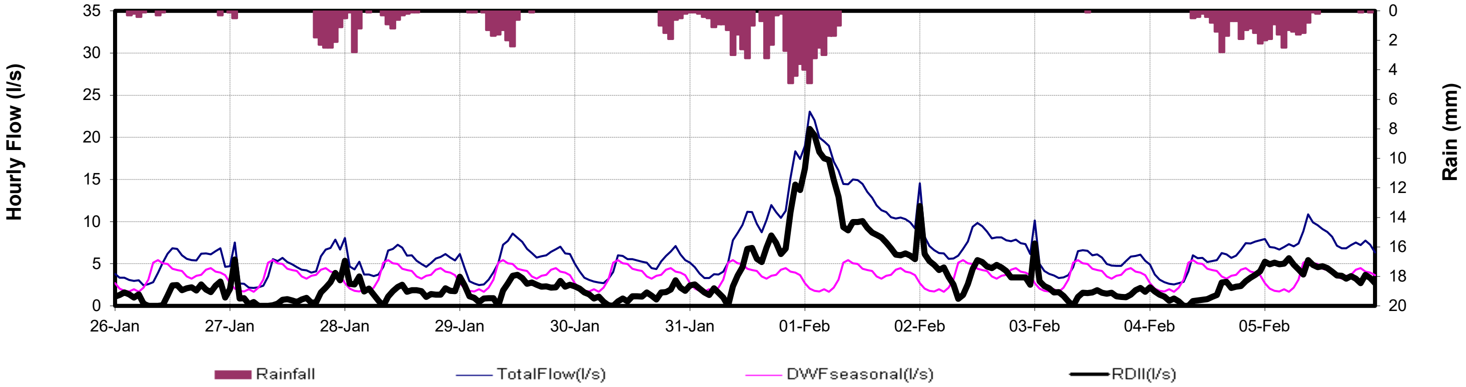
December 7 to December 17, 2018 Storm Events



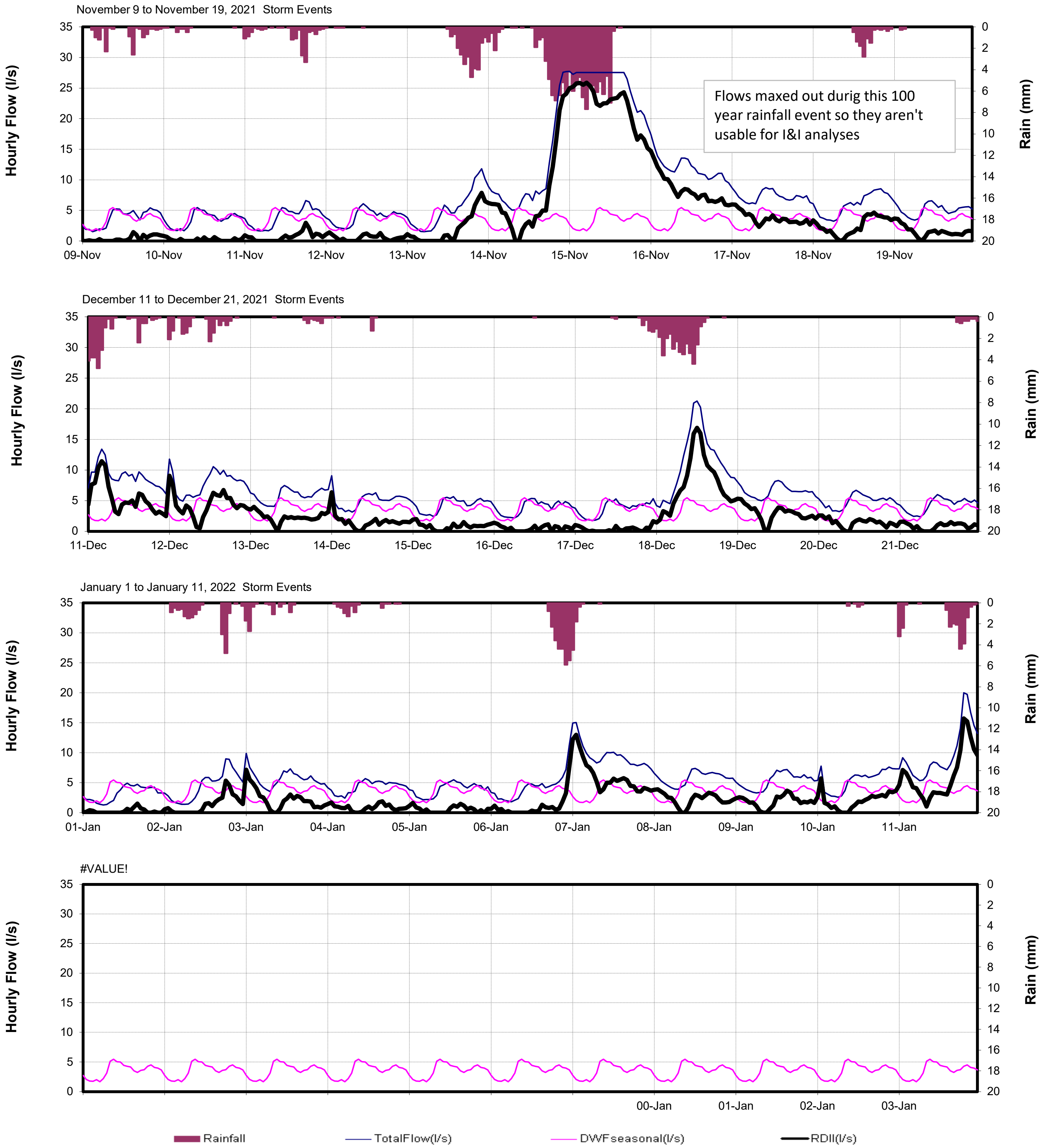
December 28 to January 7, 2019 Storm Events



January 26 to February 5, 2020 Storm Events



SPWWTP Mag Meter #2 (NS1)



November 9 to November 19, 2021 Storm Events

Flows maxed out durig this 100 year rainfall event so they aren't usable for I&I analyses

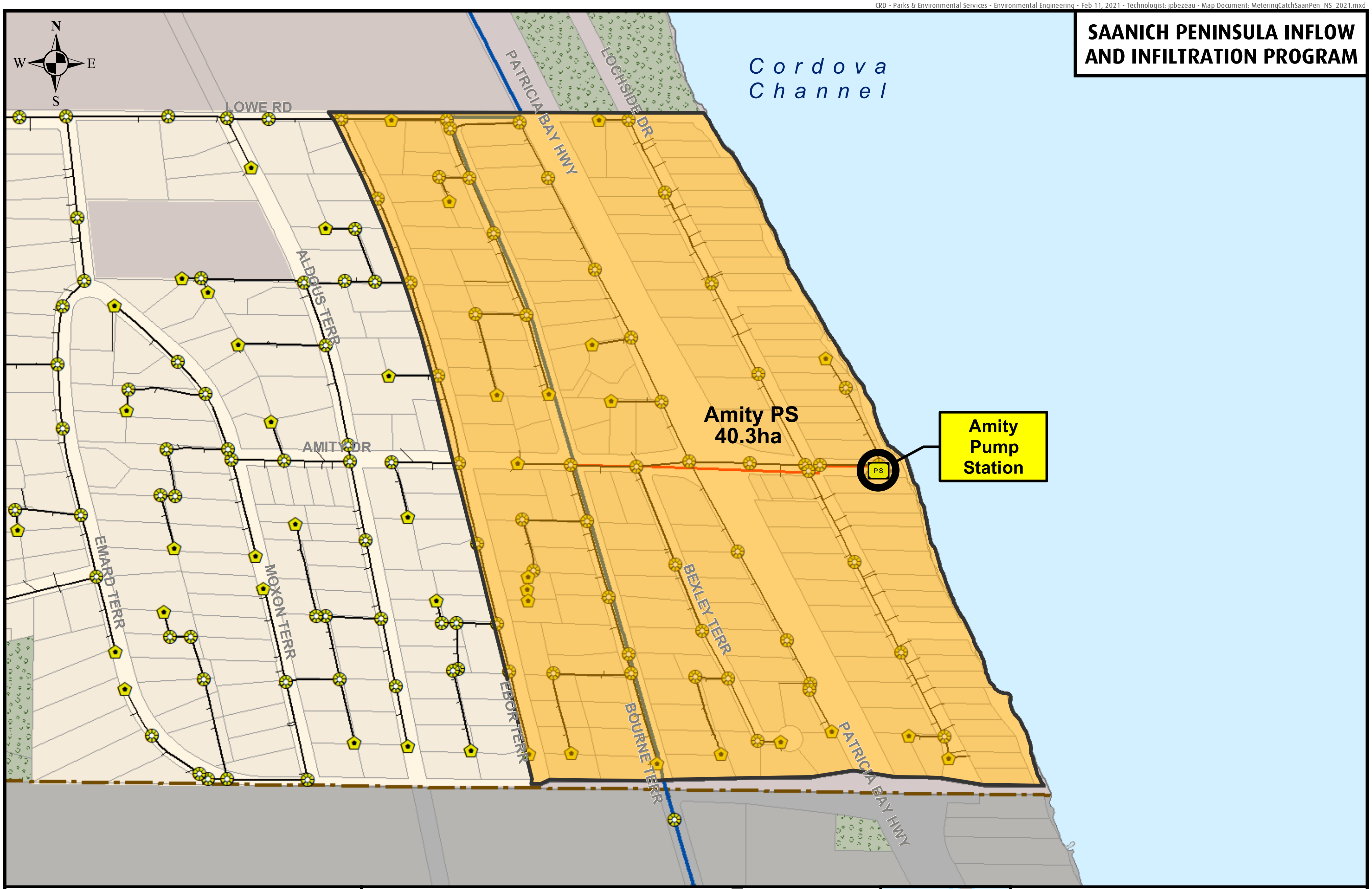
December 11 to December 21, 2021 Storm Events

January 1 to January 11, 2022 Storm Events

#VALUE!

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 85 170 340

Projection: UTM ZONE 10N, NAD83

Disclaimer

This map is for general information only and may contain inaccuracies.

- ○ Flow Monitoring Location
- ⊛ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◔ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- Catchment Area
- Non-Sewered Area
- Lot Lines
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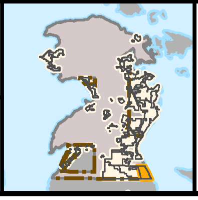
- Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Amity PS

Site Code: NS02

CRD

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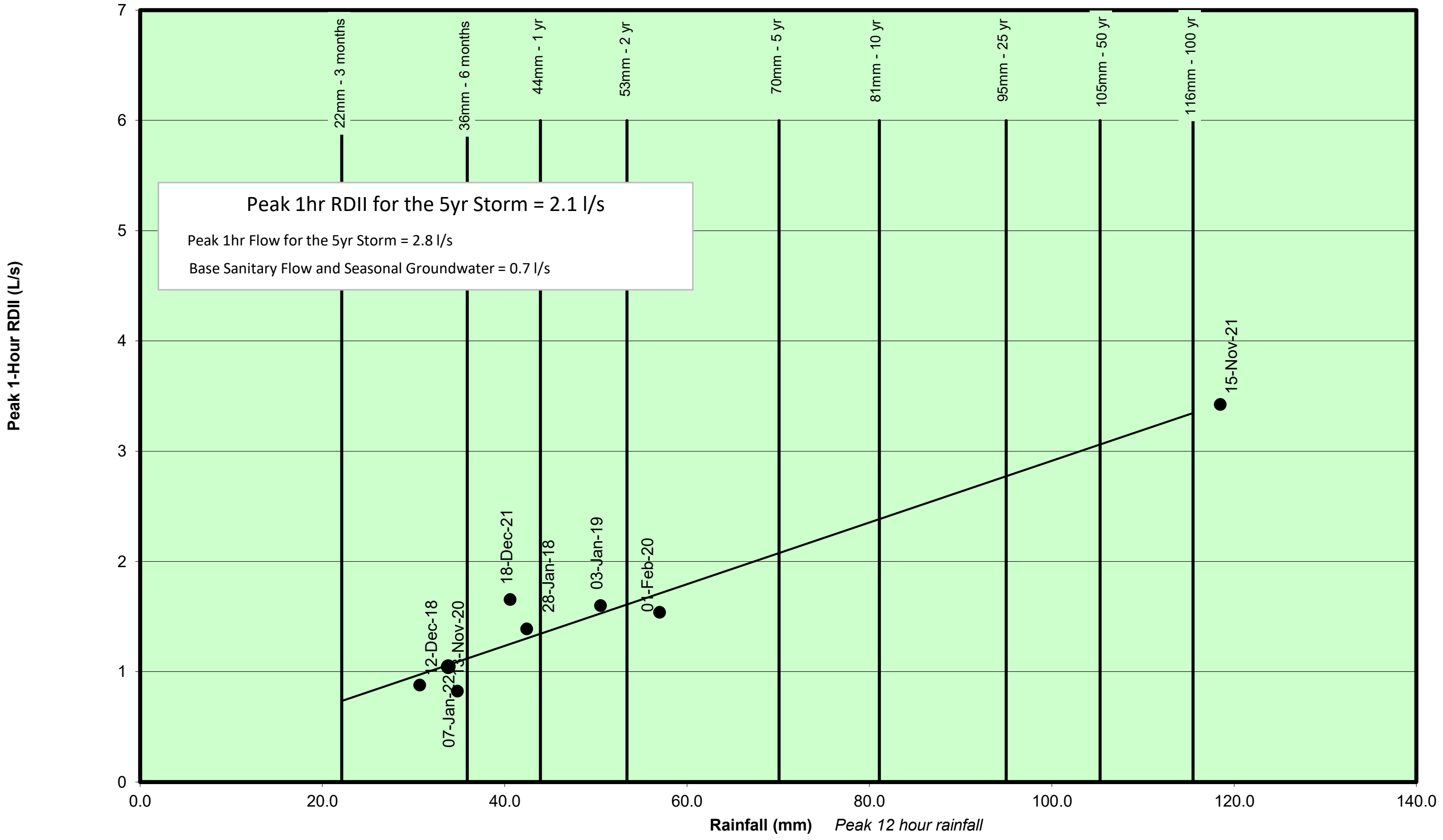
Amity (NS2)

Peak 1-hr RDII by Storm Event

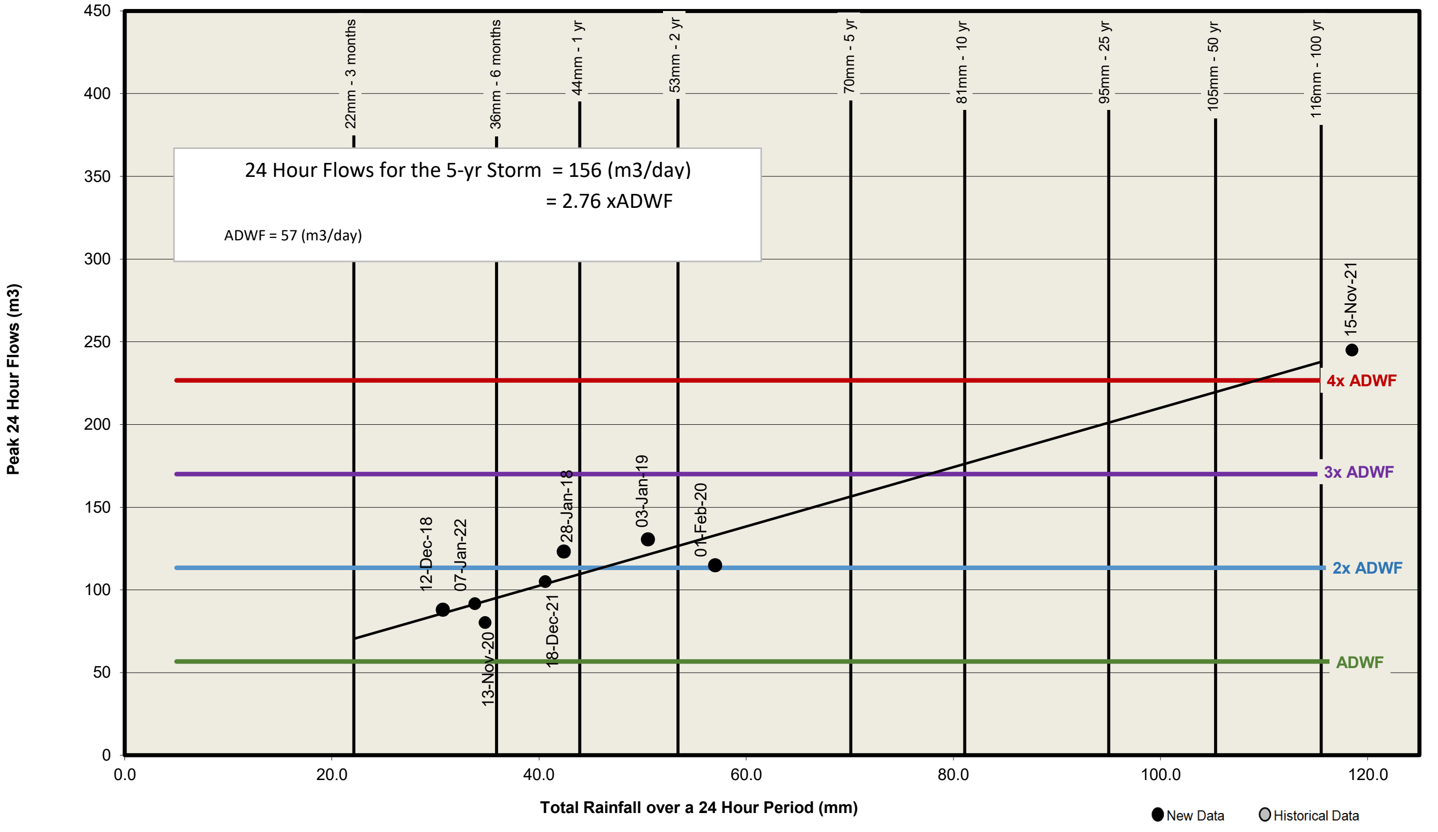


Peak 1hr RDII for the 5yr Storm = 2.1 l/s

Peak 1hr Flow for the 5yr Storm = 2.8 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.7 l/s

Peak 24-Hour Flows by Storm Event



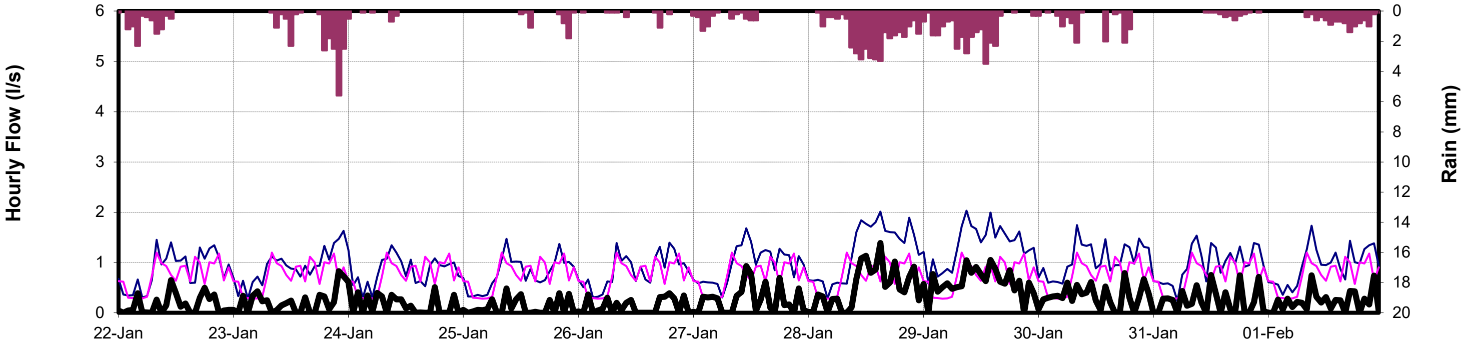
24 Hour Flows for the 5-yr Storm = 156 (m3/day)

= 2.76 xADWF

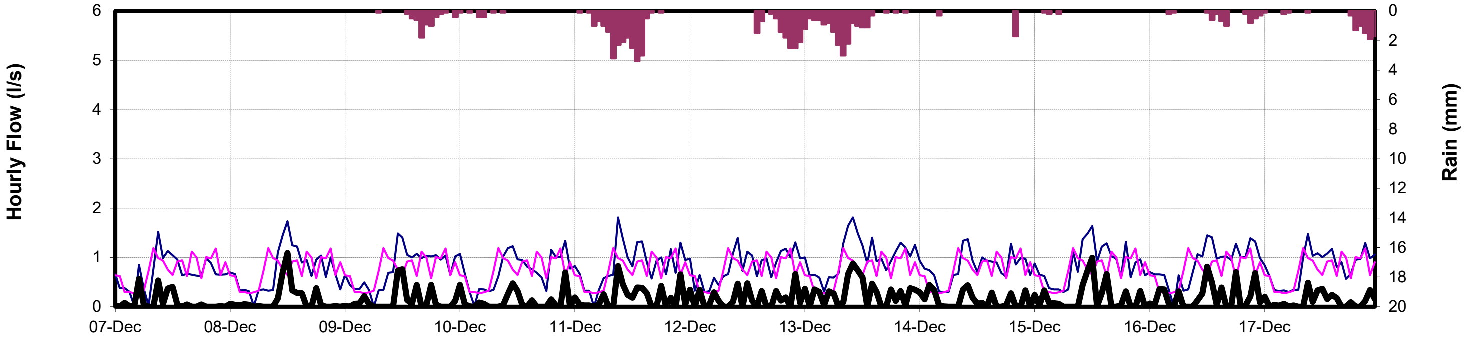
ADWF = 57 (m3/day)

Amity (NS2)

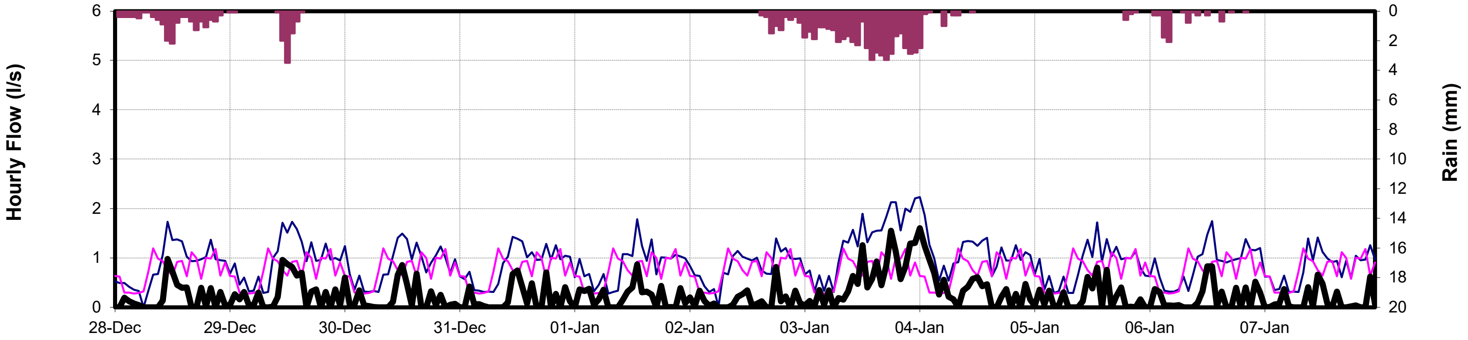
January 22 to February 1, 2018 Storm Events



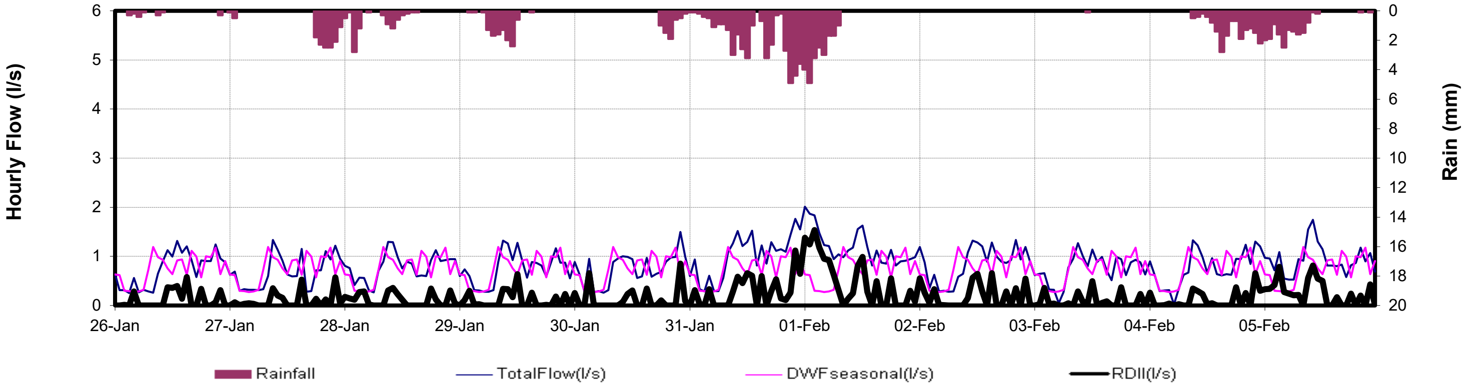
December 7 to December 17, 2018 Storm Events



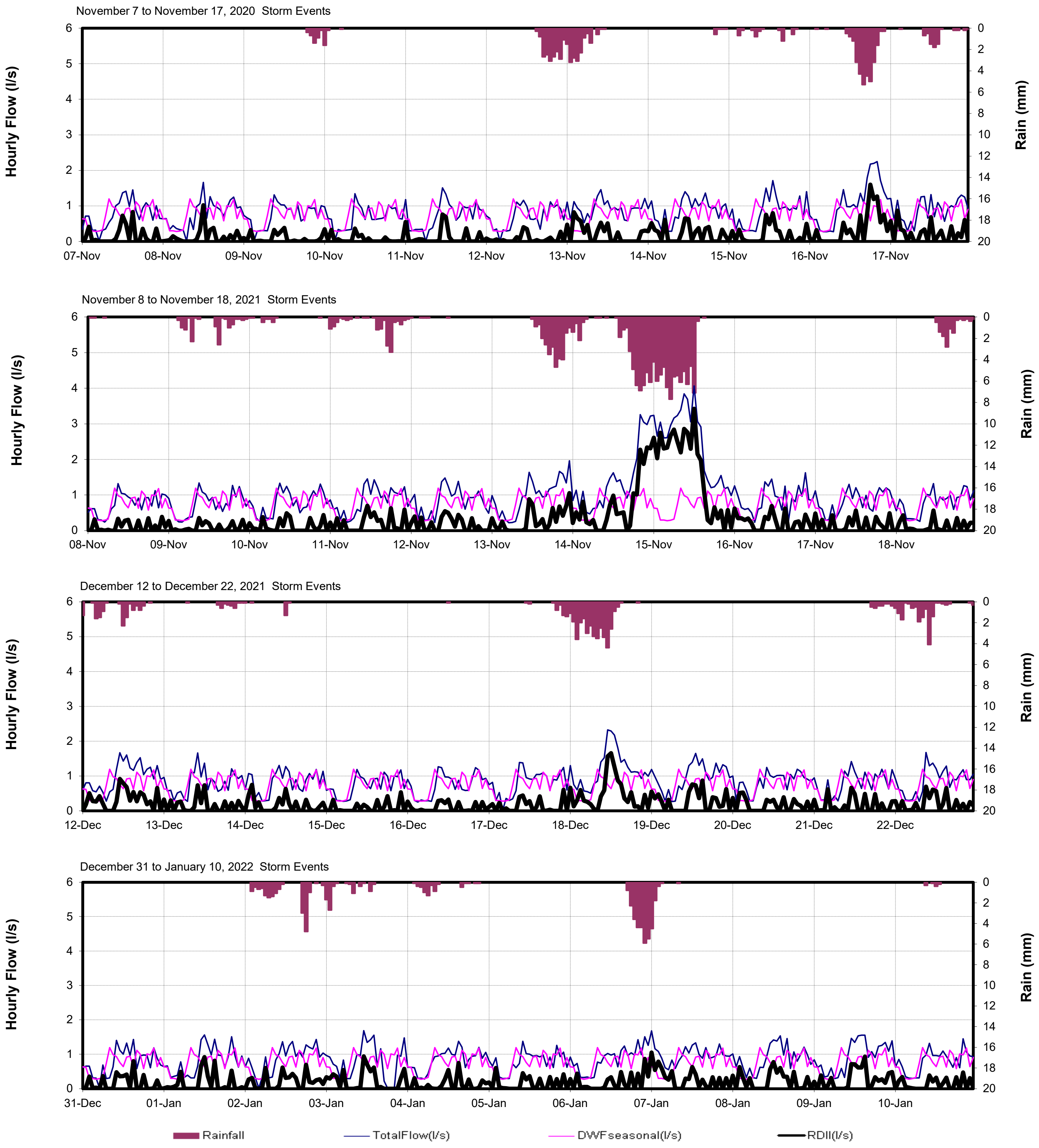
December 28 to January 7, 2019 Storm Events



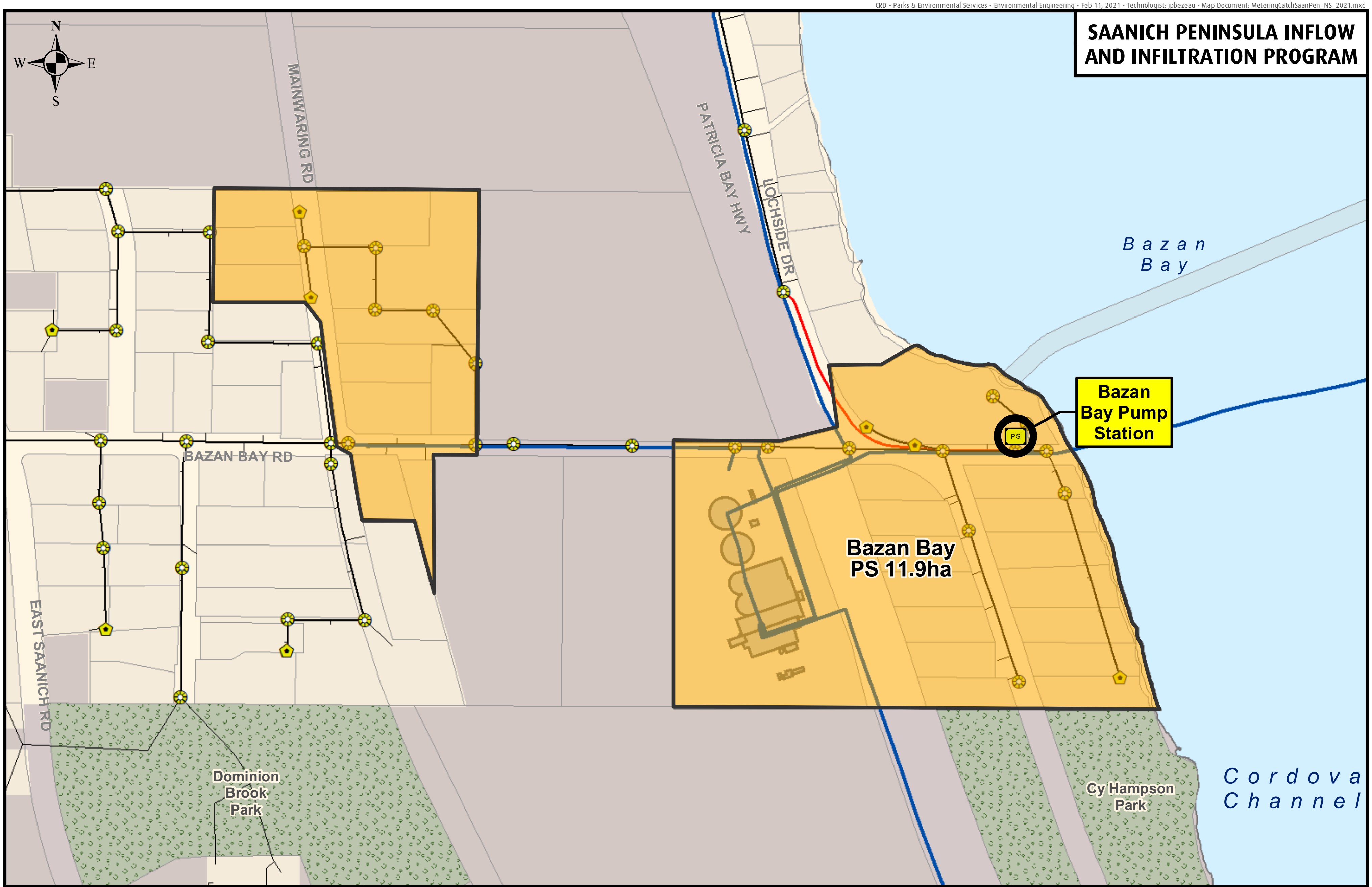
January 26 to February 5, 2020 Storm Events



Amity (NS2)


November 7 to November 17, 2020 Storm Events
November 8 to November 18, 2021 Storm Events
December 12 to December 22, 2021 Storm Events
December 31 to January 10, 2022 Storm Events
Hourly Flow (l/s)
Rain (mm)
0
1
2
3
4
5
6
0
2
4
6
8
10
12
14
16
18
20
07-Nov
08-Nov
09-Nov
10-Nov
11-Nov
12-Nov
13-Nov
14-Nov
15-Nov
16-Nov
17-Nov
18-Nov
12-Dec
13-Dec
14-Dec
15-Dec
16-Dec
17-Dec
18-Dec
19-Dec
20-Dec
21-Dec
22-Dec
31-Dec
01-Jan
02-Jan
03-Jan
04-Jan
05-Jan
06-Jan
07-Jan
08-Jan
09-Jan
10-Jan
Rainfall
TotalFlow(l/s)
DWFseasonal(l/s)
RDII(l/s)

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 55 110 220

Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
✺ Manhole
⬟ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
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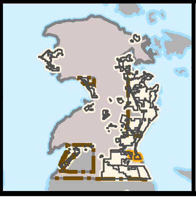

FLOW MONITORING AREA

Catchment: Bazan Bay PS

Site Code: NS3

CRD
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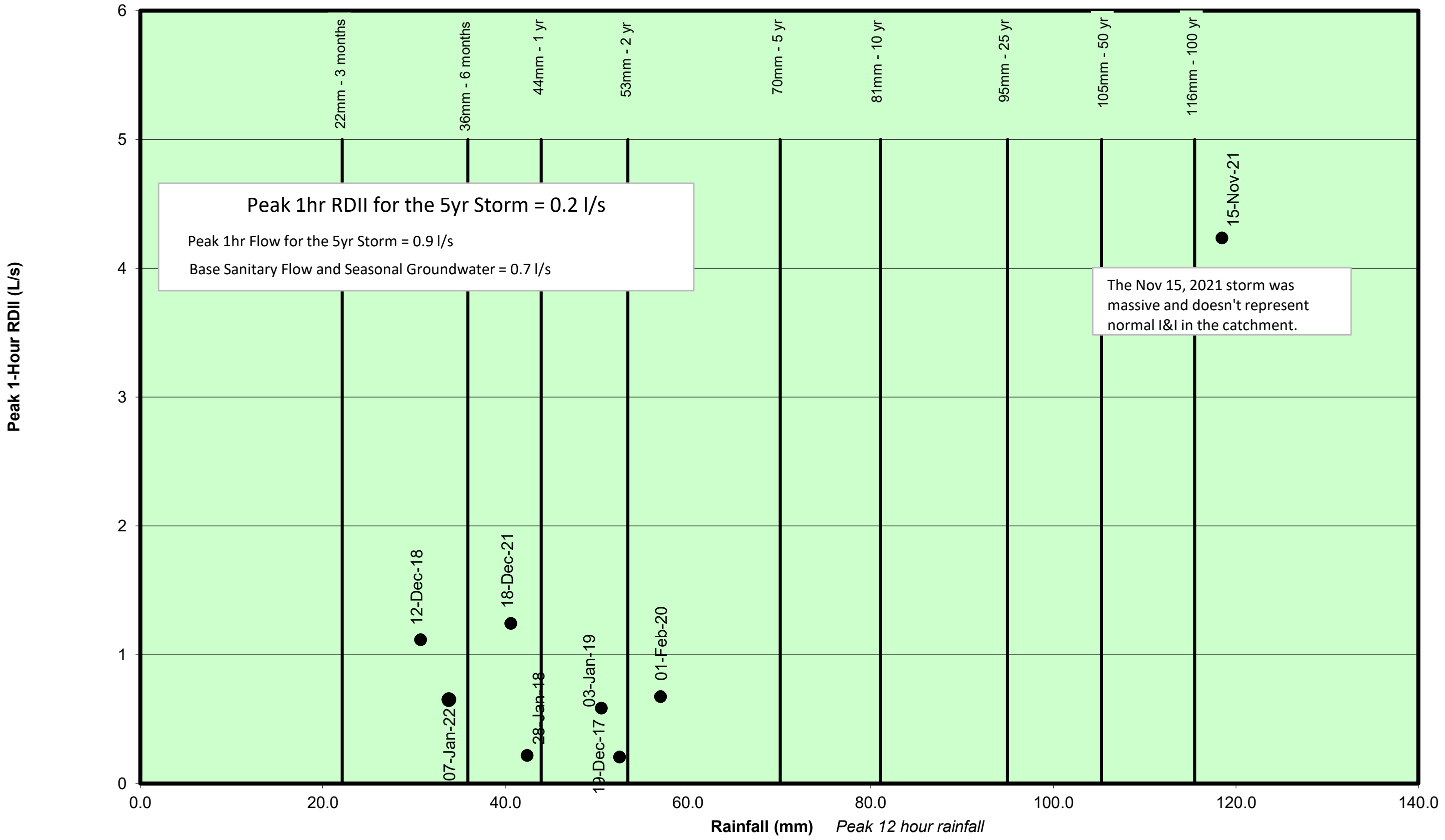
Bazan Bay PS (NS3)

Peak 1-hr RDII by Storm Event



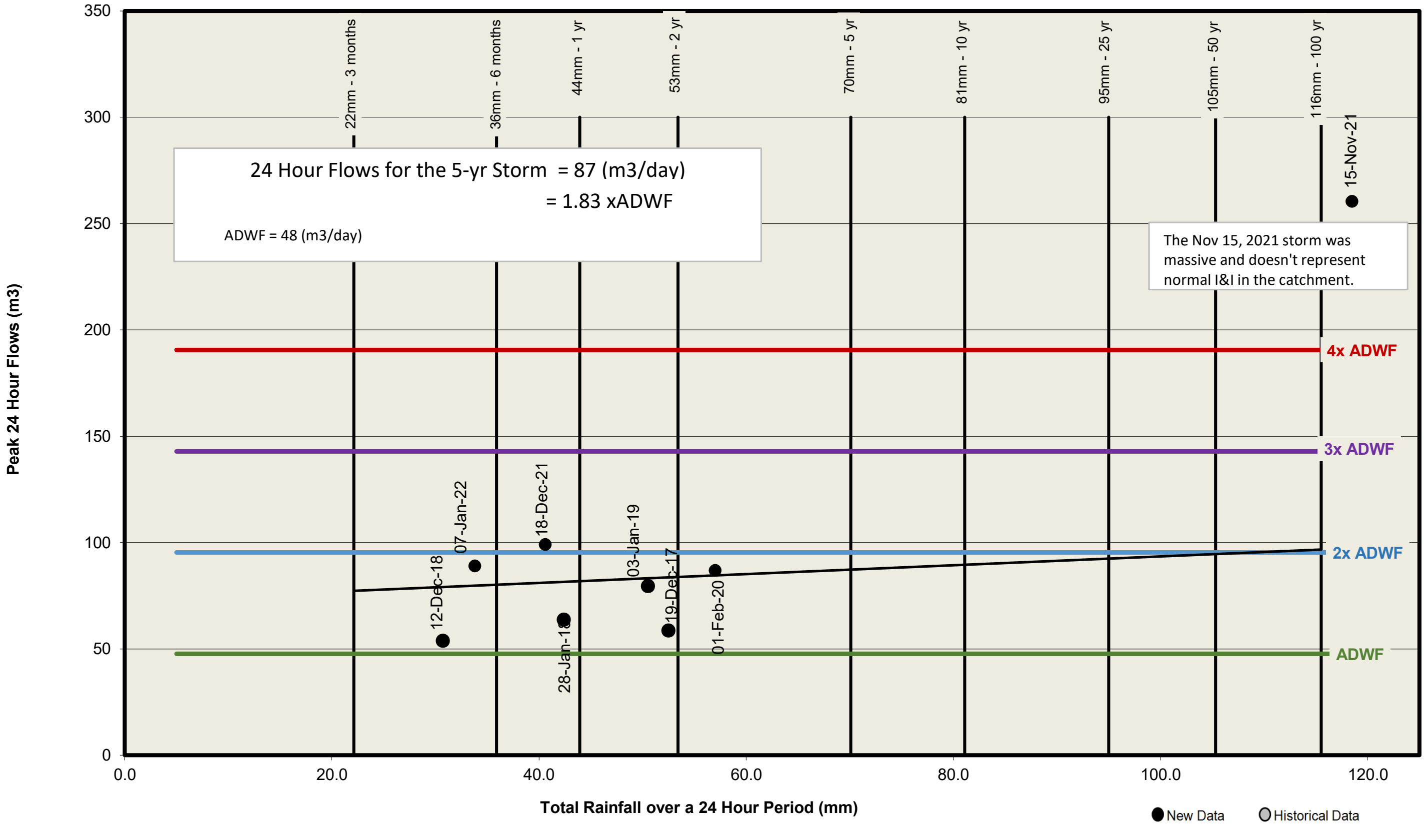
Peak 1hr RDII for the 5yr Storm = 0.2 l/s

Peak 1hr Flow for the 5yr Storm = 0.9 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.7 l/s

The Nov 15, 2021 storm was massive and doesn't represent normal I&I in the catchment.

Peak 24-Hour Flows by Storm Event



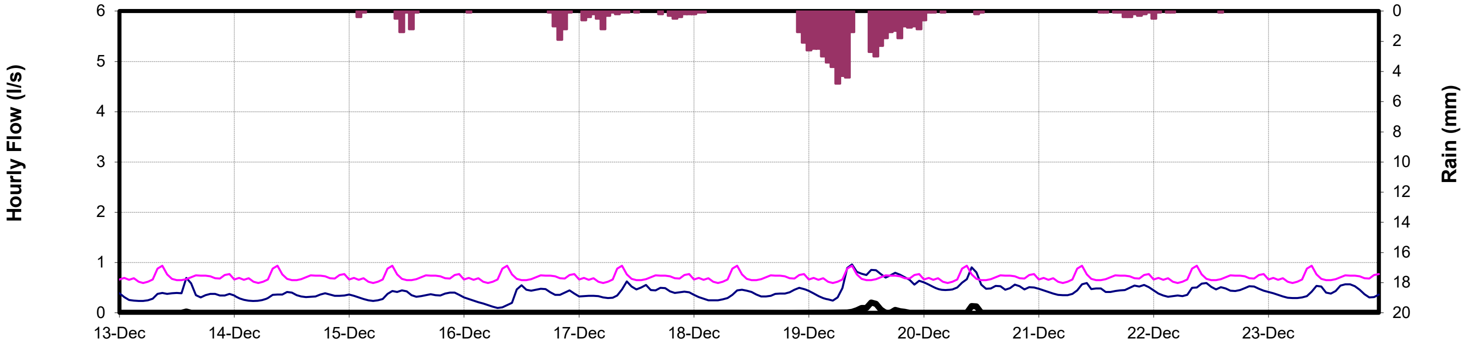
24 Hour Flows for the 5-yr Storm = 87 (m3/day)
= 1.83 xADWF

ADWF = 48 (m3/day)

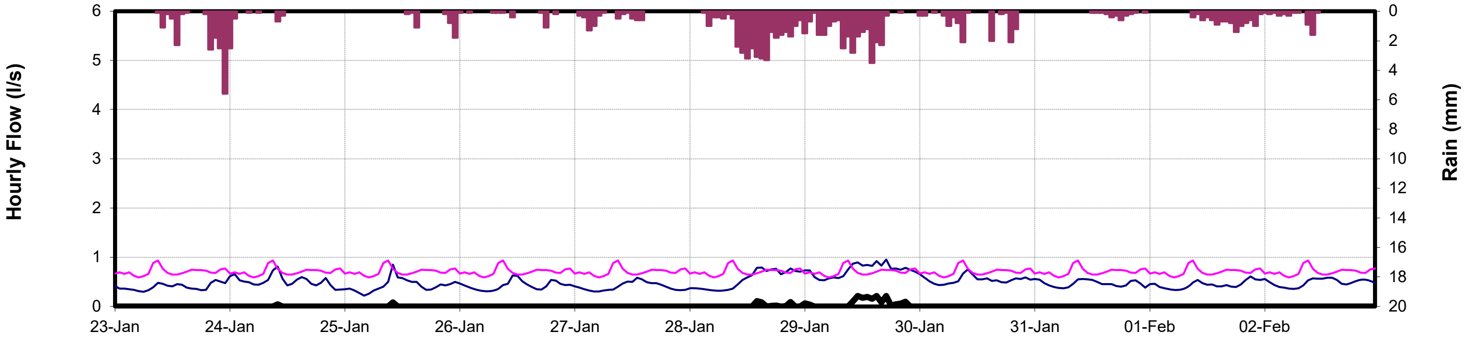
The Nov 15, 2021 storm was massive and doesn't represent normal I&I in the catchment.

Bazan Bay PS (NS3)

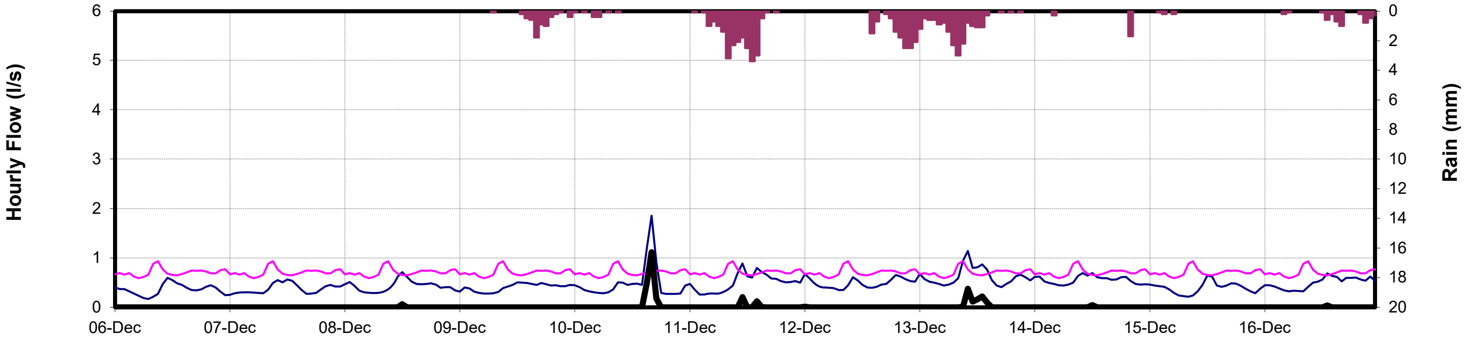
December 13 to December 23, 2017 Storm Events



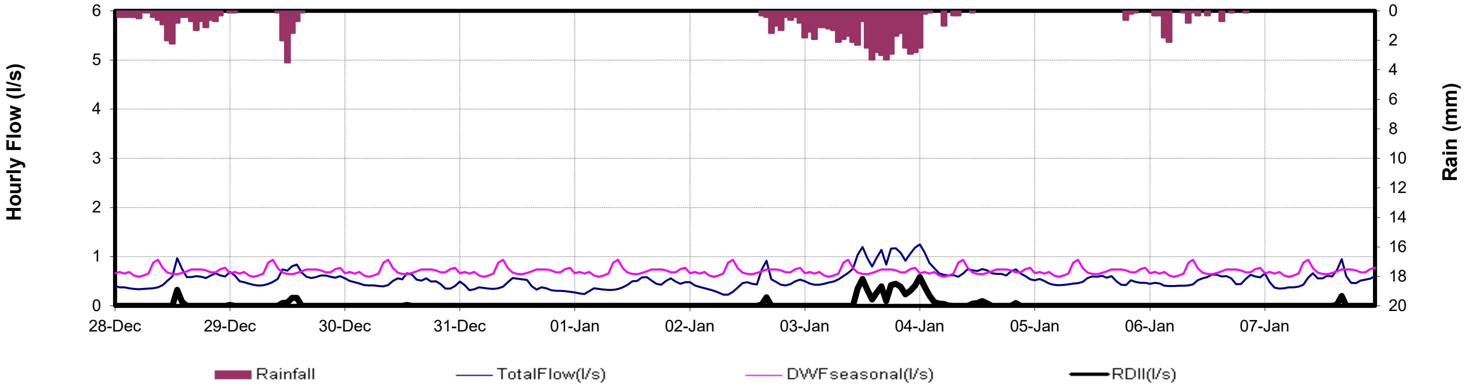
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

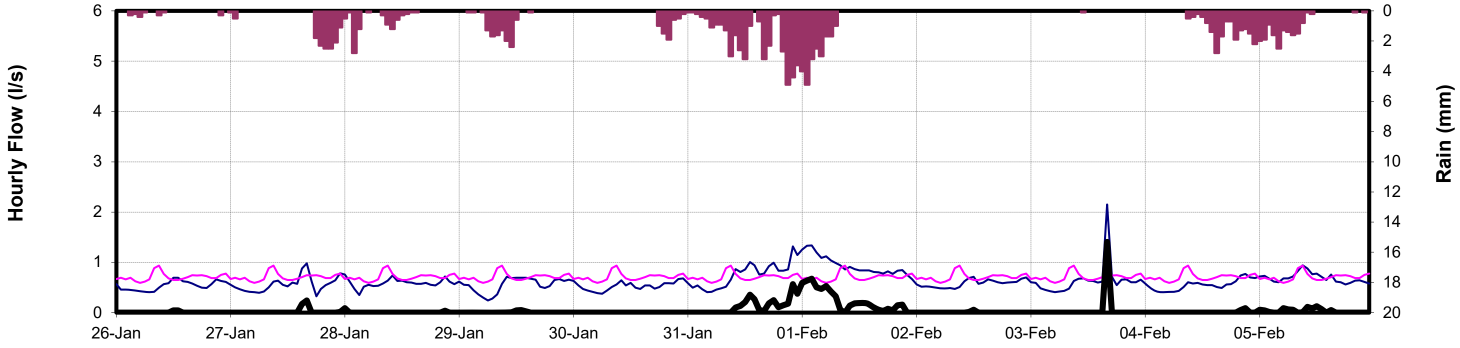


December 28 to January 7, 2019 Storm Events

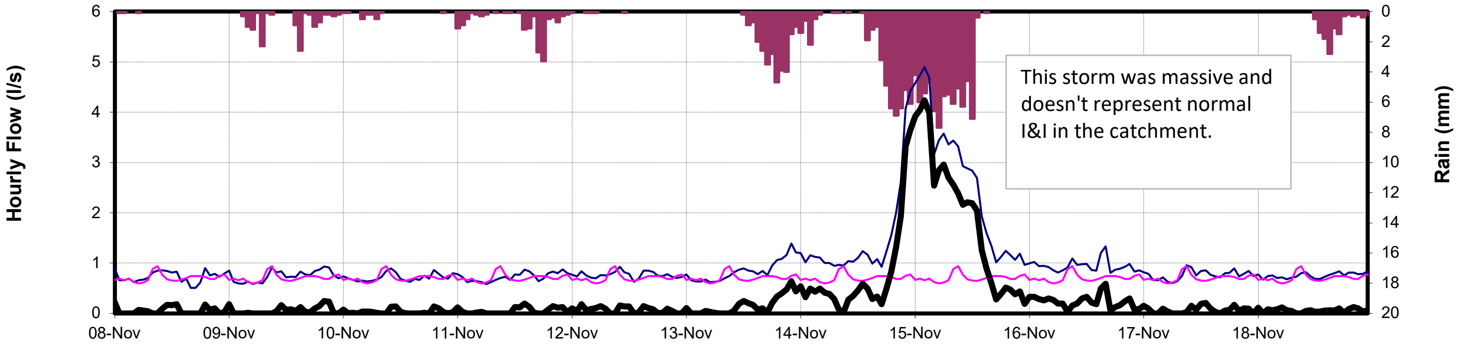


Bazan Bay PS (NS3)

January 26 to February 5, 2020 Storm Events

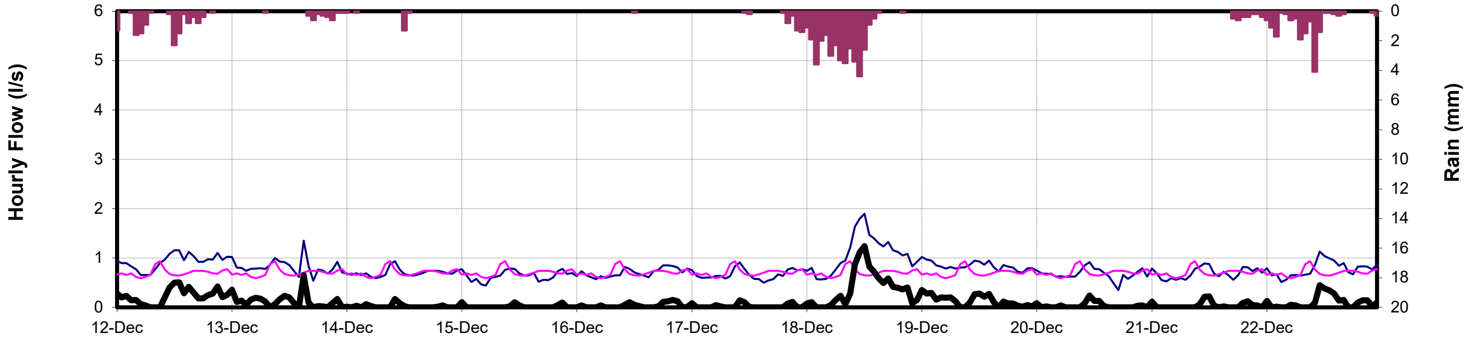


November 8 to November 18, 2021 Storm Events

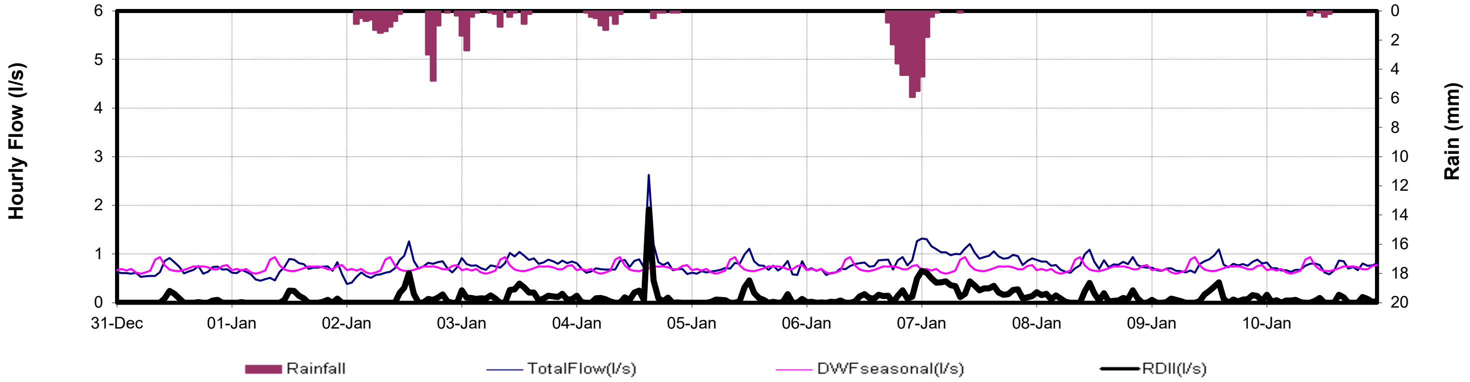


This storm was massive and doesn't represent normal I&I in the catchment.

December 12 to December 22, 2021 Storm Events

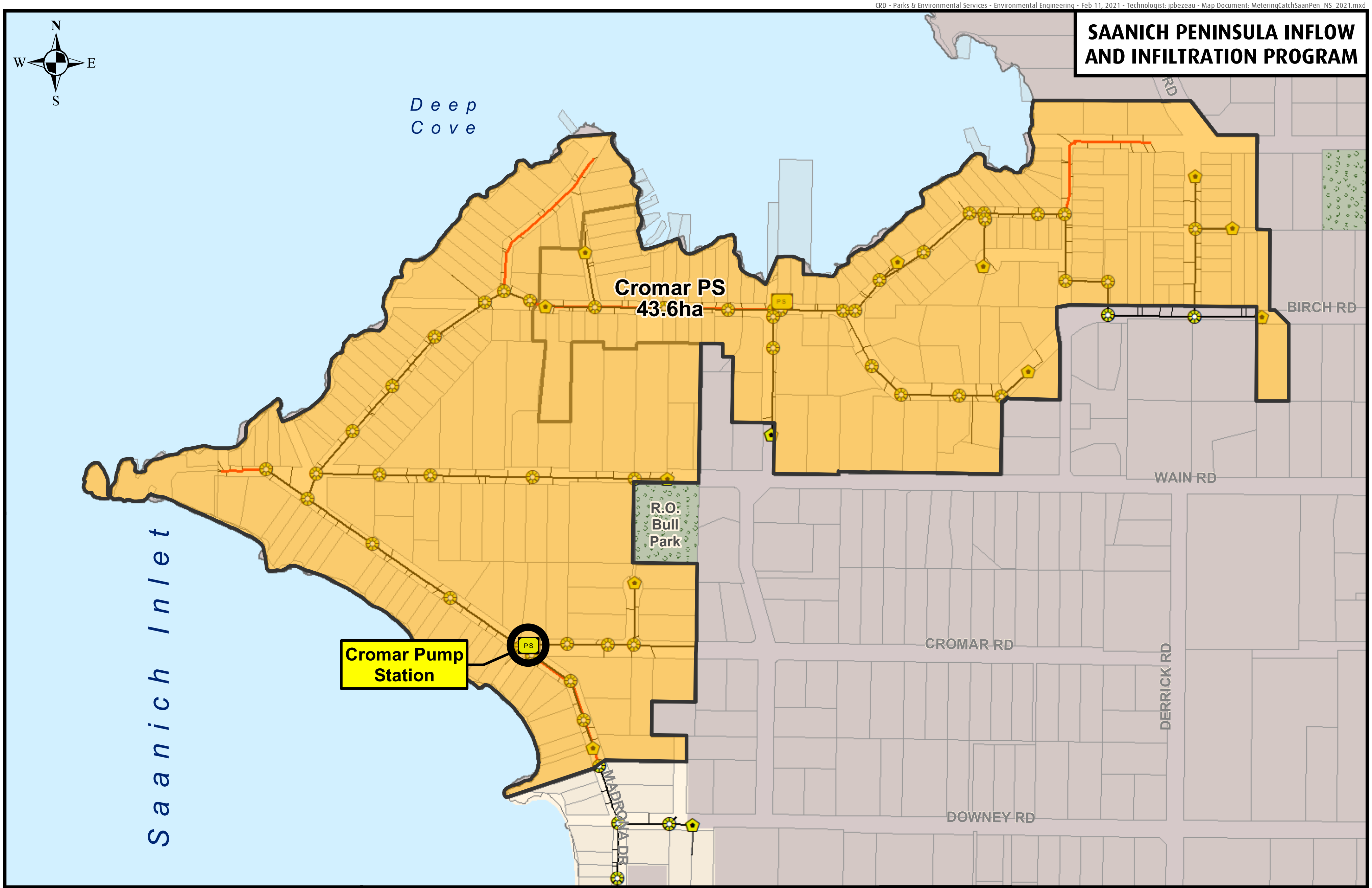


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 85 170 340

Projection: UTM ZONE 10N, NAD83

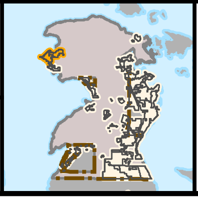
Disclaimer
This map is for general information only and may contain inaccuracies.

- ○ Flow Monitoring Location
- ✪ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◙ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- Catchment Area
- Non-Sewered Area
- Lot Lines
- Parks
- Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

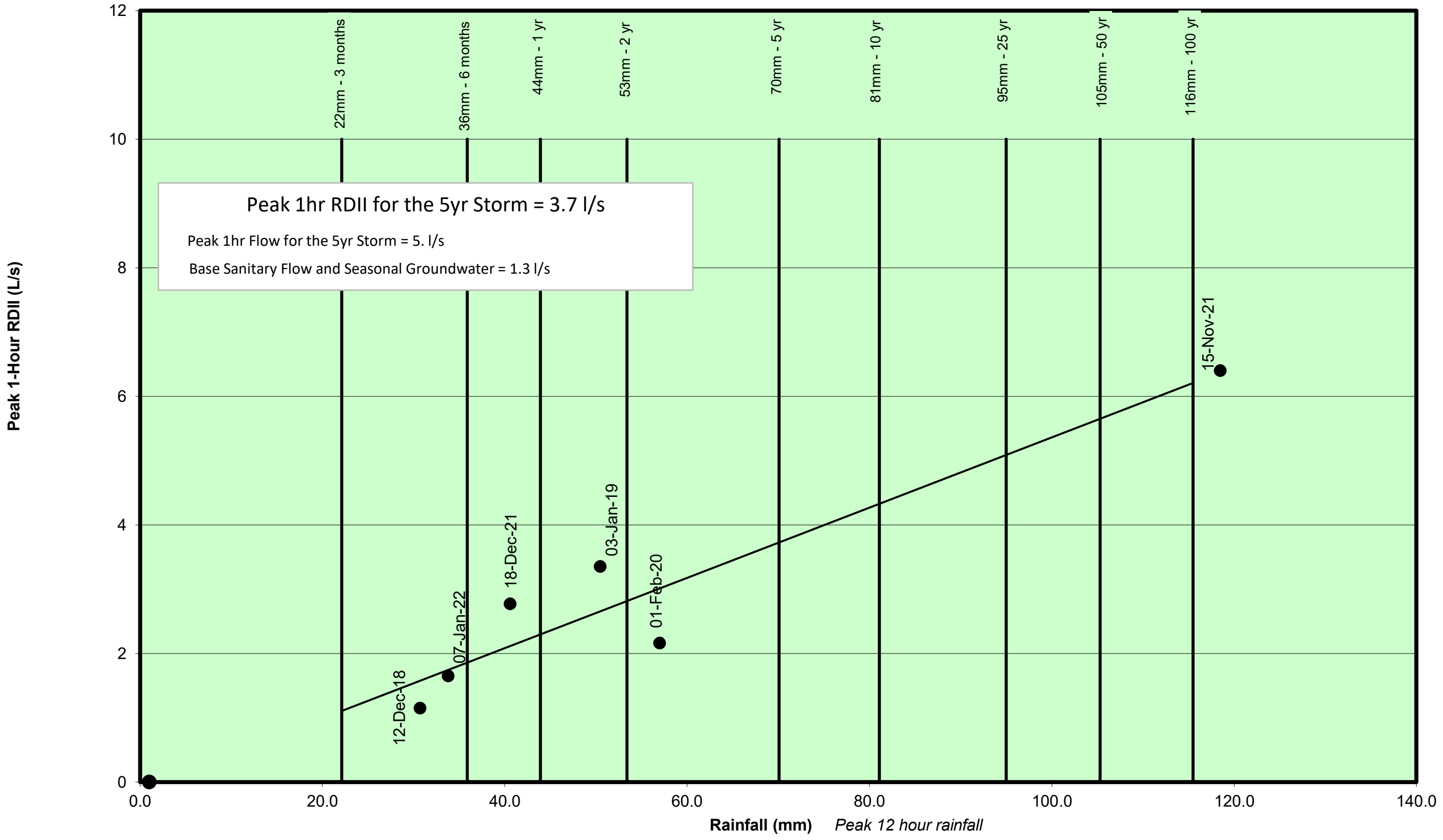
Catchment: Cromar PS

Site Code: NS4

Making a difference...together

Cromar PS (NS4)

Peak 1-hr RDII by Storm Event

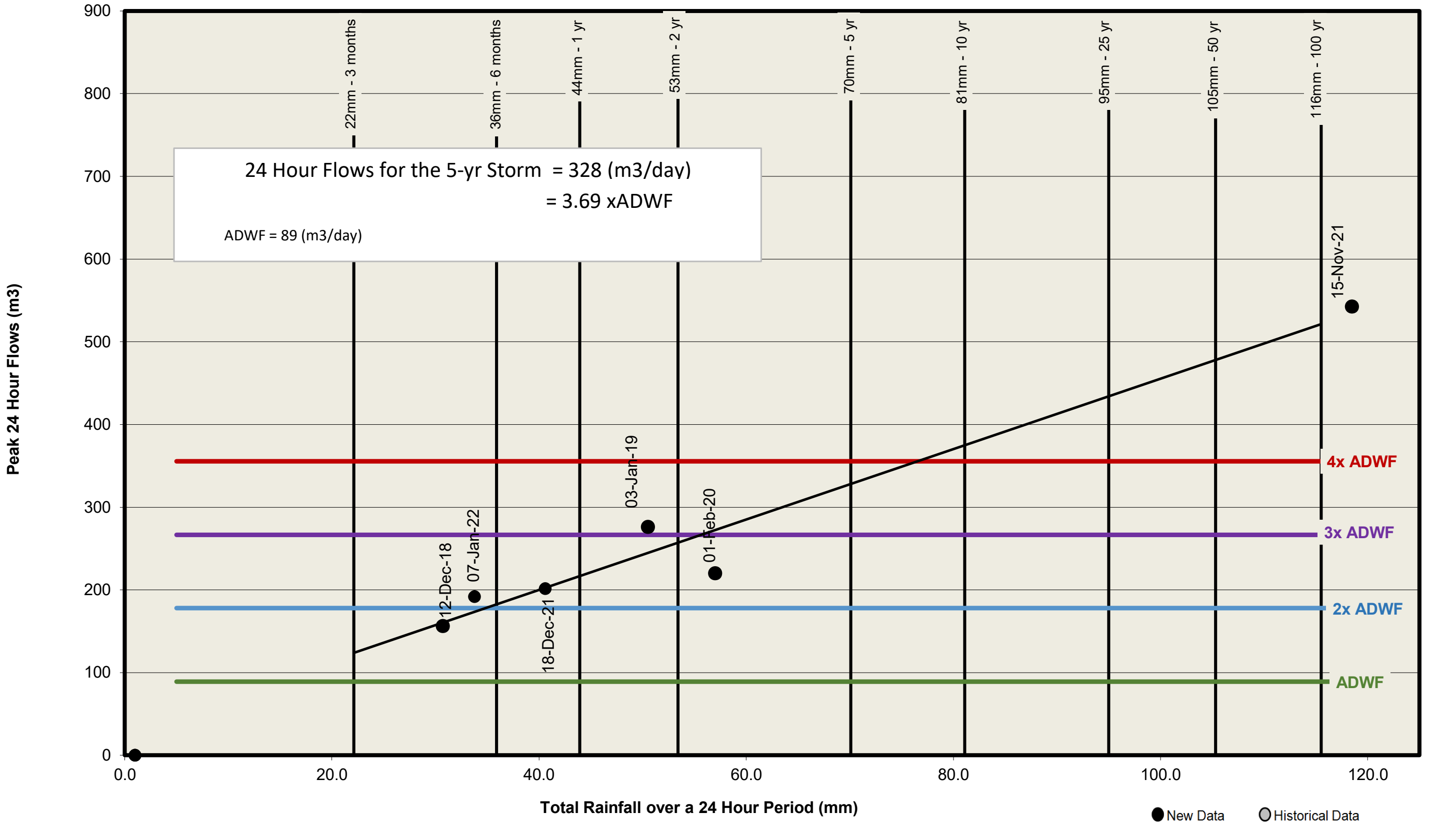


Peak 1hr RDII for the 5yr Storm = 3.7 l/s

Peak 1hr Flow for the 5yr Storm = 5. l/s

Base Sanitary Flow and Seasonal Groundwater = 1.3 l/s

Peak 24-Hour Flows by Storm Event



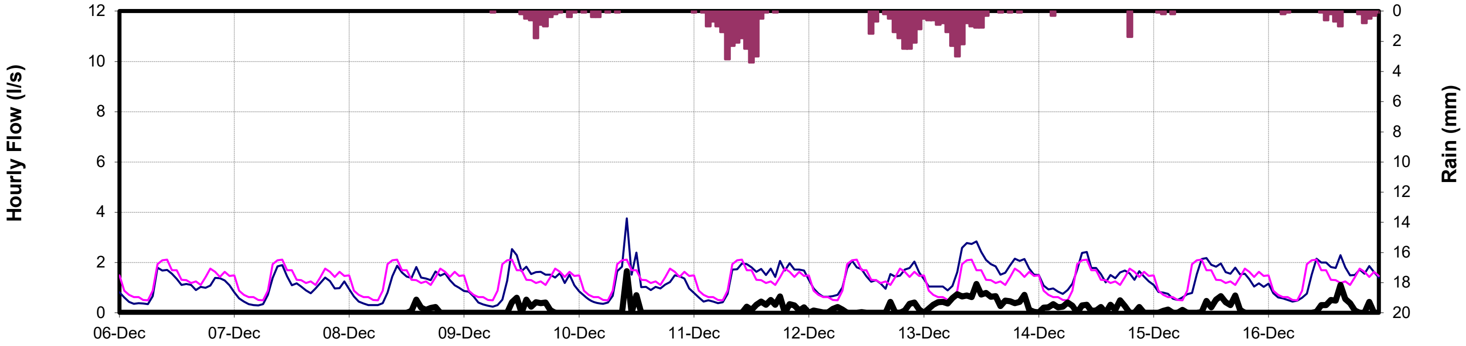
24 Hour Flows for the 5-yr Storm = 328 (m3/day)

= 3.69 xADWF

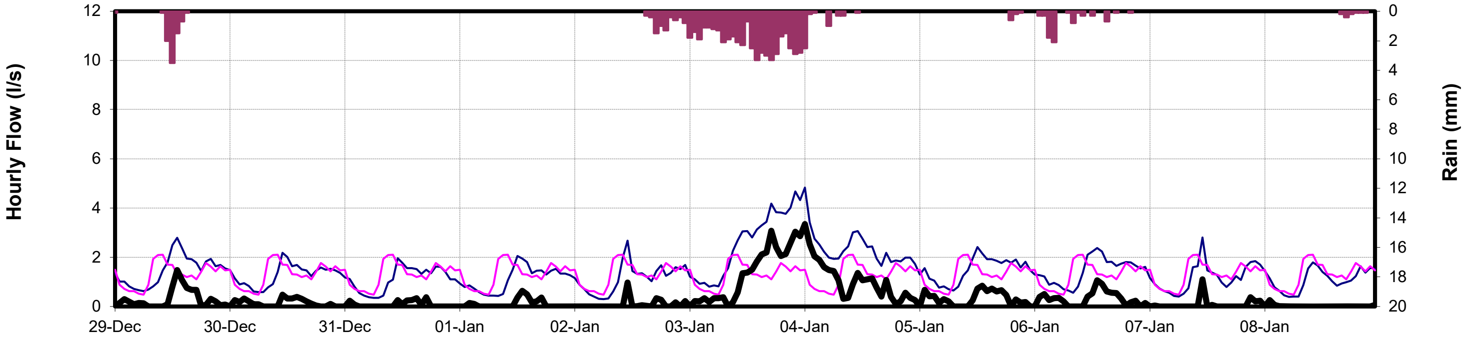
ADWF = 89 (m3/day)

Cromar PS (NS4)

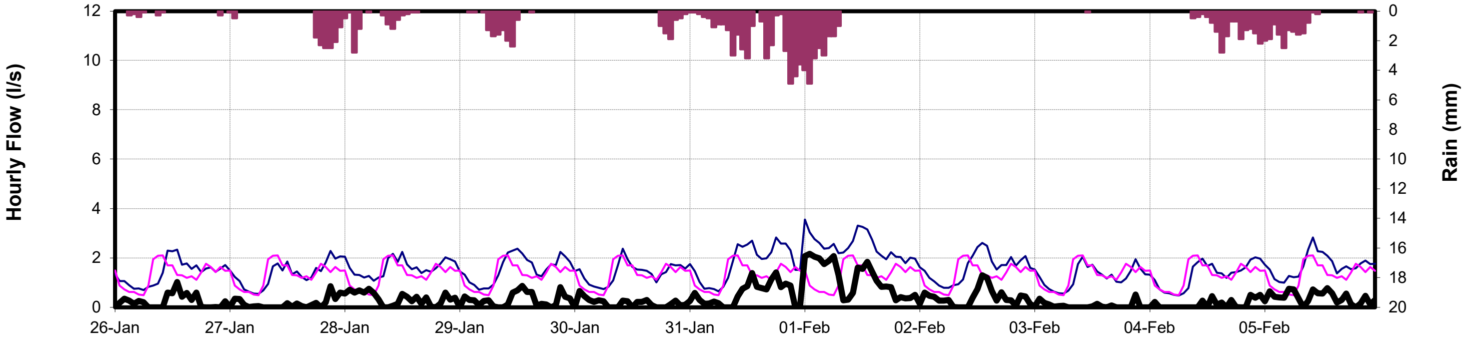
December 6 to December 16, 2018 Storm Events



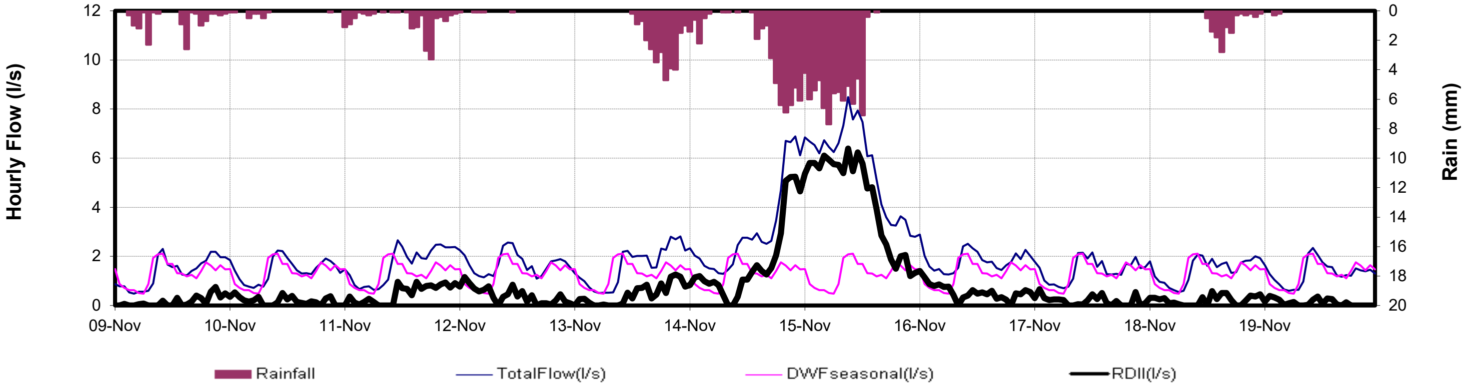
December 29 to January 8, 2019 Storm Events



January 26 to February 5, 2020 Storm Events

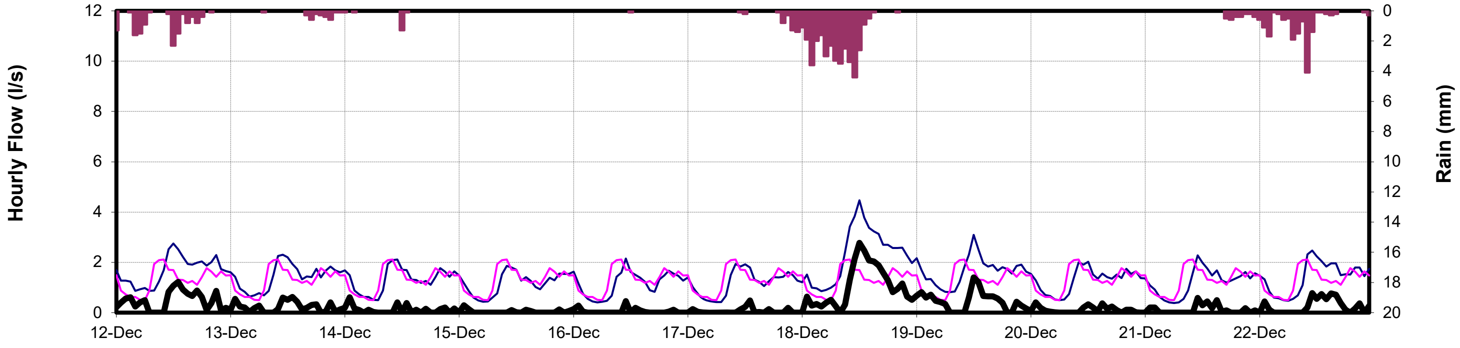


November 9 to November 19, 2021 Storm Events

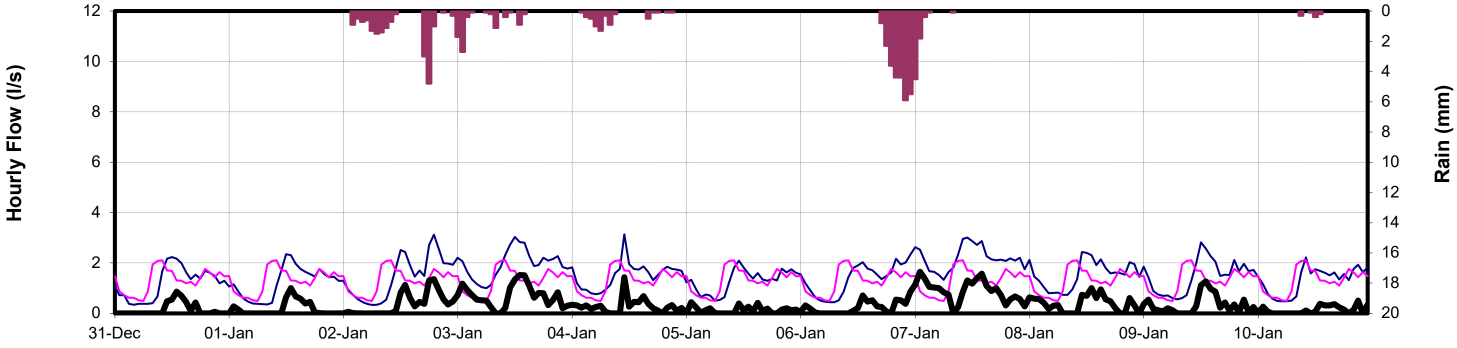


Cromar PS (NS4)

December 12 to December 22, 2021 Storm Events



December 31 to January 10, 2022 Storm Events



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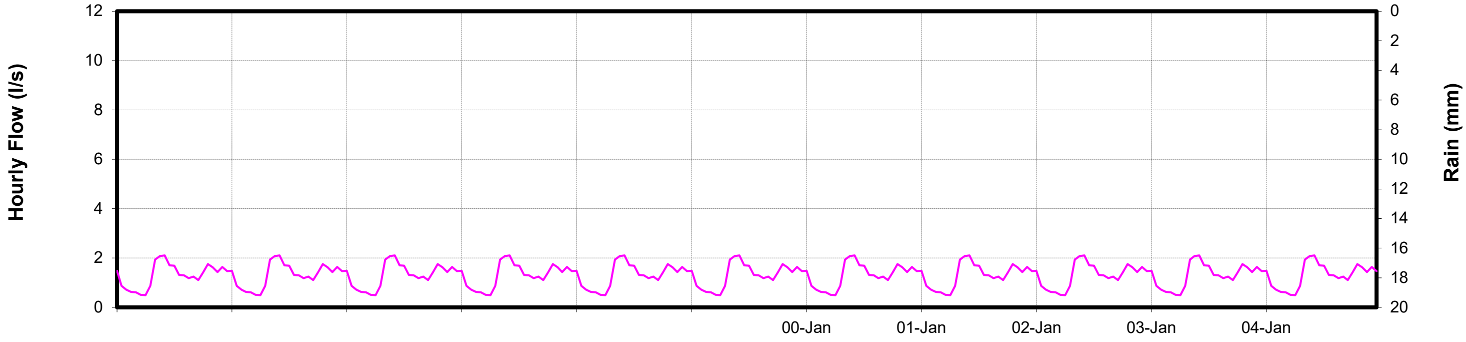
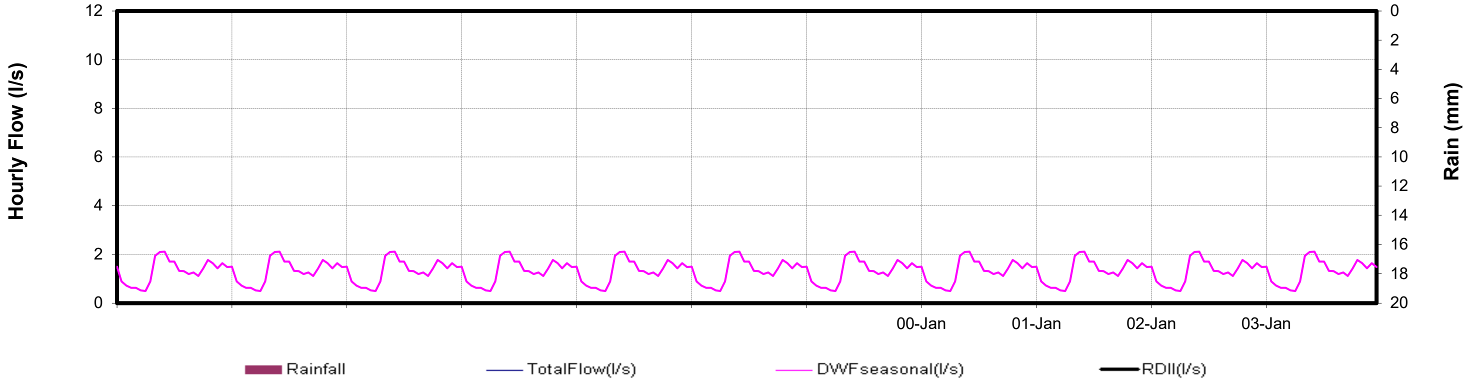
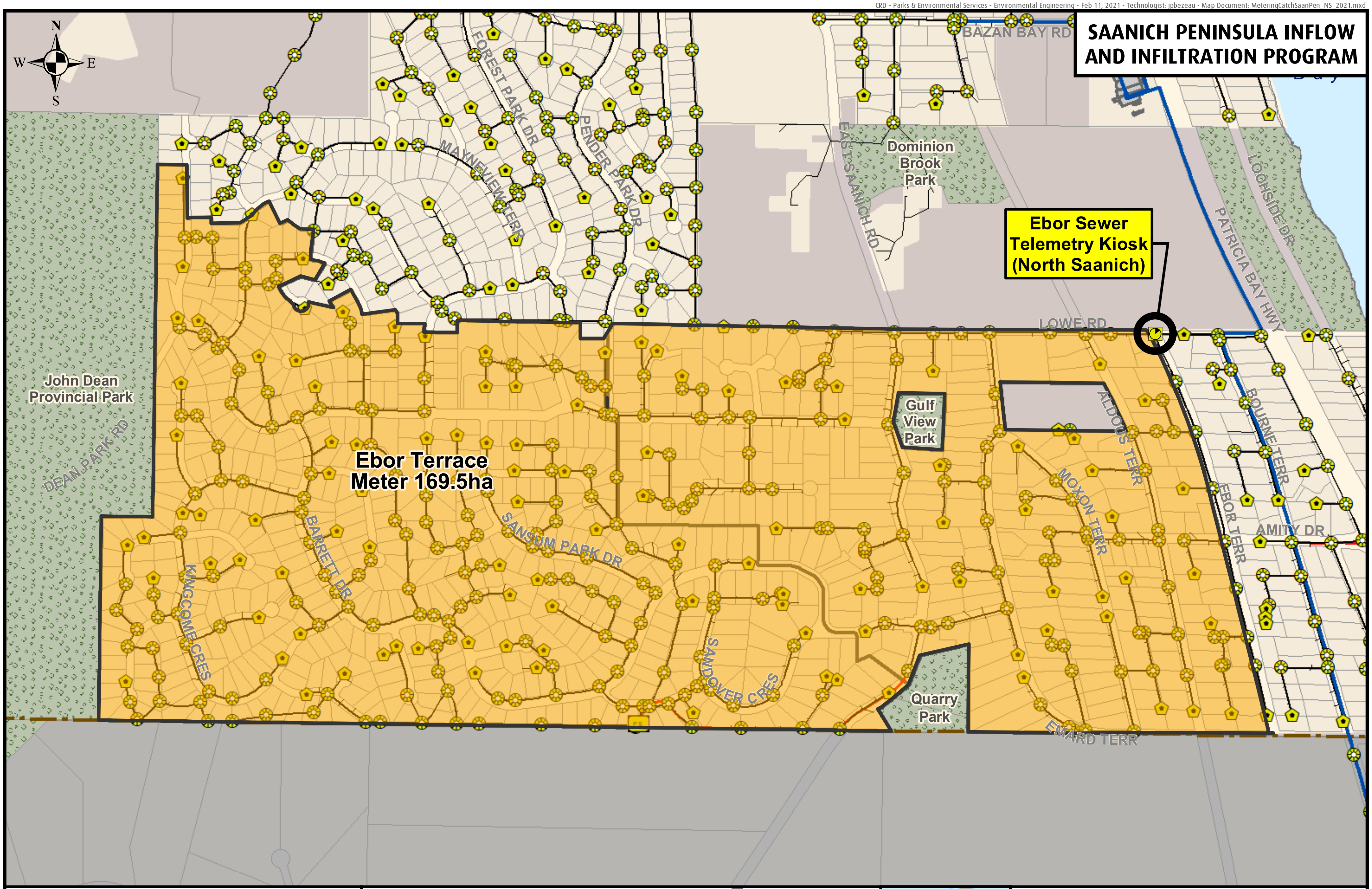


#VALUE!



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 140 280 560

Projection: UTM ZONE 10N, NAD83

Disclaimer
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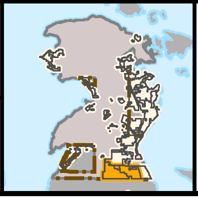
- ○ Flow Monitoring Location
- ✺ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◔ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- Catchment Area
- Non-Sewered Area
- Lot Lines
- Parks
- Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Ebor Terrace Meter

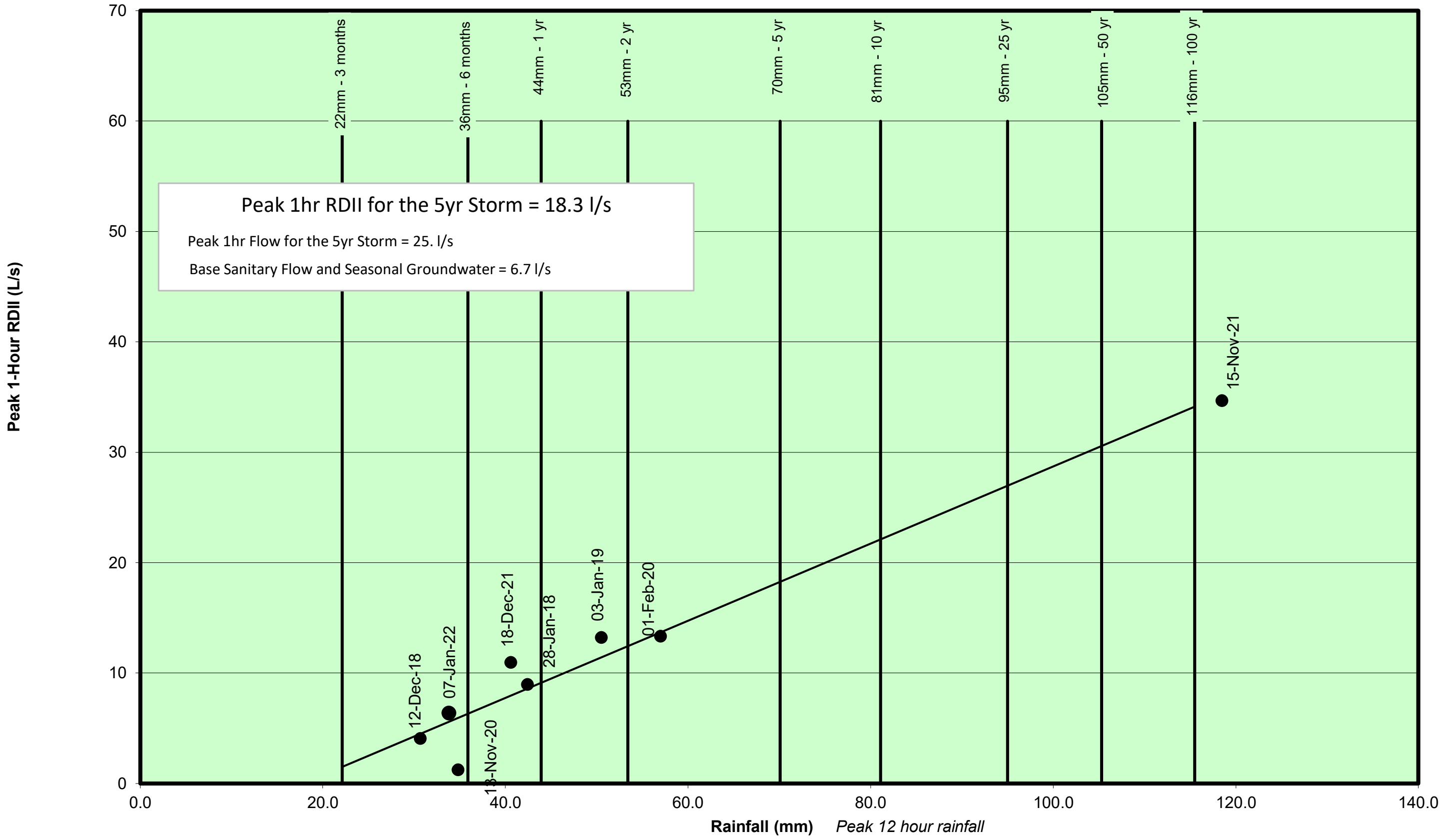
Site Code: NS5

CRD

Making a difference...together

Ebor (NS5)

Peak 1-hr RDII by Storm Event

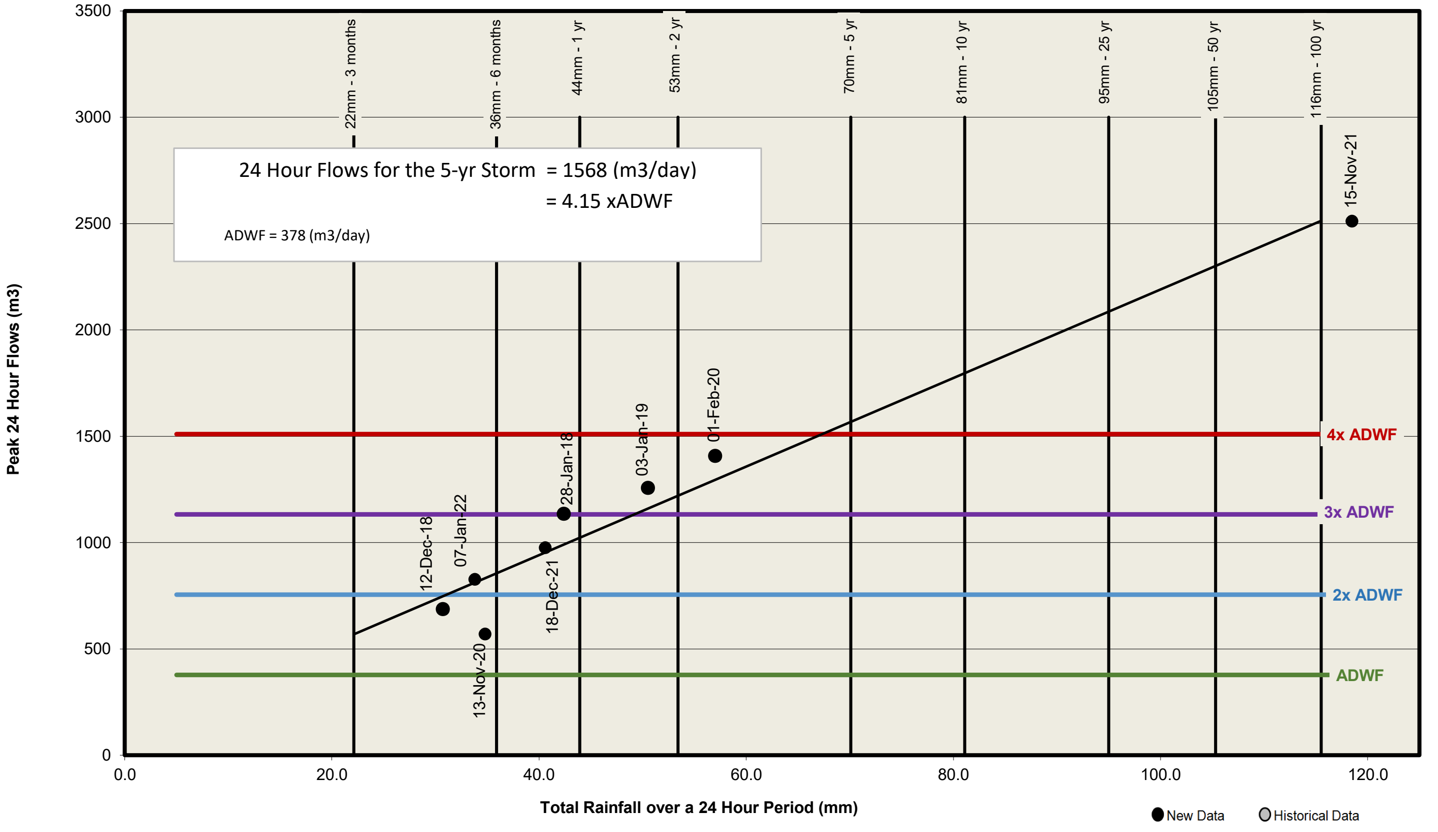


Peak 1hr RDII for the 5yr Storm = 18.3 l/s

Peak 1hr Flow for the 5yr Storm = 25. l/s

Base Sanitary Flow and Seasonal Groundwater = 6.7 l/s

Peak 24-Hour Flows by Storm Event

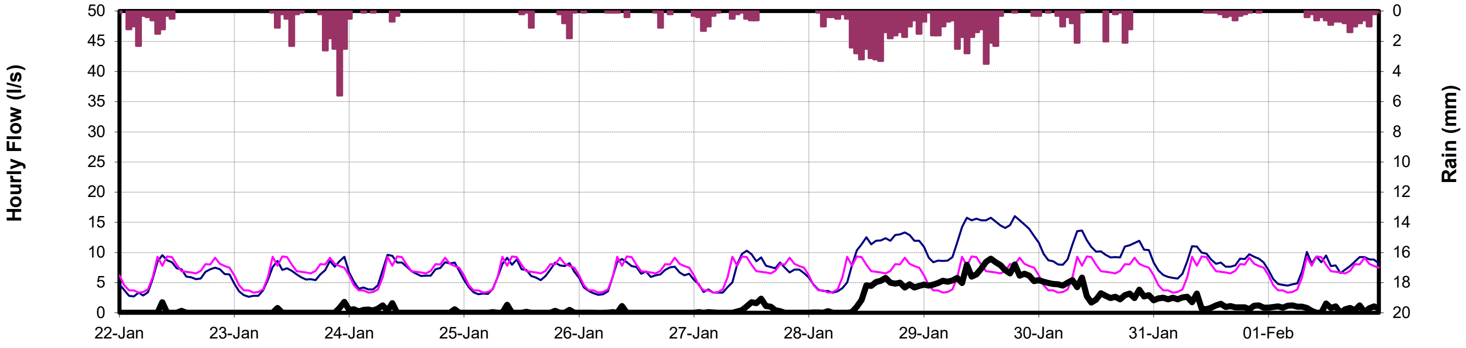


24 Hour Flows for the 5-yr Storm = 1568 (m3/day)
= 4.15 xADWF

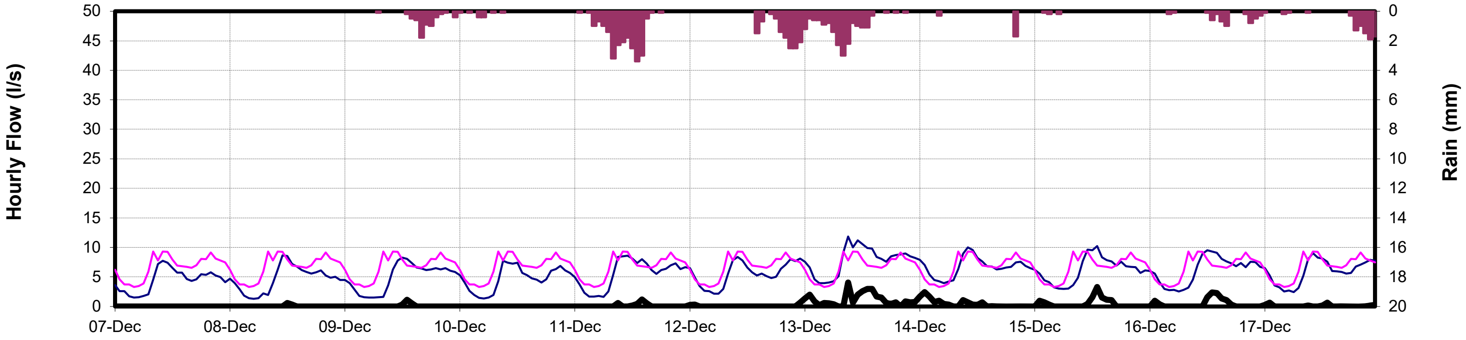
ADWF = 378 (m3/day)

Ebor (NS5)

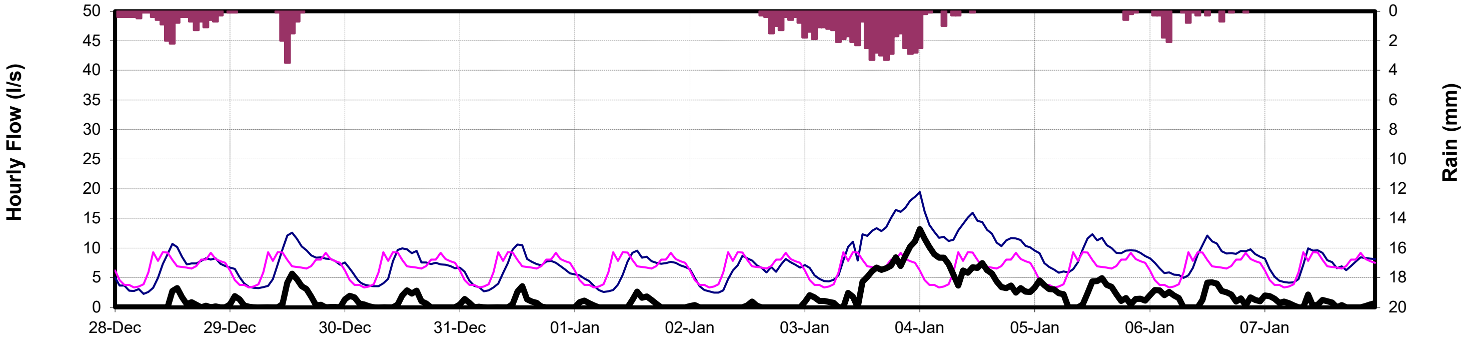
January 22 to February 1, 2018 Storm Events



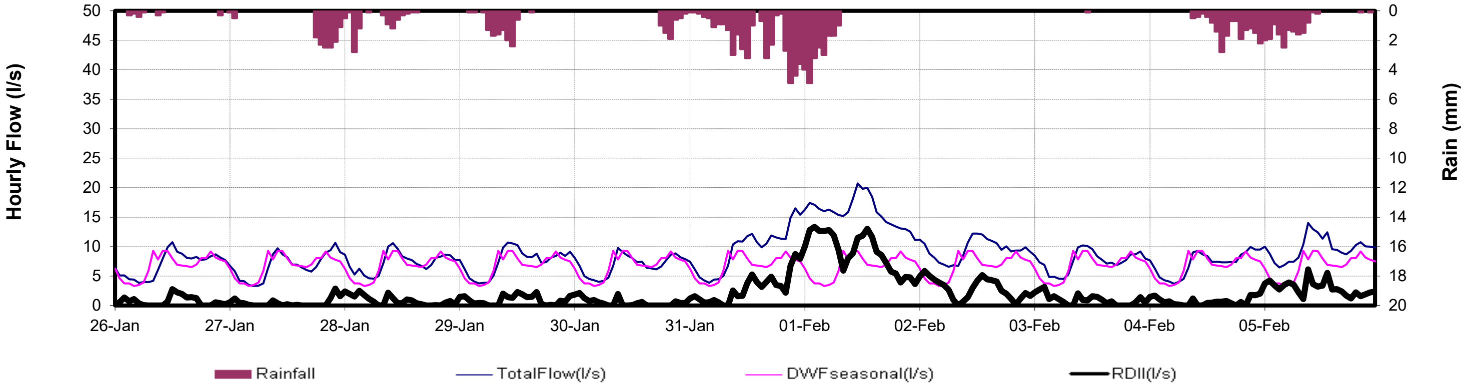
December 7 to December 17, 2018 Storm Events



December 28 to January 7, 2019 Storm Events

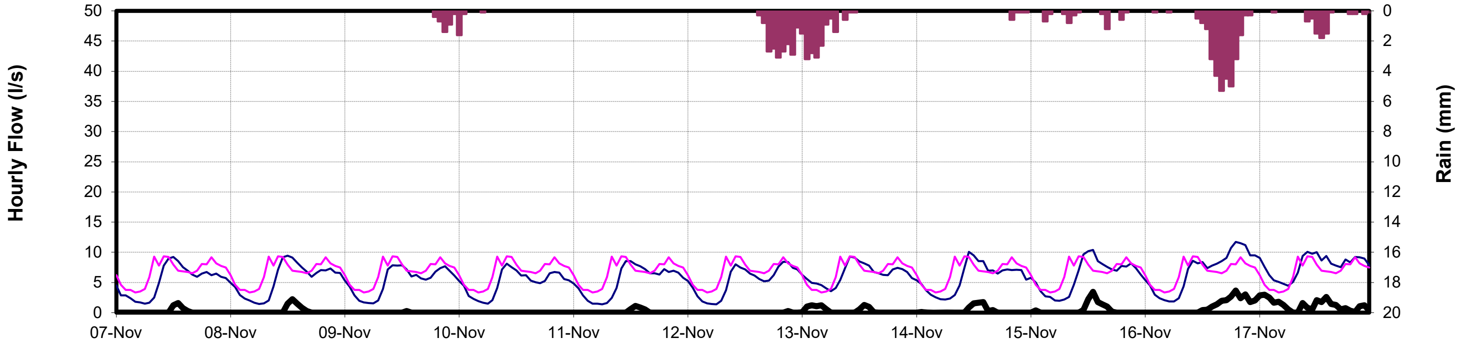


January 26 to February 5, 2020 Storm Events

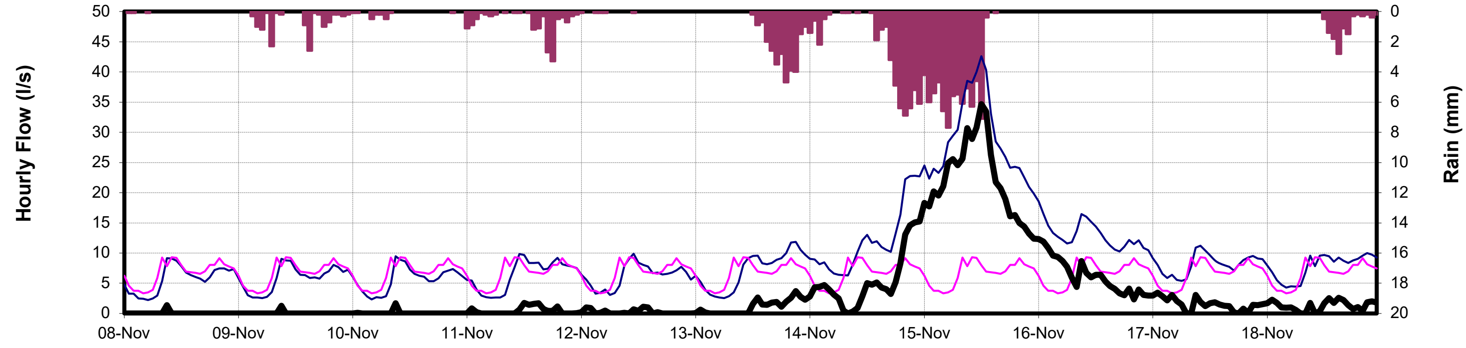


Ebor (NS5)

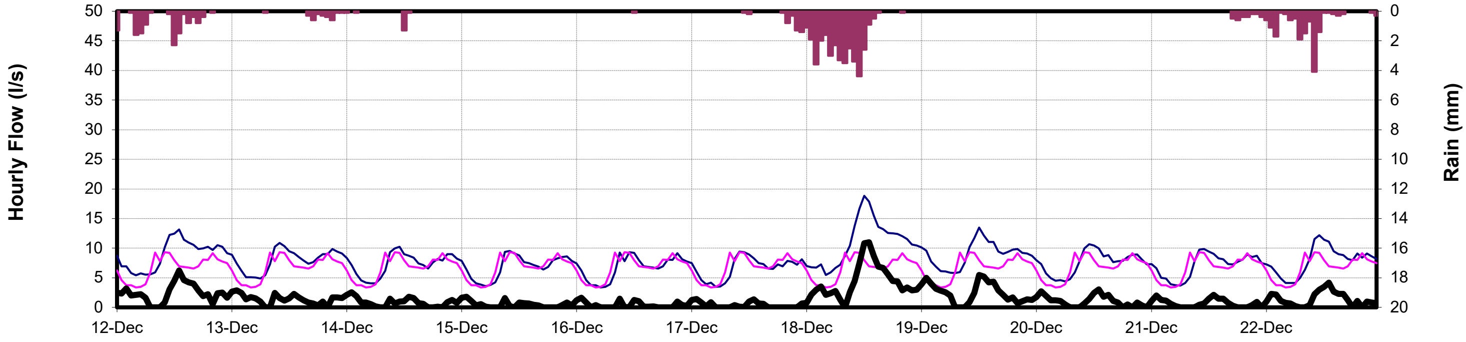
November 7 to November 17, 2020 Storm Events



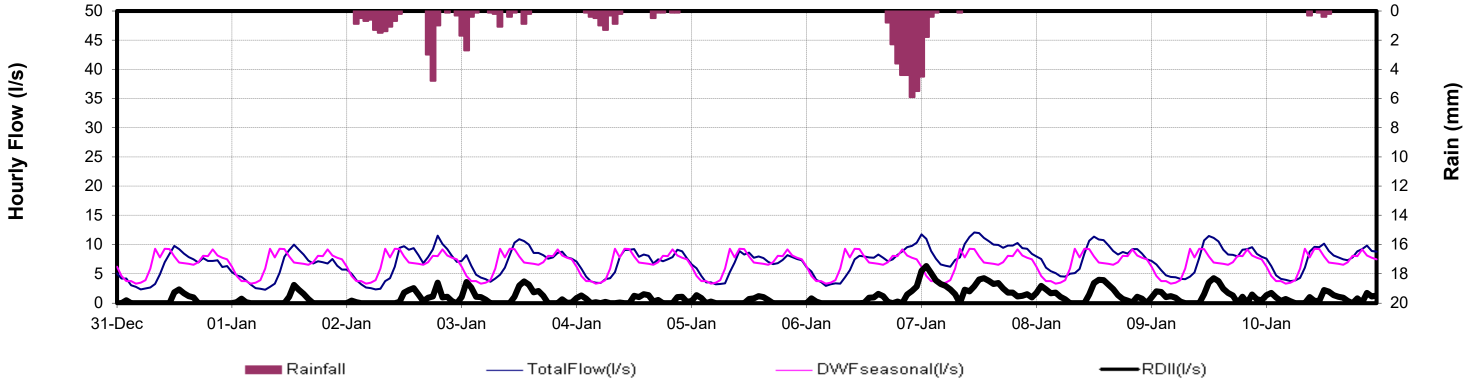
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

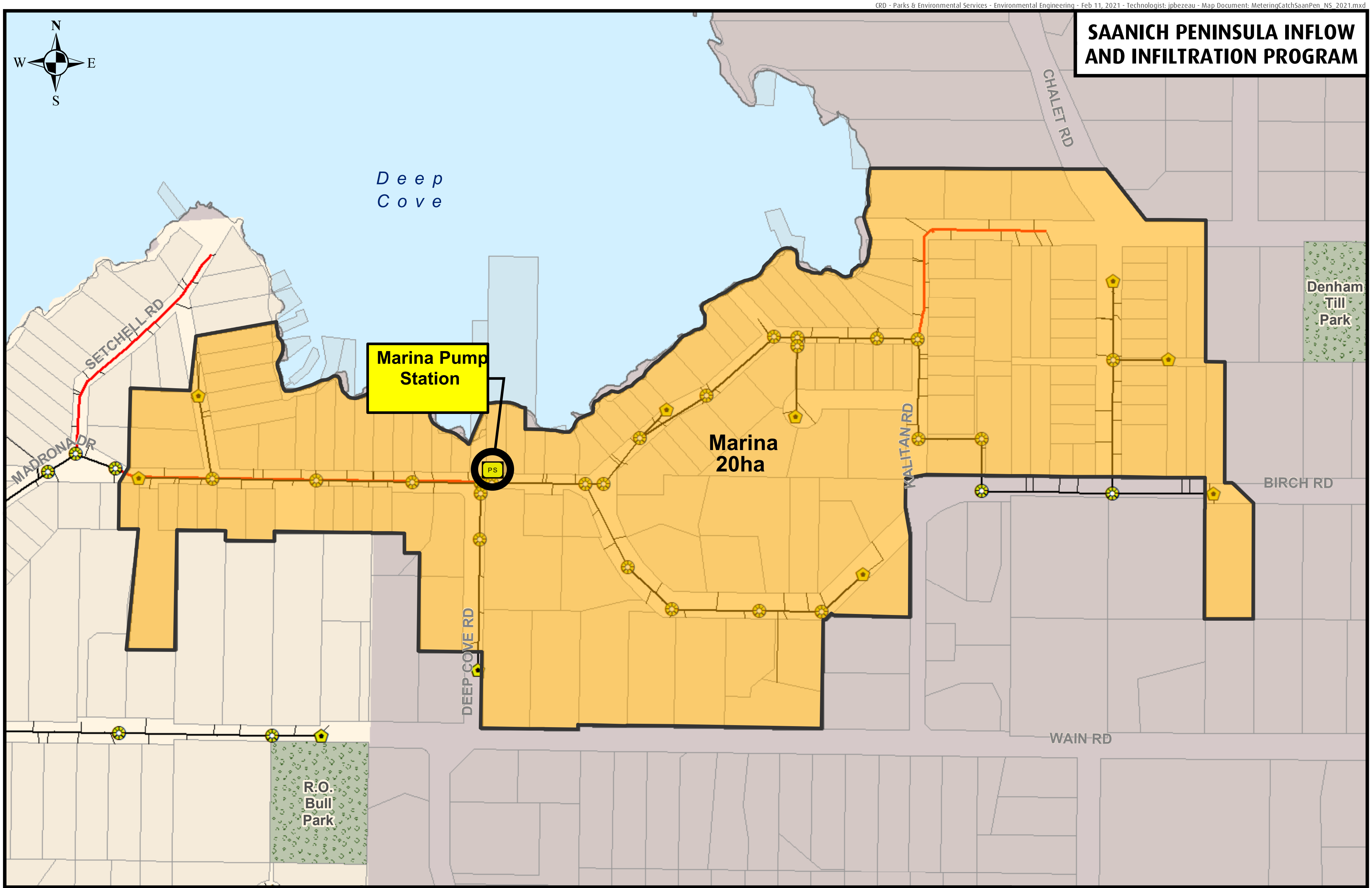


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 55 110 220

Projection: UTM ZONE 10N, NAD83

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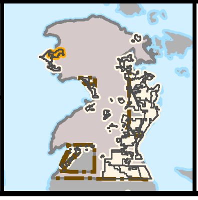
○ Flow Monitoring Location
Manhole
Cleanout
PS Pump Station
Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

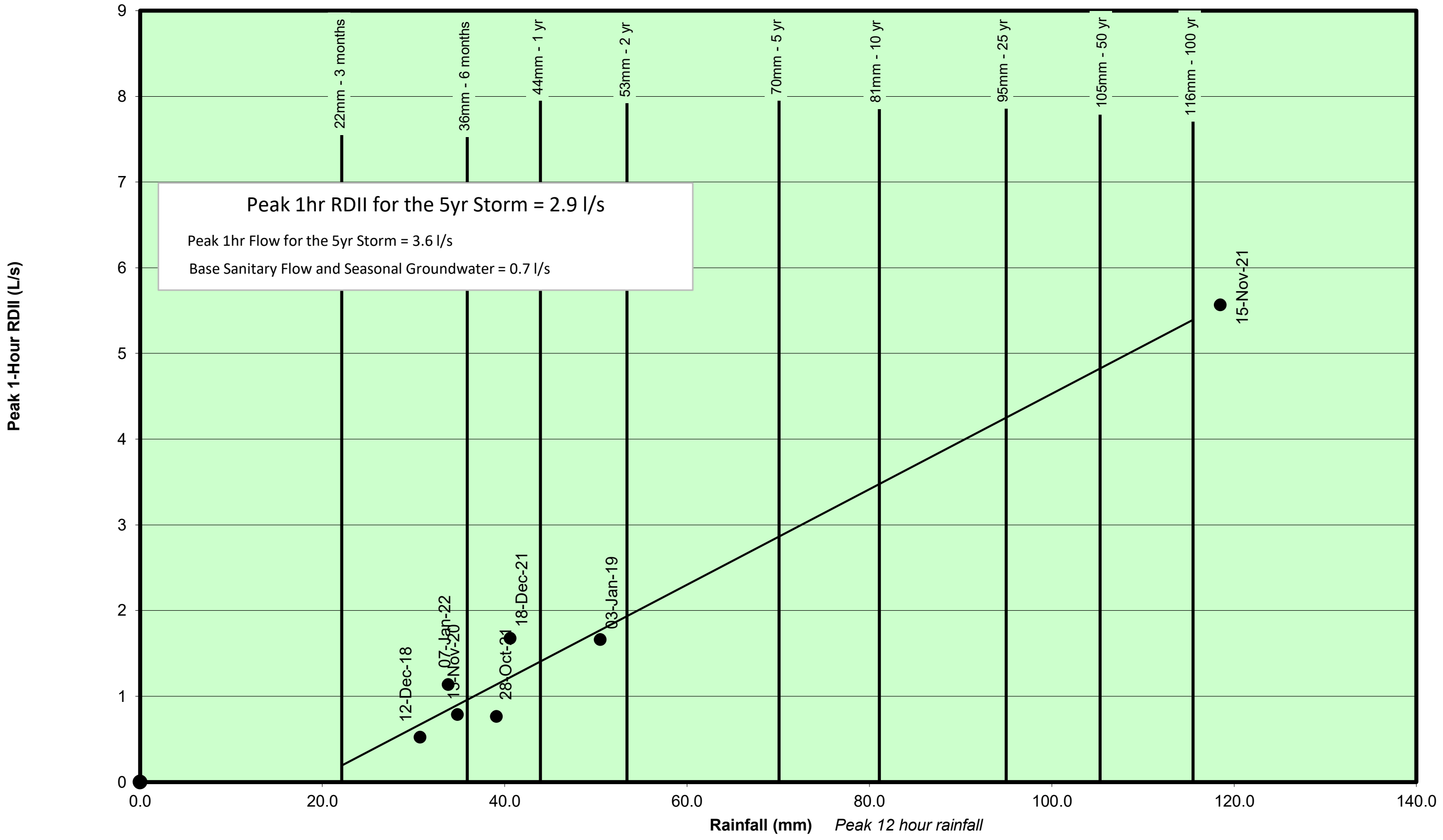
Catchment: Marina

Site Code: NS6

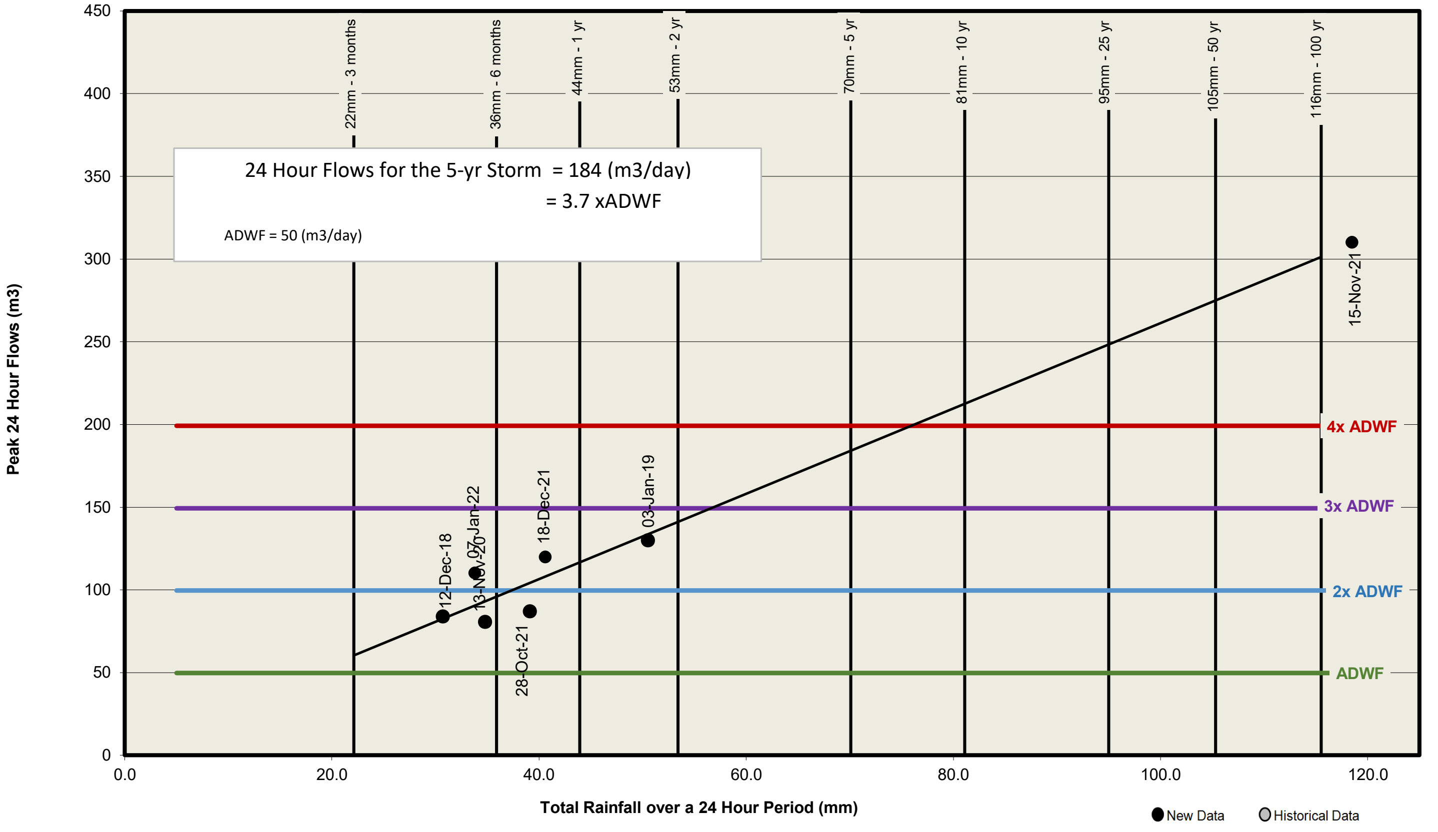
CRD
Making a difference...together

Marina (NS6)

Peak 1-hr RDII by Storm Event

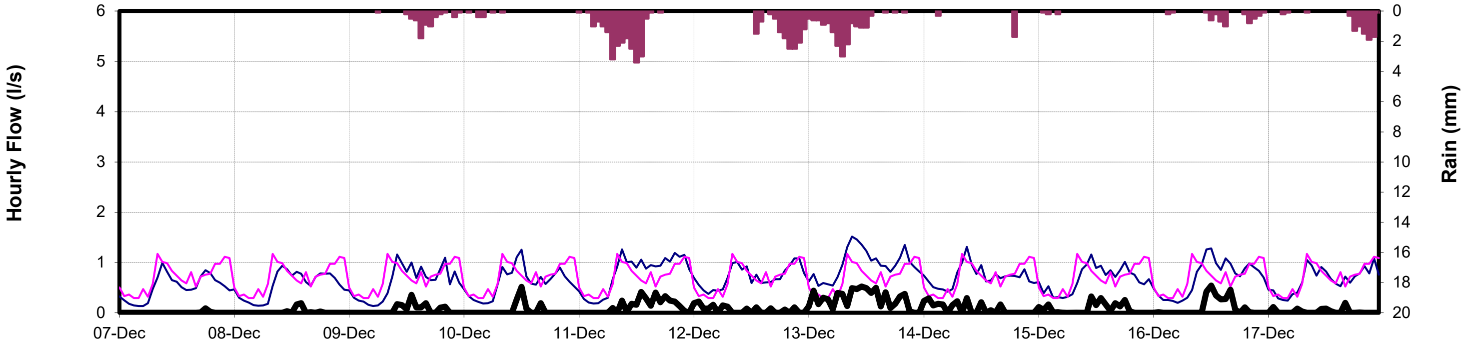


Peak 24-Hour Flows by Storm Event

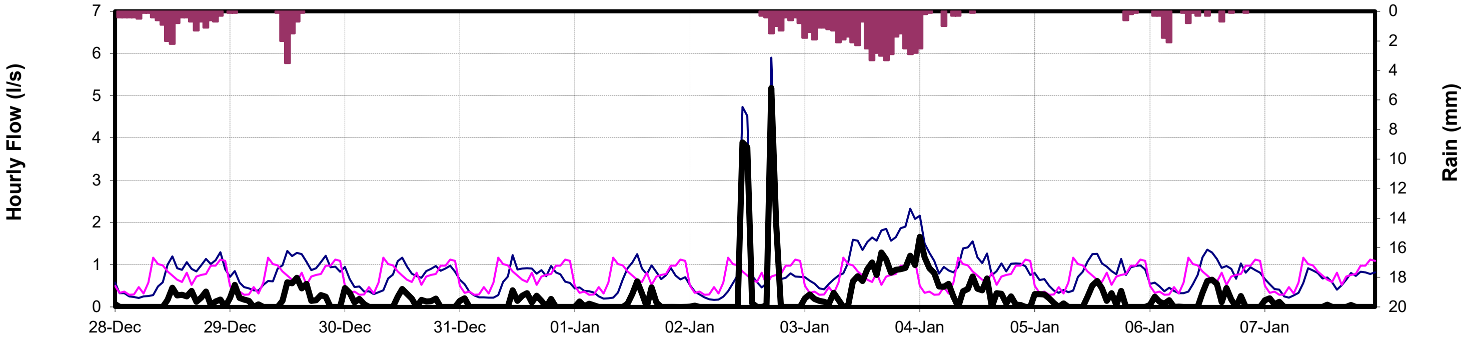


Marina (NS6)

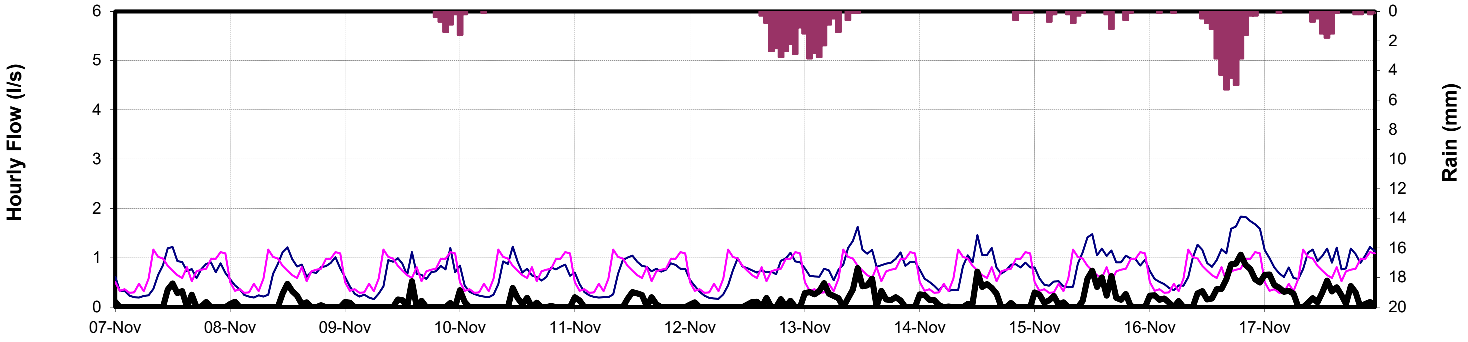
December 7 to December 17, 2018 Storm Events



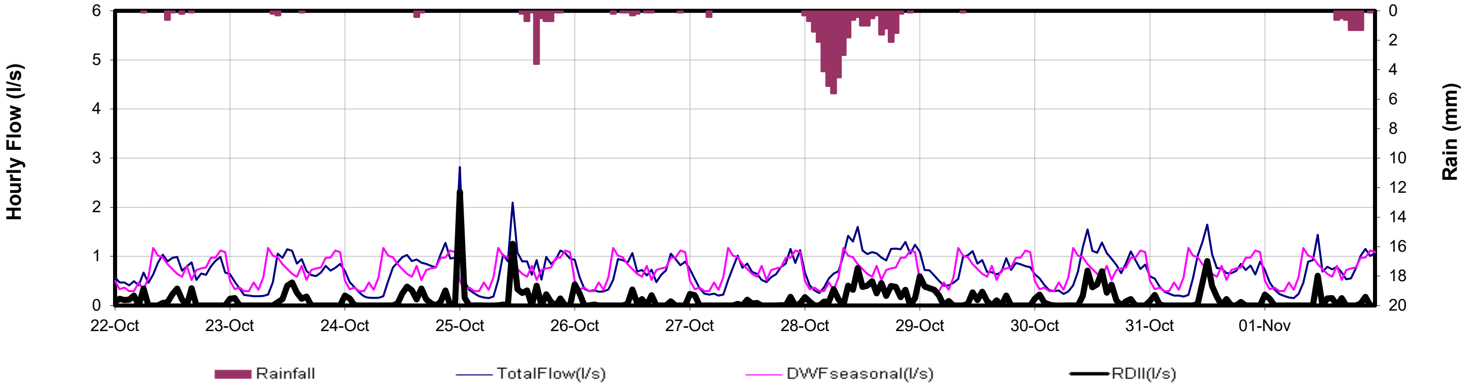
December 28 to January 7, 2019 Storm Events



November 7 to November 17, 2020 Storm Events

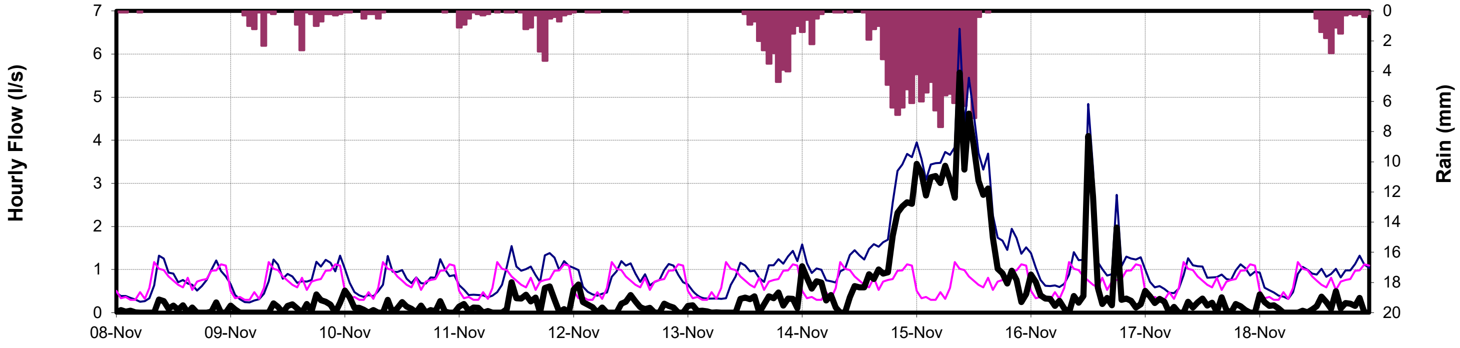


October 22 to November 1, 2021 Storm Events

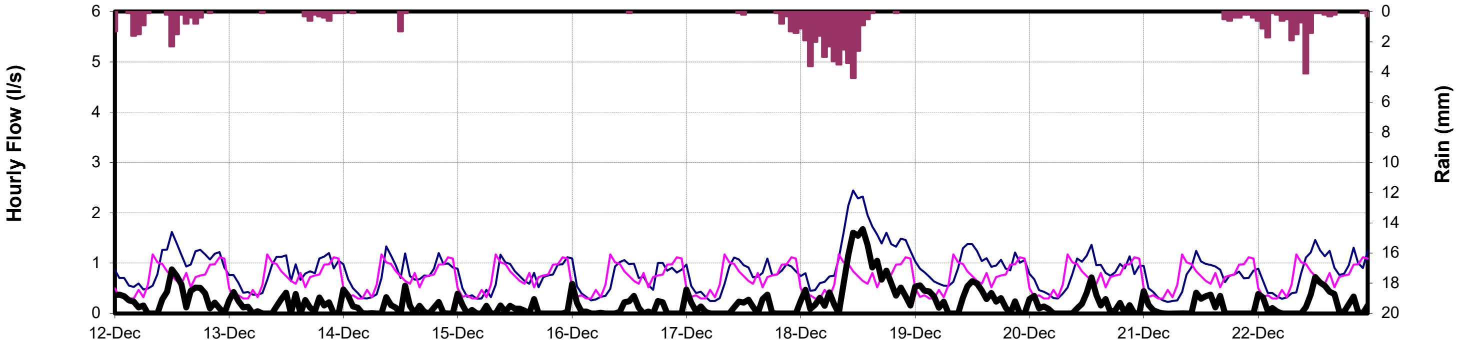


Marina (NS6)

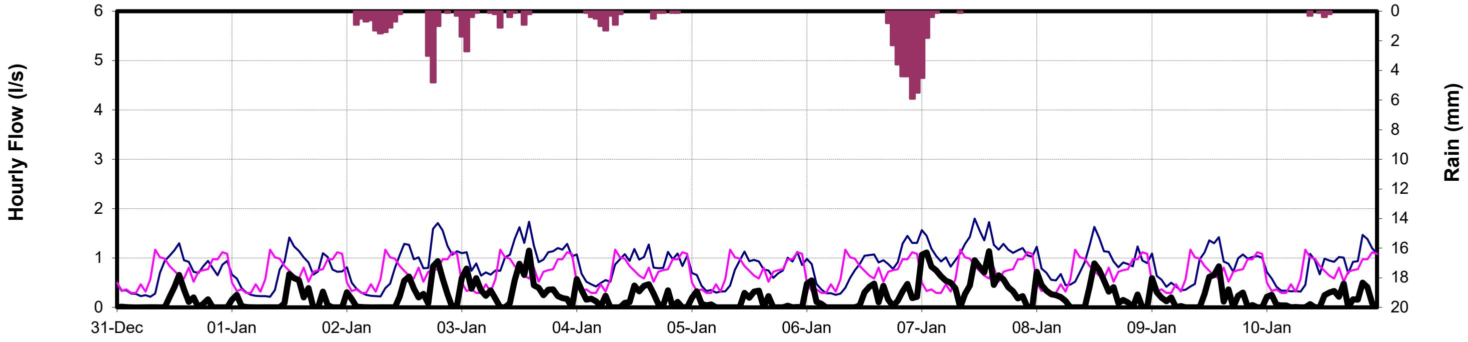
November 8 to November 18, 2021 Storm Events

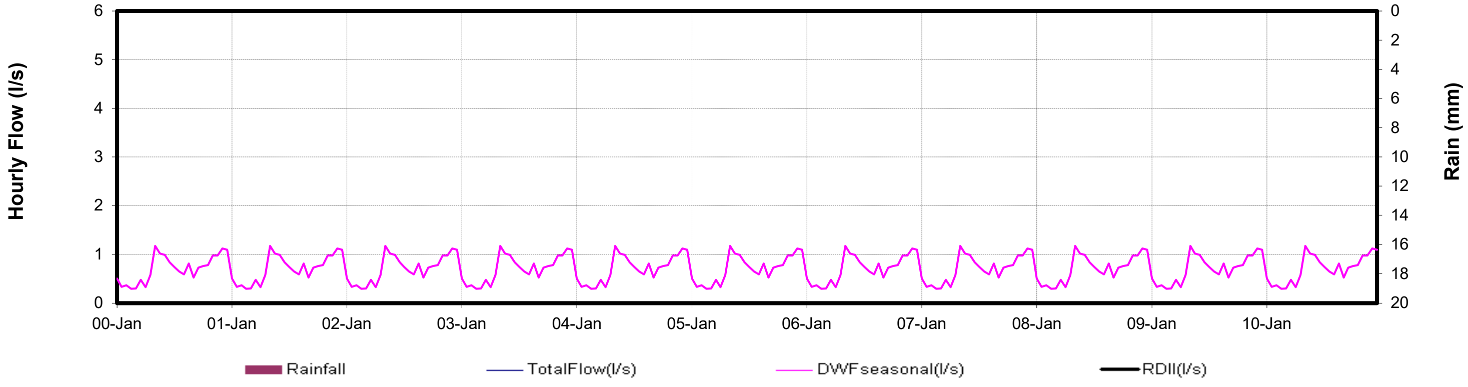


December 12 to December 22, 2021 Storm Events



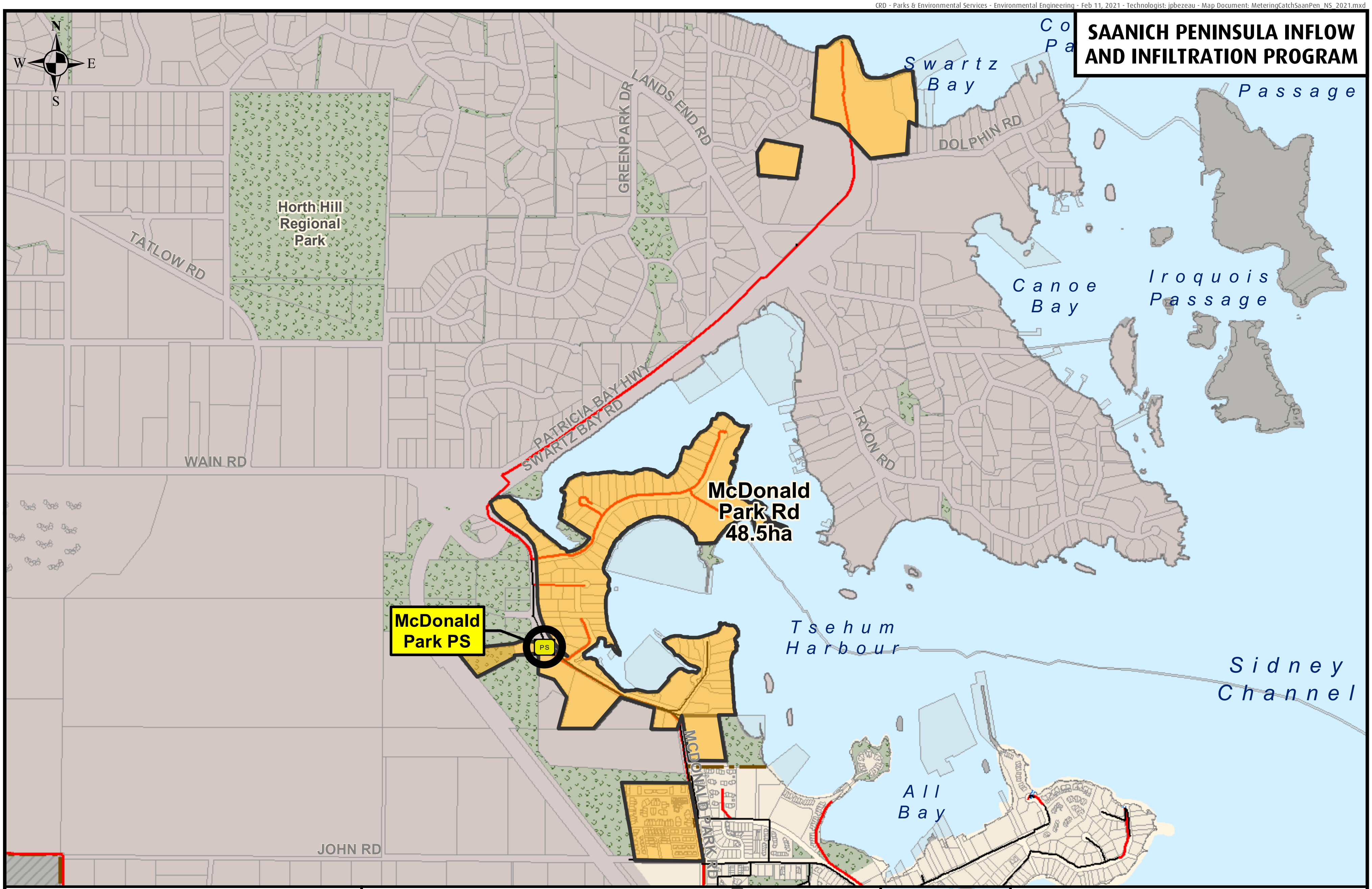
December 31 to January 10, 2022 Storm Events





CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



0 225 450 900 Metres

Projection: UTM ZONE 10N, NAD83

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- ❂ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◘ Metering Chamber

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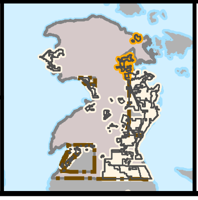


FLOW MONITORING AREA

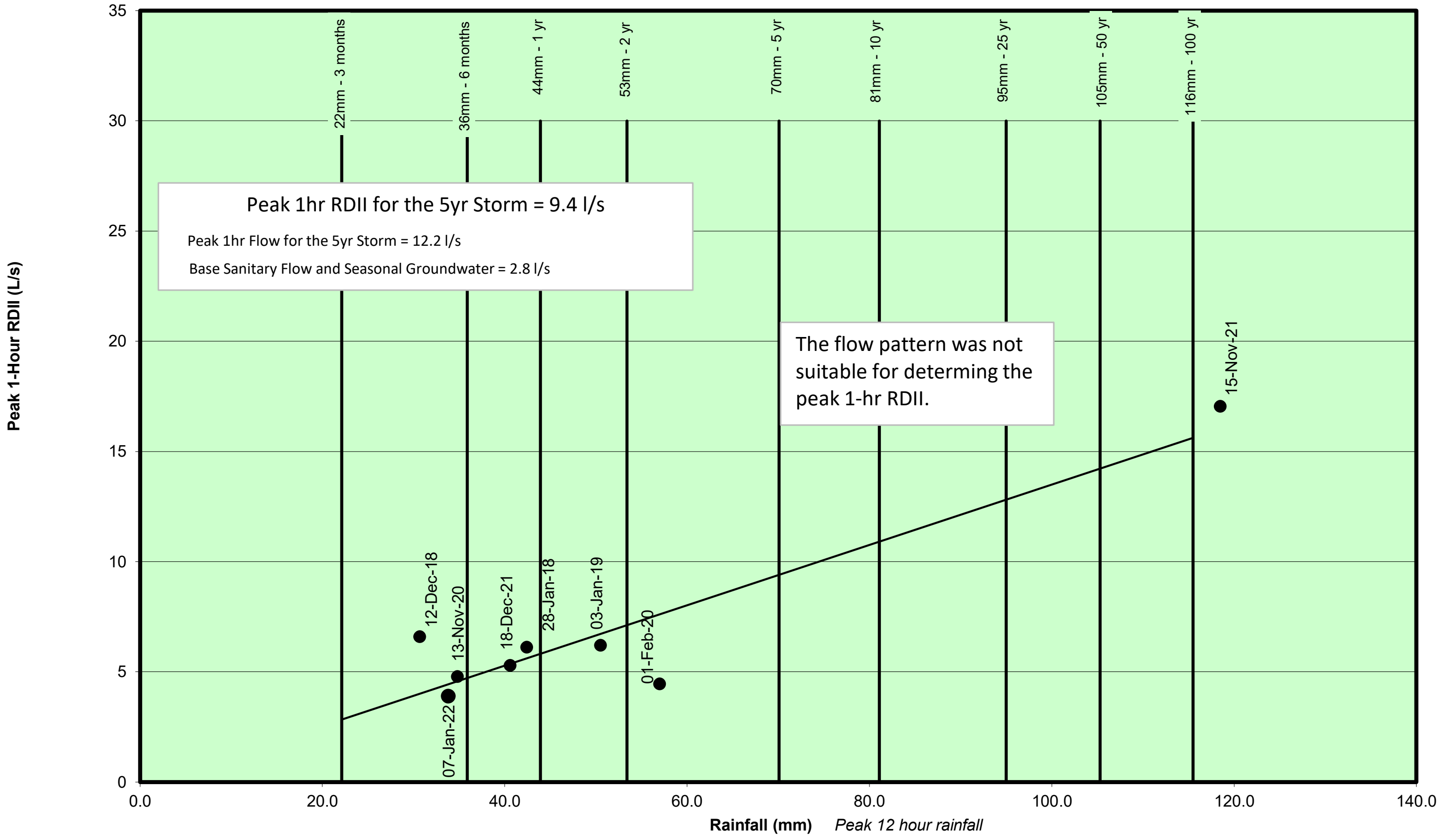
Catchment: McDonald Park Rd

Site Code: NS7

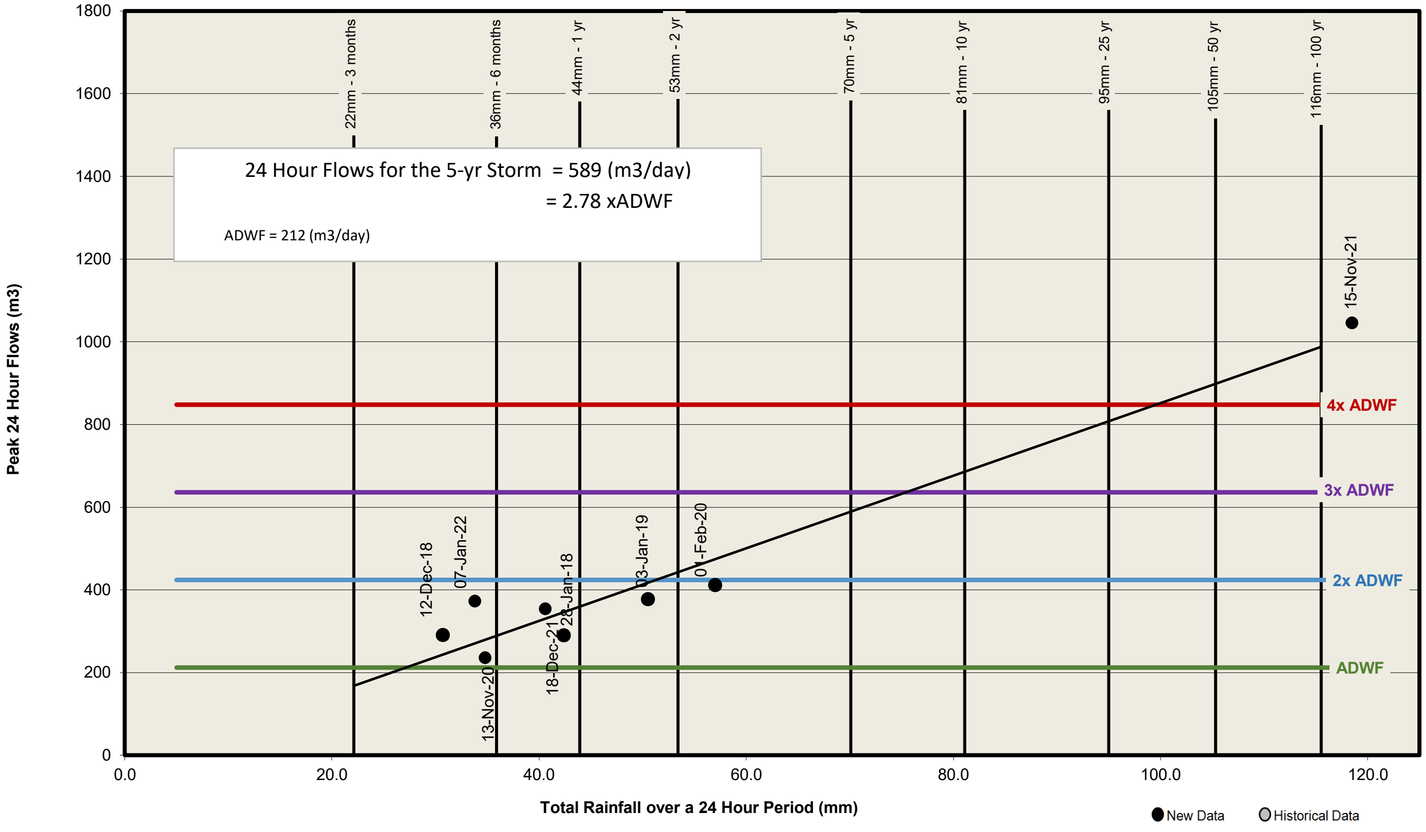
Making a difference...together

McDonald (NS7)

Peak 1-hr RDII by Storm Event

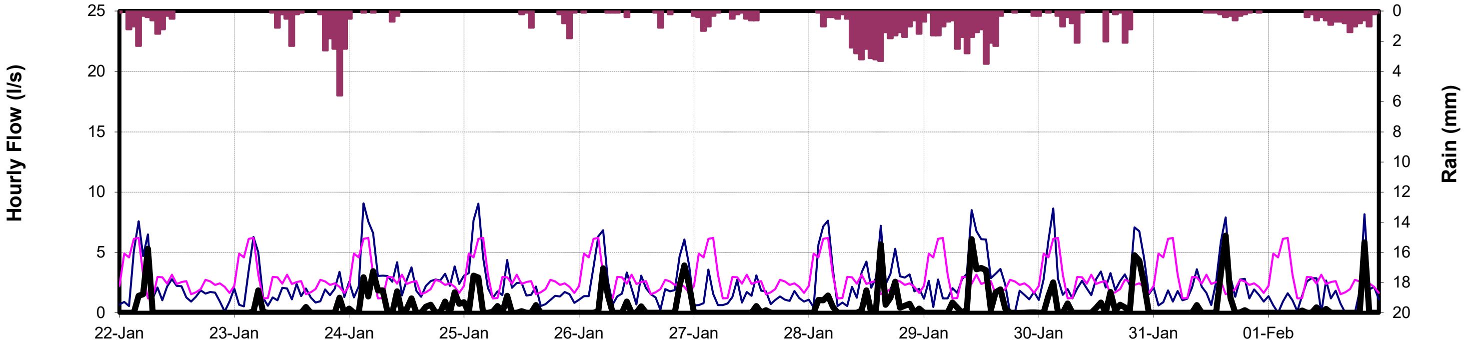


Peak 24-Hour Flows by Storm Event

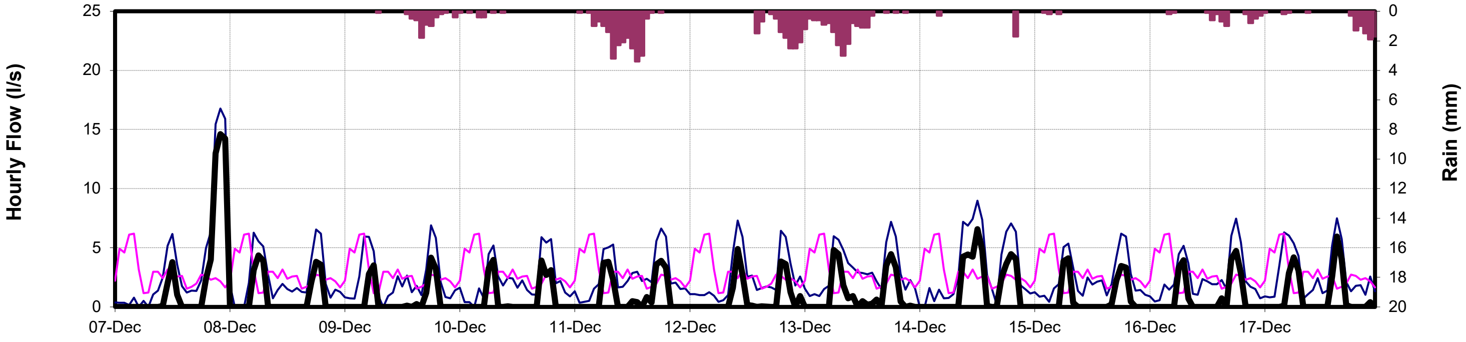


McDonald (NS7)

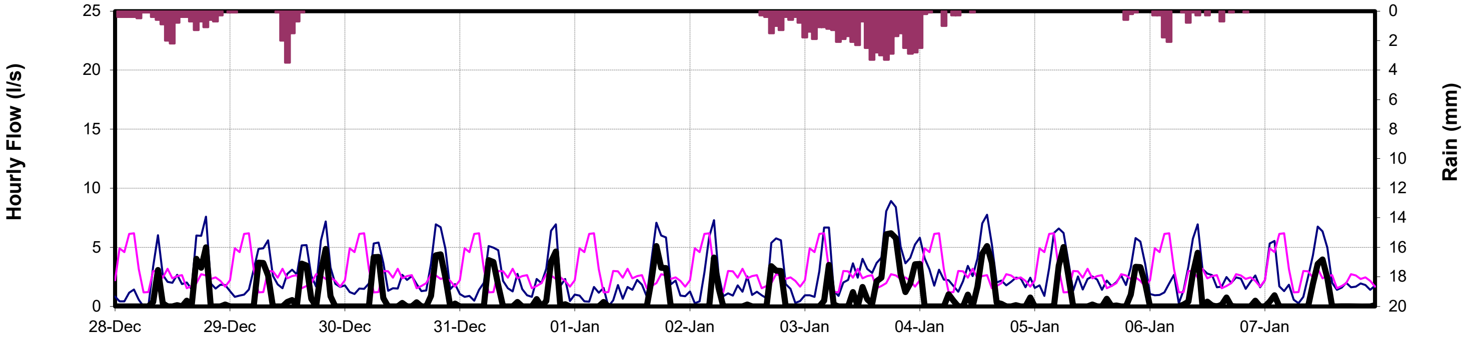
January 22 to February 1, 2018 Storm Events



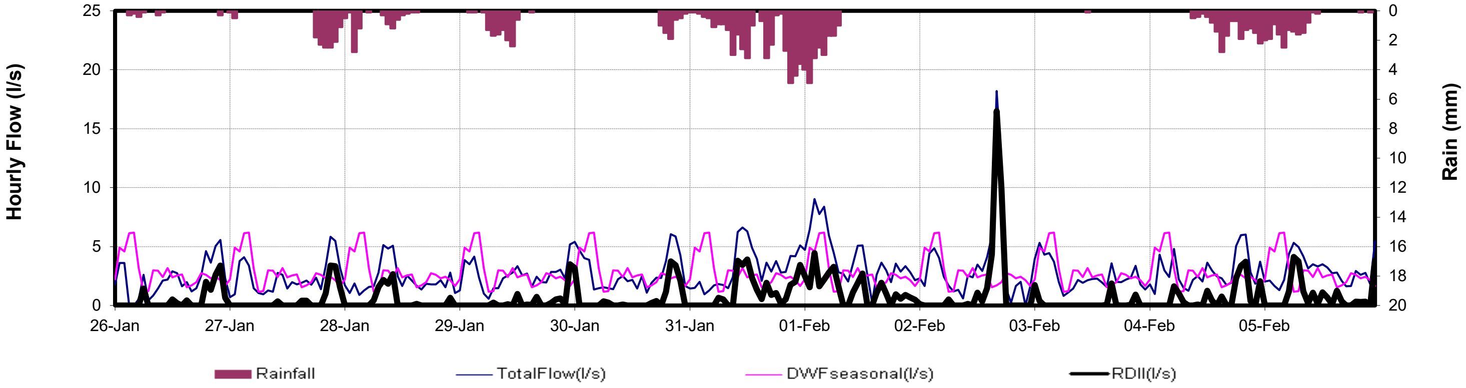
December 7 to December 17, 2018 Storm Events



December 28 to January 7, 2019 Storm Events

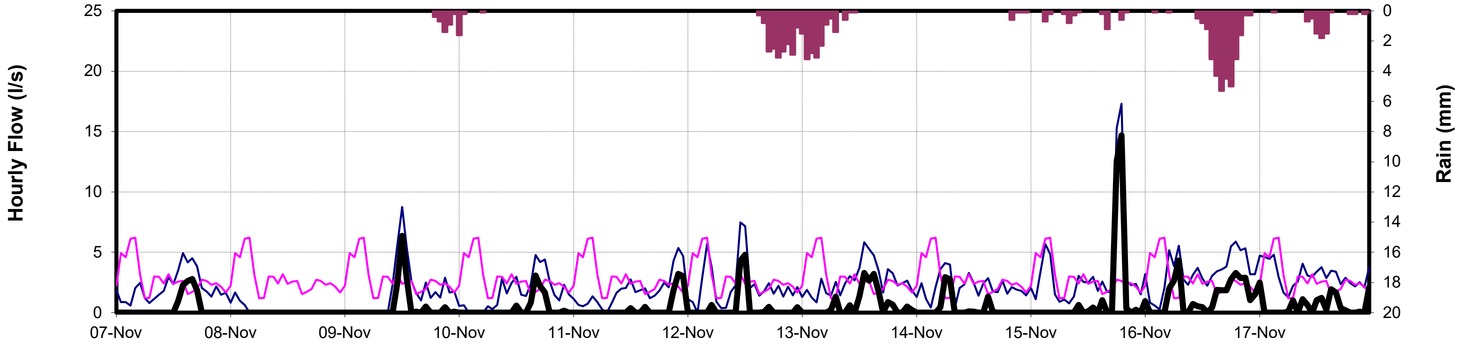


January 26 to February 5, 2020 Storm Events

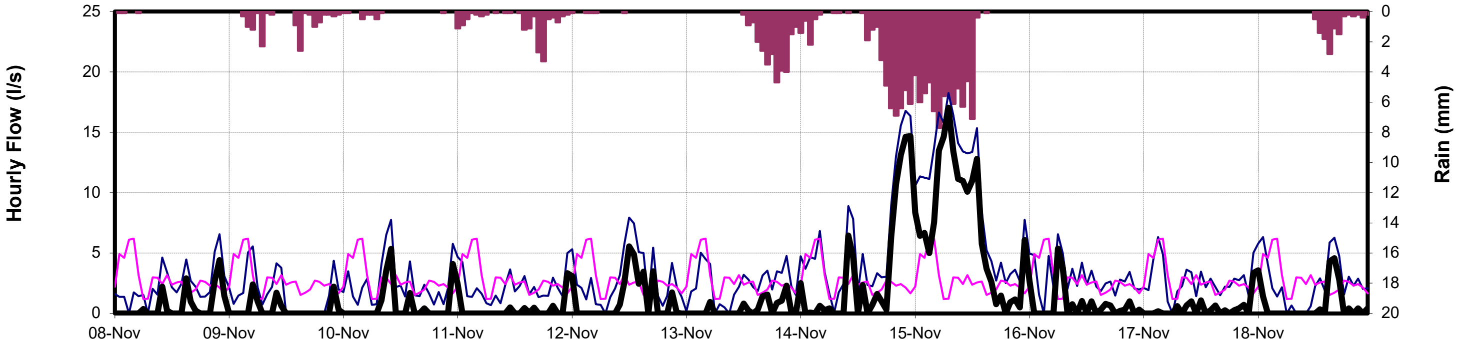


McDonald (NS7)

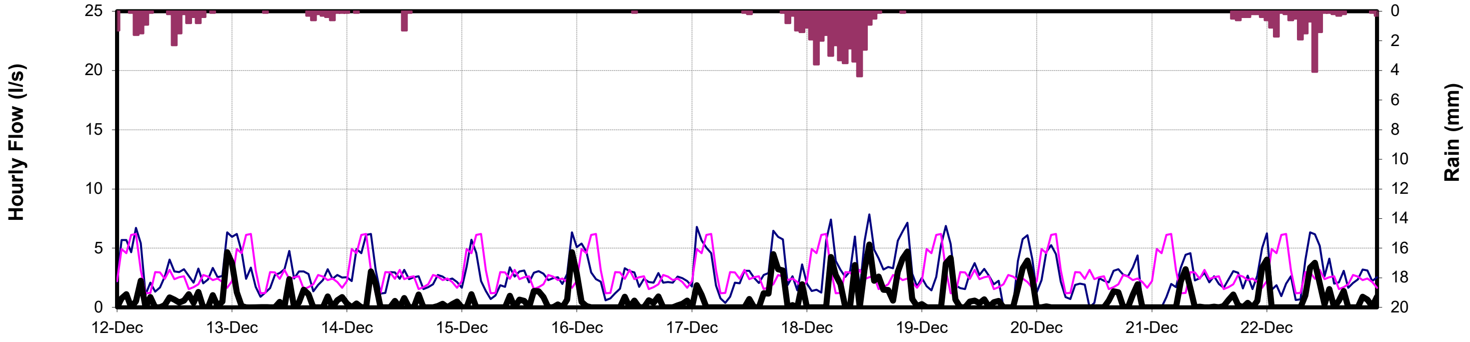
November 7 to November 17, 2020 Storm Events



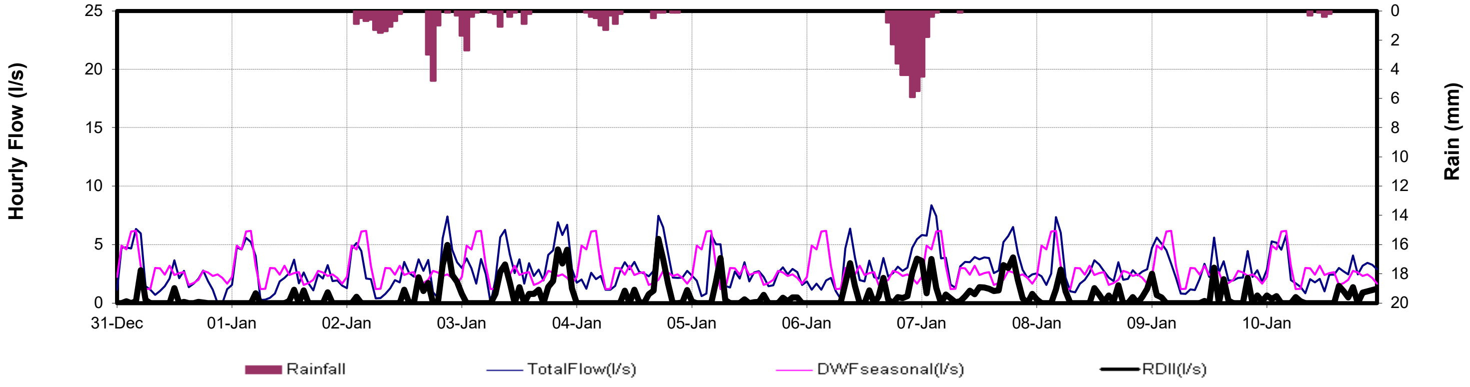
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

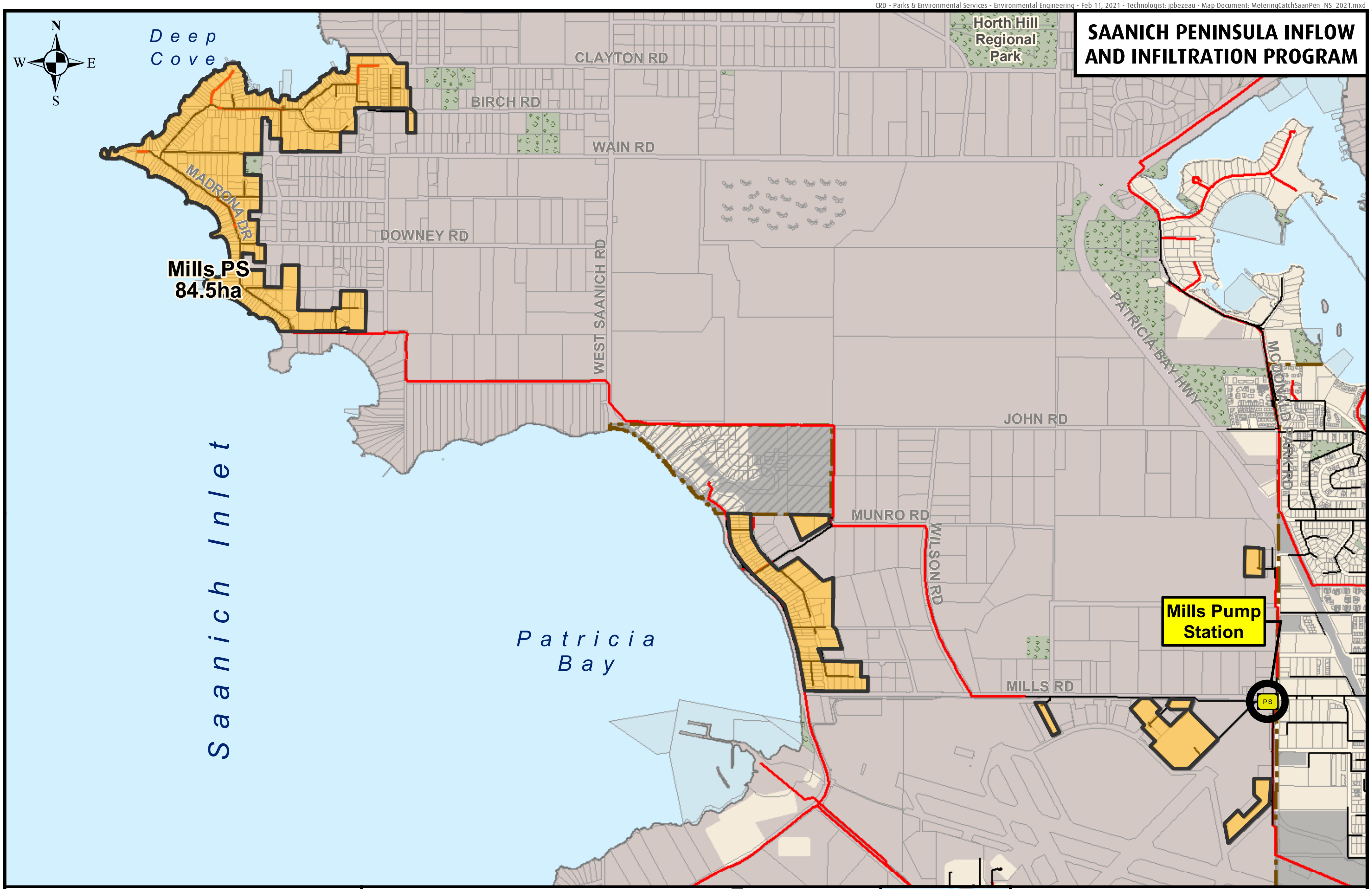


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 325 650 1,300

Projection: UTM ZONE 10N, NAD83

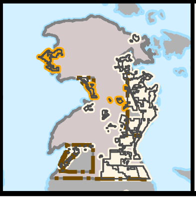
Disclaimer
This map is for general information only and may contain inaccuracies.

- ○ Flow Monitoring Location
- ✲ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◙ Metering Chamber

Sanitary Sewers

- ― Gravity Main Installed After 1930
- ― Gravity Main Installed Before 1930
- ― Force Main
- ═ Relief, Outfall, Overflow Sewer
- ― CRD Sewer

- ▨ Catchment Area
- ▨ Non-Sewered Area
- ☐ Lot Lines
- ▨ Parks
- ▨ Sewered Park Areas
- - - Catchment Boundary
- -·- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

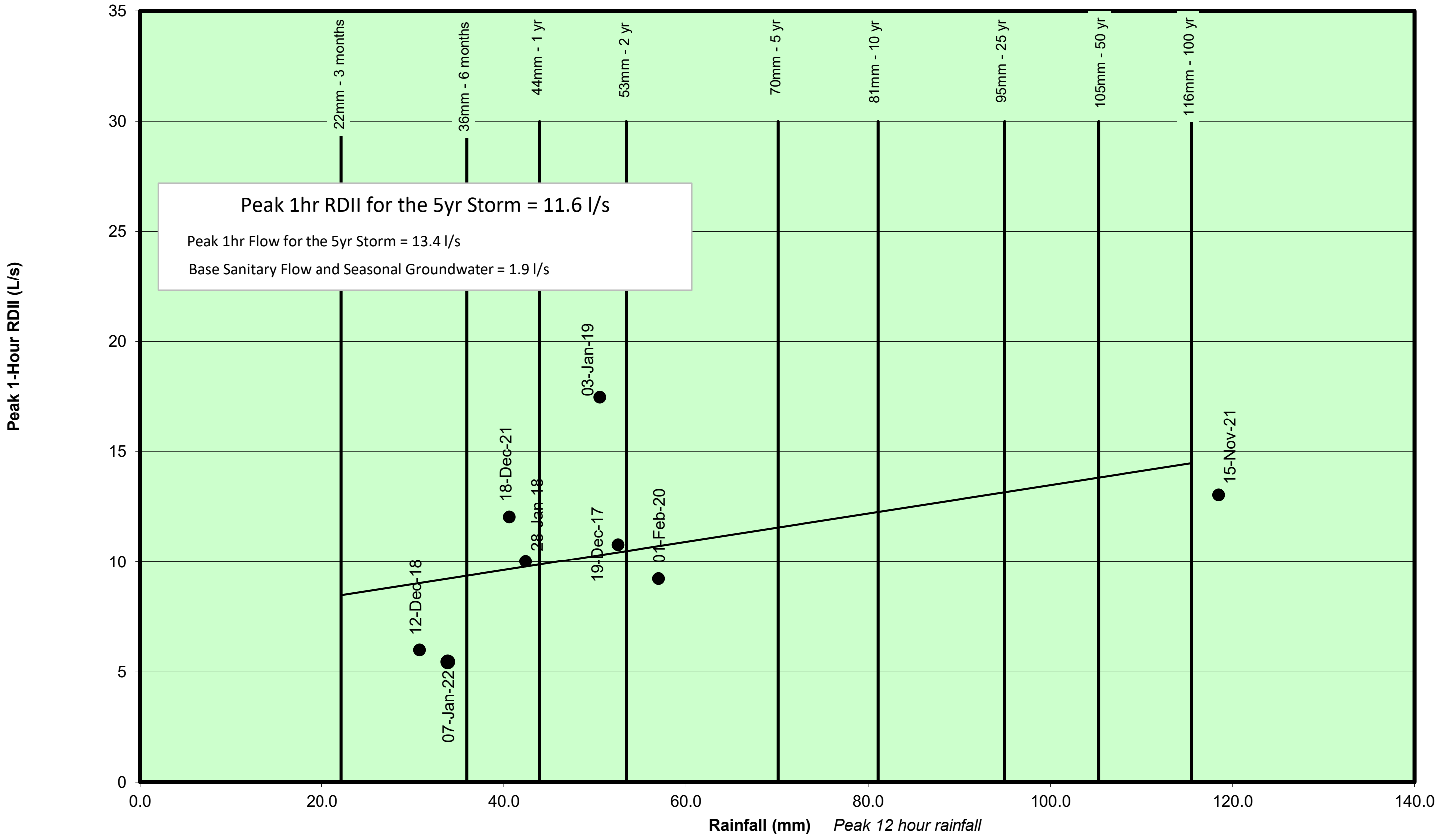
Catchment: Mills PS

Site Code: NS8

CRD
Making a difference...together

Mills PS (NS8)

Peak 1-hr RDII by Storm Event

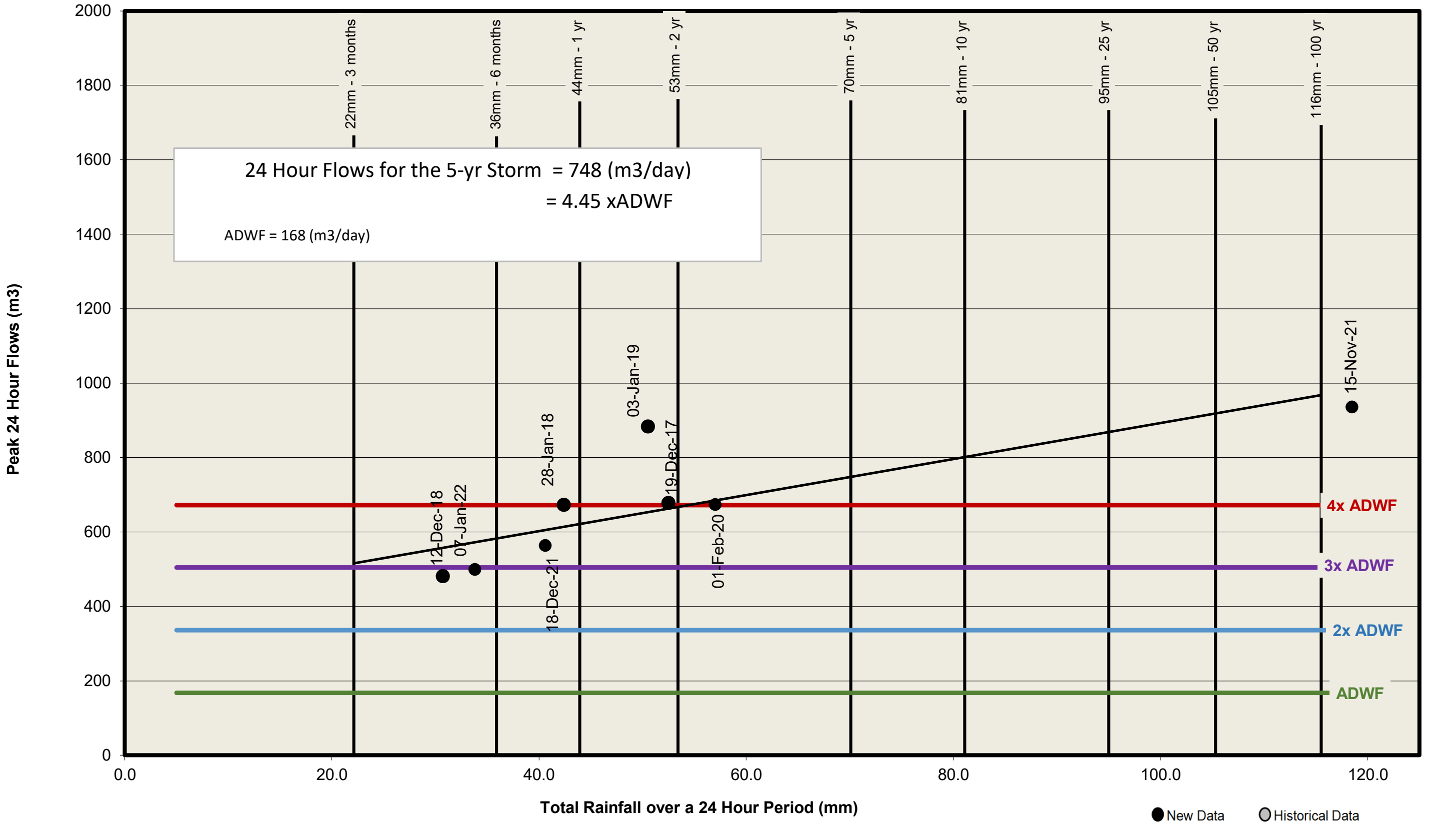


Peak 1hr RDII for the 5yr Storm = 11.6 l/s

Peak 1hr Flow for the 5yr Storm = 13.4 l/s

Base Sanitary Flow and Seasonal Groundwater = 1.9 l/s

Peak 24-Hour Flows by Storm Event

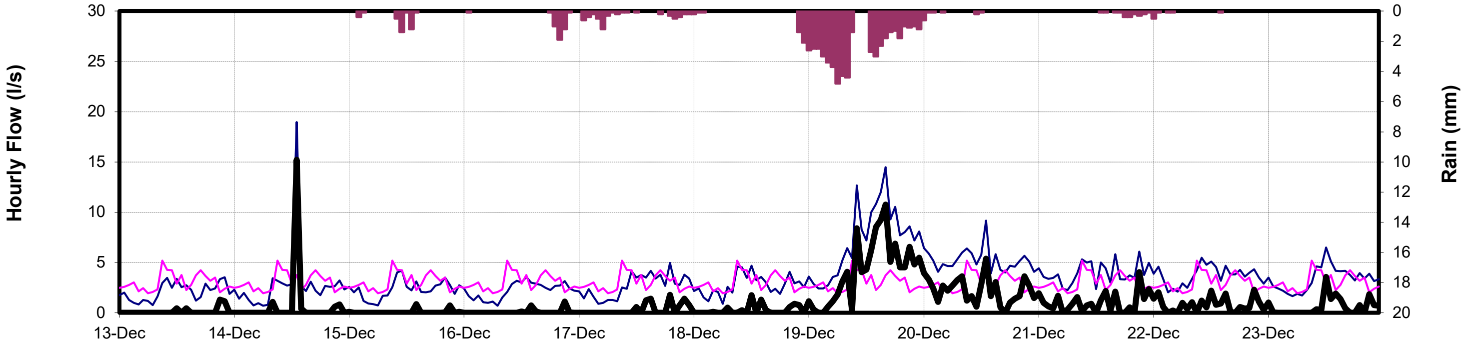


24 Hour Flows for the 5-yr Storm = 748 (m3/day)
= 4.45 xADWF

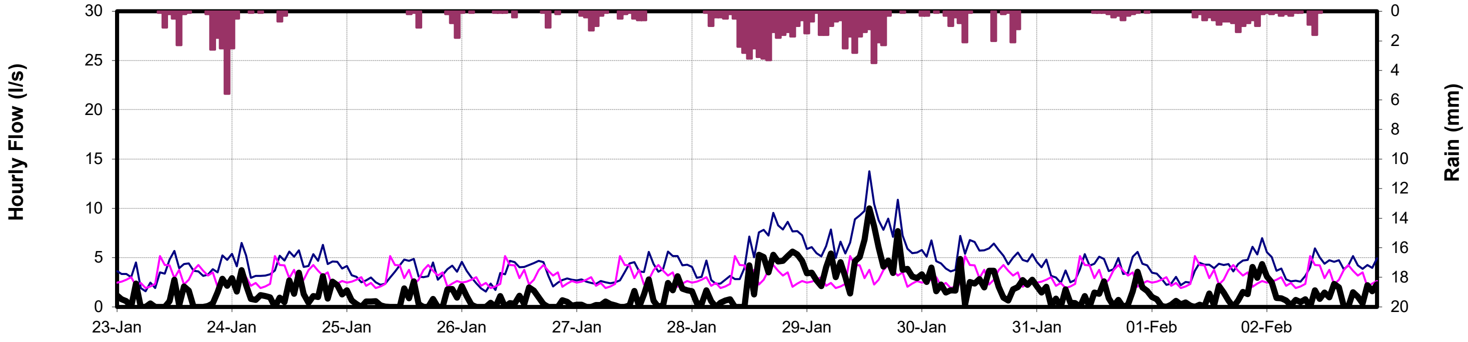
ADWF = 168 (m3/day)

Mills PS (NS8)

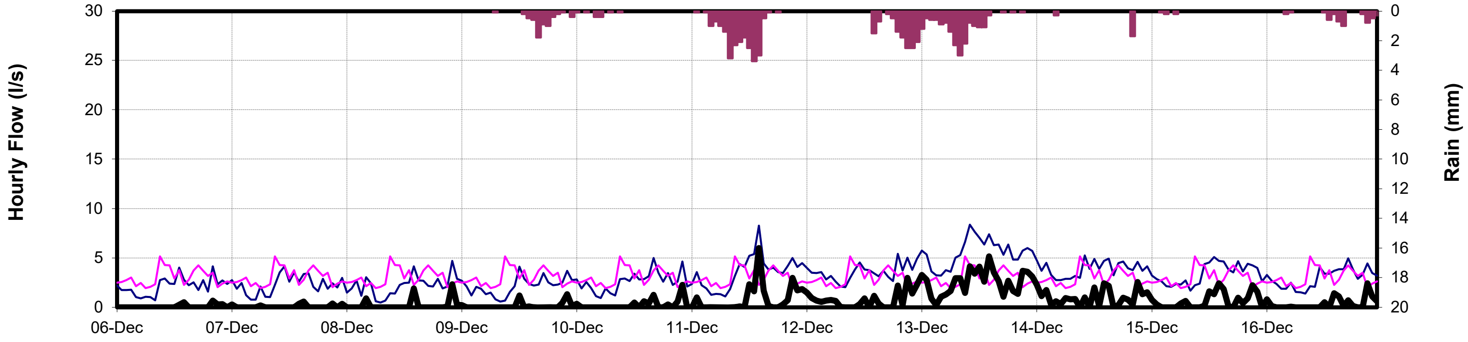
December 13 to December 23, 2017 Storm Events



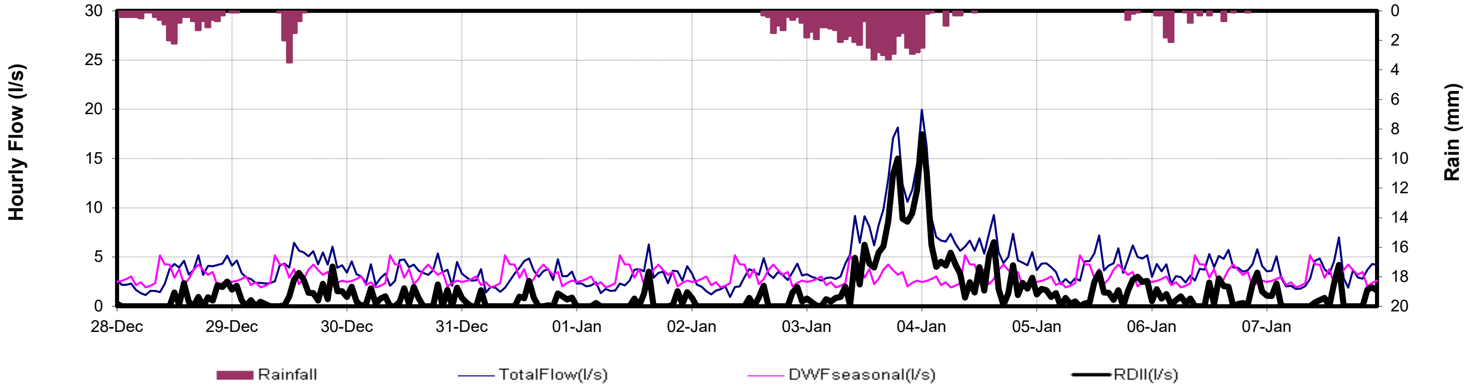
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

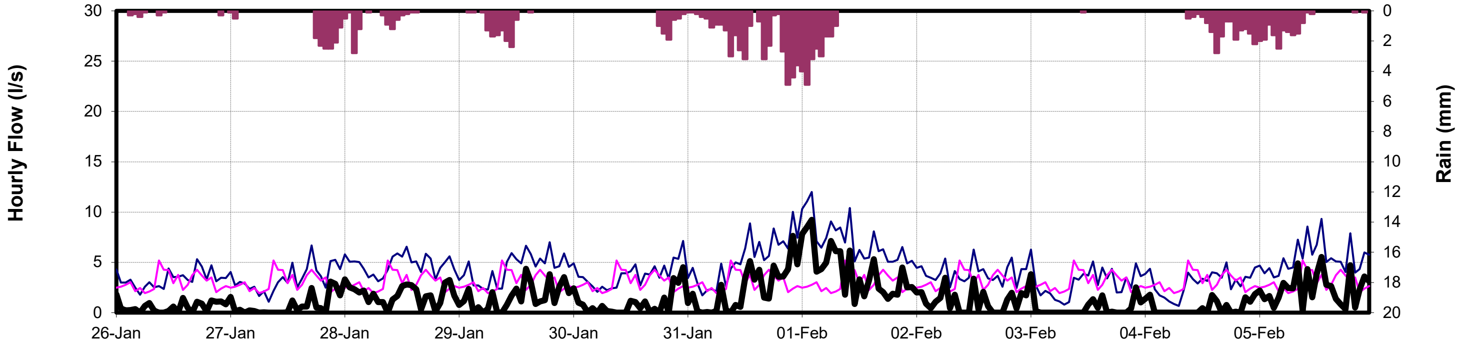


December 28 to January 7, 2019 Storm Events

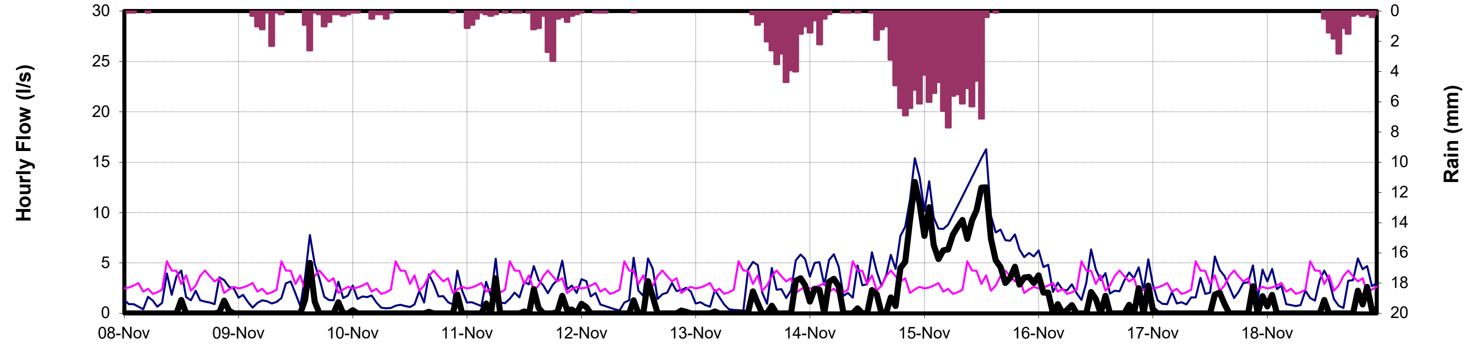


Mills PS (NS8)

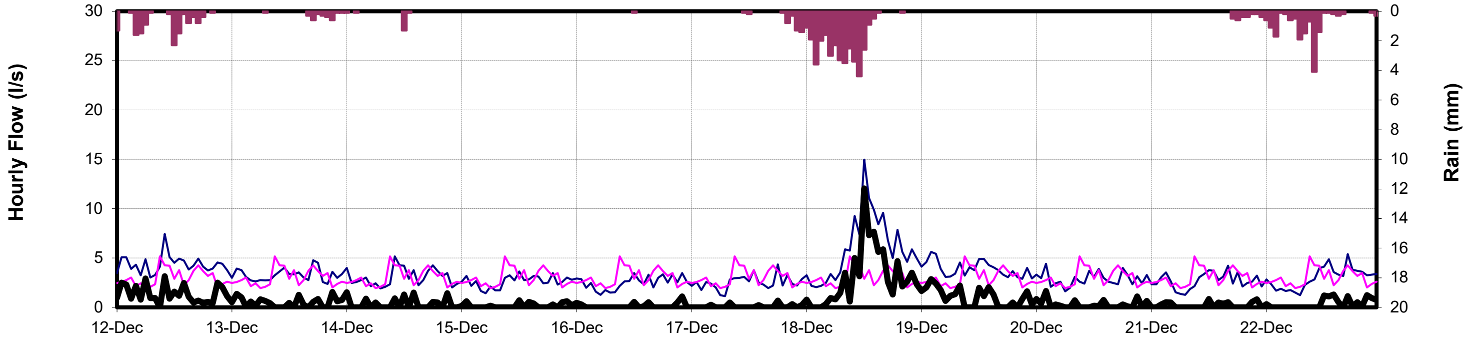
January 26 to February 5, 2020 Storm Events



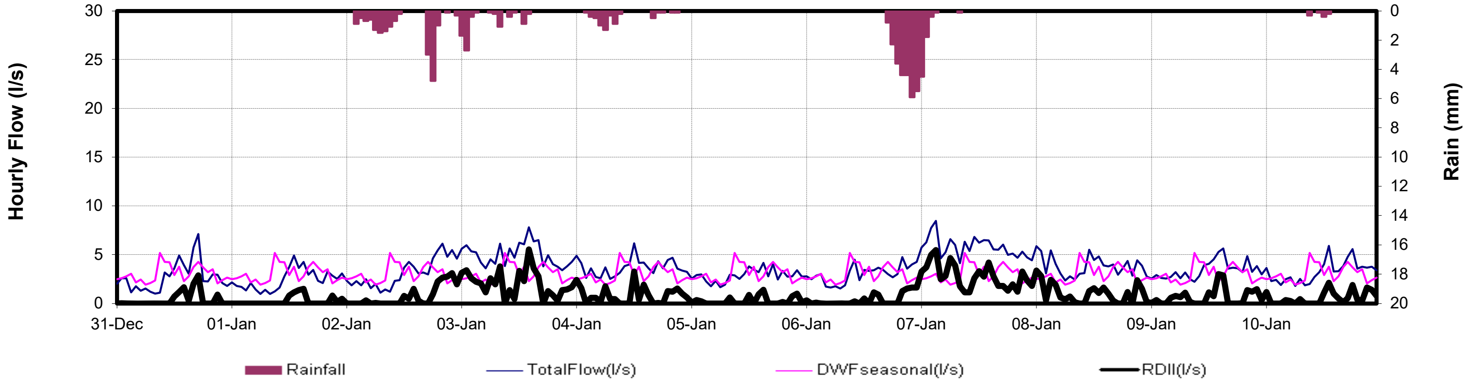
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

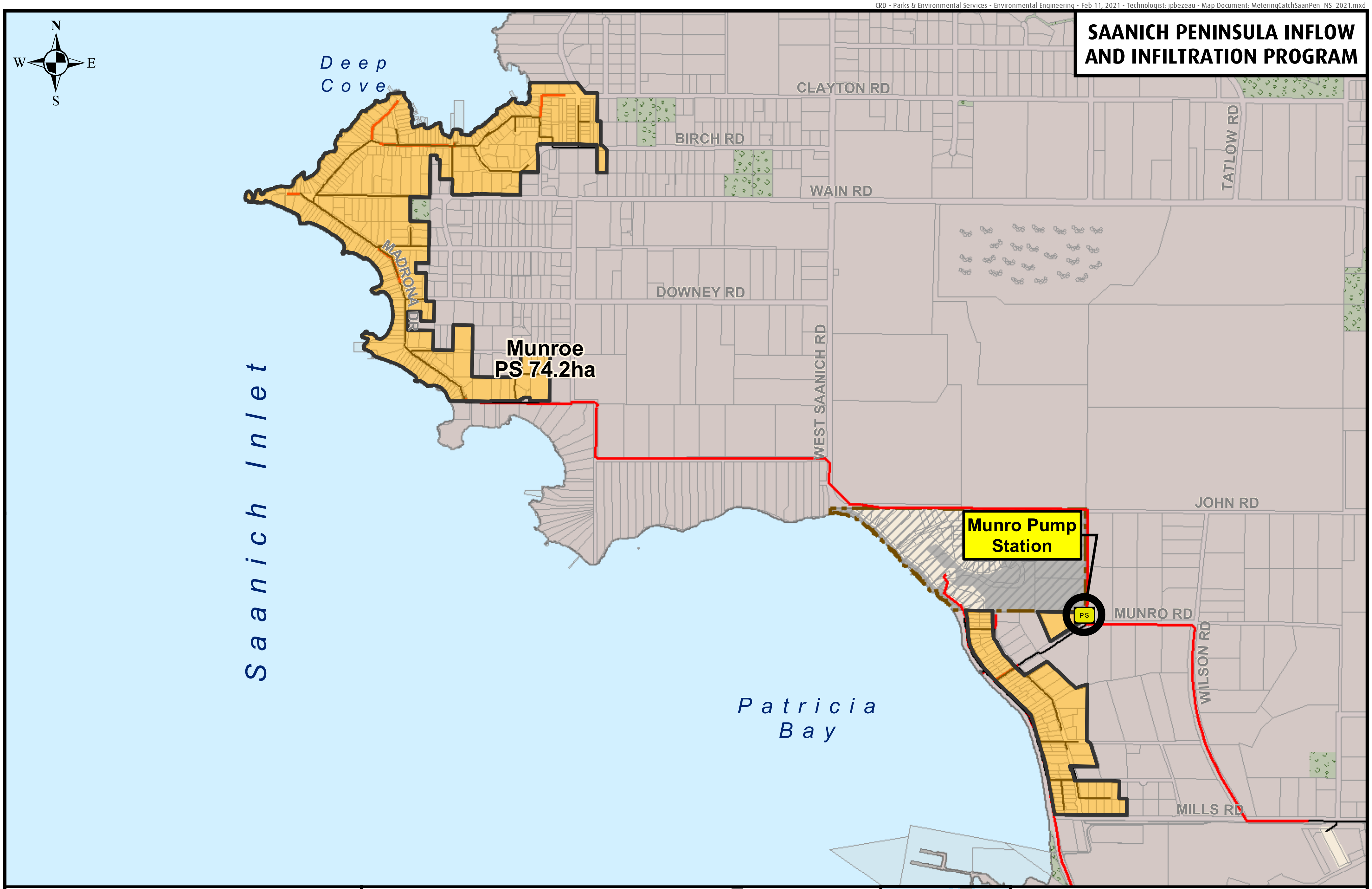


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 285 570 1,140

Projection: UTM ZONE 10N, NAD83

Disclaimer
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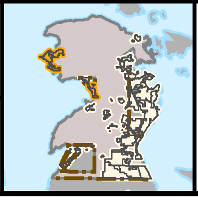
○ Flow Monitoring Location
Manhole
Cleanout
PS Pump Station
Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries



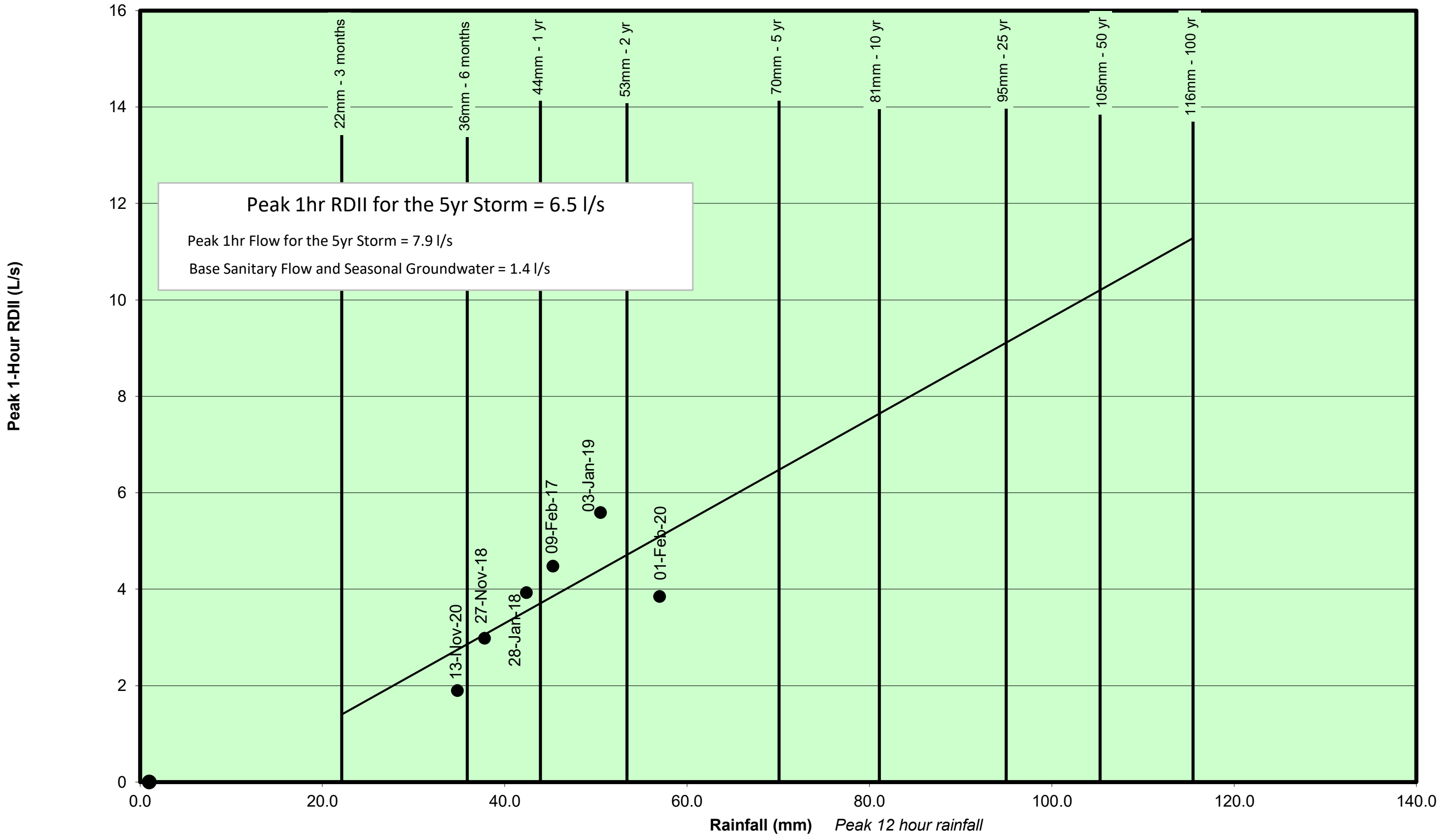
FLOW MONITORING AREA

Catchment: Munroe PS
Site Code: NS9

Making a difference...together

Munro (NS9)

Peak 1-hr RDII by Storm Event

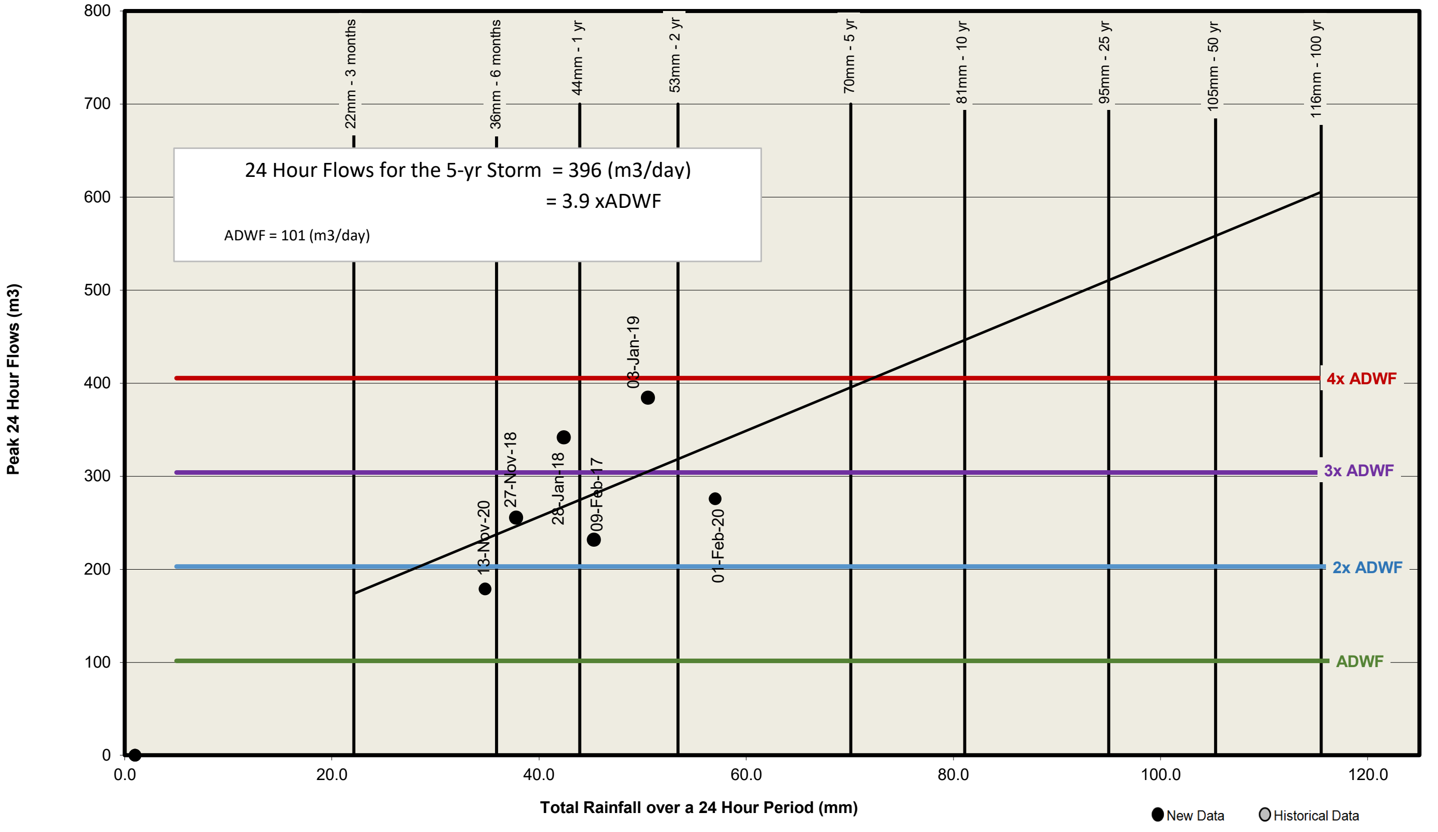


Peak 1hr RDII for the 5yr Storm = 6.5 l/s

Peak 1hr Flow for the 5yr Storm = 7.9 l/s

Base Sanitary Flow and Seasonal Groundwater = 1.4 l/s

Peak 24-Hour Flows by Storm Event



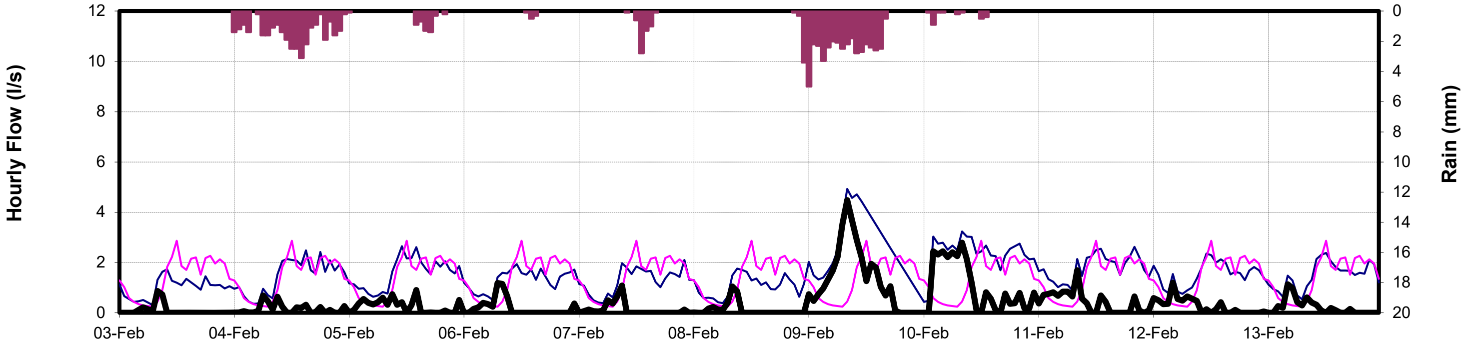
24 Hour Flows for the 5-yr Storm = 396 (m3/day)

= 3.9 xADWF

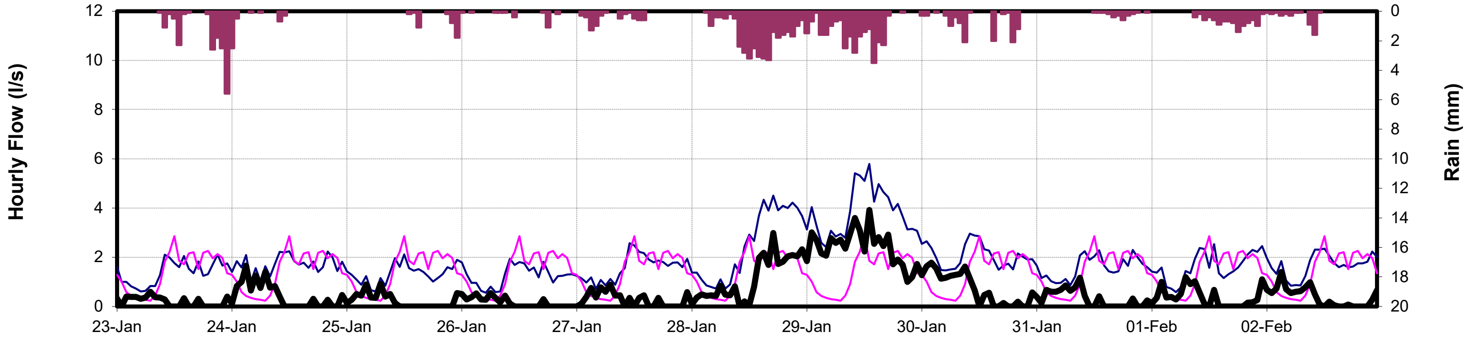
ADWF = 101 (m3/day)

Munro (NS9)

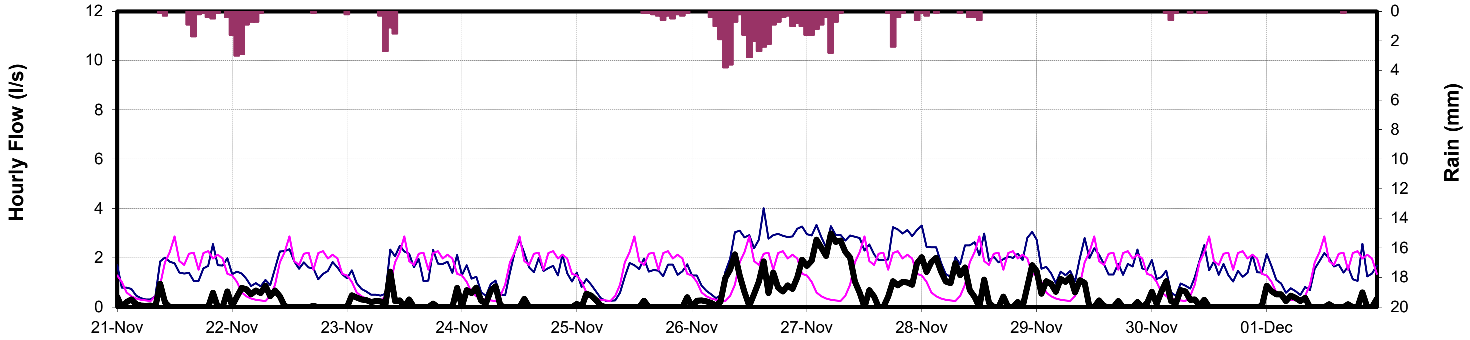
February 3 to February 13, 2017 Storm Events



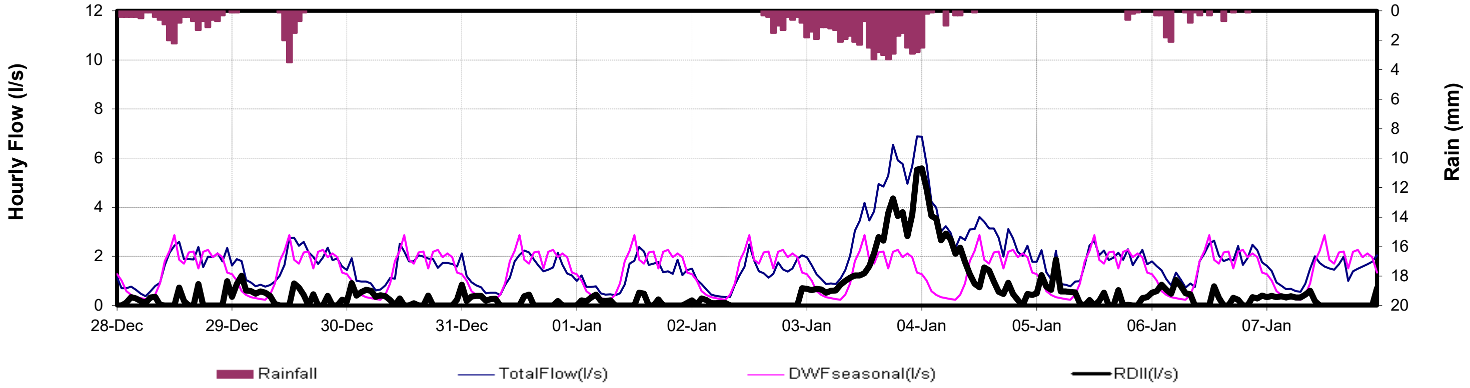
January 23 to February 2, 2018 Storm Events



November 21 to December 1, 2018 Storm Events

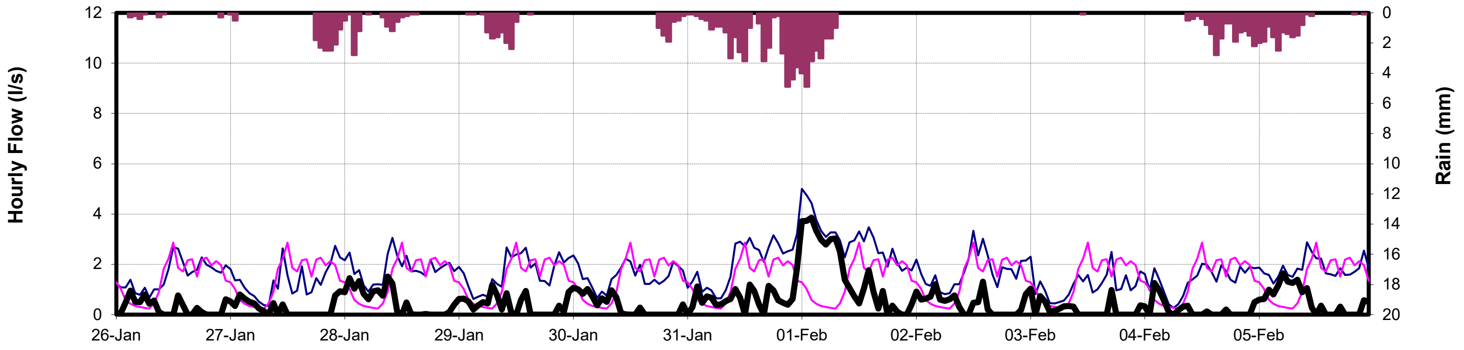


December 28 to January 7, 2019 Storm Events

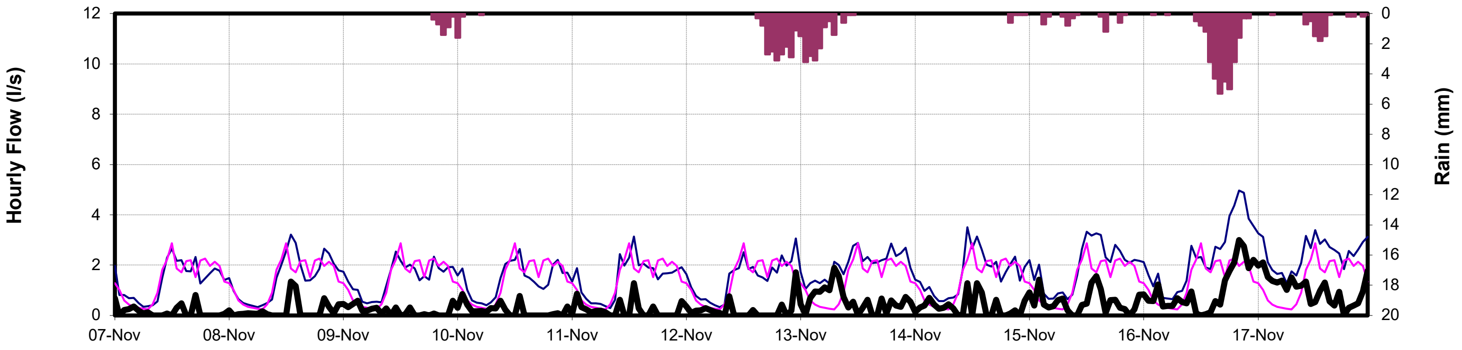


Munro (NS9)

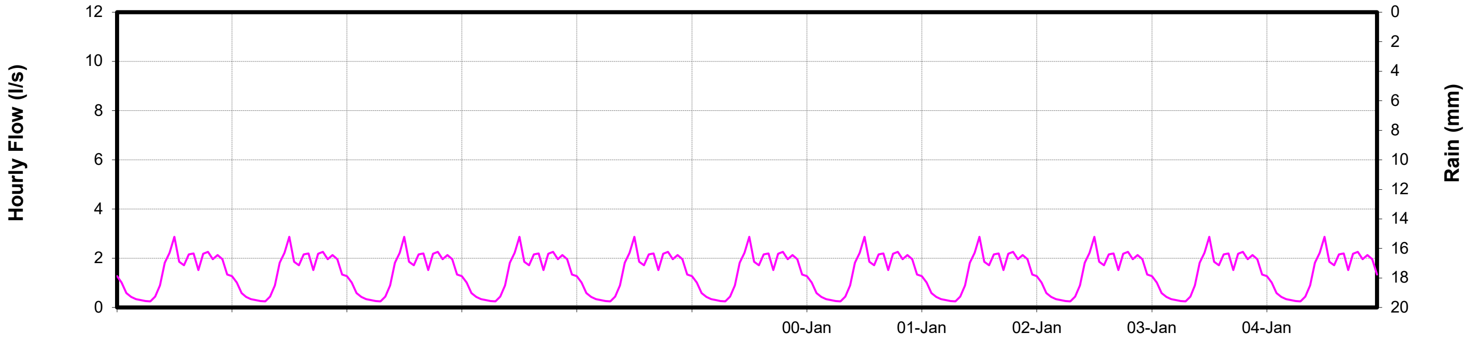
January 26 to February 5, 2020 Storm Events

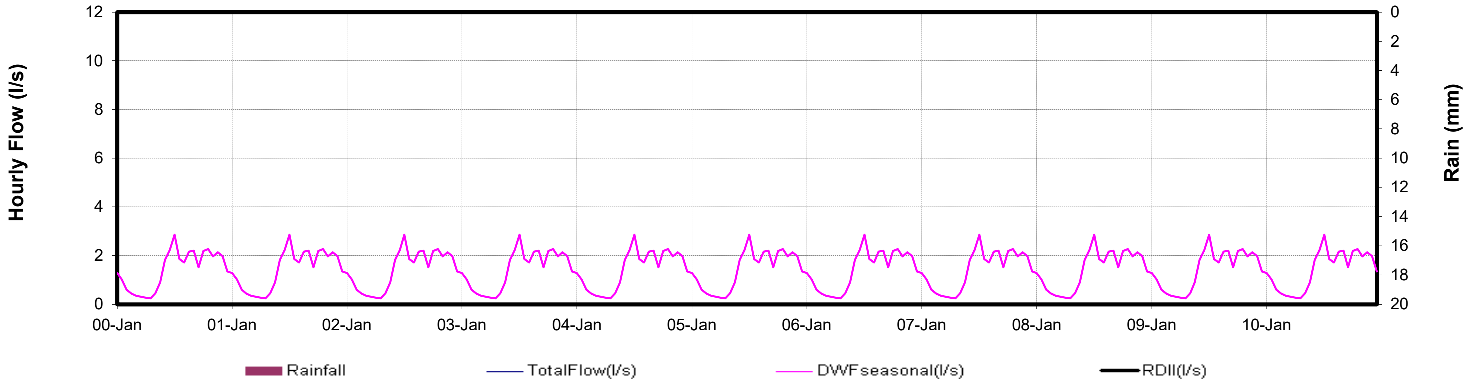


November 7 to November 17, 2020 Storm Events



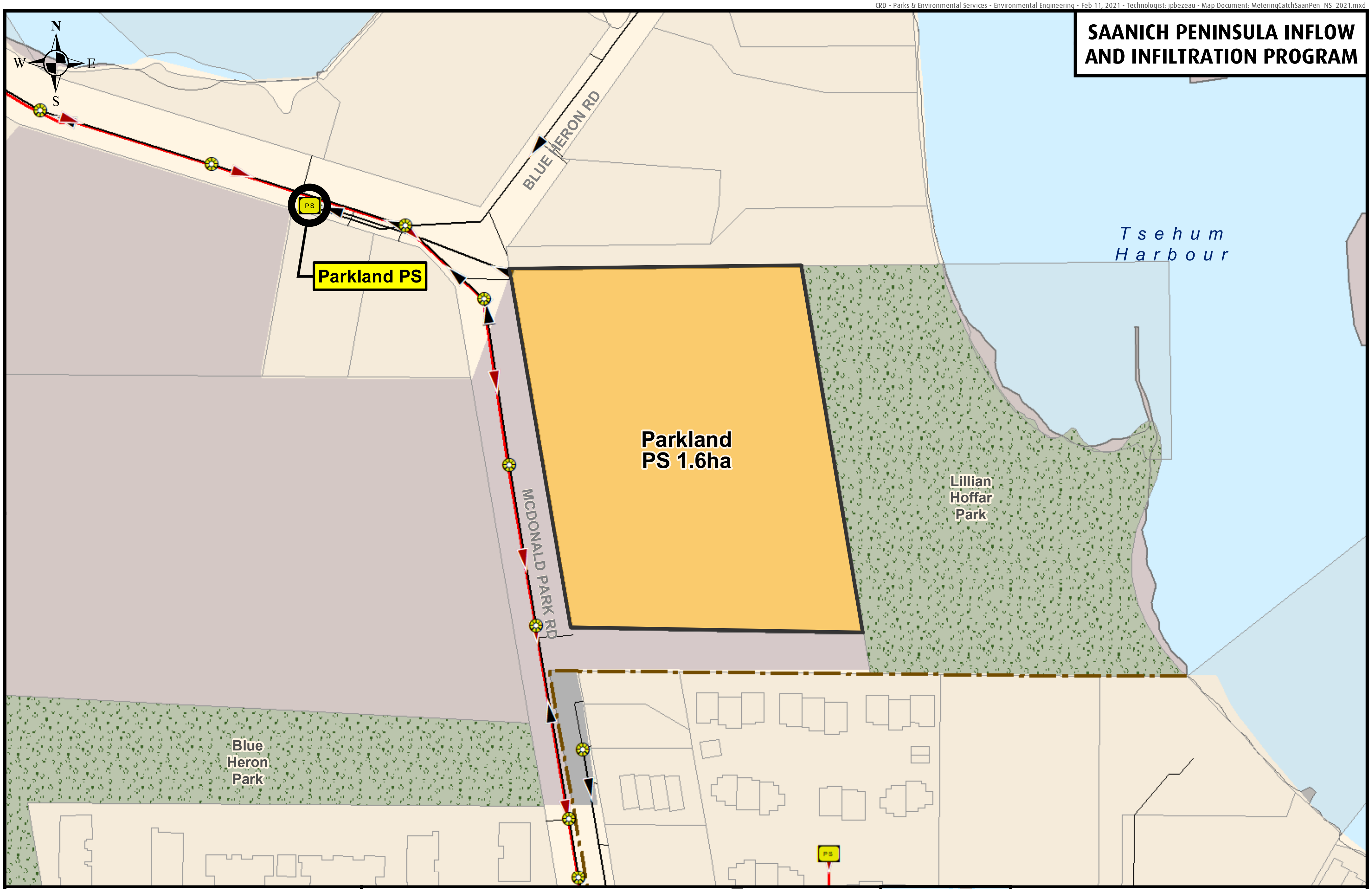
#VALUE!





CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 25 50 100

Projection: UTM ZONE 10N, NAD83

Disclaimer
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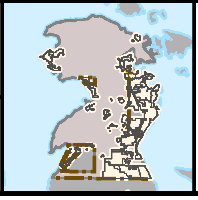
○	Flow Monitoring Location
✿	Manhole
⬠	Cleanout
PS	Pump Station
◔	Metering Chamber

Sanitary Sewers

—	Gravity Main Installed After 1930
—	Gravity Main Installed Before 1930
—	Force Main
═	Relief, Outfall, Overflow Sewer
—	CRD Sewer

▨	Catchment Area
▨	Non-Sewered Area
☐	Lot Lines
▨	Parks
▨	Sewered Park Areas
- -	Catchment Boundary
-·-	Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Parkland PS

Site Code: NS14

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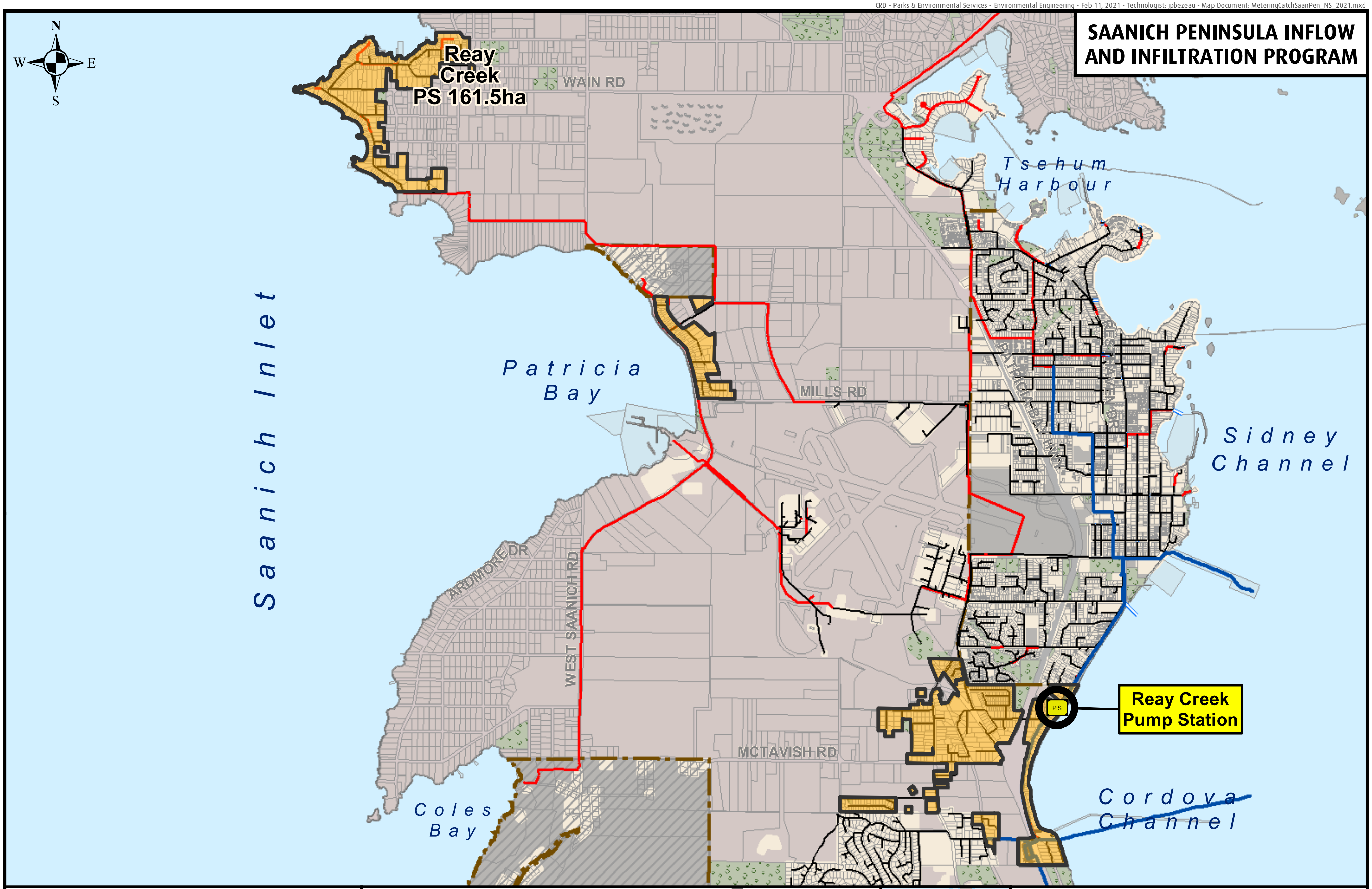
CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 550 1,100 2,200

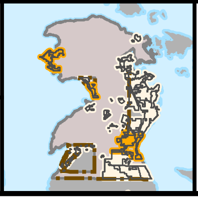
Projection: UTM ZONE 10N, NAD83

- ○ Flow Monitoring Location
- ● Manhole
- ⬟ Cleanout
- PS Pump Station
- ● Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- ▨ Catchment Area
- ▨ Non-Sewered Area
- ☐ Lot Lines
- ▨ Parks
- ▨ Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

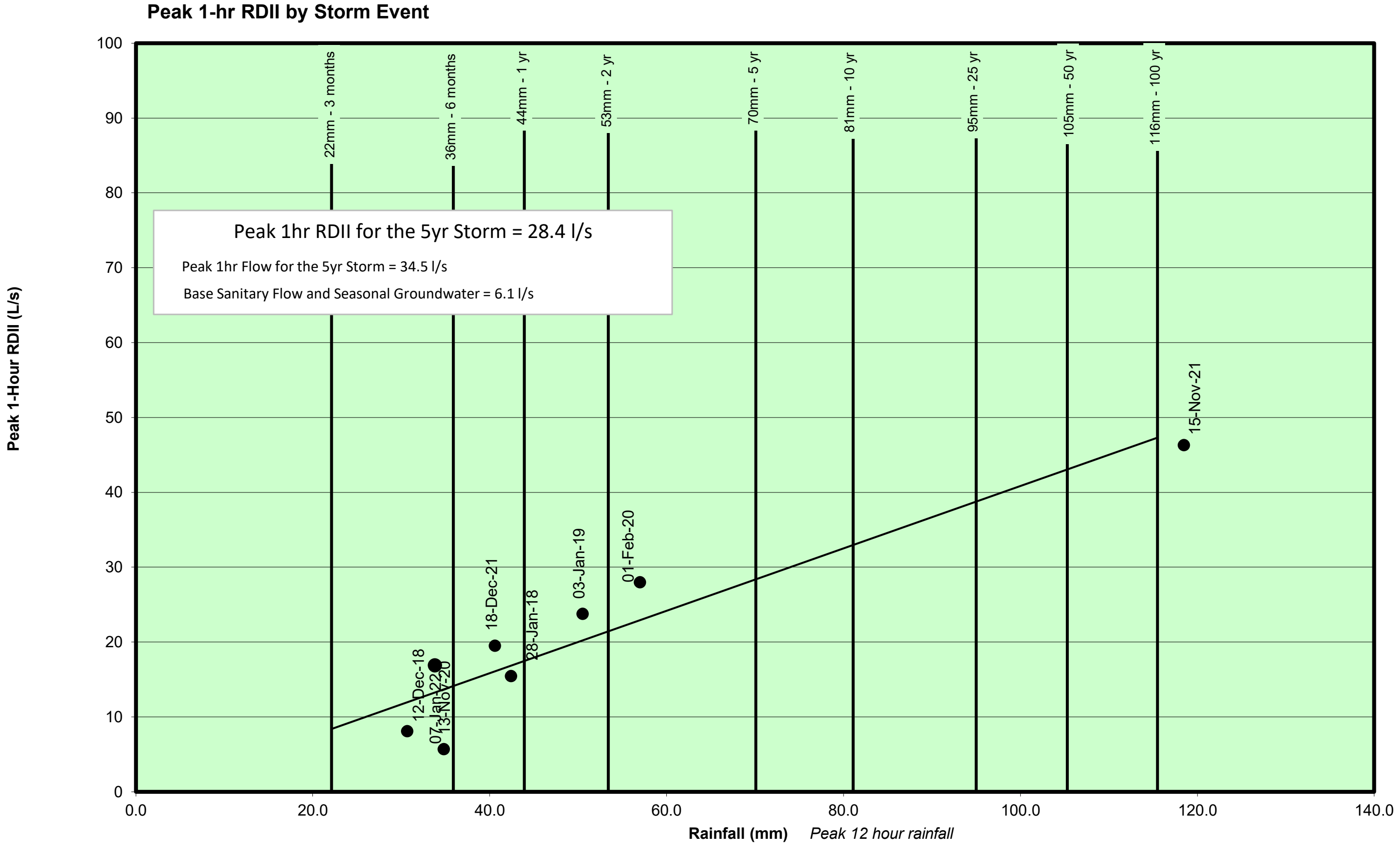
Catchment: Reay Creek PS

Site Code: NS10

CRD

Making a difference...together

Reay Creek (NS10)

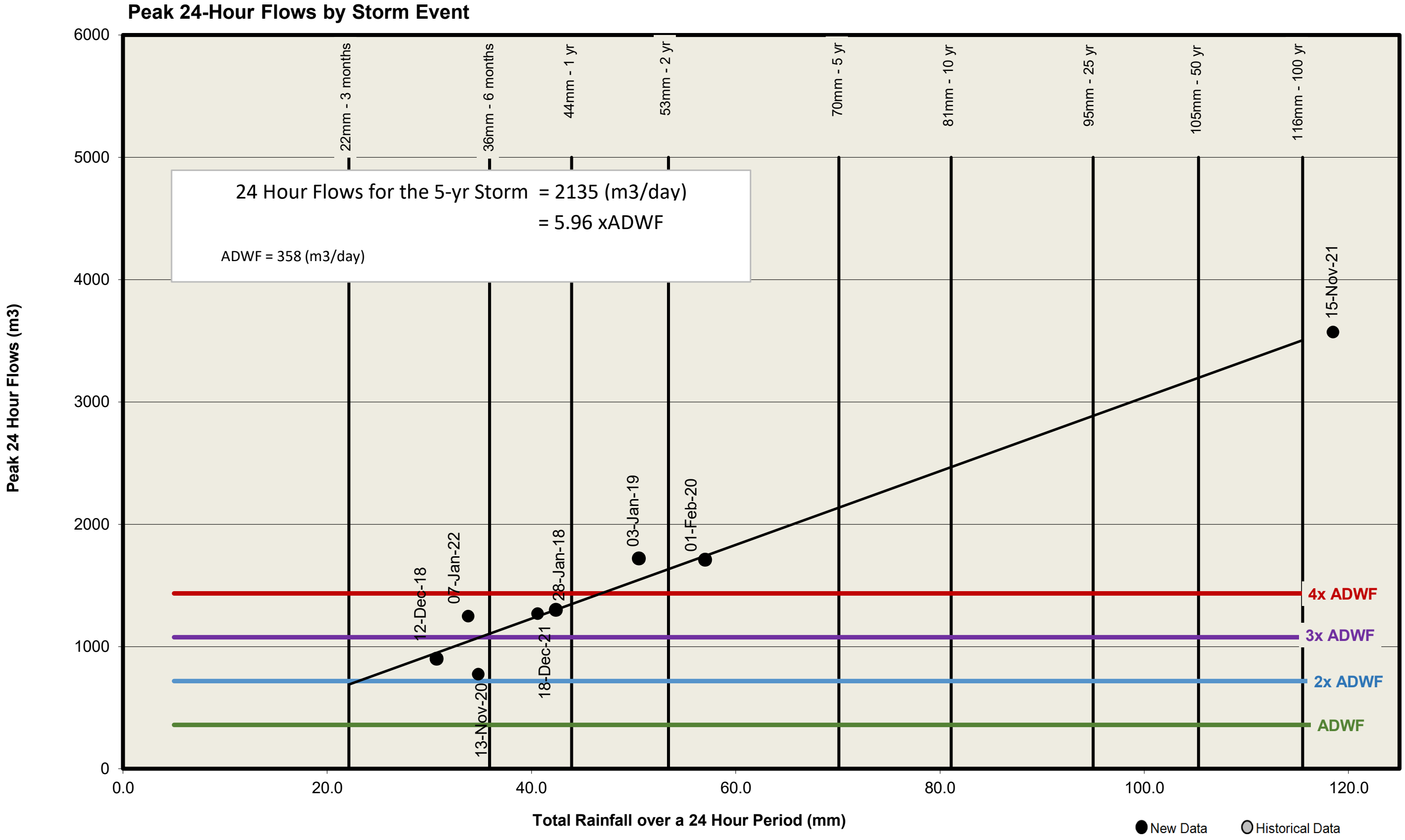


Peak 1-hr RDII by Storm Event

Peak 1hr RDII for the 5yr Storm = 28.4 l/s

Peak 1hr Flow for the 5yr Storm = 34.5 l/s

Base Sanitary Flow and Seasonal Groundwater = 6.1 l/s



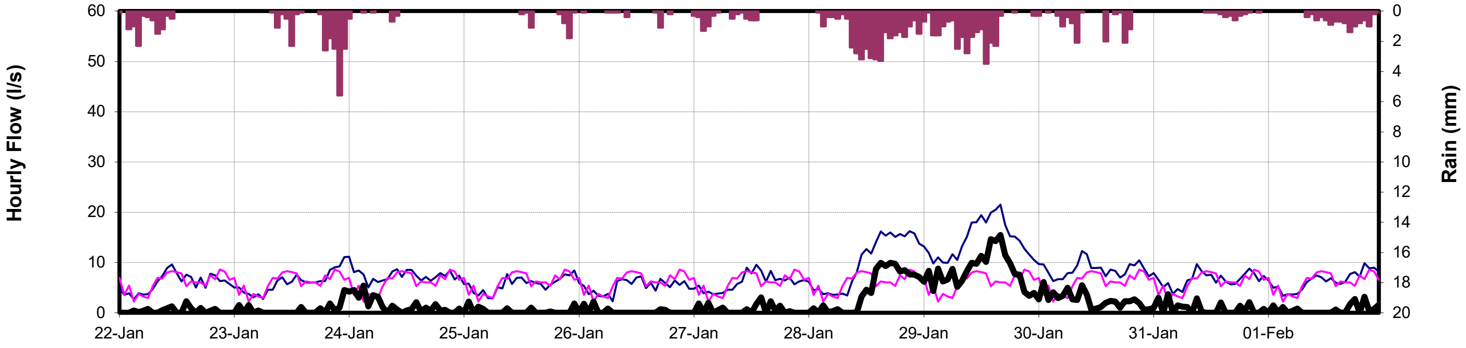
Peak 24-Hour Flows by Storm Event

24 Hour Flows for the 5-yr Storm = 2135 (m3/day)
= 5.96 xADWF

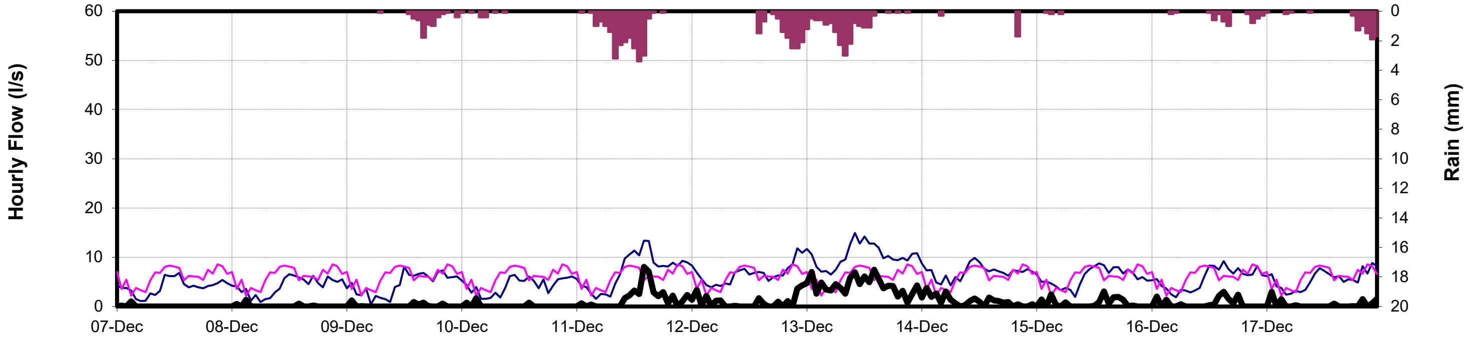
ADWF = 358 (m3/day)

Reay Creek (NS10)

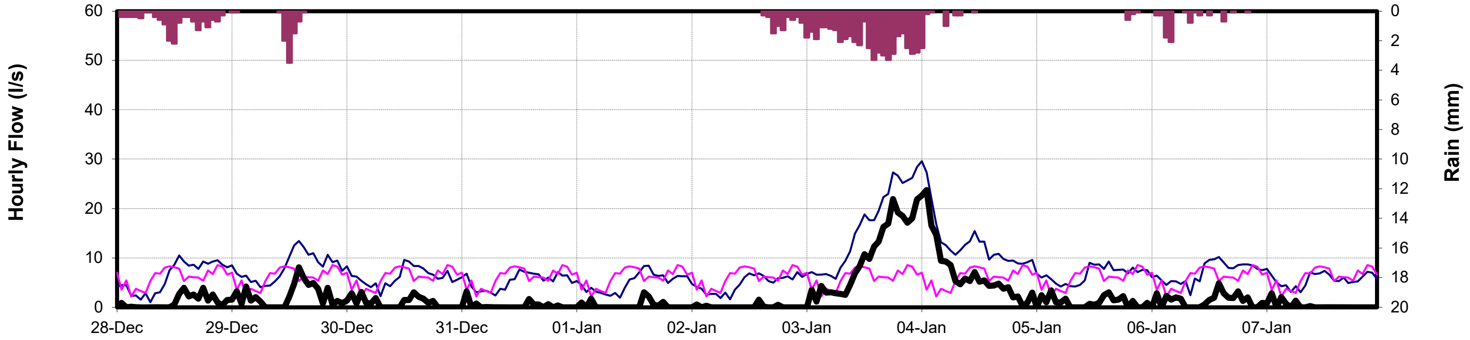
January 22 to February 1, 2018 Storm Events



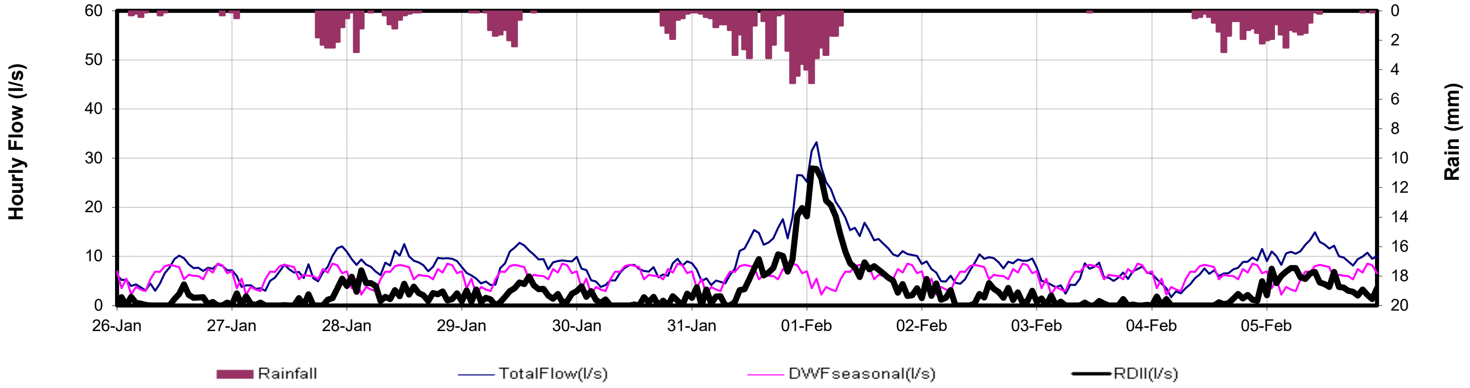
December 7 to December 17, 2018 Storm Events



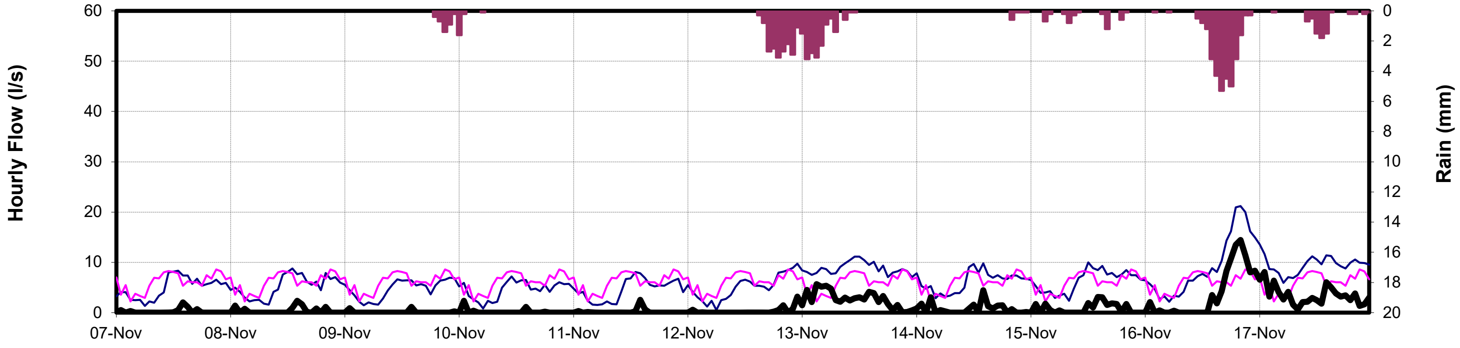
December 28 to January 7, 2019 Storm Events

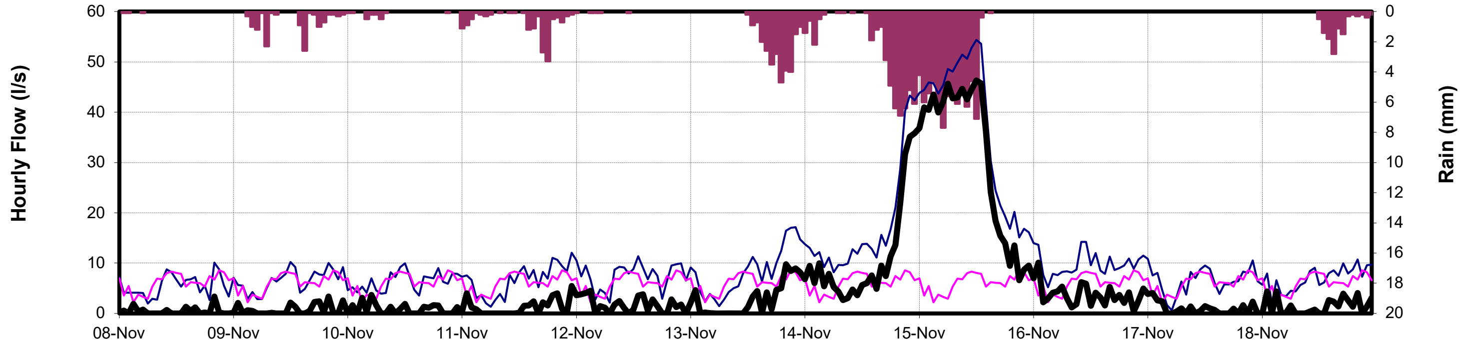


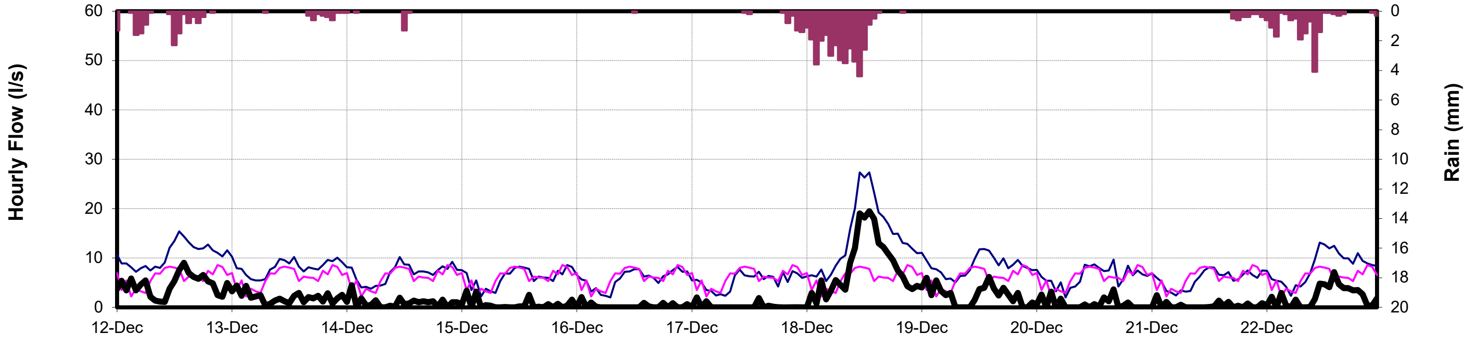
January 26 to February 5, 2020 Storm Events

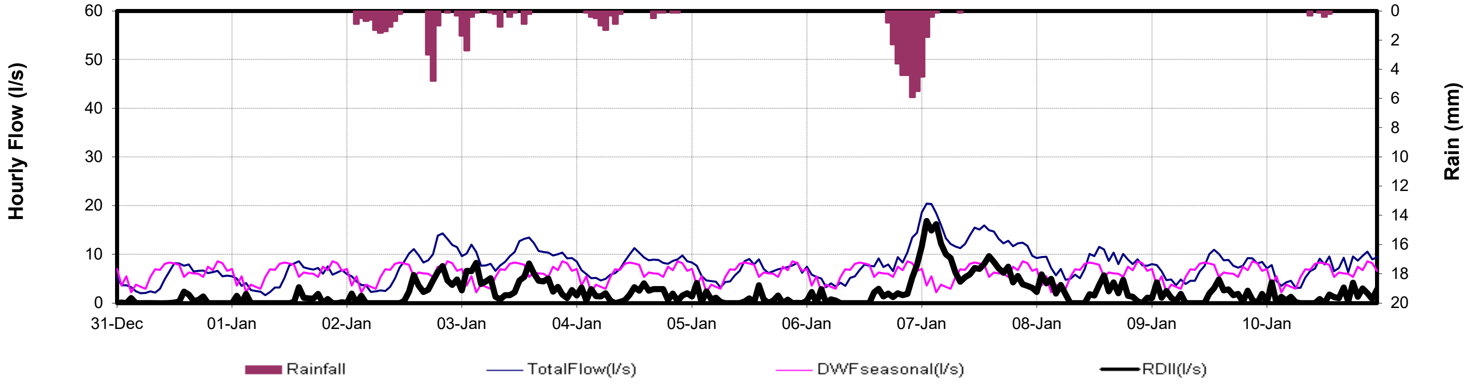


Reay Creek (NS10)


November 7 to November 17, 2020 Storm Events

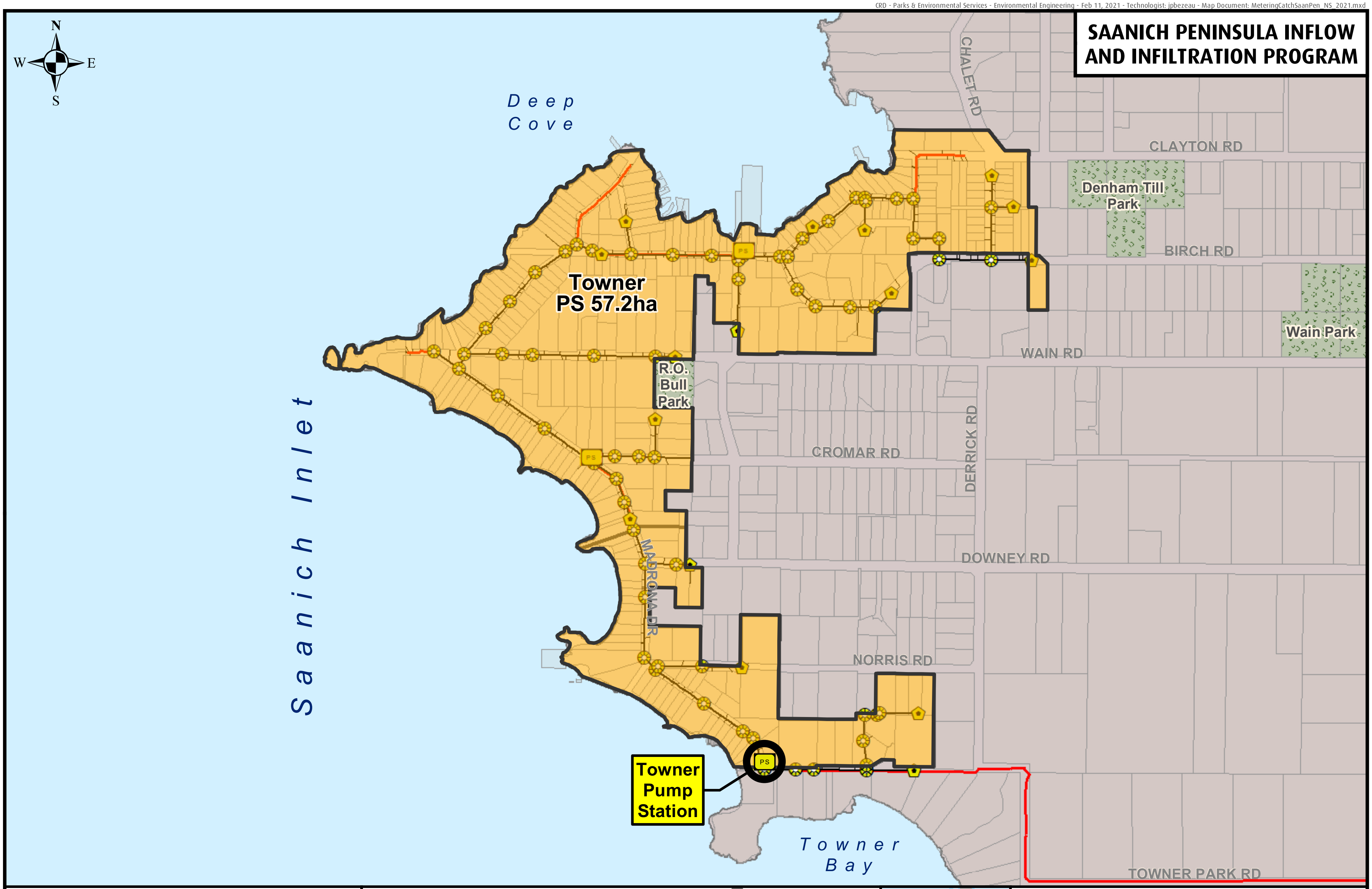

November 8 to November 18, 2021 Storm Events


December 12 to December 22, 2021 Storm Events


December 31 to January 10, 2022 Storm Events

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 140 280 560

Projection: UTM ZONE 10N, NAD83

Disclaimer

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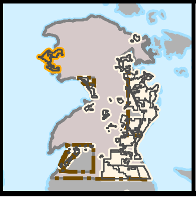
- ○ Flow Monitoring Location
- ✺ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◙ Metering Chamber

Sanitary Sewers

- — Gravity Main Installed After 1930
- — Gravity Main Installed Before 1930
- — Force Main
- = Relief, Outfall, Overflow Sewer
- — CRD Sewer

- ▨ Catchment Area
- ▨ Non-Sewered Area
- ☐ Lot Lines
- ▨ Parks
- ▨ Sewered Park Areas
- - - Catchment Boundary
- -·- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Towner PS

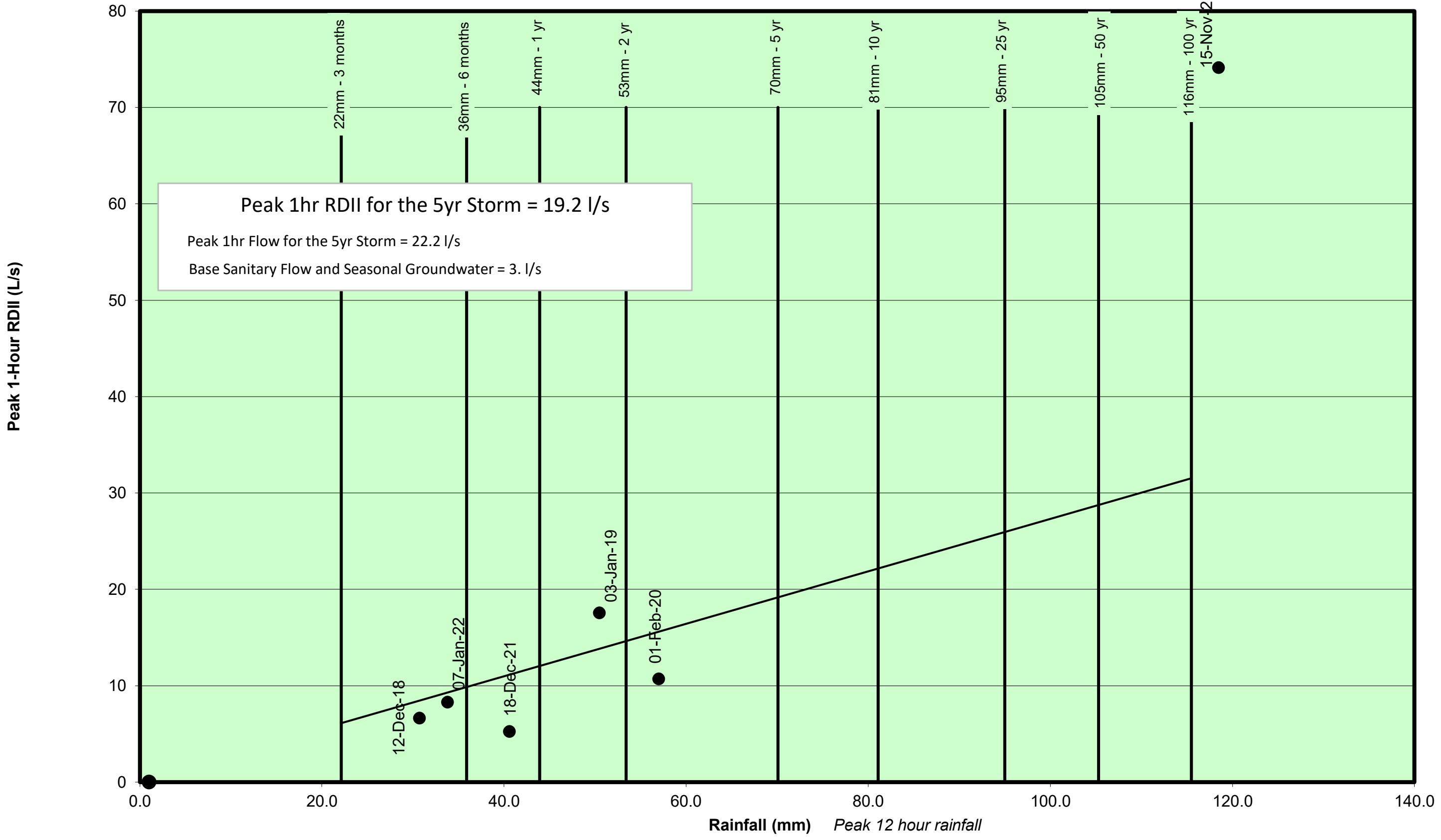
Site Code: NS11

CRD

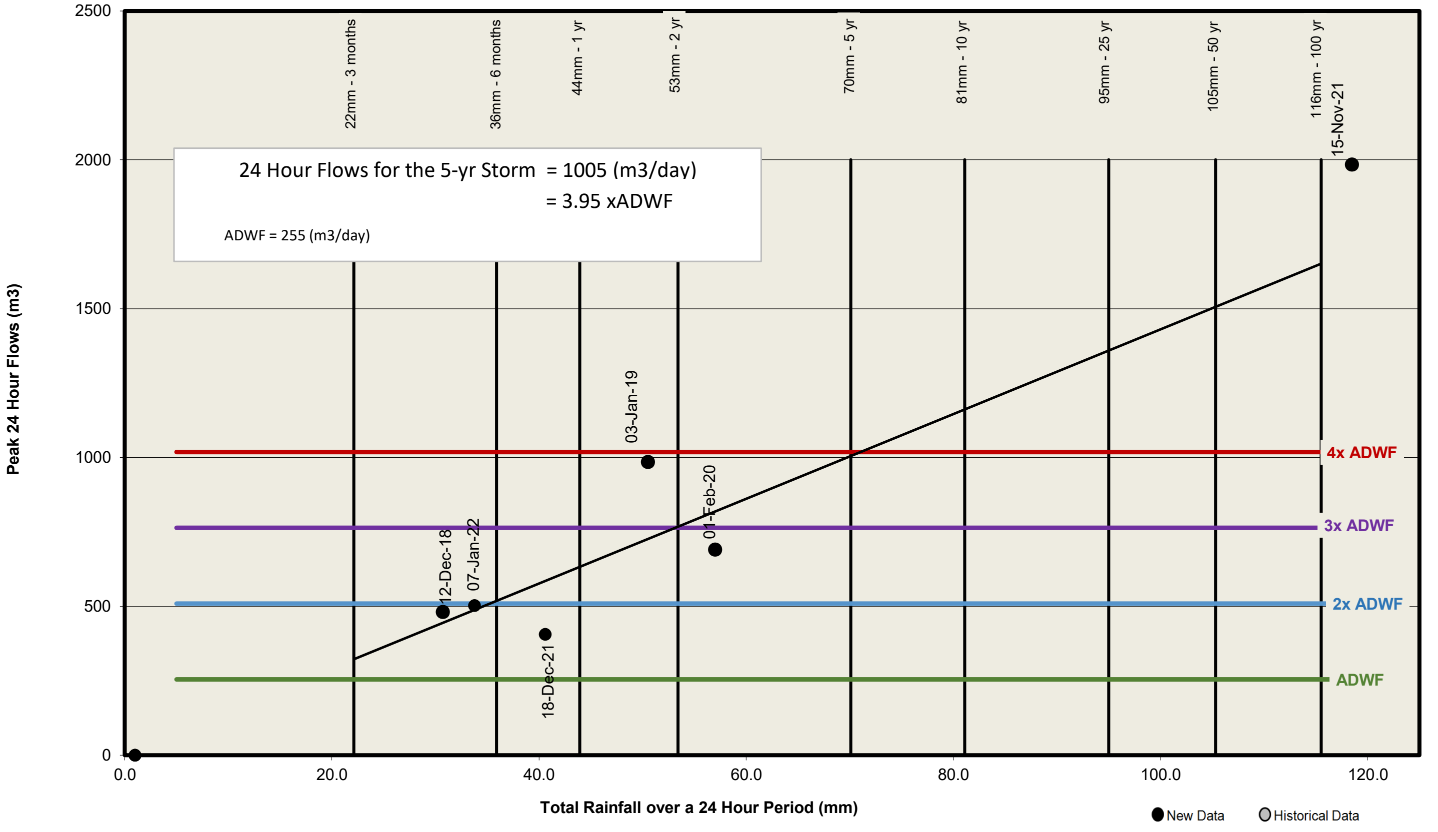
Making a difference...together

Towner PS (NS11)

Peak 1-hr RDII by Storm Event

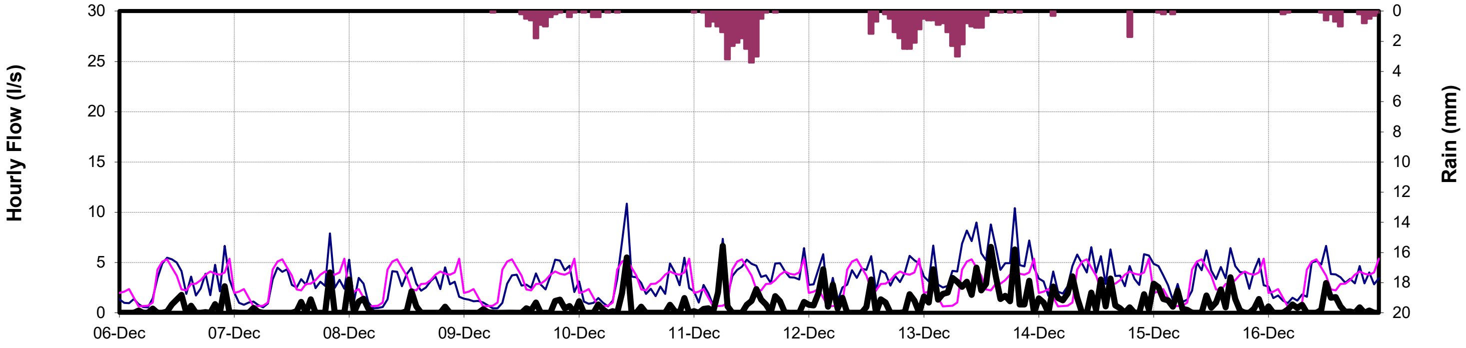


Peak 24-Hour Flows by Storm Event

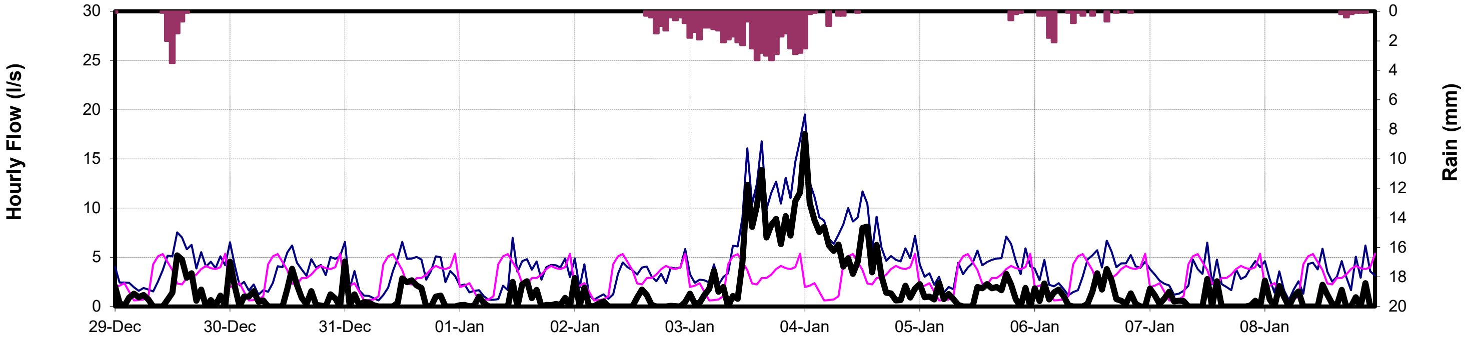


Towner PS (NS11)

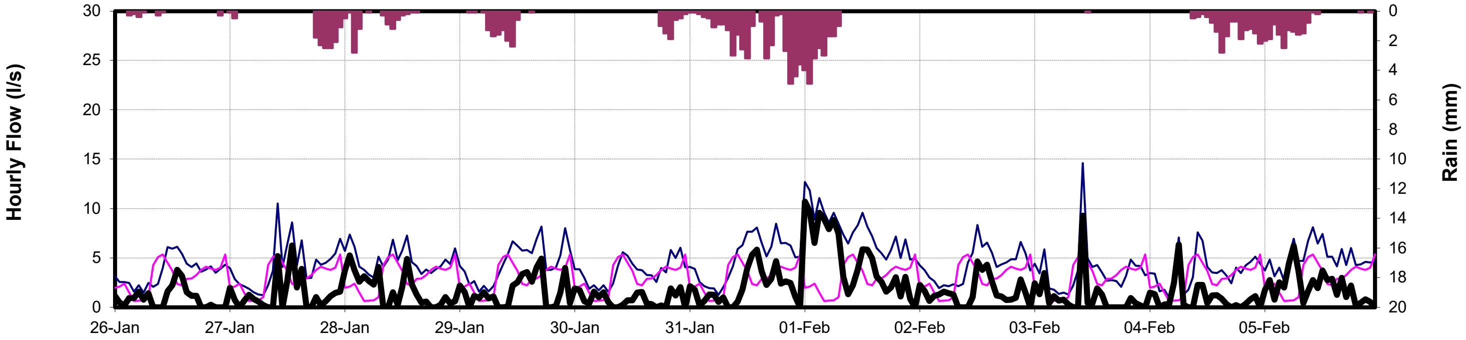
December 6 to December 16, 2018 Storm Events



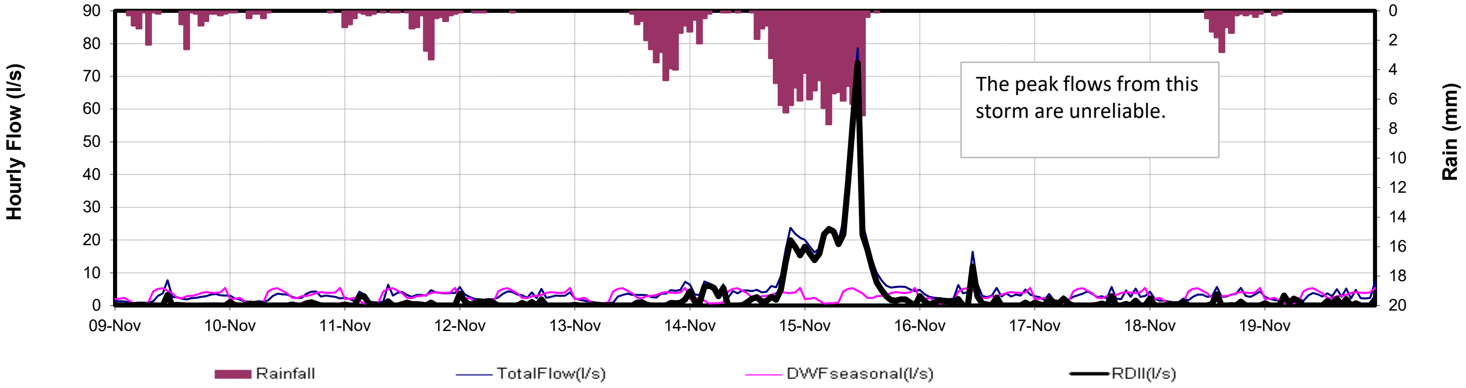
December 29 to January 8, 2019 Storm Events



January 26 to February 5, 2020 Storm Events



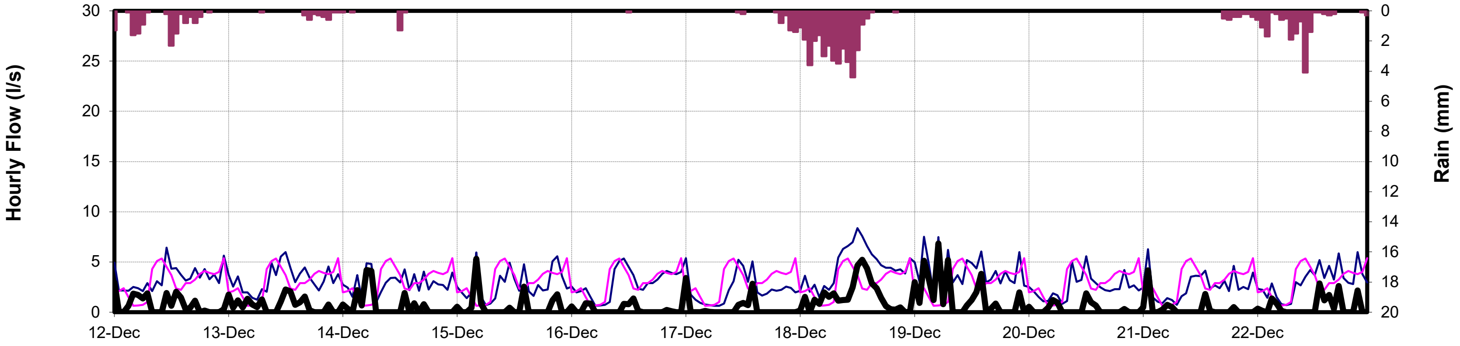
November 9 to November 19, 2021 Storm Events



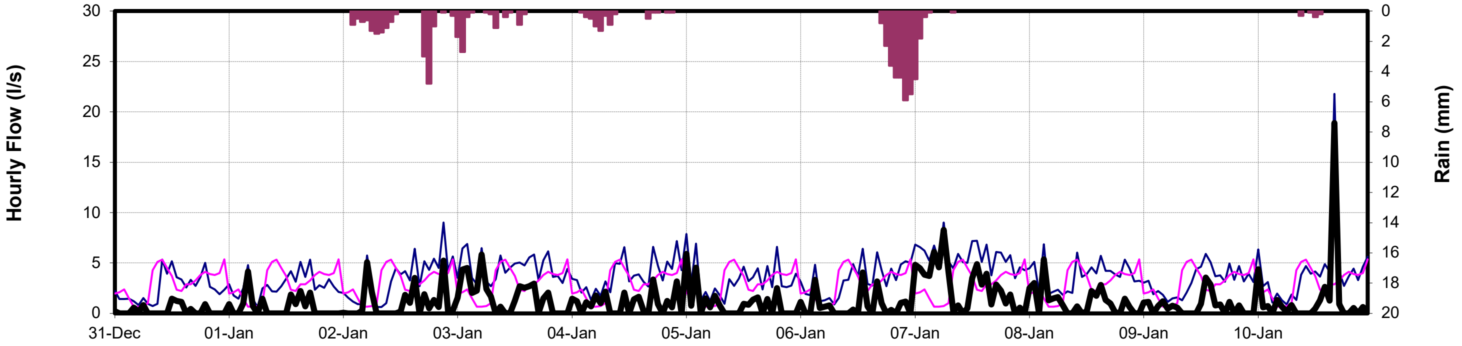
The peak flows from this storm are unreliable.

Towner PS (NS11)

December 12 to December 22, 2021 Storm Events



December 31 to January 10, 2022 Storm Events



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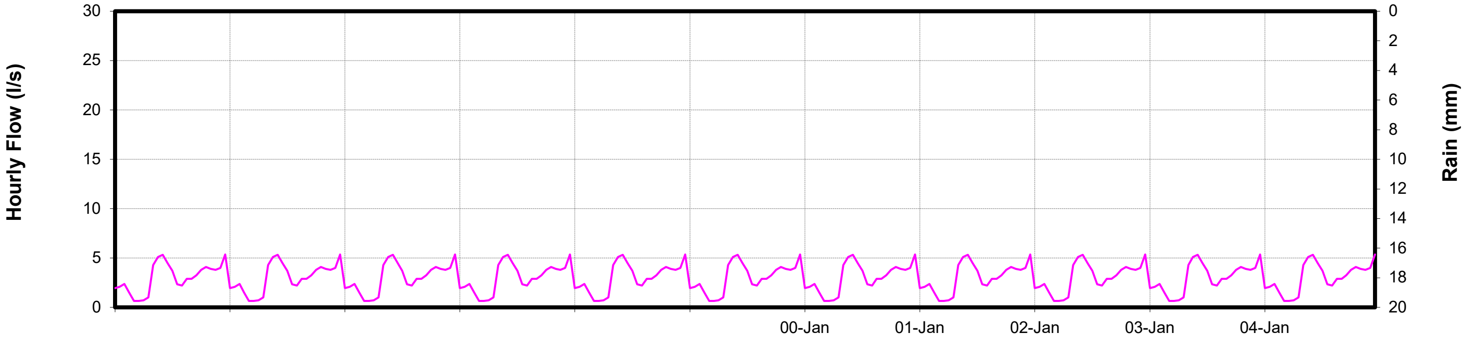

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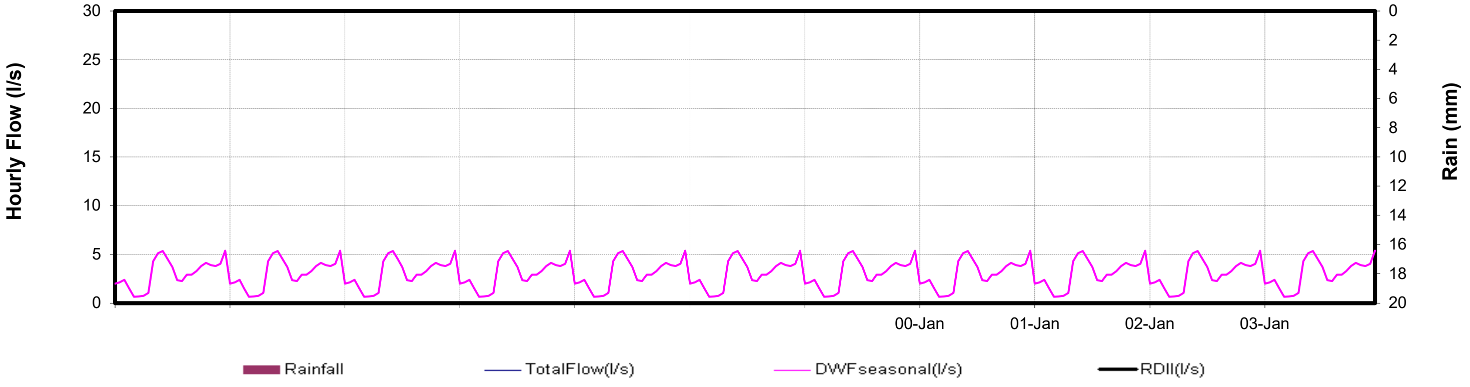
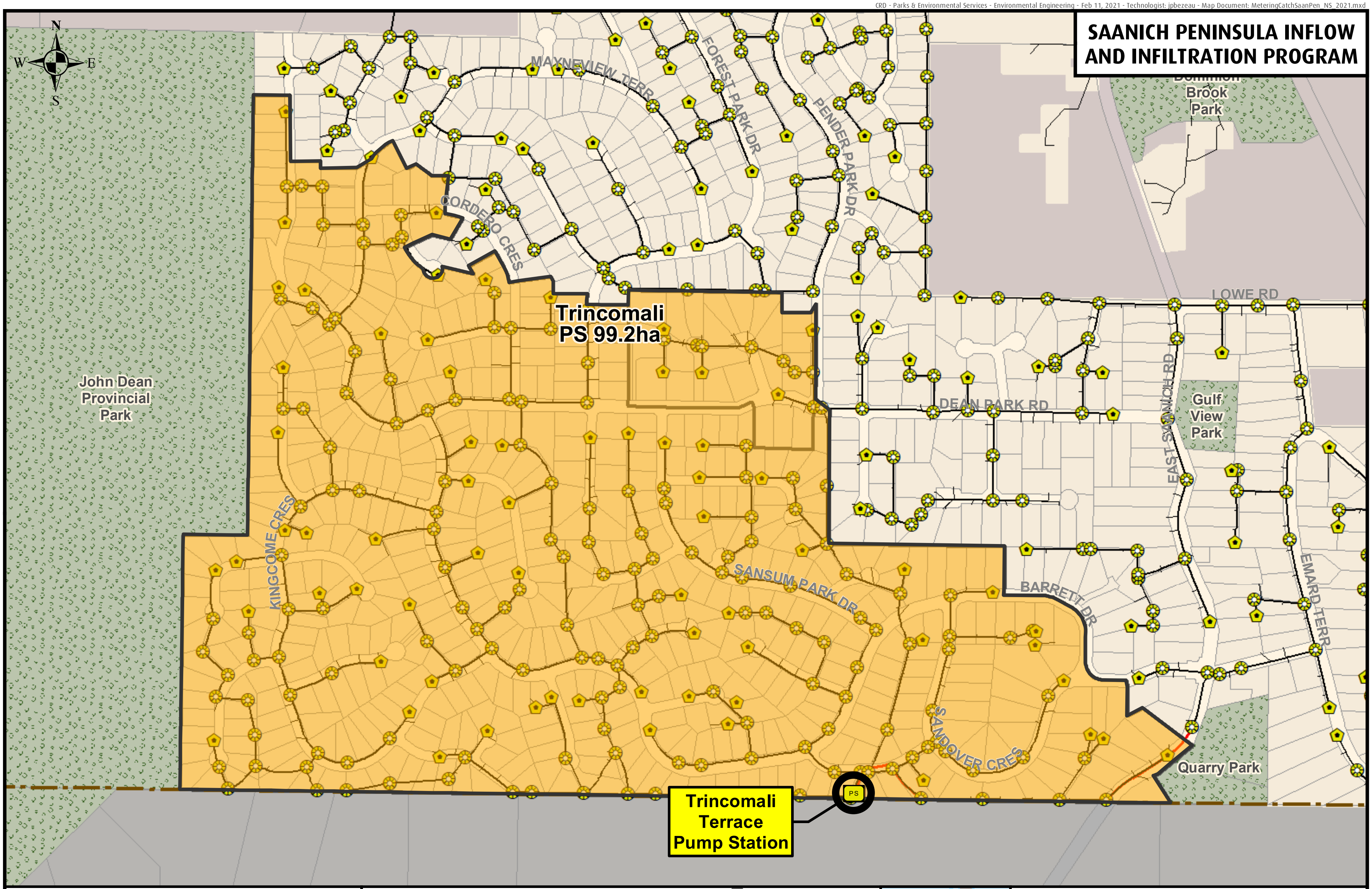


CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 112.5 225 450

Projection: UTM ZONE 10N, NAD83

Disclaimer
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○ Flow Monitoring Location
⊛ Manhole
⬠ Cleanout
PS Pump Station
◙ Metering Chamber

Sanitary Sewers
— Gravity Main Installed After 1930
— Gravity Main Installed Before 1930
— Force Main
═ Relief, Outfall, Overflow Sewer
— CRD Sewer

▨ Catchment Area
▨ Non-Sewered Area
☐ Lot Lines
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- - Catchment Boundary
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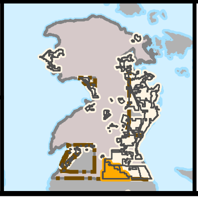


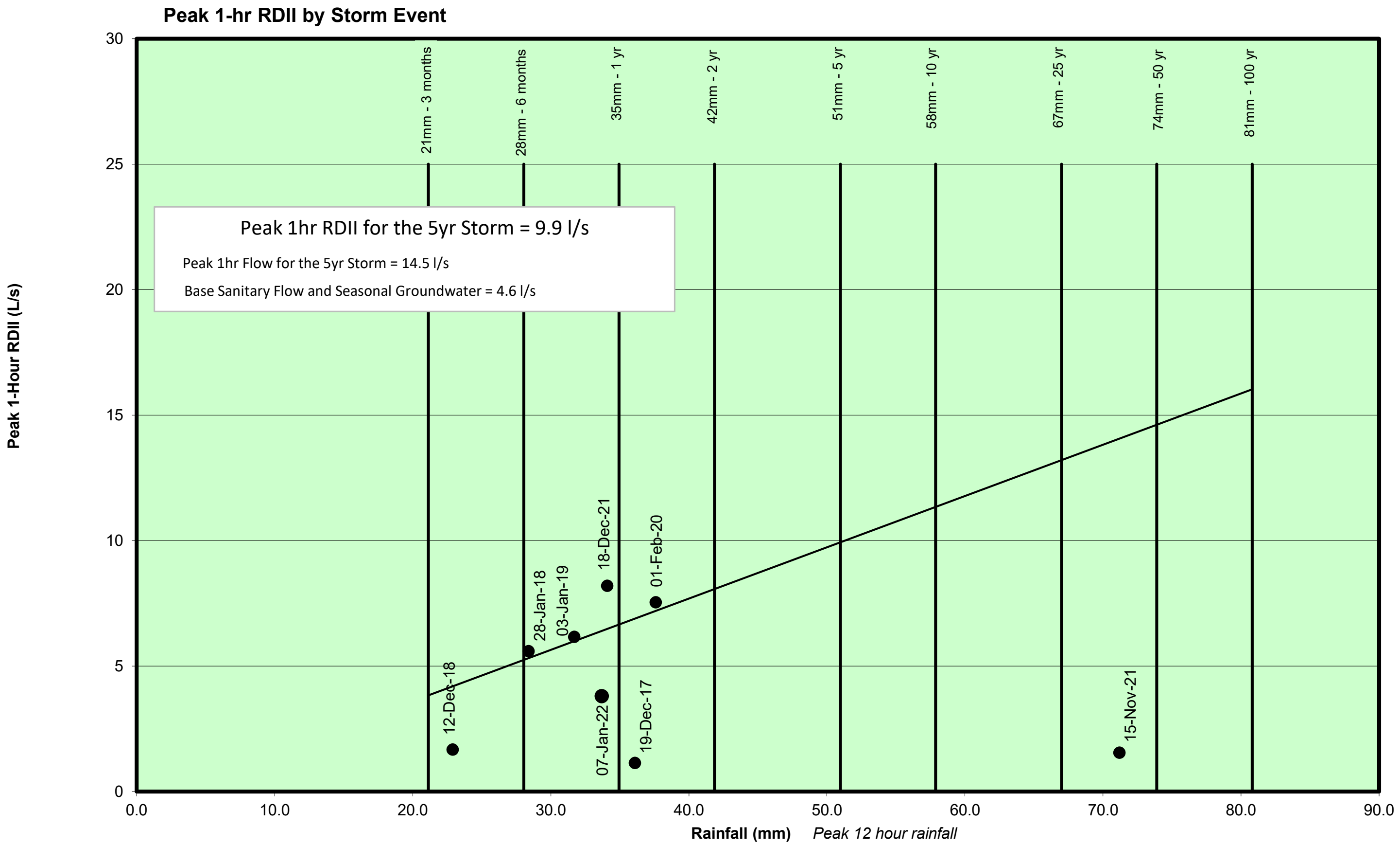
FLOW MONITORING AREA

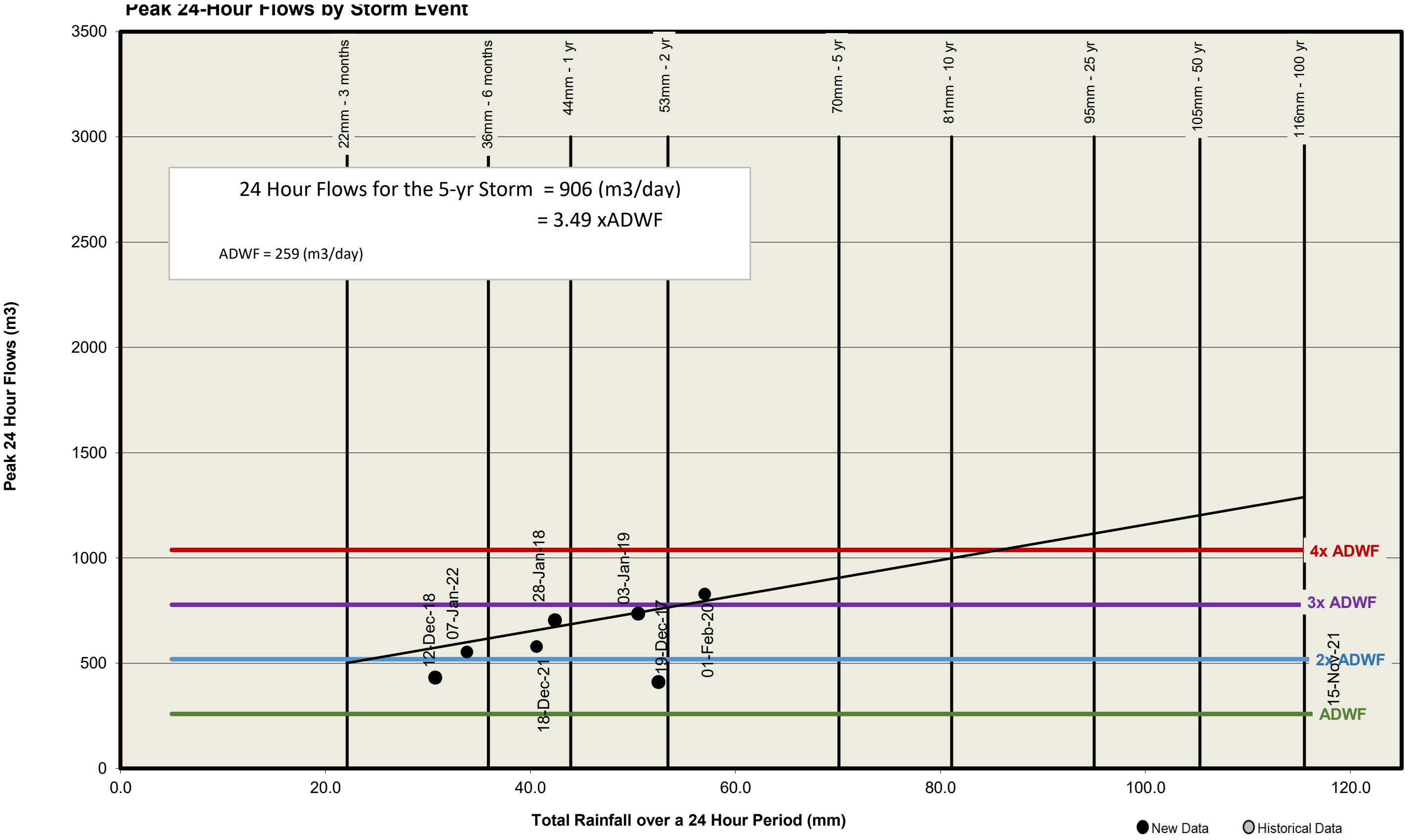
Catchment: Trincomali PS

Site Code: NS12

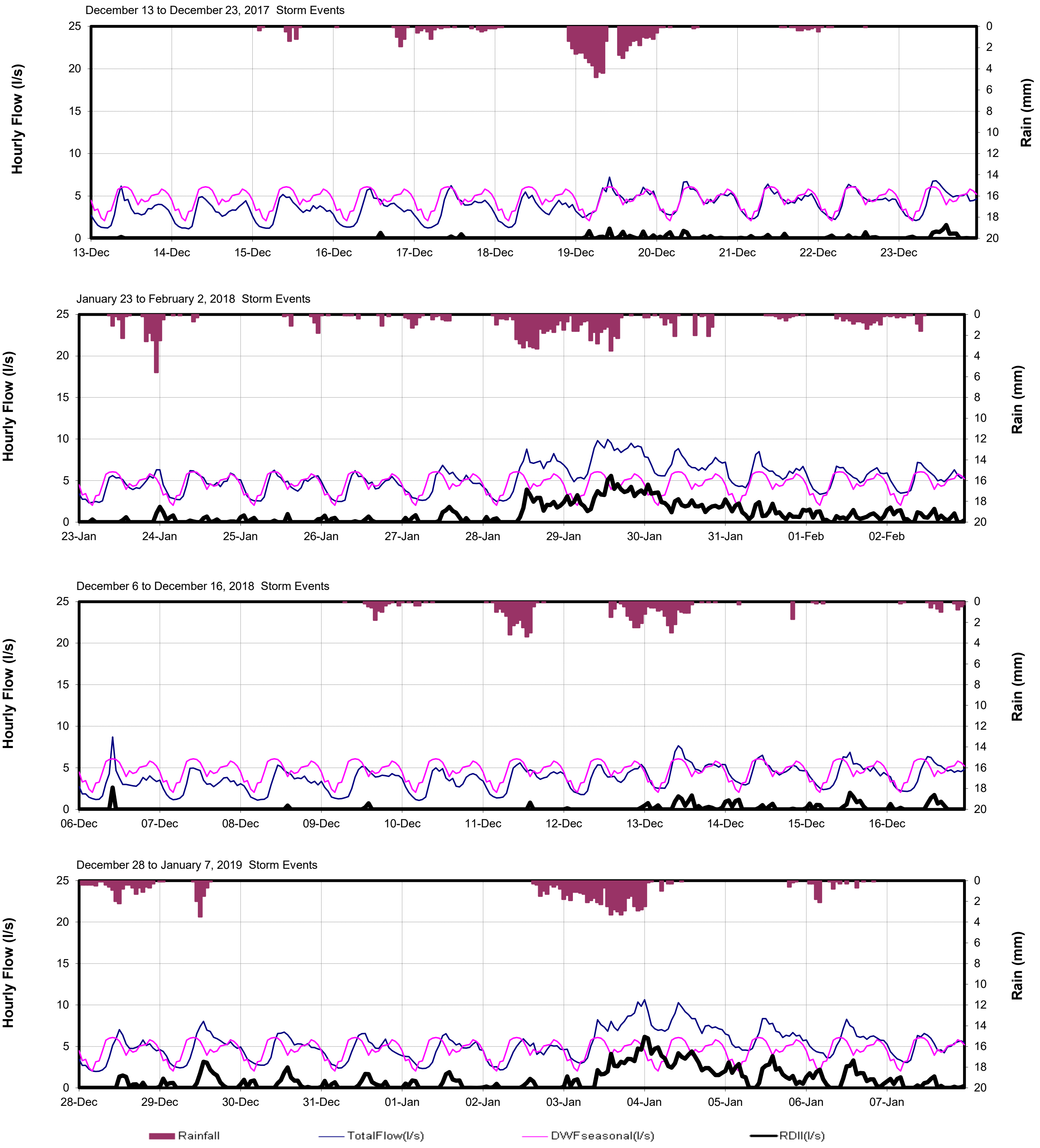
CRD
Making a difference...together

Trincomali PS (NS12)



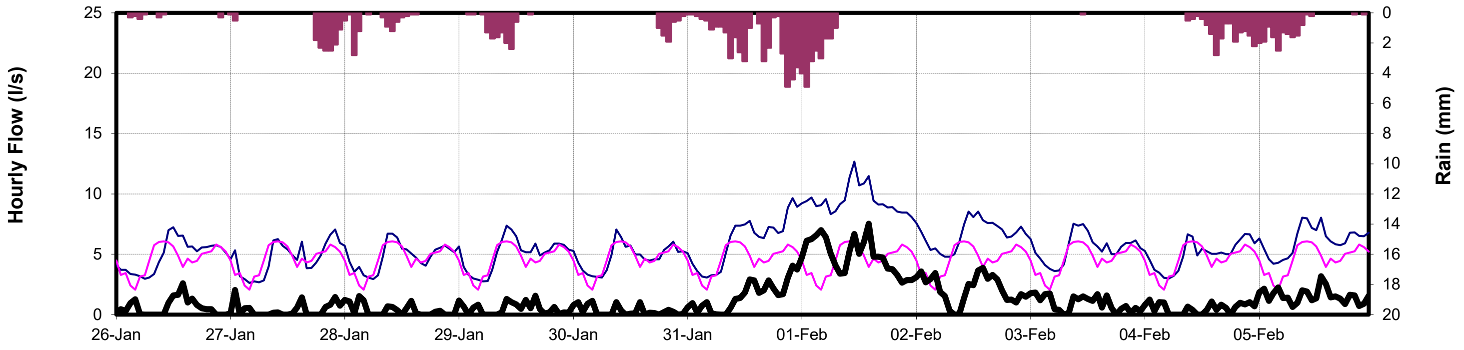


Trincomali PS (NS12)

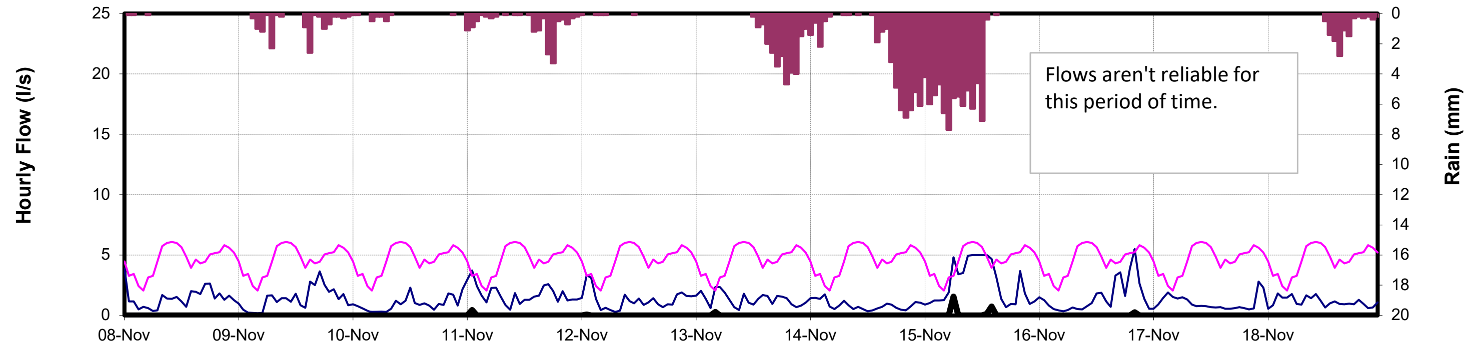


Trincomali PS (NS12)

January 26 to February 5, 2020 Storm Events

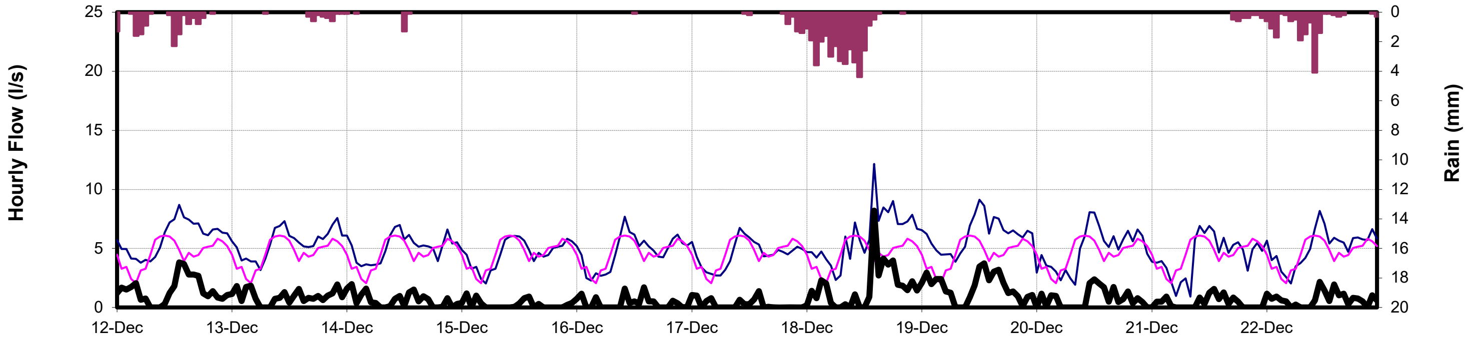


November 8 to November 18, 2021 Storm Events

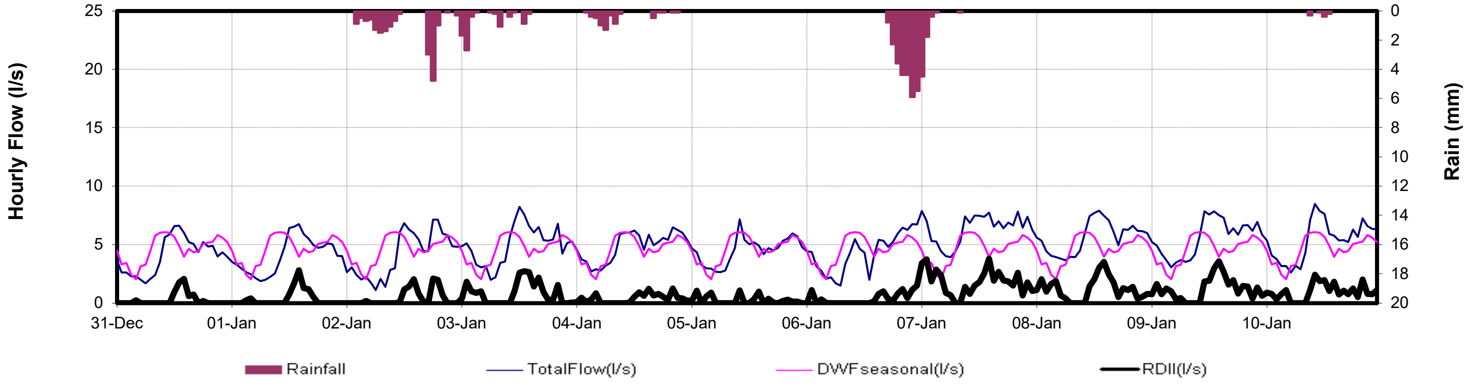


Flows aren't reliable for this period of time.

December 12 to December 22, 2021 Storm Events

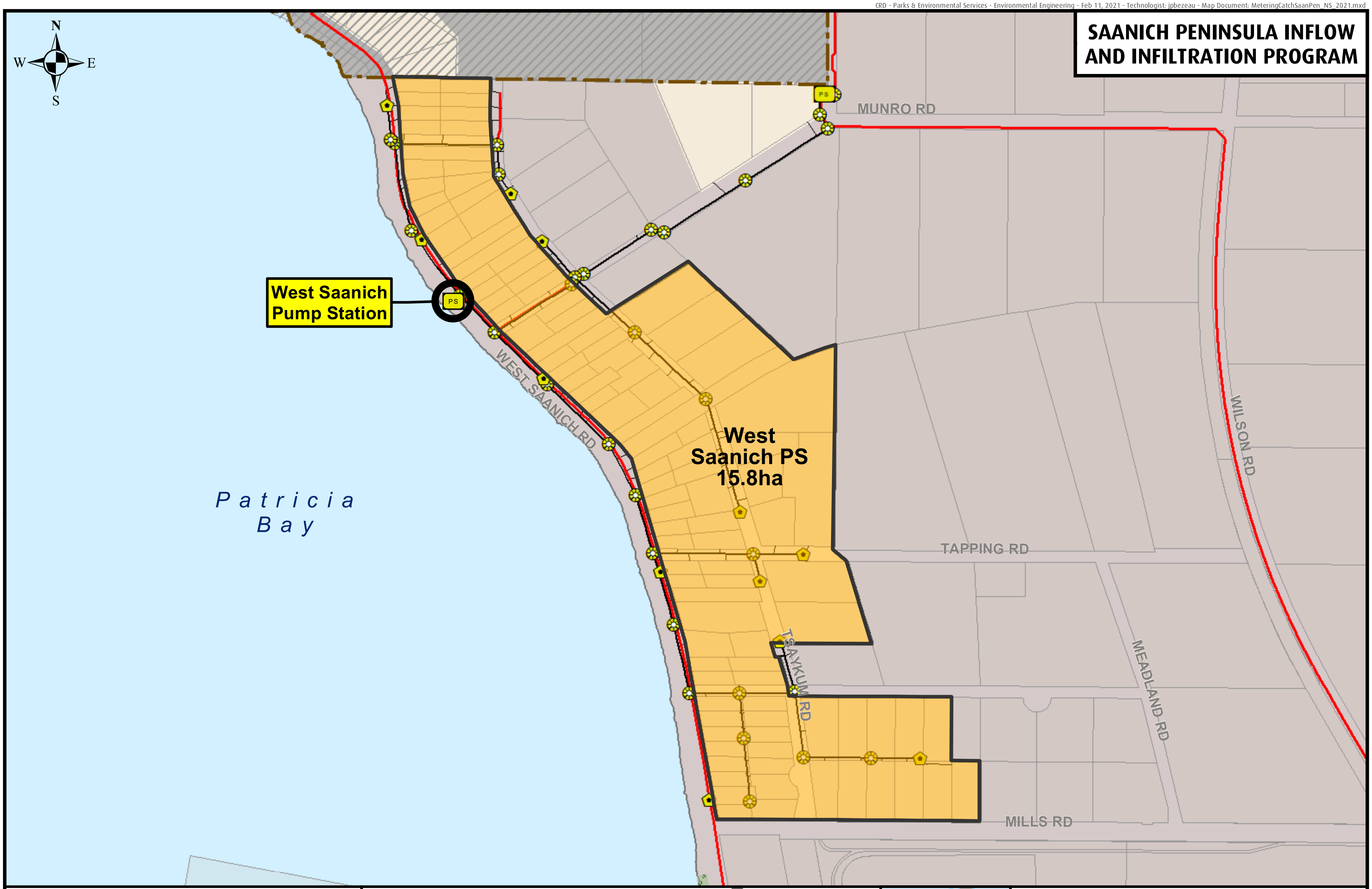


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 75 150 300

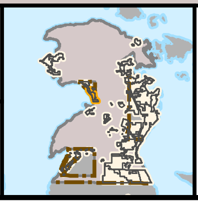
Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
● Manhole
⬟ Cleanout
PS Pump Station
● Metering Chamber

Sanitary Sewers
— Gravity Main Installed After 1930
— Gravity Main Installed Before 1930
— Force Main
═ Relief, Outfall, Overflow Sewer
— CRD Sewer

▨ Catchment Area
▨ Non-Sewered Area
☐ Lot Lines
▨ Parks
▨ Sewered Park Areas
- - Catchment Boundary
-·- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: West Saanich PS

Site Code: NS13

CRD
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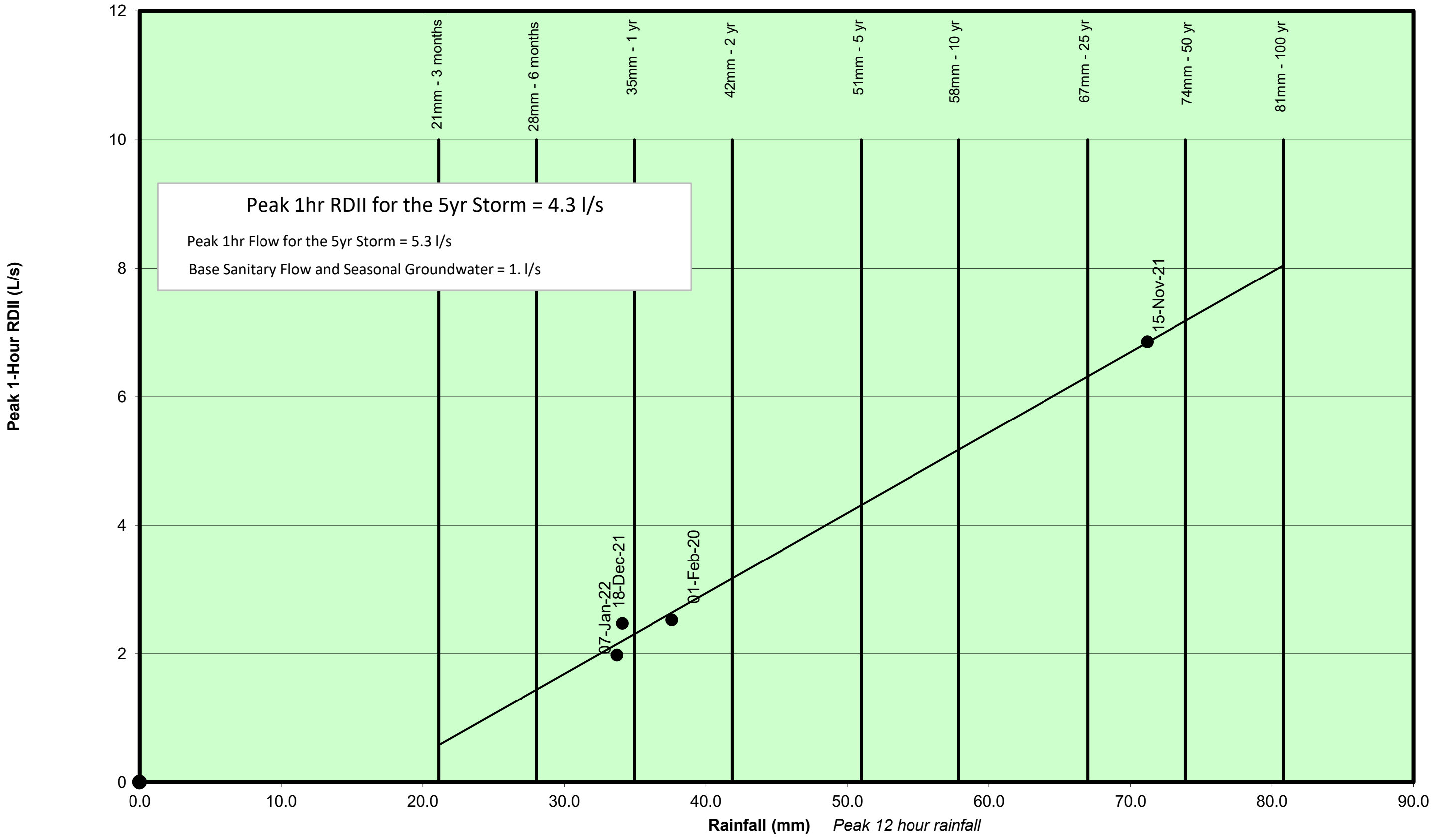
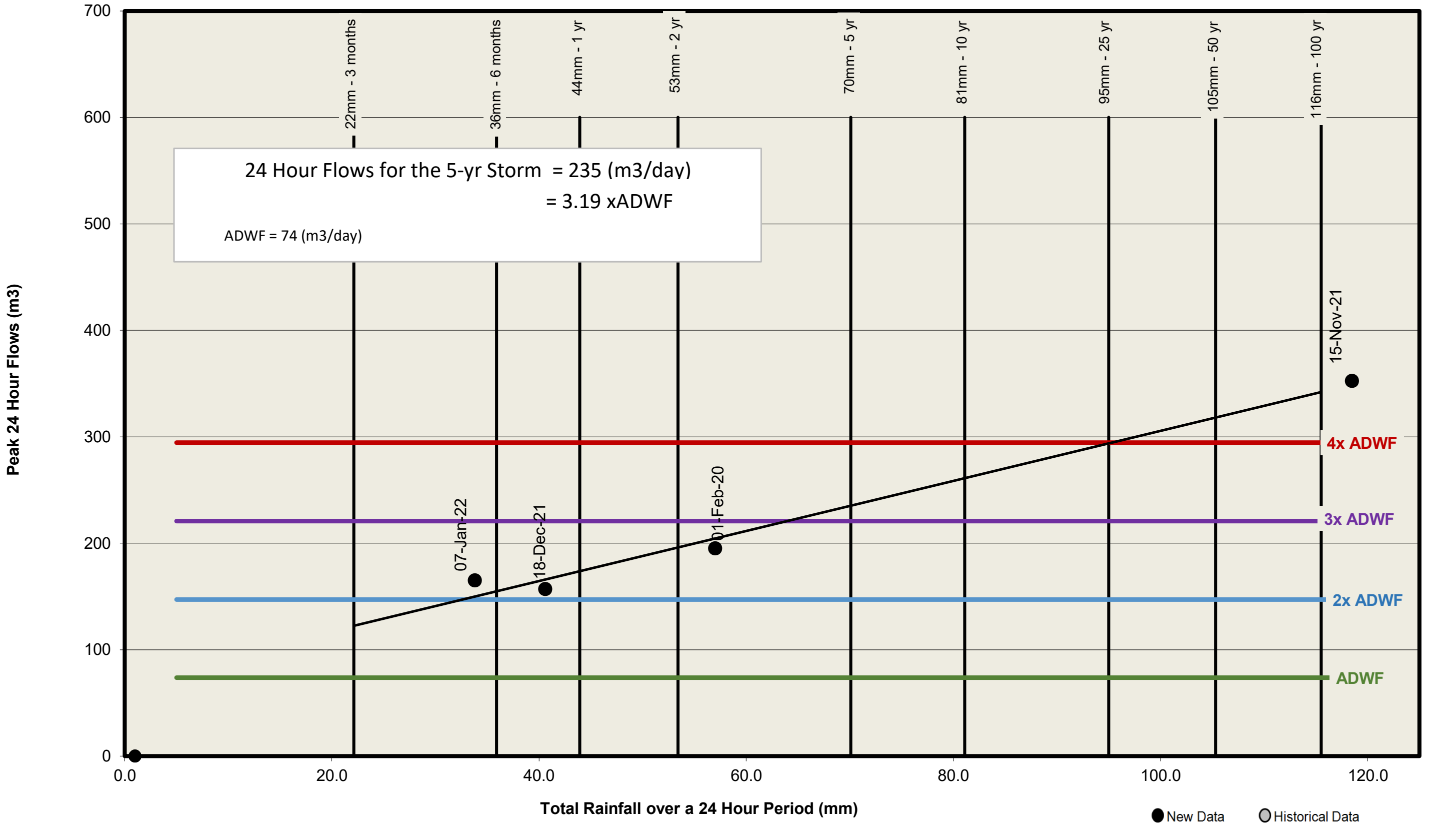
West Saanich PS (NS13)



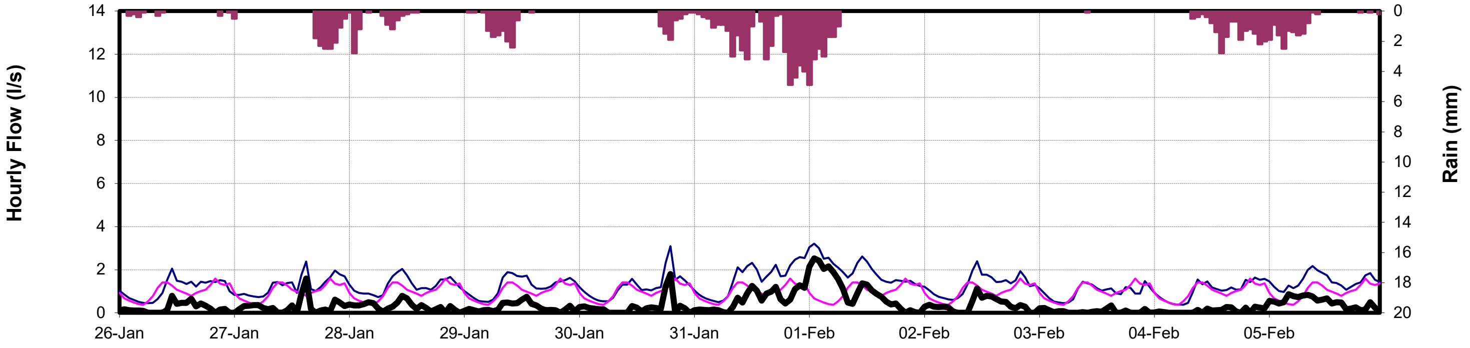
Peak 1-hr RDII by Storm Event



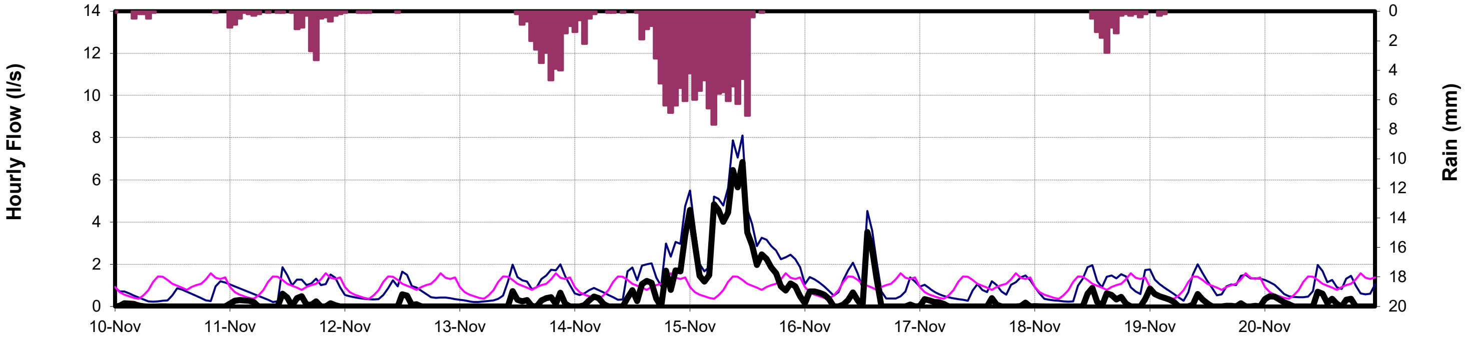
Peak 24-Hour Flows by Storm Event

West Saanich PS (NS13)

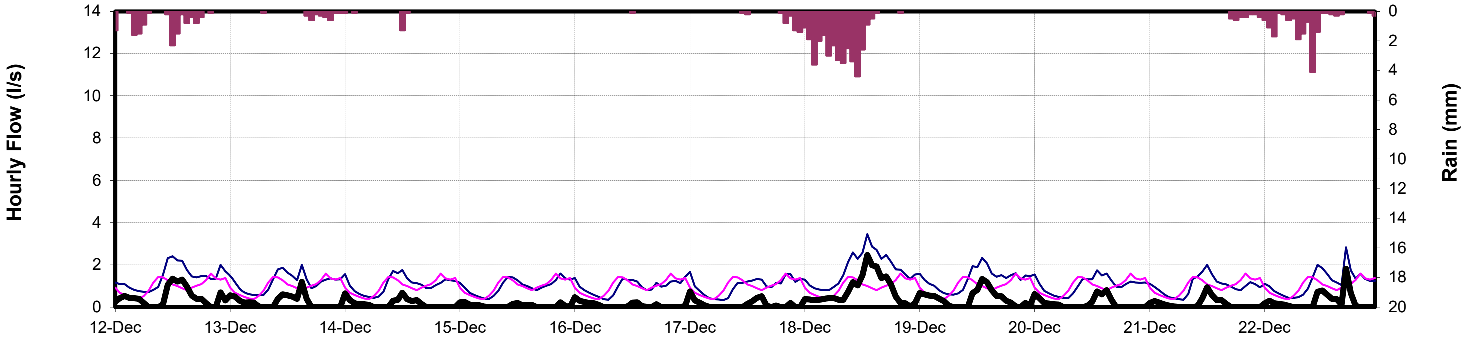
January 26 to February 5, 2020 Storm Events



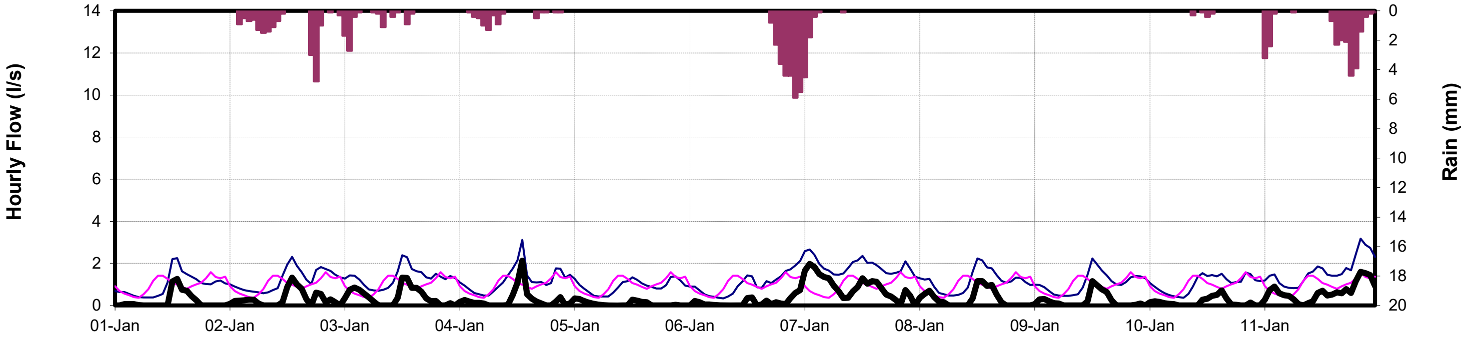
November 10 to November 20, 2021 Storm Events



December 12 to December 22, 2021 Storm Events



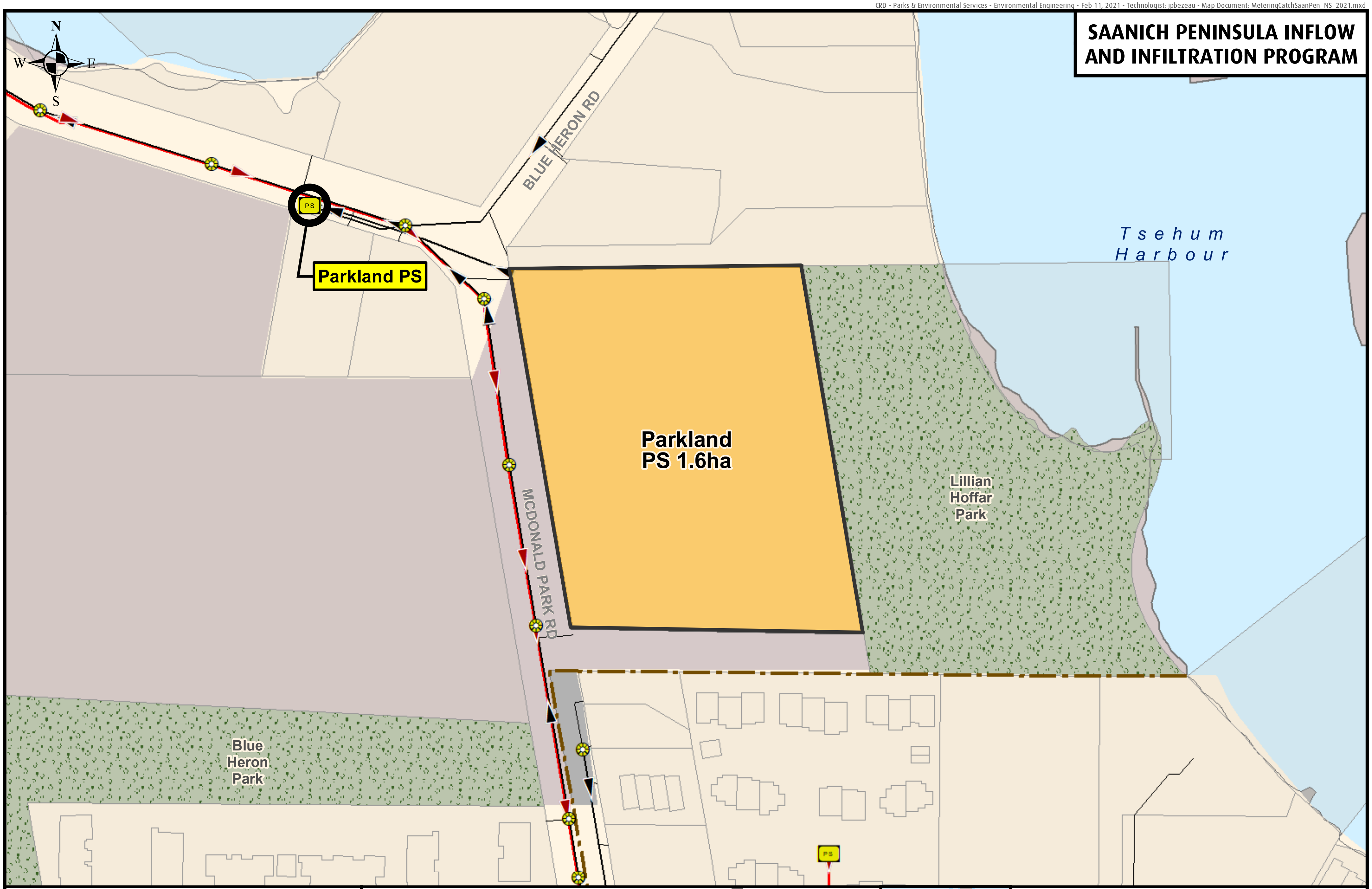
January 1 to January 11, 2022 Storm Events



▬ Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) ━ RDII(l/s)

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_NS_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 25 50 100

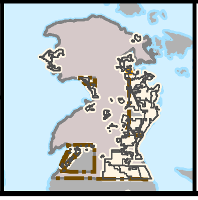
Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
● Manhole
⬟ Cleanout
PS Pump Station
● Metering Chamber

Sanitary Sewers
- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Parkland PS

Site Code: NS14

CRD
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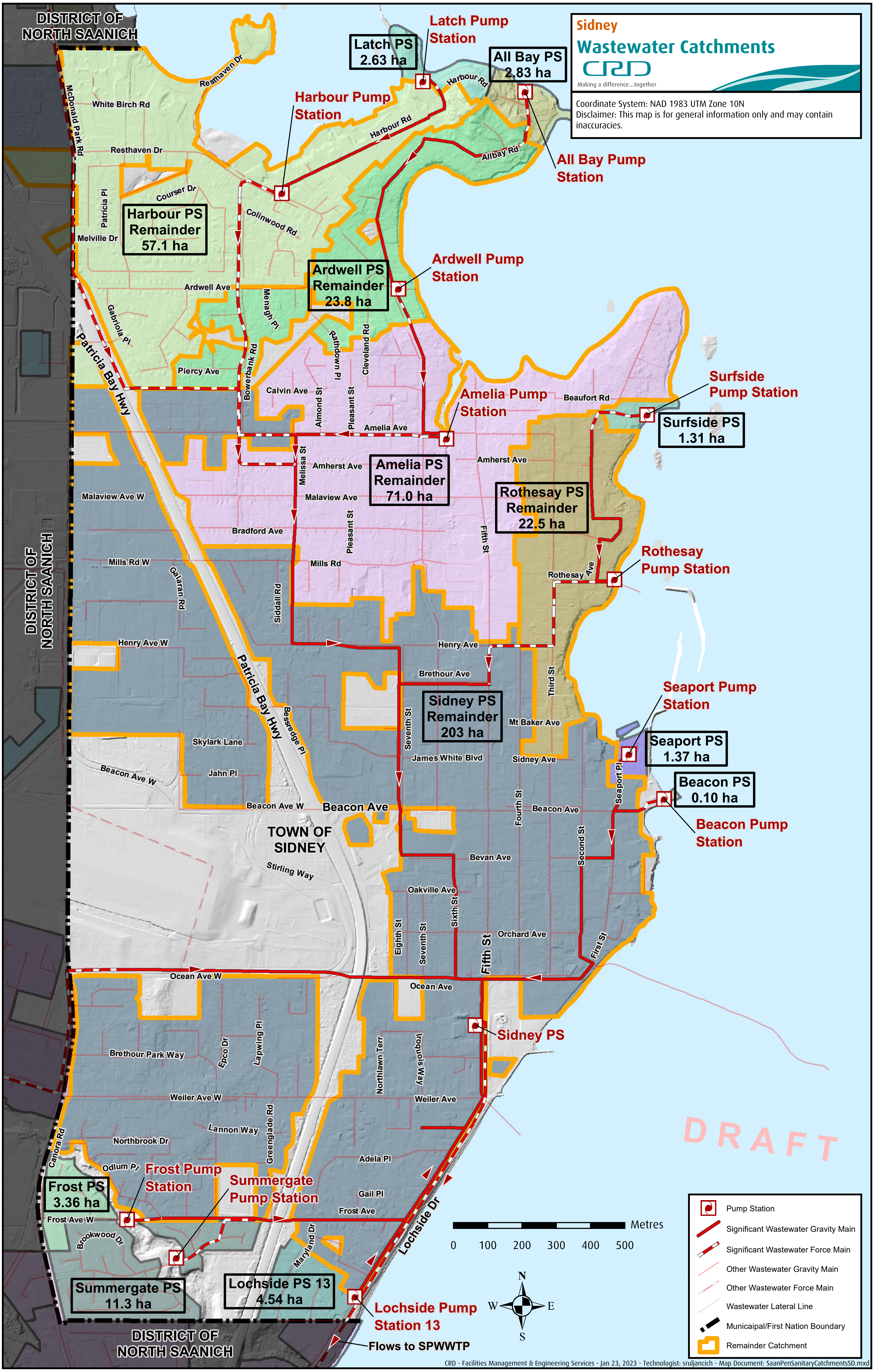
Appendix F:

Sidney: Sewer Map, Catchment Stats, Catchments Maps and Flow Charts



Sidney
Wastewater Catchments

CRD
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Coordinate System: NAD 1983 UTM Zone 10N
Disclaimer: This map is for general information only and may contain inaccuracies.

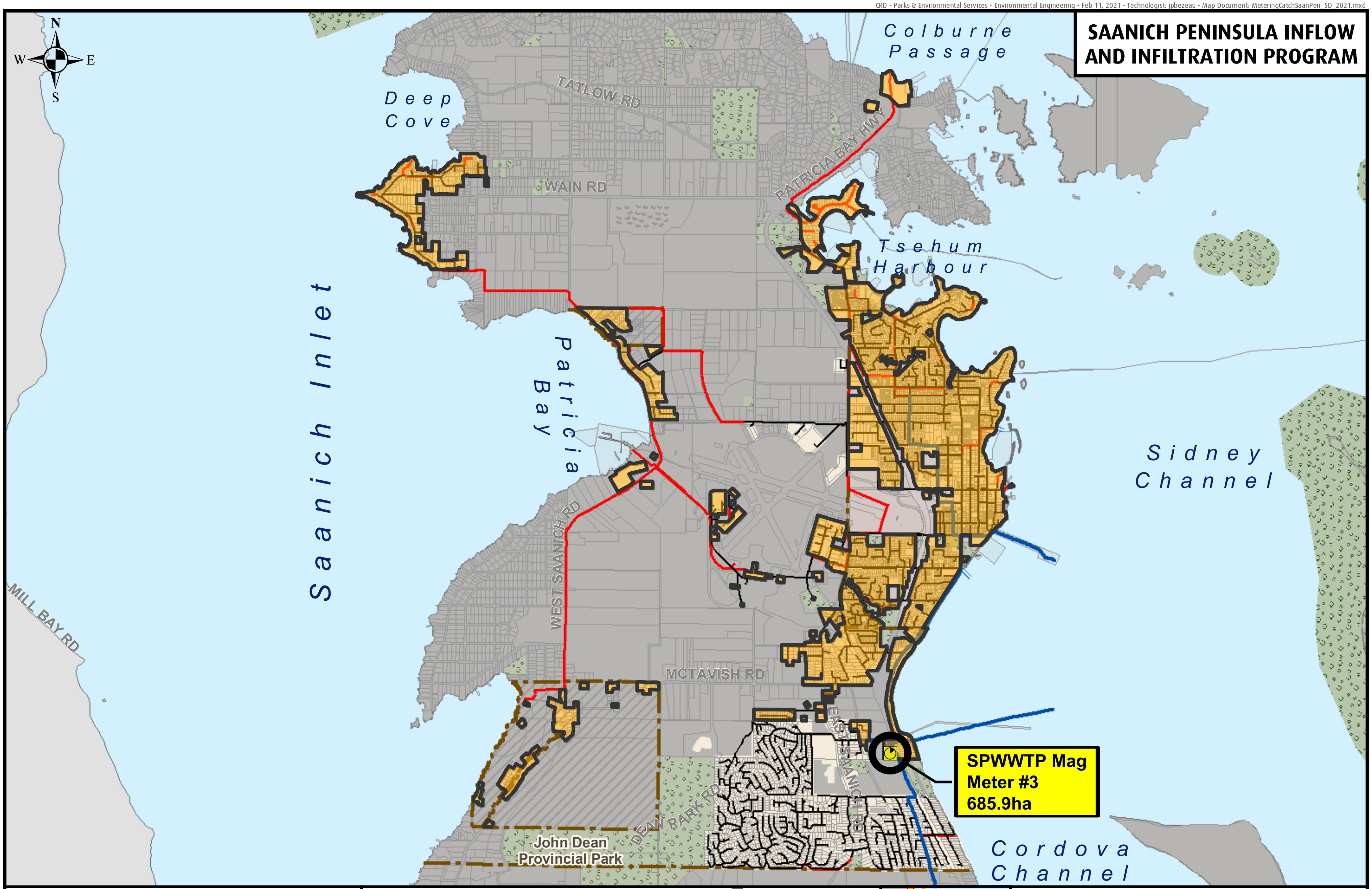
CRD - Facilities Management & Engineering Services - Jan 23, 2023 - Technologist: sruljancich - Map Document: SaanPenSanitaryCatchmentsSD.mxd

Sidney Catchment Summary Stats

Pump Station	Site Code	Catchment Stats							Gravity Sewer Pipe Type *(approximate %)*					Catchment Makeup *(approximate %)*				
		Size (ha)	Ave Age (yrs)	Gravity Sewers (m)	Force Mains (m)	PS's (#)	MH's (#)	Sewered Properties (#)	PVC	Concrete	Clay	Rehabbed	Other/Unk	Single Family	Multi Family	Commercial	Industrial	Institutional
Allbay	SID3	2.8	1970	216	0	1	4	18	38.4	61.6	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Amelia	SID4	97.6	1970	11,325	300	3	134	1192	24.5	42.6	32.9	0.0	0.0	84.3	10.9	3.5	0.0	1.3
Ardwell	SID5	26.6	1970	3,210	169	2	42	271	16.3	53.7	30.0	0.0	0.0	99.7	0.0	0.0	0.0	0.3
Beacon	SID6	0.1	NA	NA	NA	1	0	1	NA	NA	NA	NA	NA	0.0	0.0	100.0	0.0	0.0
Frost	SID7	3.4	1986	608	0	1	10	33	100.0	0.0	0.0	0.0	0.0	81.8	0.0	18.2	0.0	0.0
Harbour	SID8	59.8	1972	6,246	641	4	97	874	18.1	28.0	53.6	0.0	0.0	56.3	20.1	17.0	0.3	6.4
Latch	SID9	2.6	1980	25	8	1	3	46	59.1	40.9	0.0	0.0	0.0	0.1	63.6	36.4	0.0	0.0
Lockside	SID10	4.5	1964	606	0	1	7	46	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Ocean	SID11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Rothesay	SID12	23.8	1957	2,257	220	2	30	372	4.6	38.0	57.4	0.0	0.0	65.8	29.3	0.1	0.0	4.8
Seaport	SID13	1.2	1989	50	0	1	2	45	100.0	0.0	0.0	0.0	0.0	0.0	16.2	62.7	0.0	21.1
Summergate	SID14	11.3	NA	2,020	0	1	48	235	0.0	0.0	0.0	0.0	100.0	99.9	0.0	0.1	0.0	0.0
Surfside	SID15	1.3	1971	96	0	1	2	10	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_SD_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



SPWWTP Mag Meter #3
685.9ha

Metres
0 750 1,500 3,000

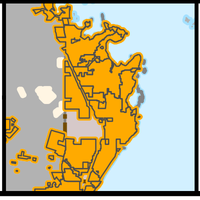
Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
✲ Manhole
⬟ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
— Gravity Main Installed After 1930
— Gravity Main Installed Before 1930
— Force Main
═ Relief, Outfall, Overflow Sewer
— CRD Sewer

🟧 Catchment Area
⬜ Non-Sewered Area
⬜ Lot Lines
▨ Parks
▨ Sewered Park Areas
- - Catchment Boundary
-·- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: SPWWTP Sidney Meter

Site Code: SID1

CRD
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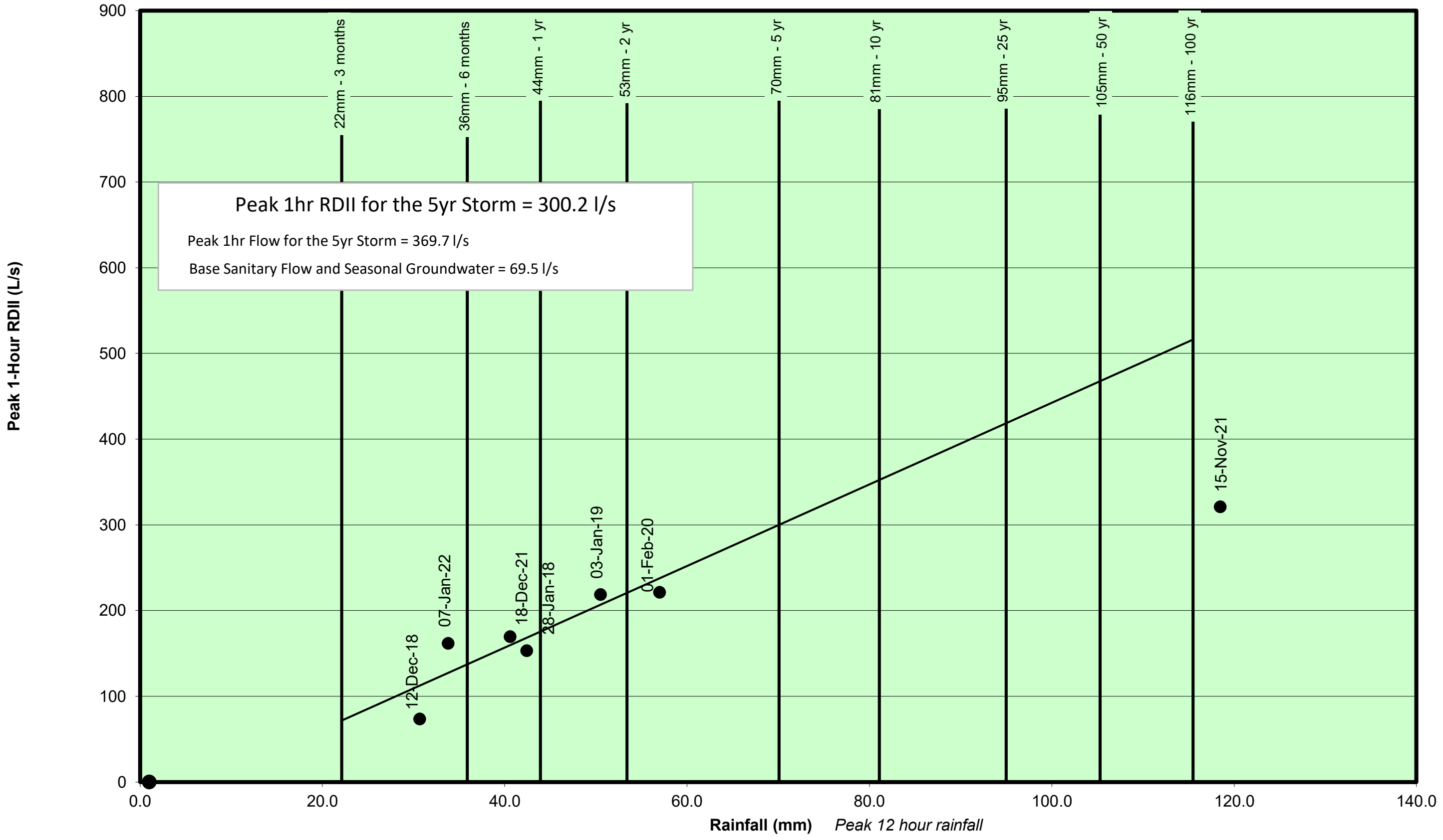
SPWWTP Mag Meter #3 (SID1)

Peak 1-hr RDII by Storm Event

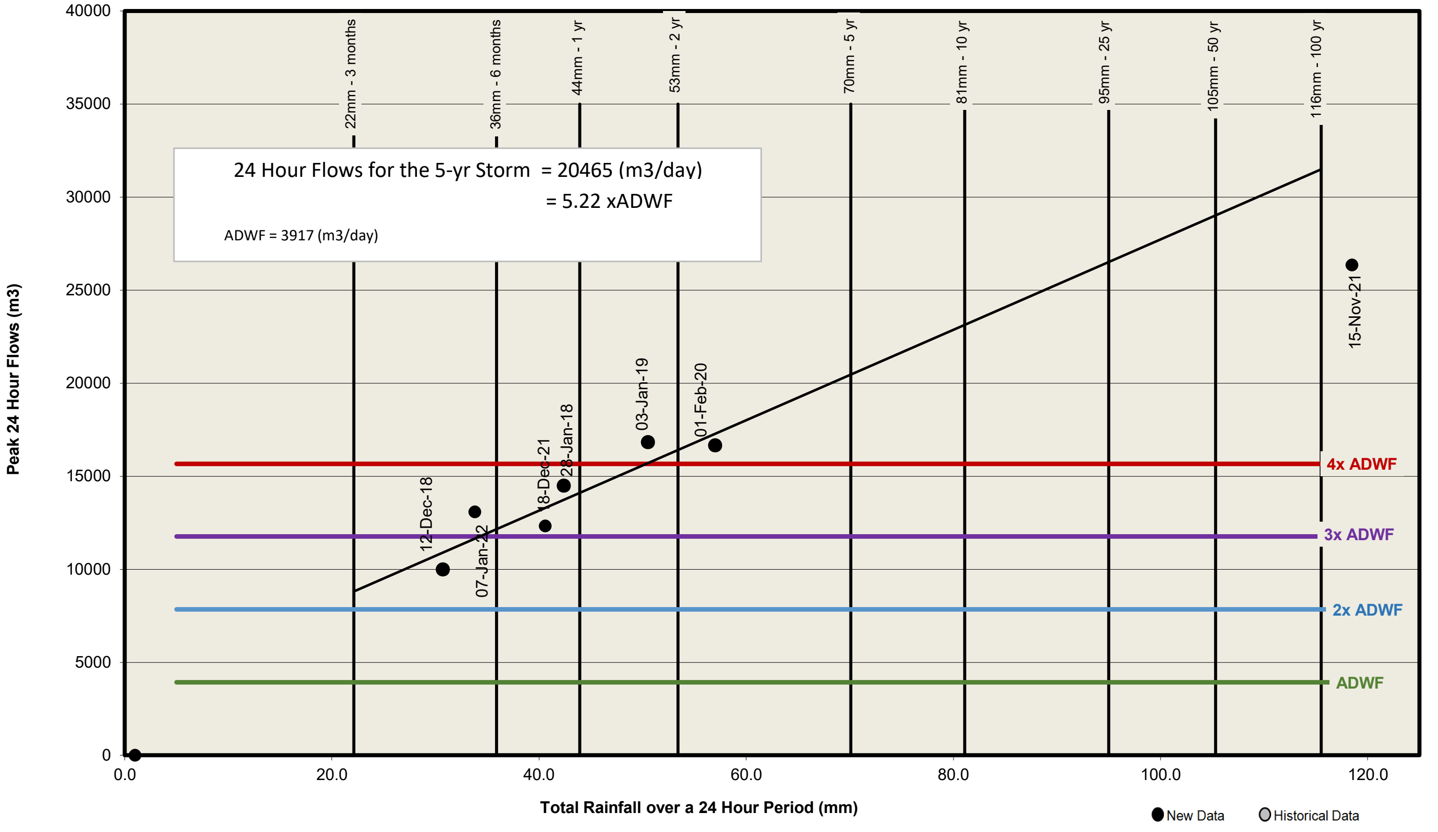


Peak 1hr RDII for the 5yr Storm = 300.2 l/s

Peak 1hr Flow for the 5yr Storm = 369.7 l/s

Base Sanitary Flow and Seasonal Groundwater = 69.5 l/s

Peak 24-Hour Flows by Storm Event

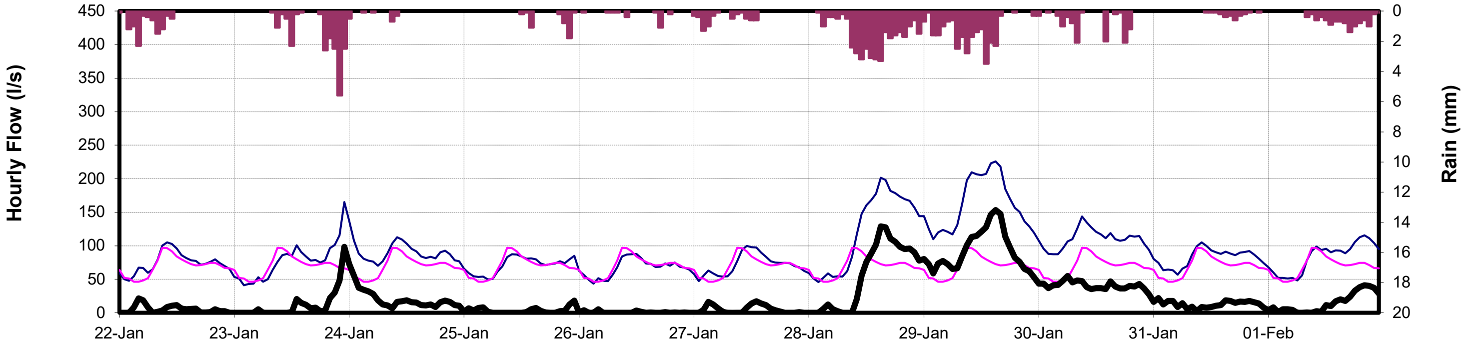


24 Hour Flows for the 5-yr Storm = 20465 (m3/day)
= 5.22 xADWF

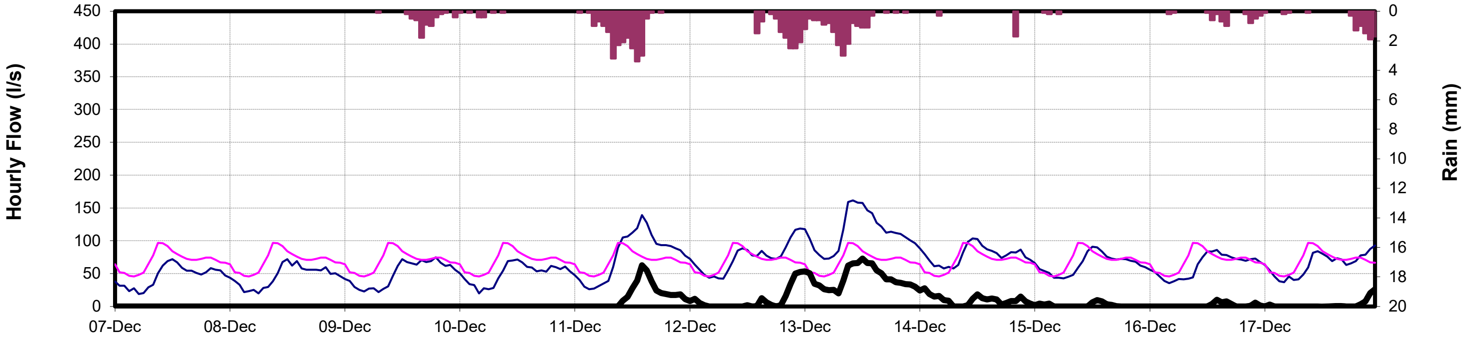
ADWF = 3917 (m3/day)

SPWWTP Mag Meter #3 (SID1)

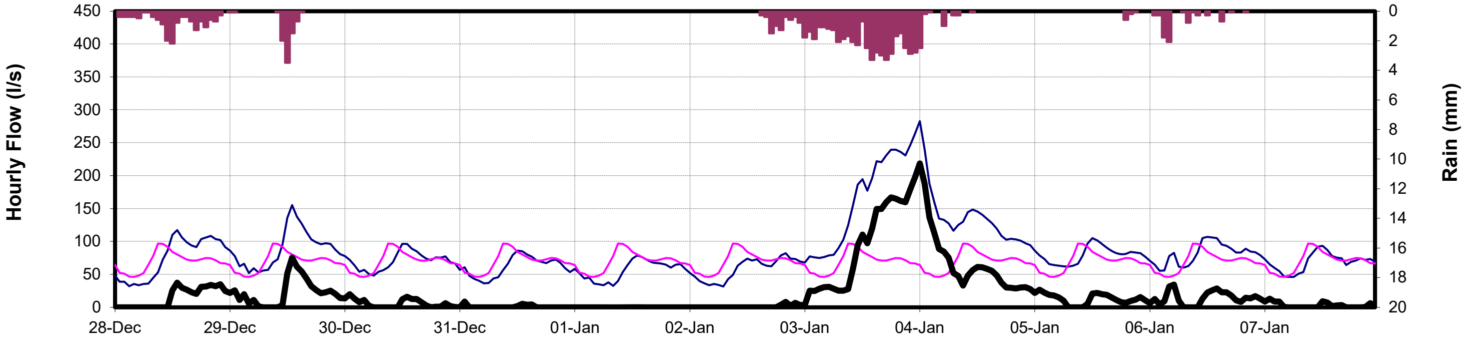
January 22 to February 1, 2018 Storm Events



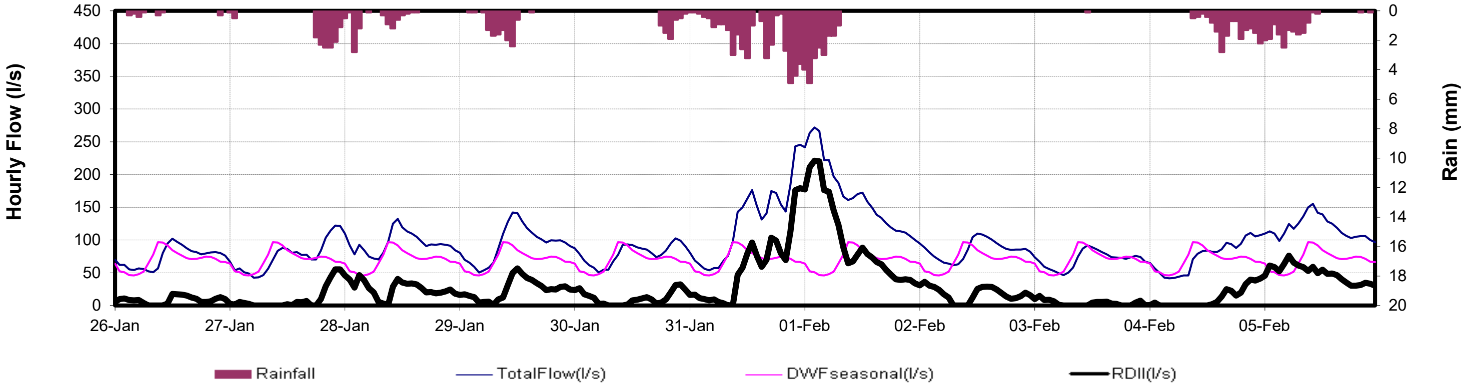
December 7 to December 17, 2018 Storm Events



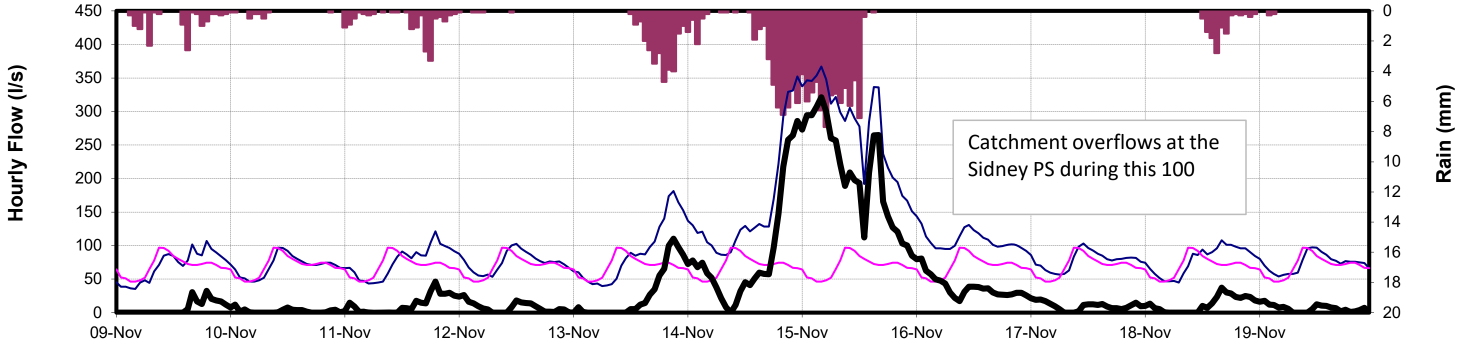
December 28 to January 7, 2019 Storm Events



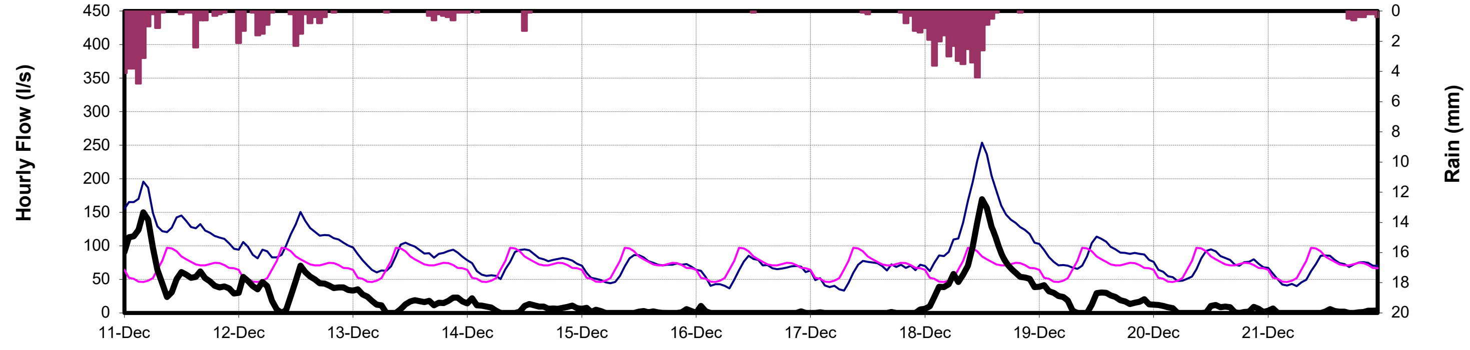
January 26 to February 5, 2020 Storm Events

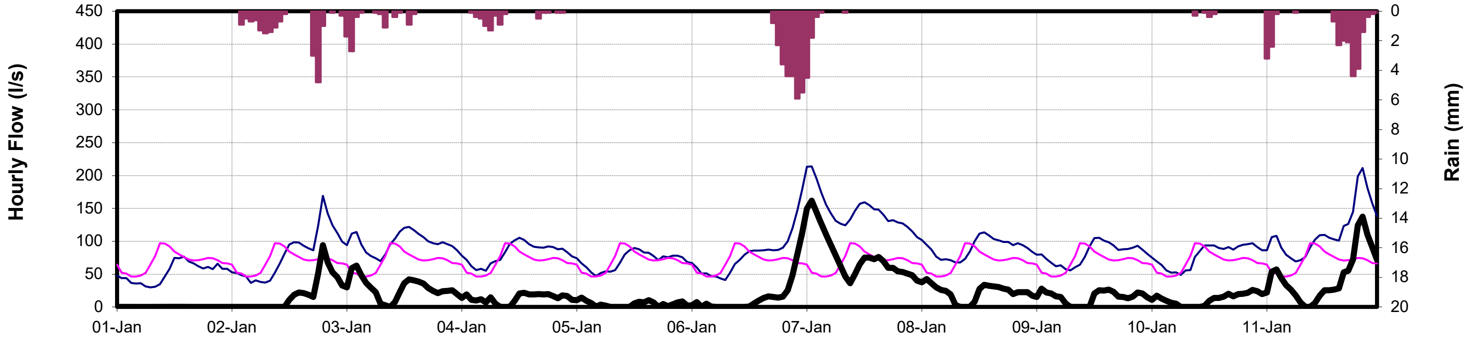


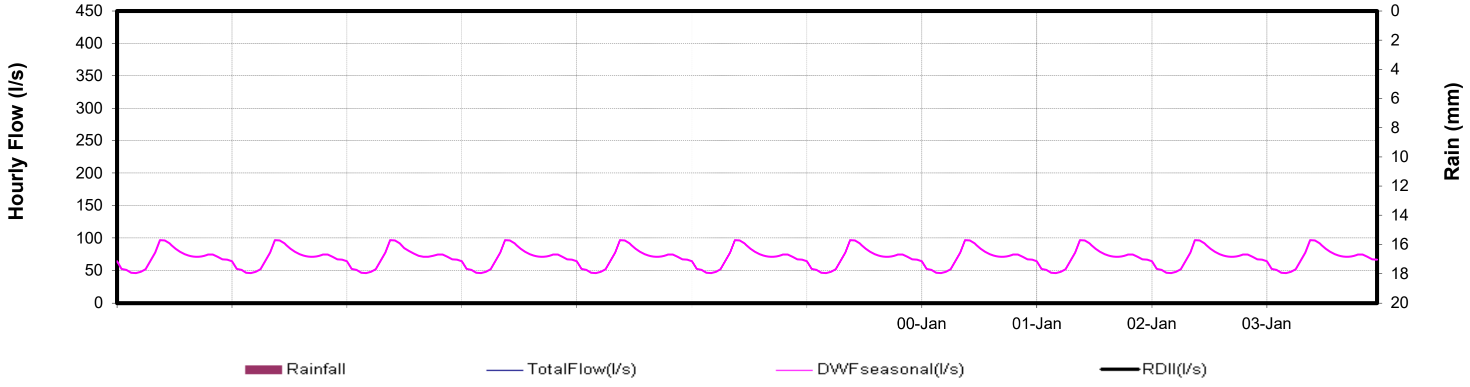
SPWWTP Mag Meter #3 (SID1)


November 9 to November 19, 2021 Storm Events

Catchment overflows at the Sidney PS during this 100


December 11 to December 21, 2021 Storm Events


January 1 to January 11, 2022 Storm Events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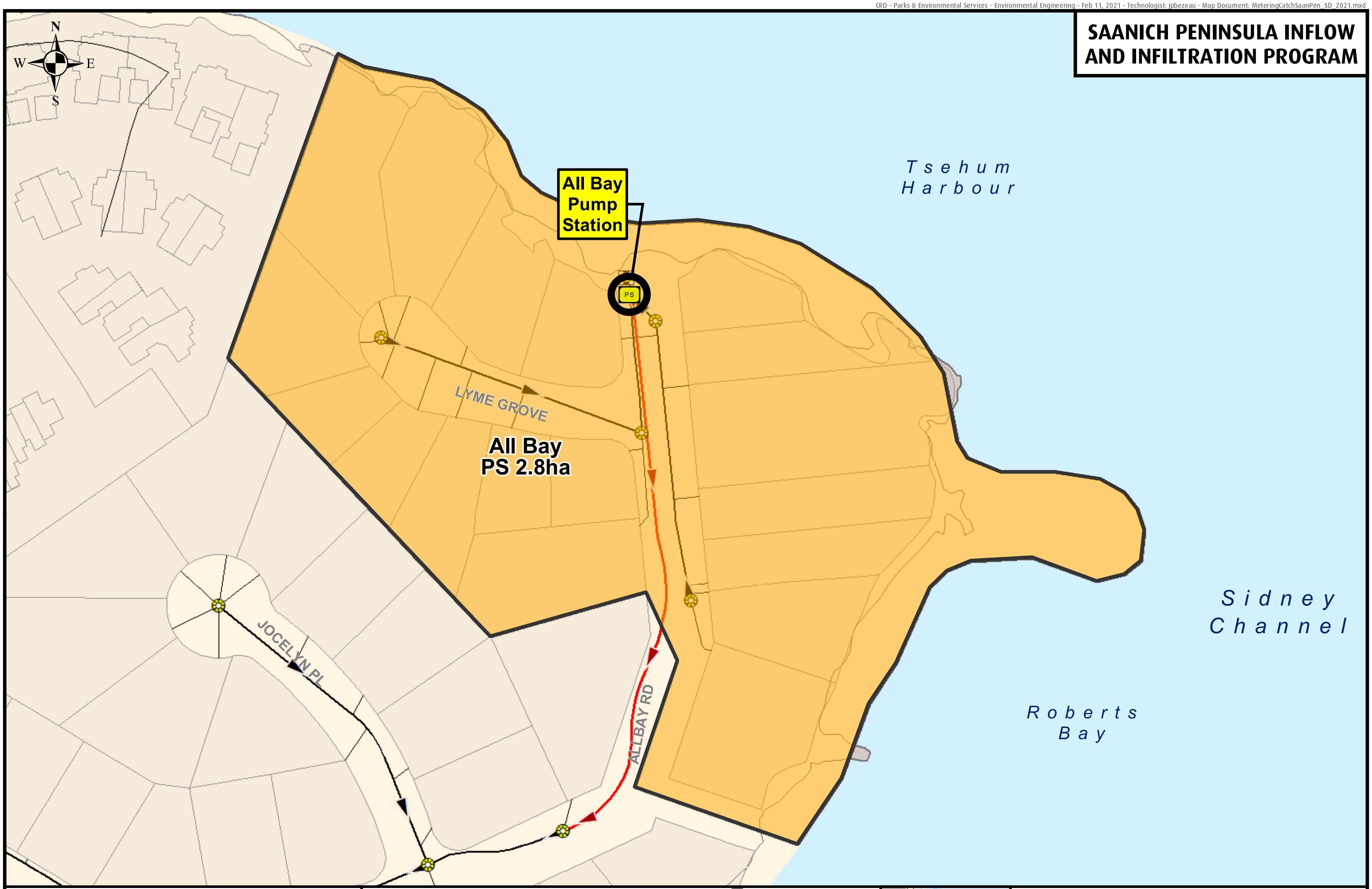
CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_SD_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 20 40 80

Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
✲ Manhole
⬟ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

Catchment: All Bay PS

Site Code: SID3

CRD
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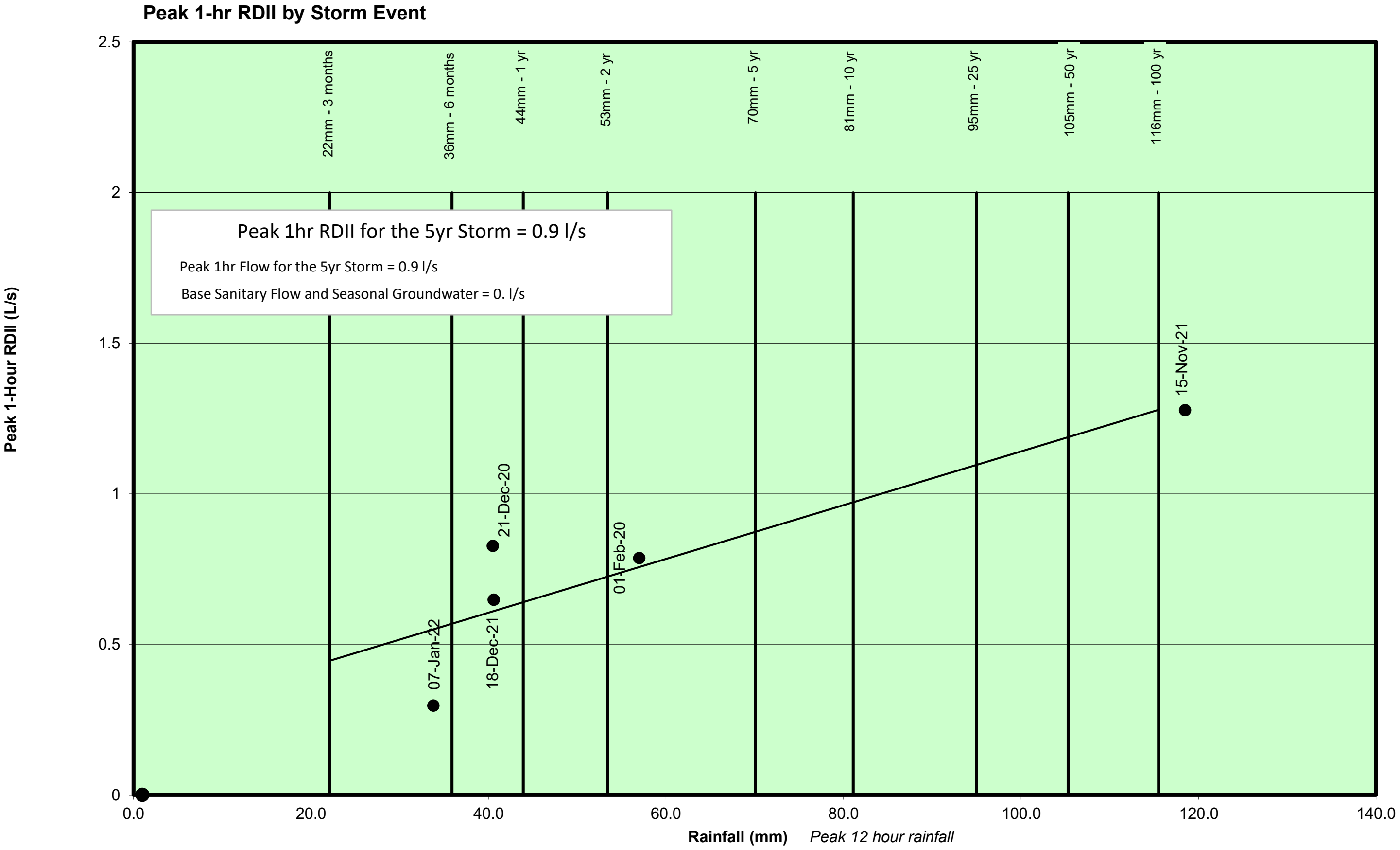
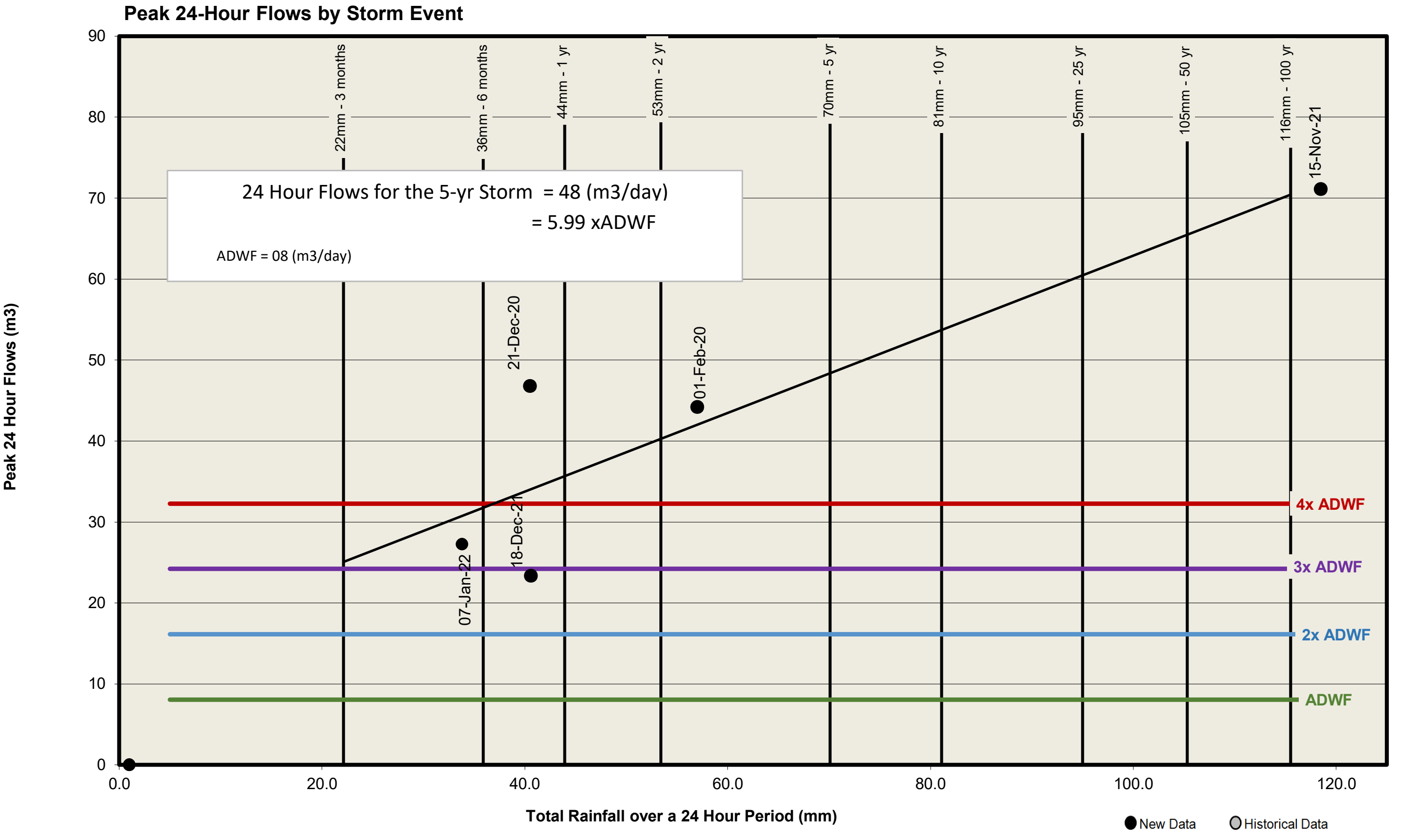
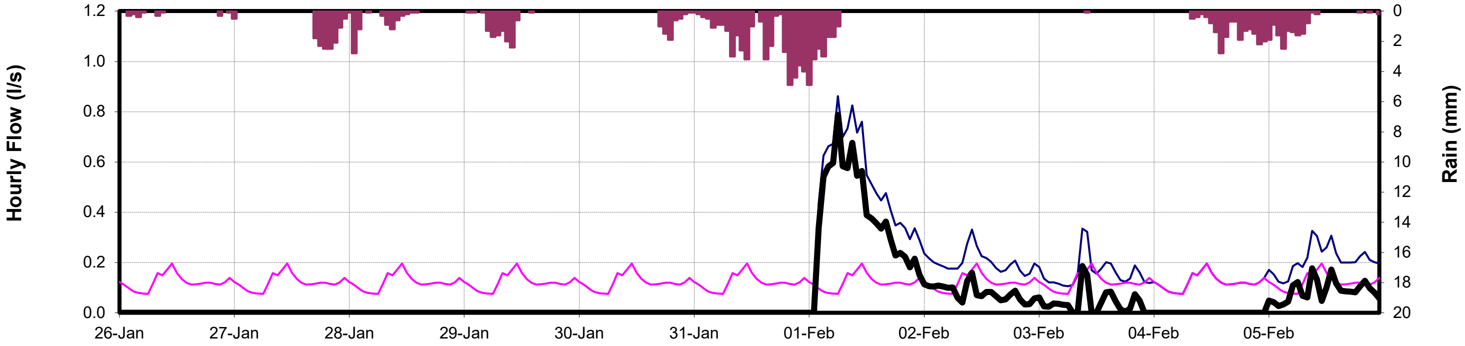
All Bay PS (SID3)



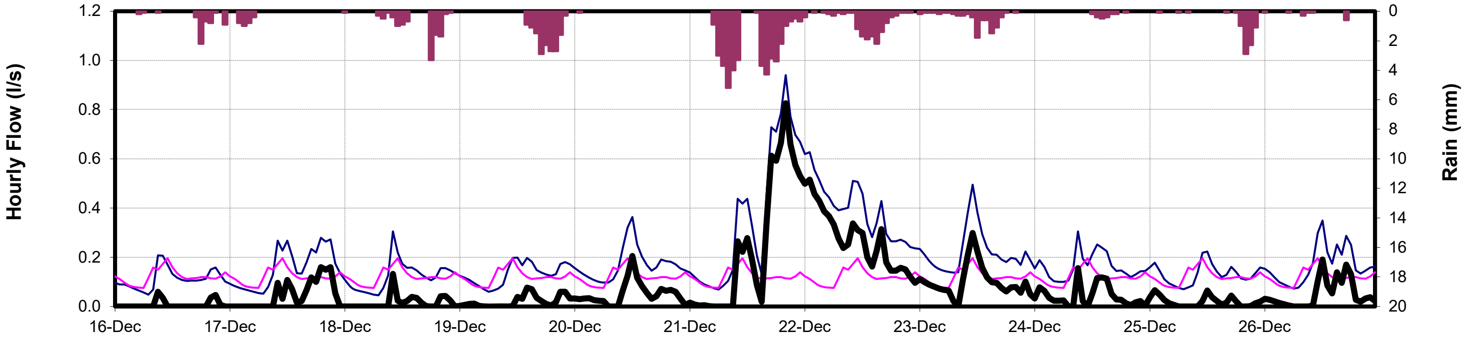


All Bay PS (SID3)

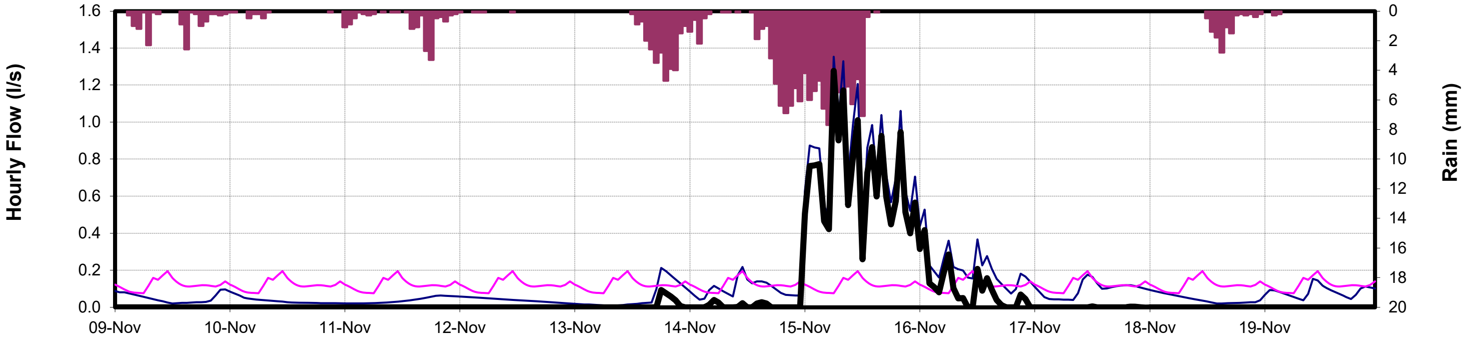
January 26 to February 5, 2020 Storm Events



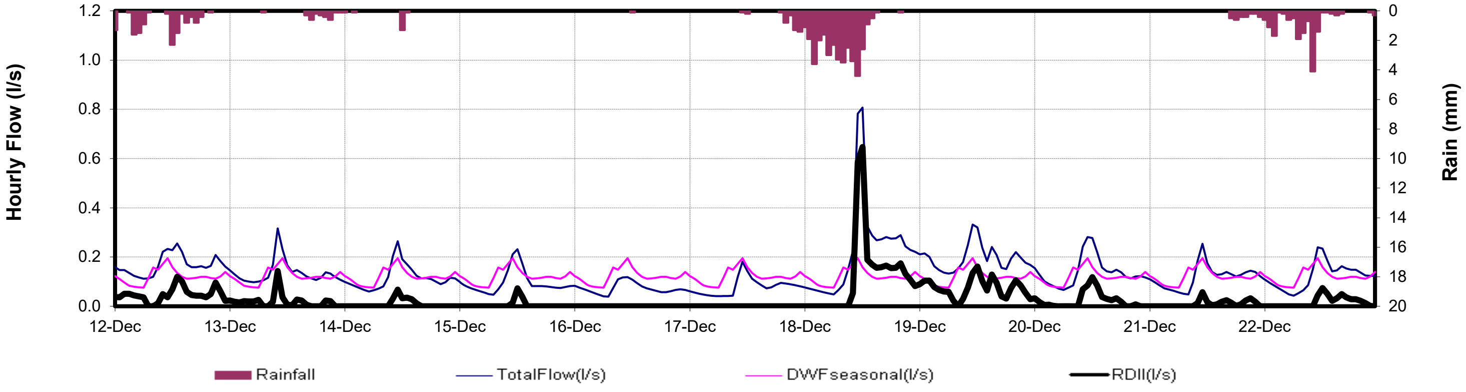
December 16 to December 26, 2020 Storm Events



November 9 to November 19, 2021 Storm Events

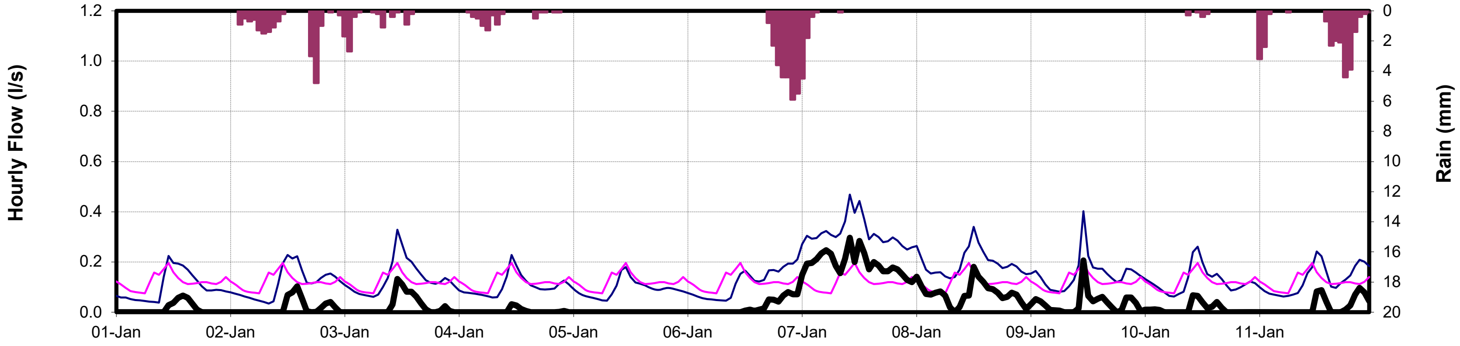


December 12 to December 22, 2021 Storm Events



All Bay PS (SID3)

January 1 to January 11, 2022 Storm Events



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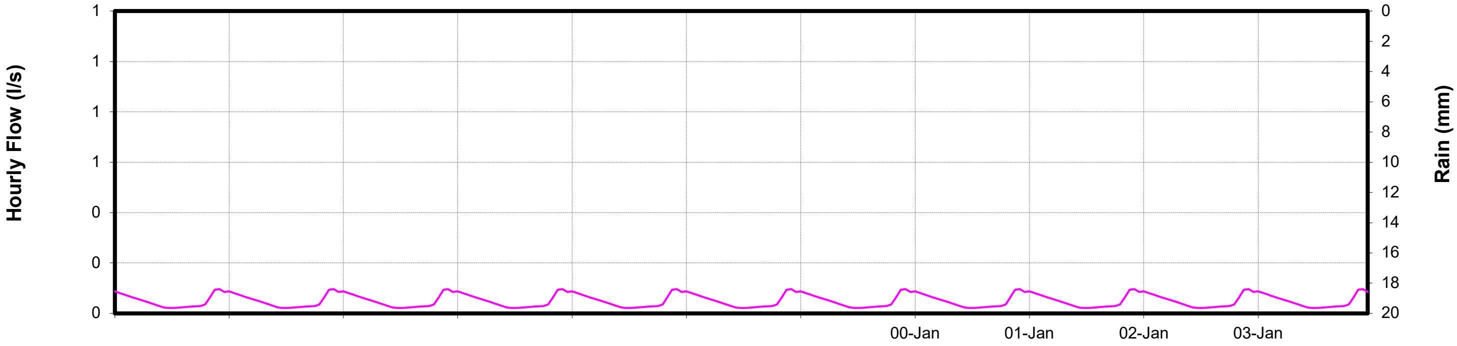

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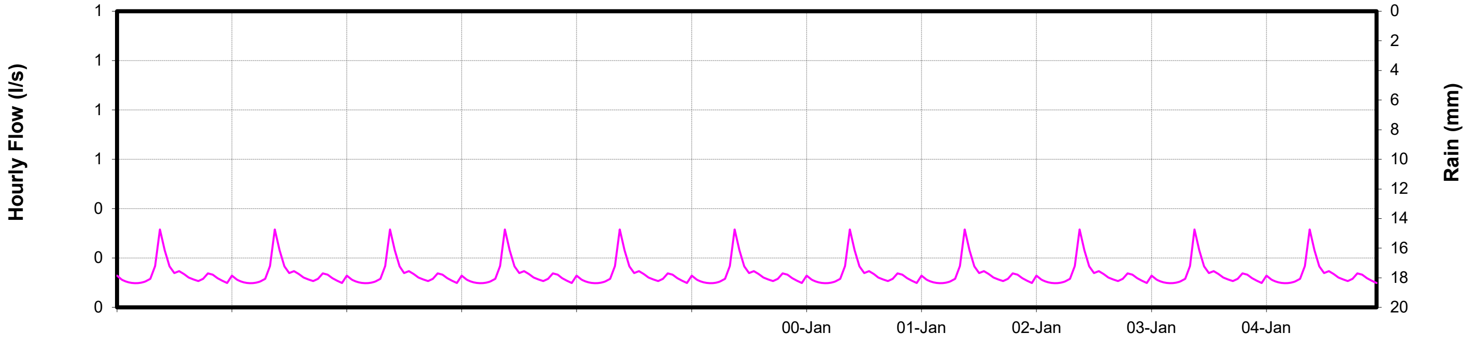

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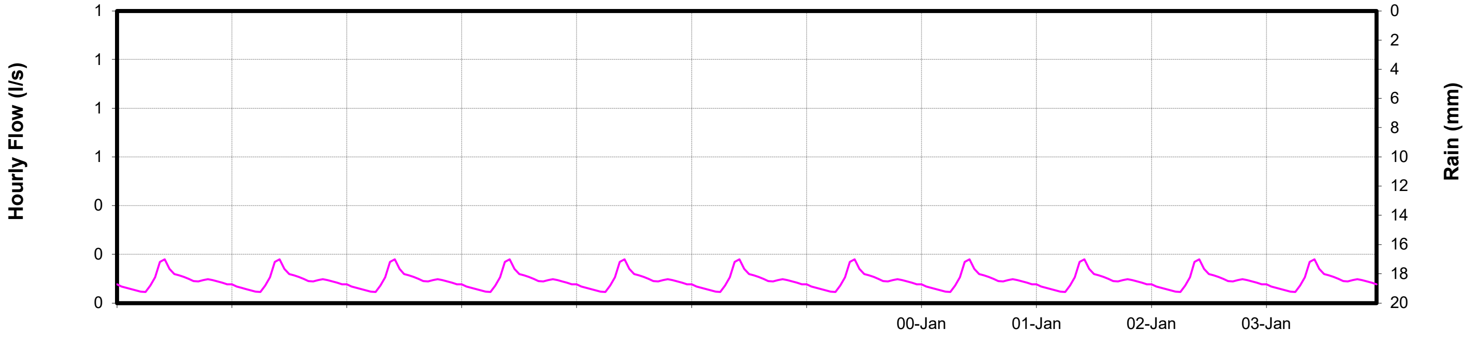
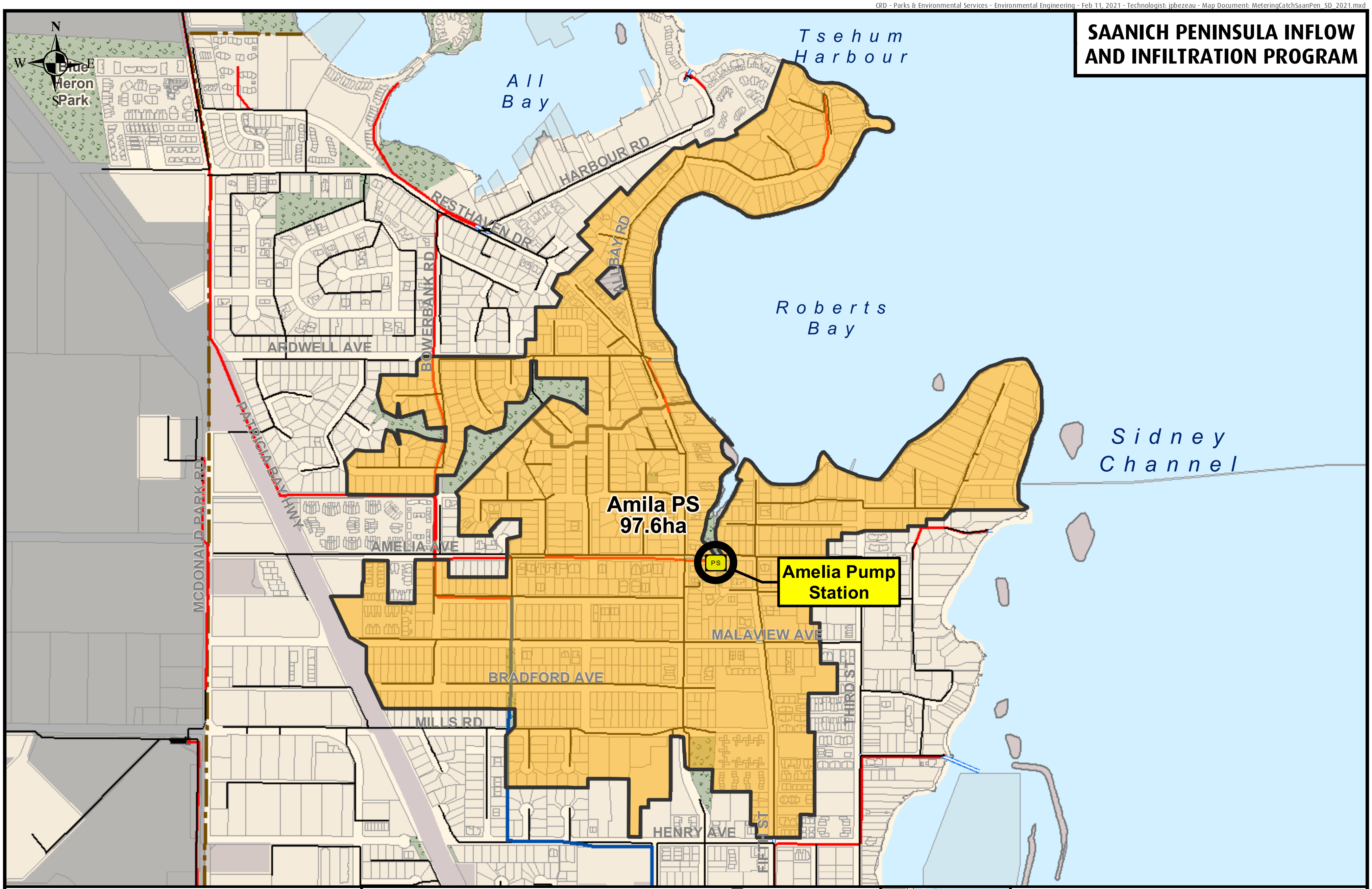


▬ Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) ▬ RDII(l/s)

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_SD_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 155 310 620

Projection: UTM ZONE 10N, NAD83

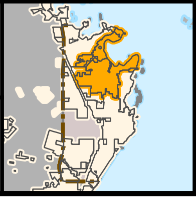
Disclaimer
This map is for general information only and may contain inaccuracies.

○	Flow Monitoring Location
✲	Manhole
⬟	Cleanout
PS	Pump Station
◙	Metering Chamber

Sanitary Sewers

—	Gravity Main Installed After 1930
—	Gravity Main Installed Before 1930
—	Force Main
=	Relief, Outfall, Overflow Sewer
—	CRD Sewer

▨	Catchment Area
▨	Non-Sewered Area
☐	Lot Lines
▨	Parks
▨	Sewered Park Areas
- -	Catchment Boundary
-·-	Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Amila PS

Site Code: SID4

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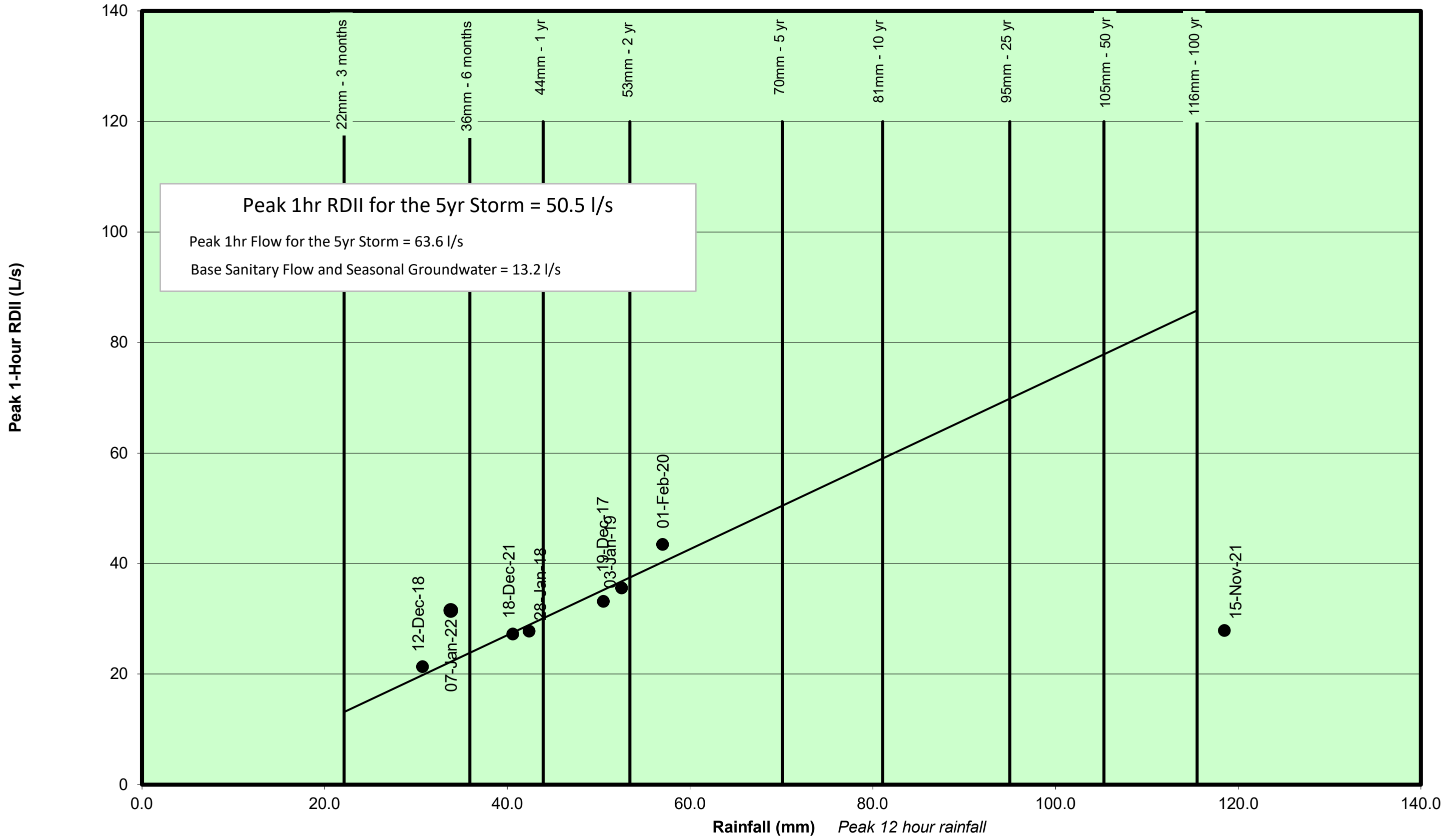
Amelia PS (SID4)

Peak 1-hr RDII by Storm Event

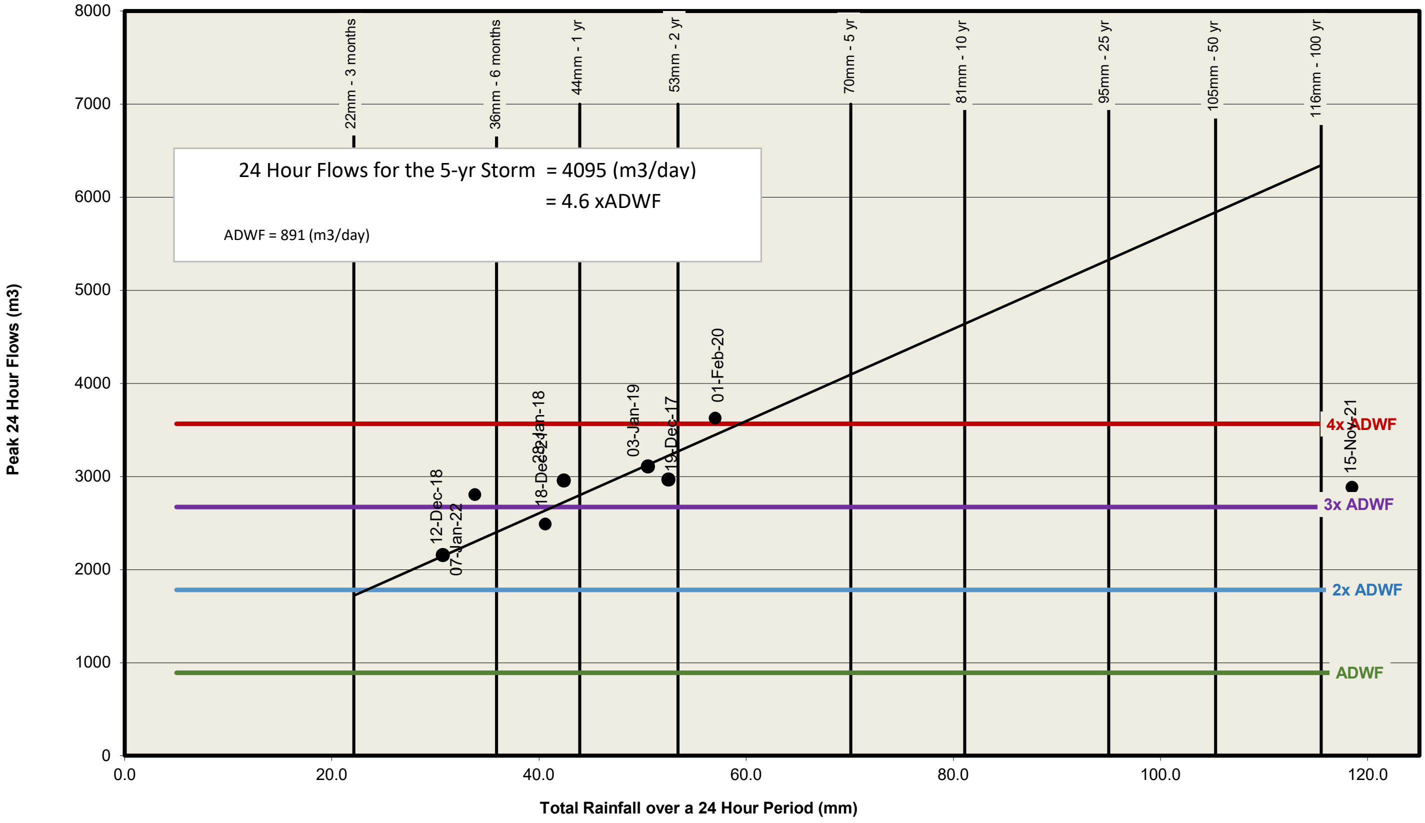


Peak 1hr RDII for the 5yr Storm = 50.5 l/s

Peak 1hr Flow for the 5yr Storm = 63.6 l/s

Base Sanitary Flow and Seasonal Groundwater = 13.2 l/s

Peak 24-Hour Flows by Storm Event

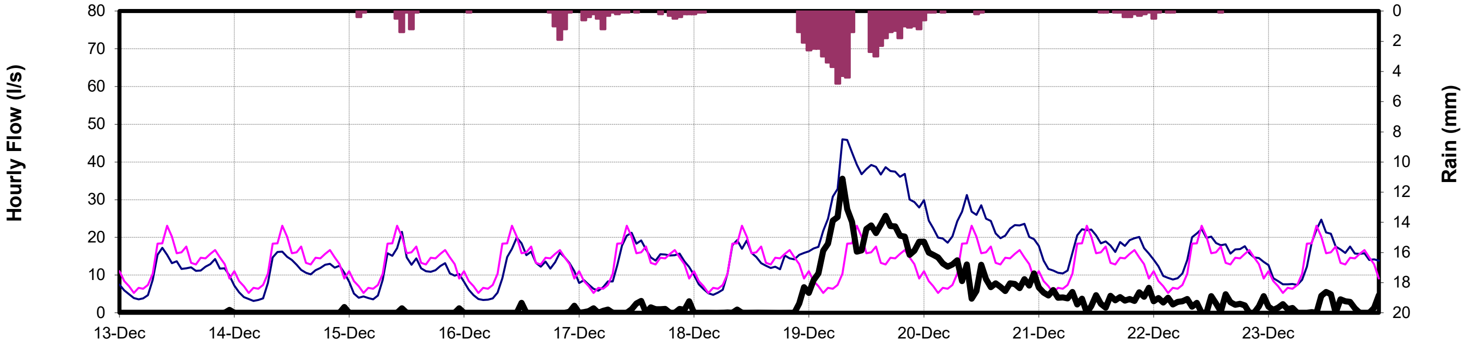


24 Hour Flows for the 5-yr Storm = 4095 (m3/day)
= 4.6 xADWF

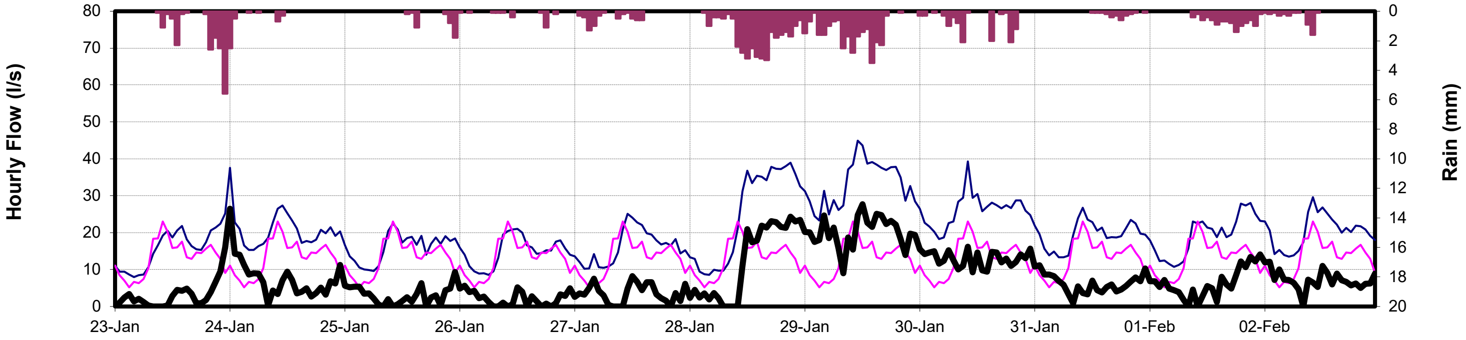
ADWF = 891 (m3/day)

Amelia PS (SID4)

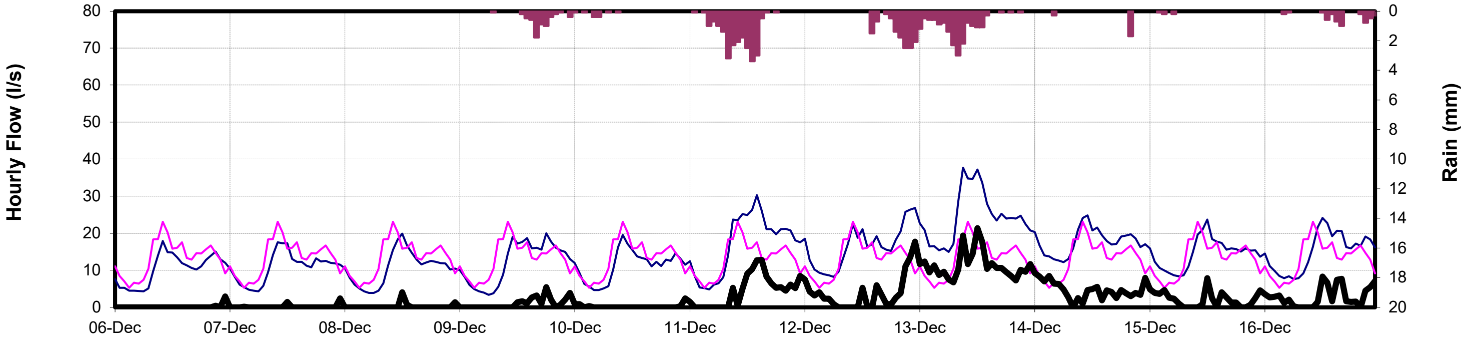
December 13 to December 23, 2017 Storm Events



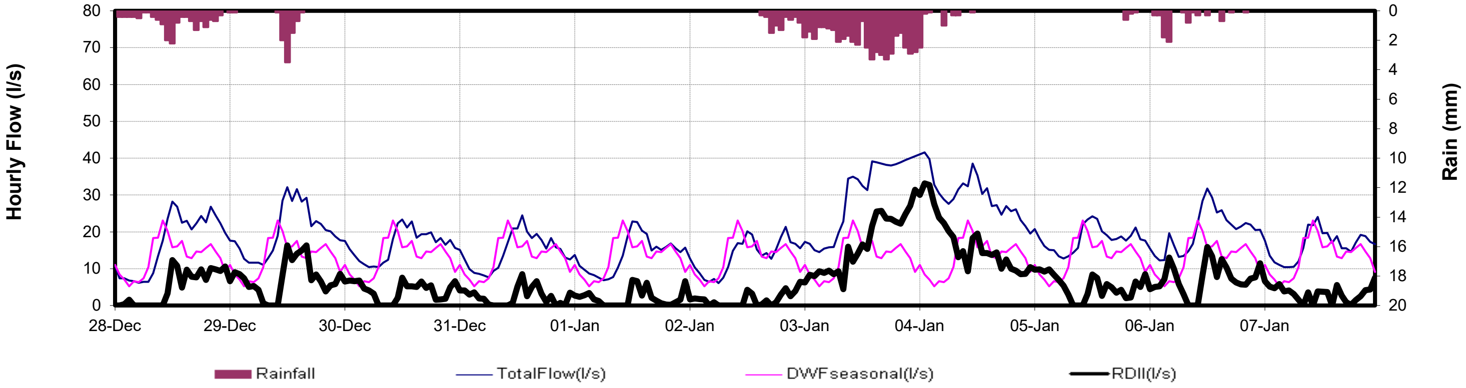
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

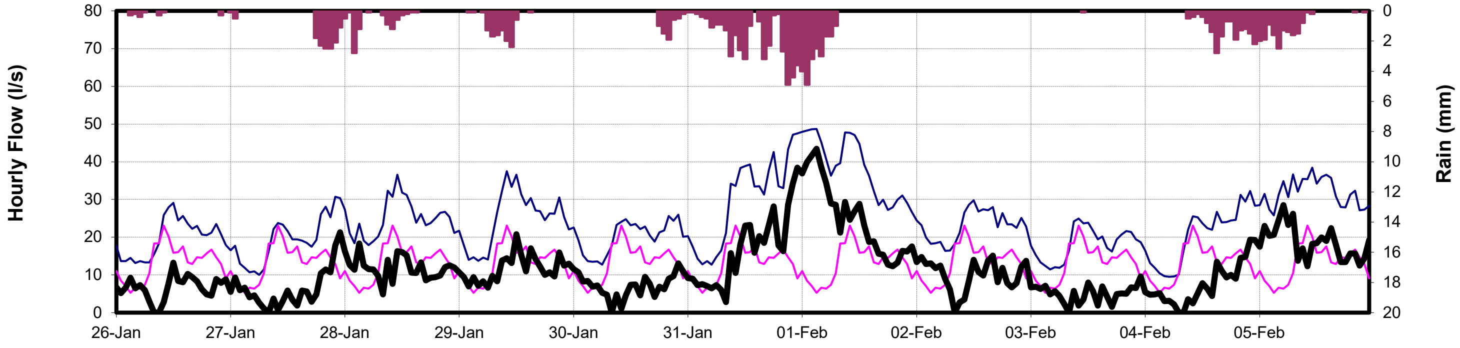


December 28 to January 7, 2019 Storm Events

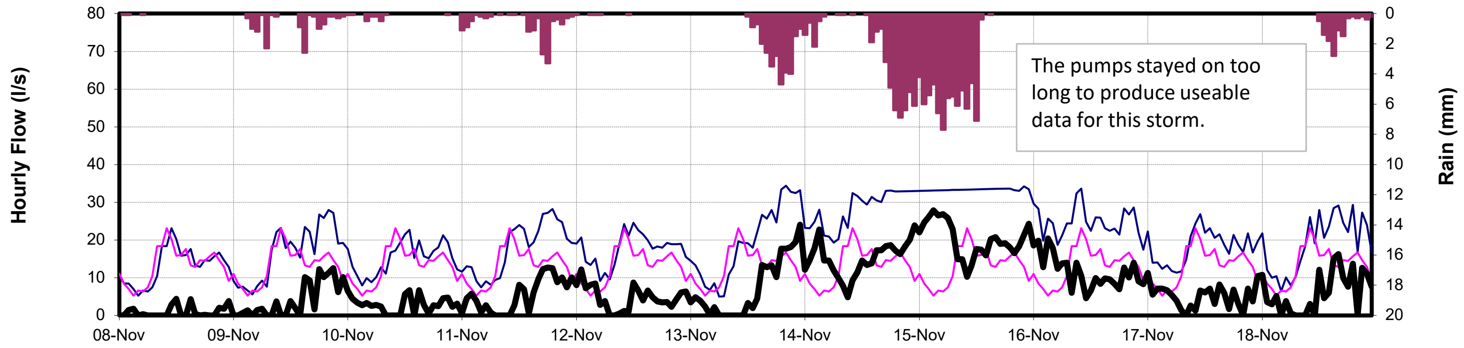


Amelia PS (SID4)

January 26 to February 5, 2020 Storm Events

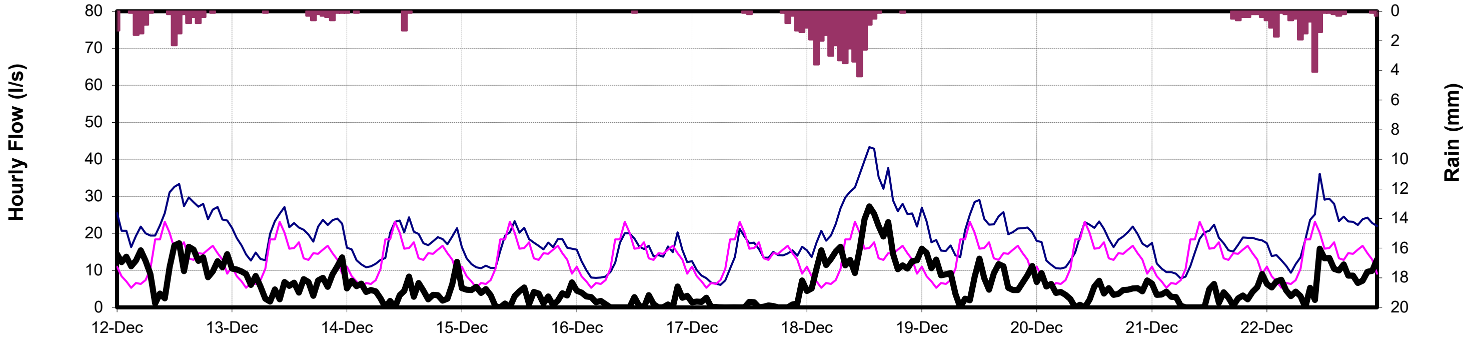


November 8 to November 18, 2021 Storm Events

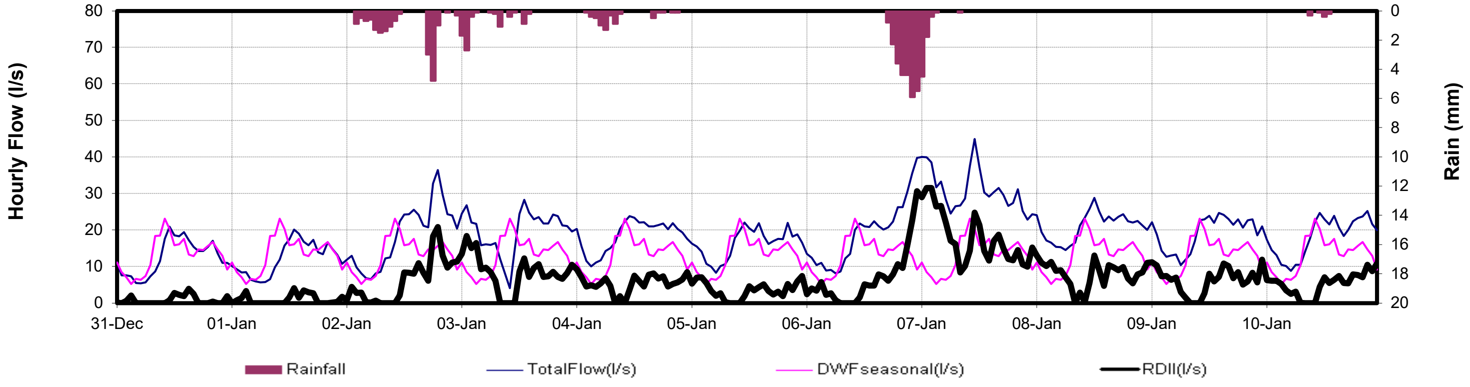


The pumps stayed on too long to produce useable data for this storm.

December 12 to December 22, 2021 Storm Events



December 31 to January 10, 2022 Storm Events



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SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM

0 85 170 340 Metres

Projection: UTM ZONE 10N, NAD83

Disclaimer

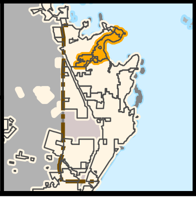
This map is for general information only and may contain inaccuracies.

- ○ Flow Monitoring Location
- ● Manhole
- ⬟ Cleanout
- PS Pump Station
- ◙ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- Catchment Area
- Non-Sewered Area
- Lot Lines
- Parks
- Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Ardwell PS

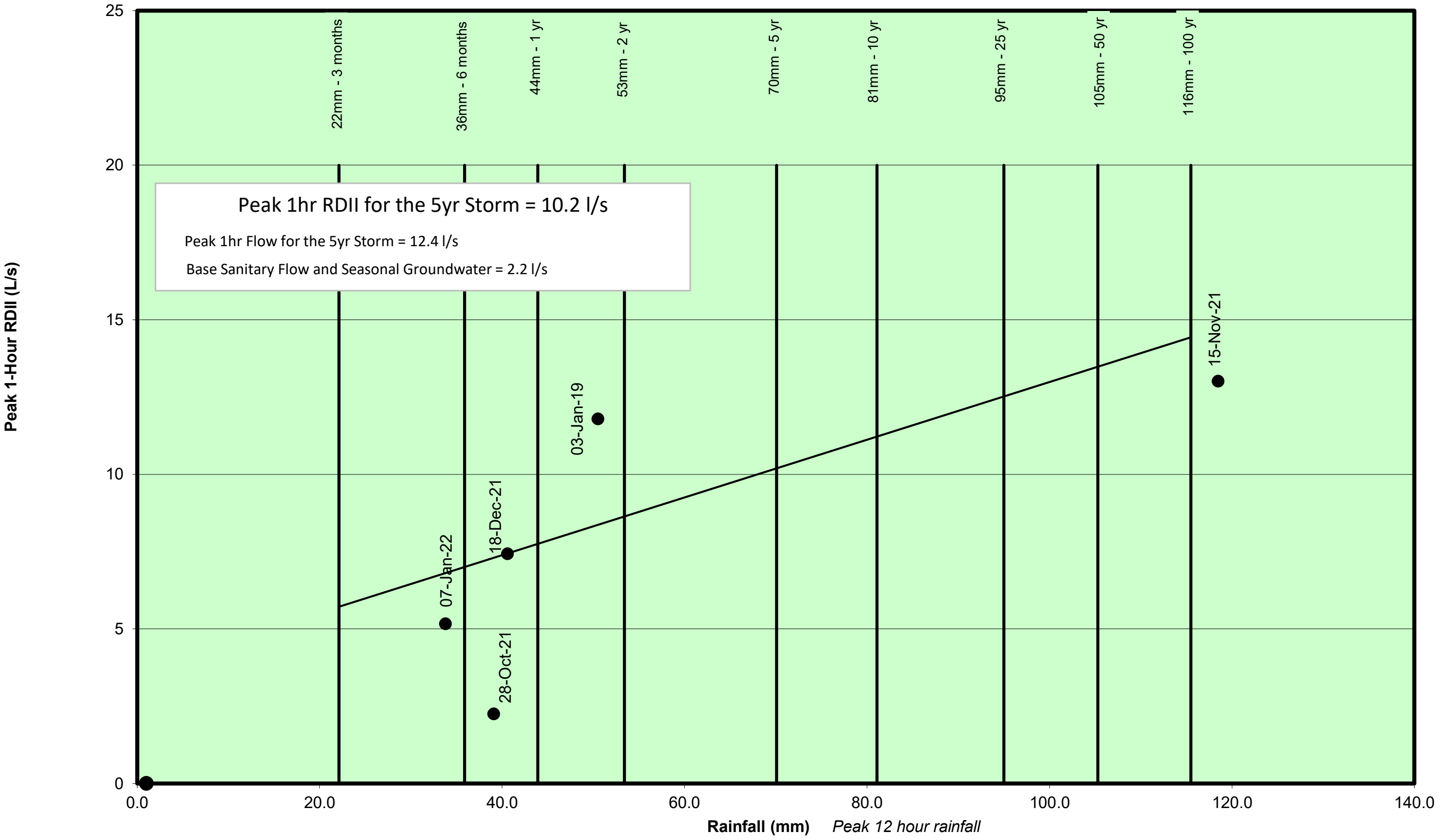
Site Code: SID5

CRD

Making a difference...together

Ardwell PS (SID5)

Peak 1-hr RDII by Storm Event

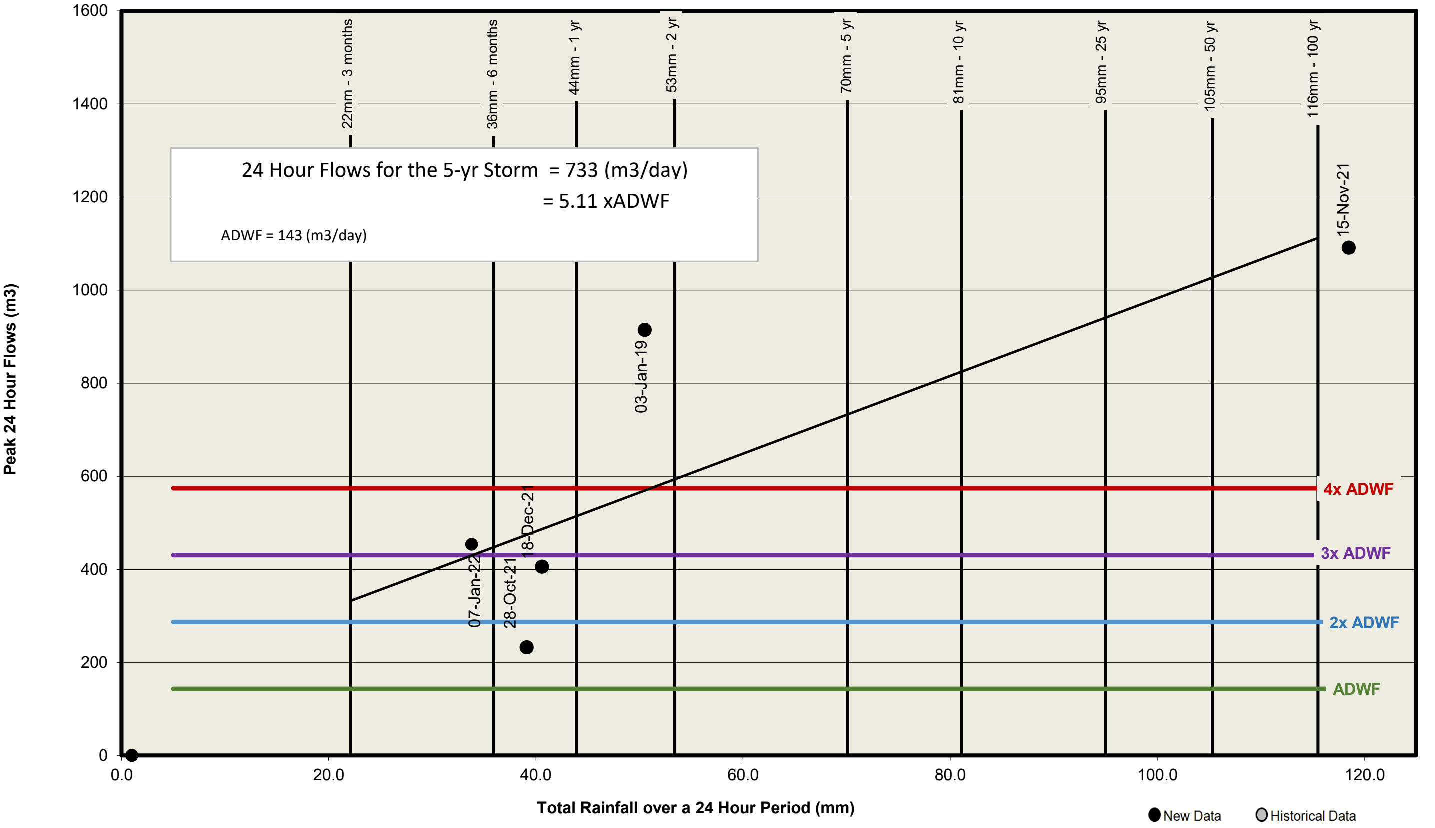


Peak 1hr RDII for the 5yr Storm = 10.2 l/s

Peak 1hr Flow for the 5yr Storm = 12.4 l/s

Base Sanitary Flow and Seasonal Groundwater = 2.2 l/s

Peak 24-Hour Flows by Storm Event



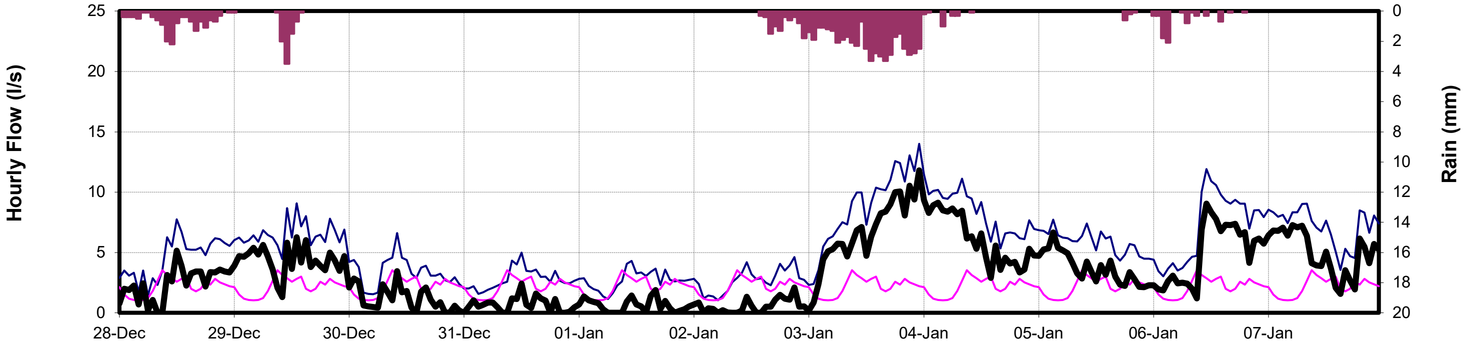
24 Hour Flows for the 5-yr Storm = 733 (m3/day)

= 5.11 xADWF

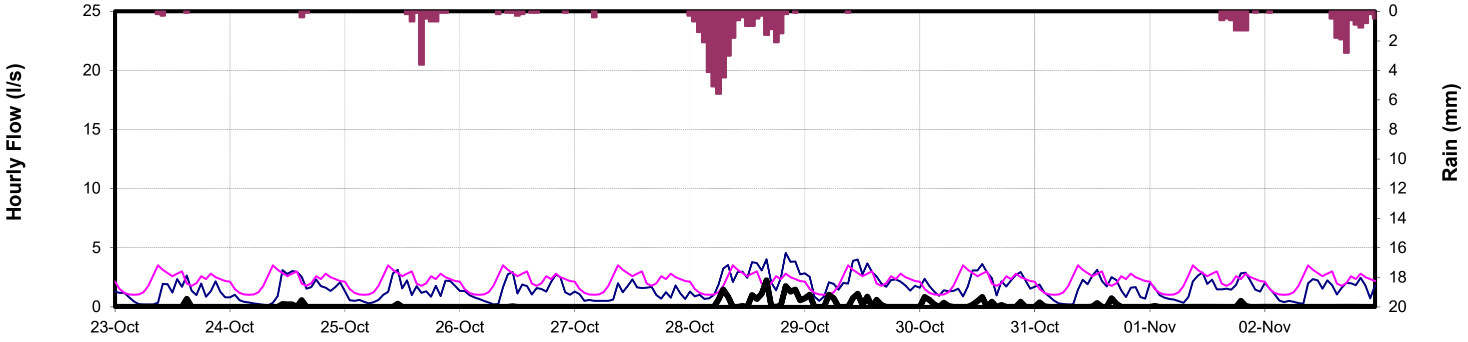
ADWF = 143 (m3/day)

Ardwell PS (SID5)

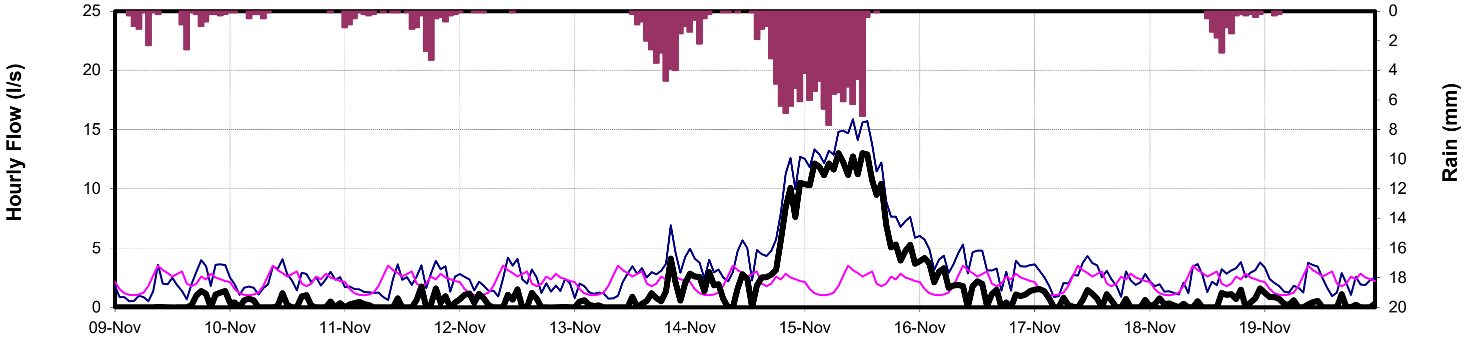
December 28 to January 7, 2019 Storm Events



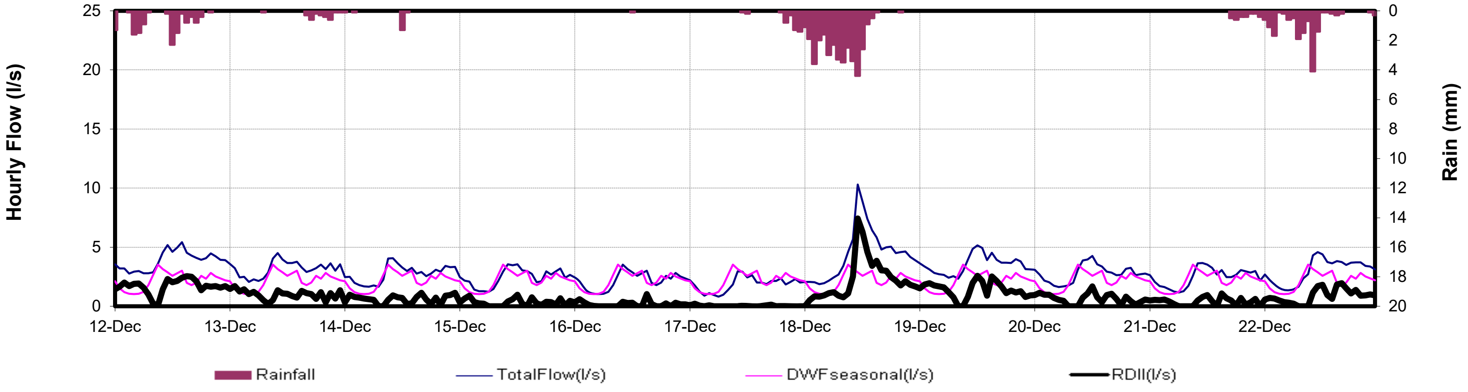
October 23 to November 2, 2021 Storm Events



November 9 to November 19, 2021 Storm Events

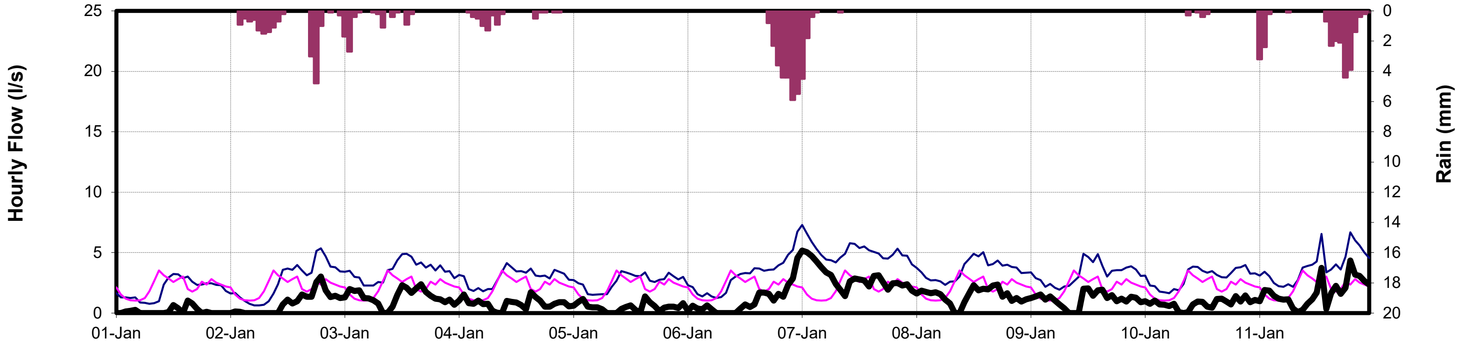


December 12 to December 22, 2021 Storm Events



Ardwell PS (SID5)

January 1 to January 11, 2022 Storm Events



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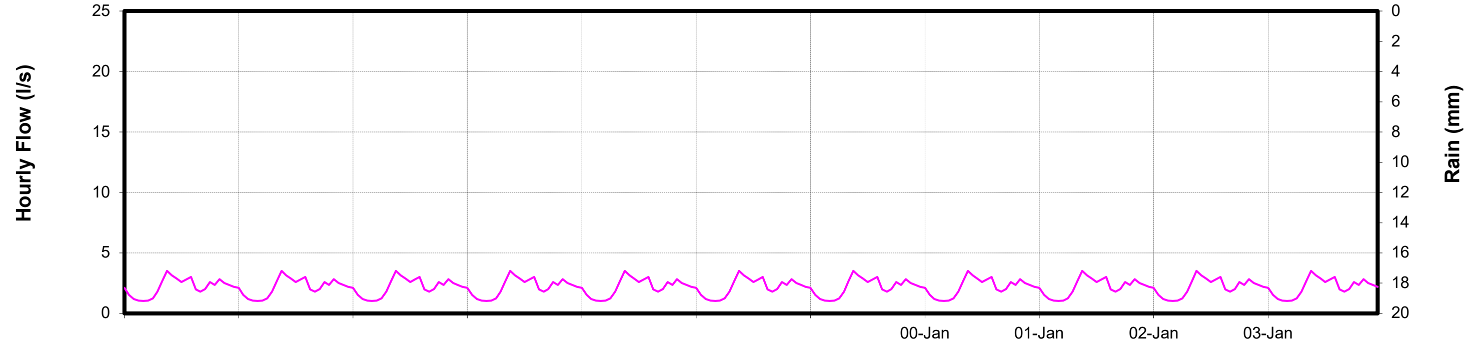

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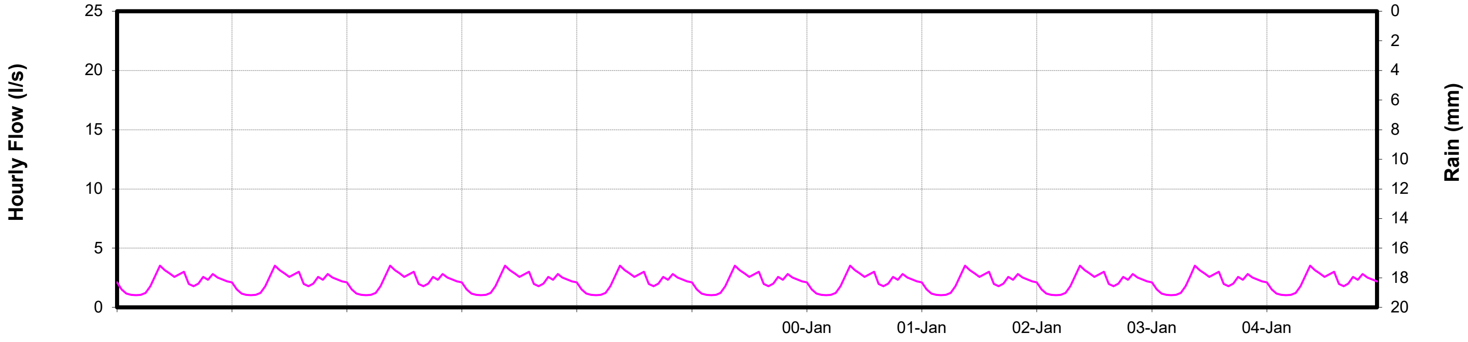

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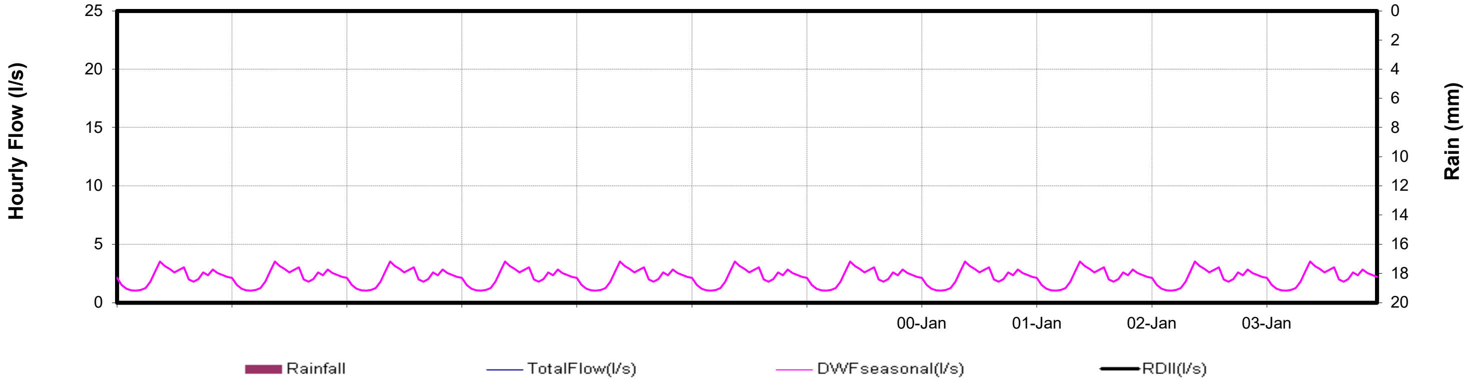

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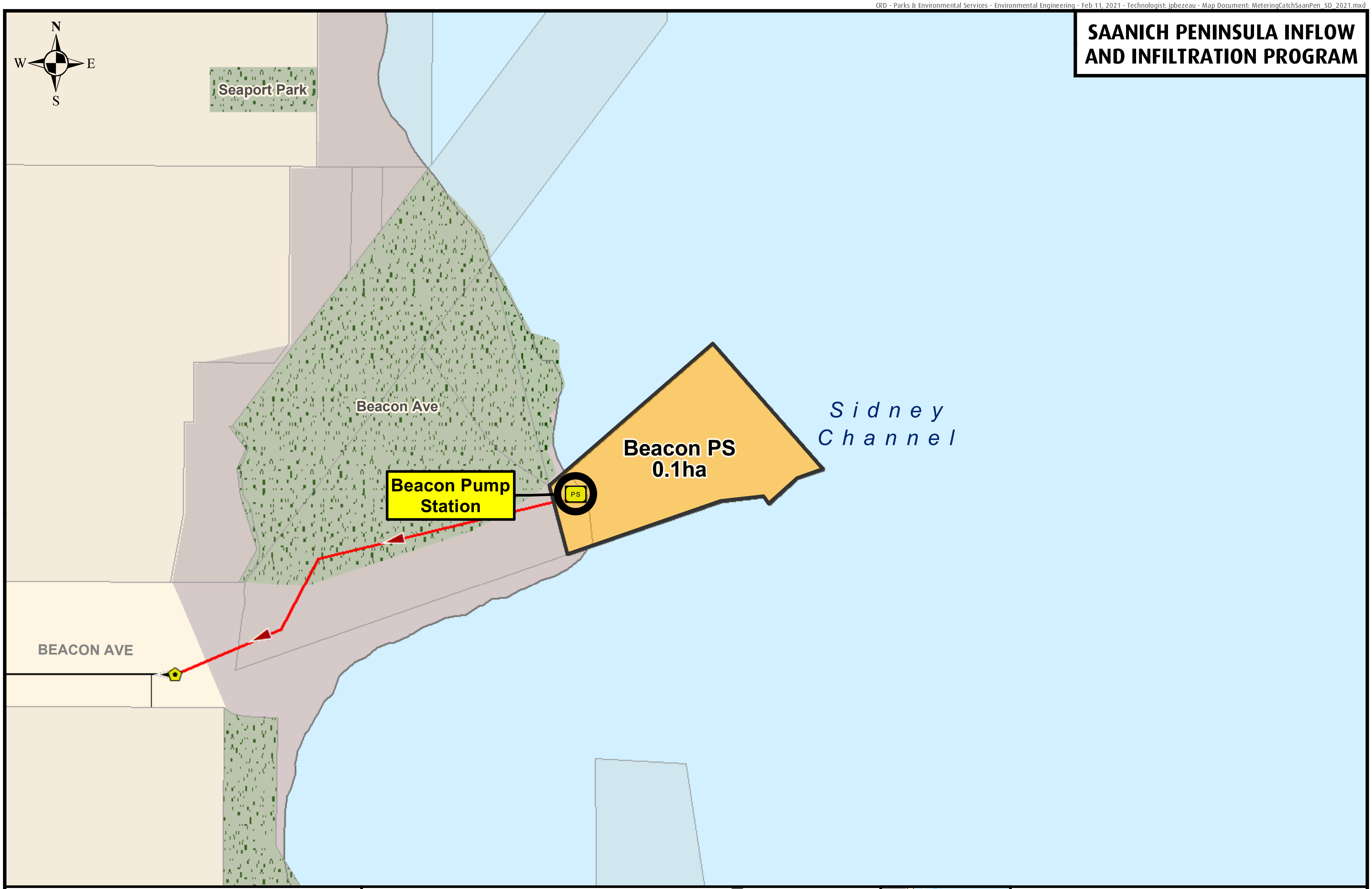
SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 12.5 25 50

Projection: UTM ZONE 10N, NAD83

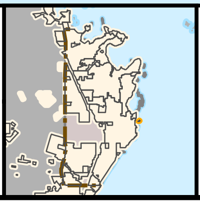
Disclaimer

○	Flow Monitoring Location
✲	Manhole
⬟	Cleanout
PS	Pump Station
◙	Metering Chamber

Sanitary Sewers

—	Gravity Main Installed After 1930
—	Gravity Main Installed Before 1930
—	Force Main
=	Relief, Outfall, Overflow Sewer
—	CRD Sewer

▨	Catchment Area
▨	Non-Sewered Area
☐	Lot Lines
▨	Parks
▨	Sewered Park Areas
- -	Catchment Boundary
-·-	Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

Catchment: Beacon PS

Site Code: SID6

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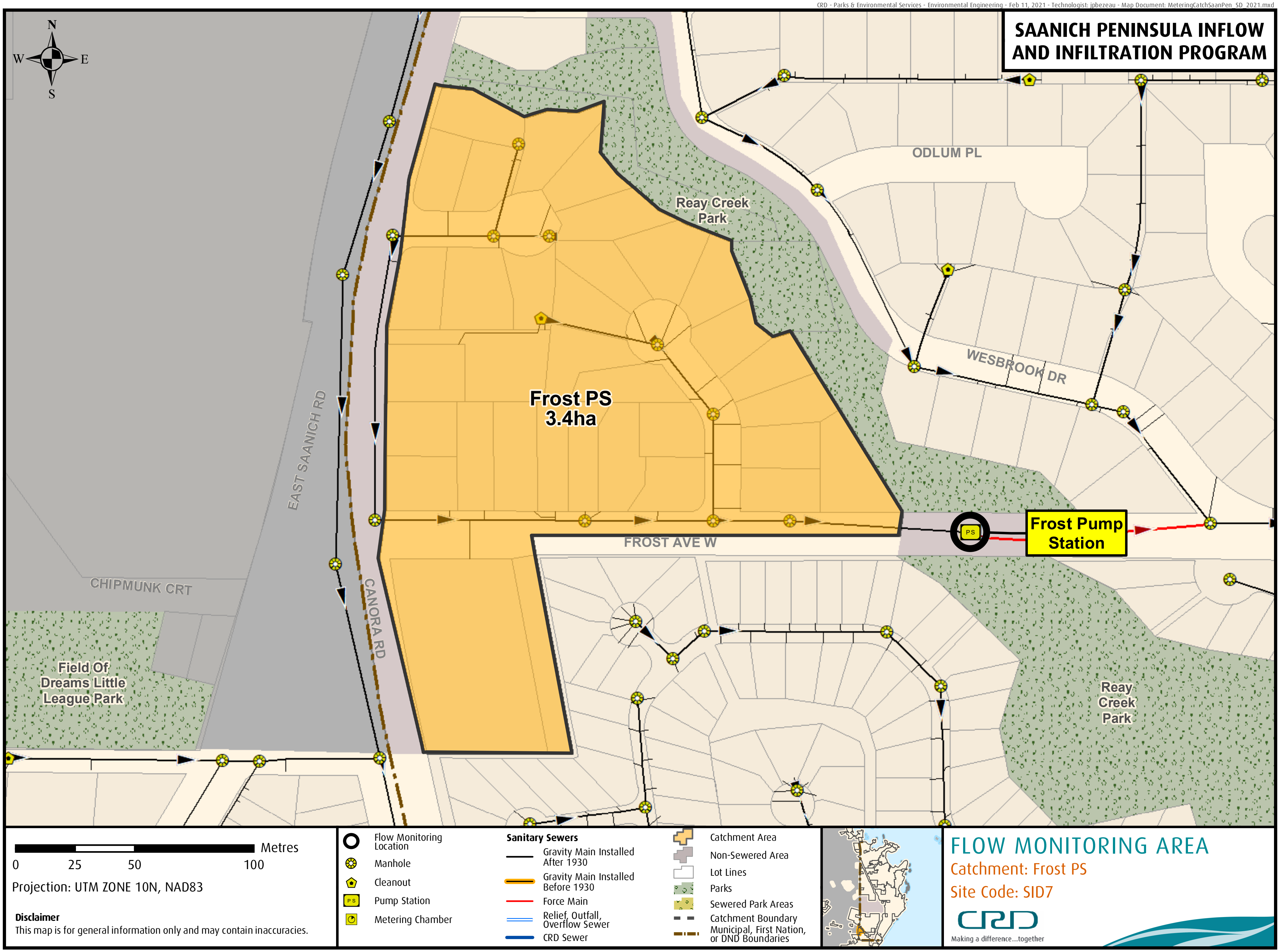
CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_SD_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Projection: UTM ZONE 10N, NAD83

Disclaimer

FLOW MONITORING AREA

Catchment: Frost PS

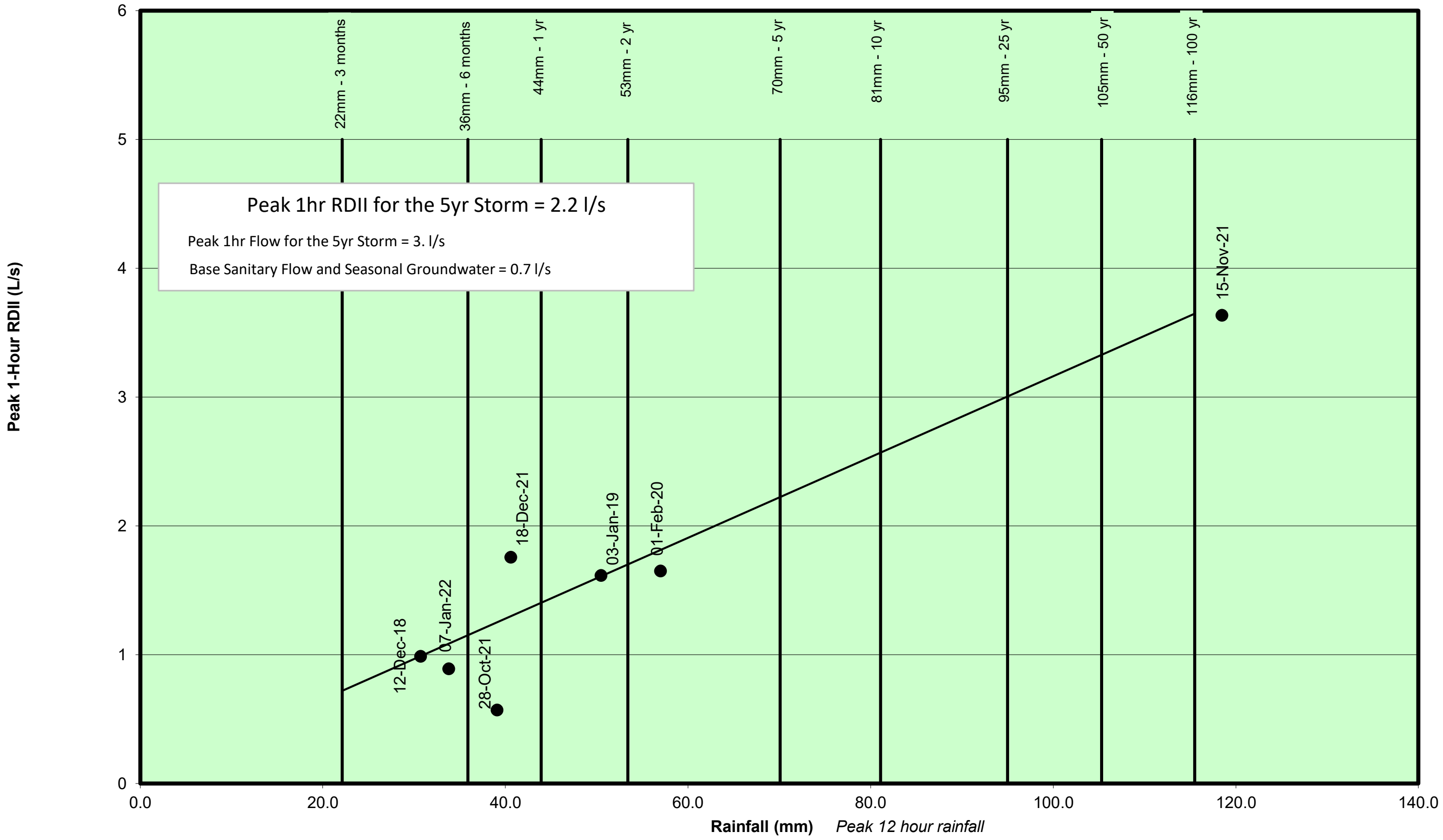
Site Code: SID7

CRD

Making a difference...together

Frost PS (SID7)

Peak 1-hr RDII by Storm Event

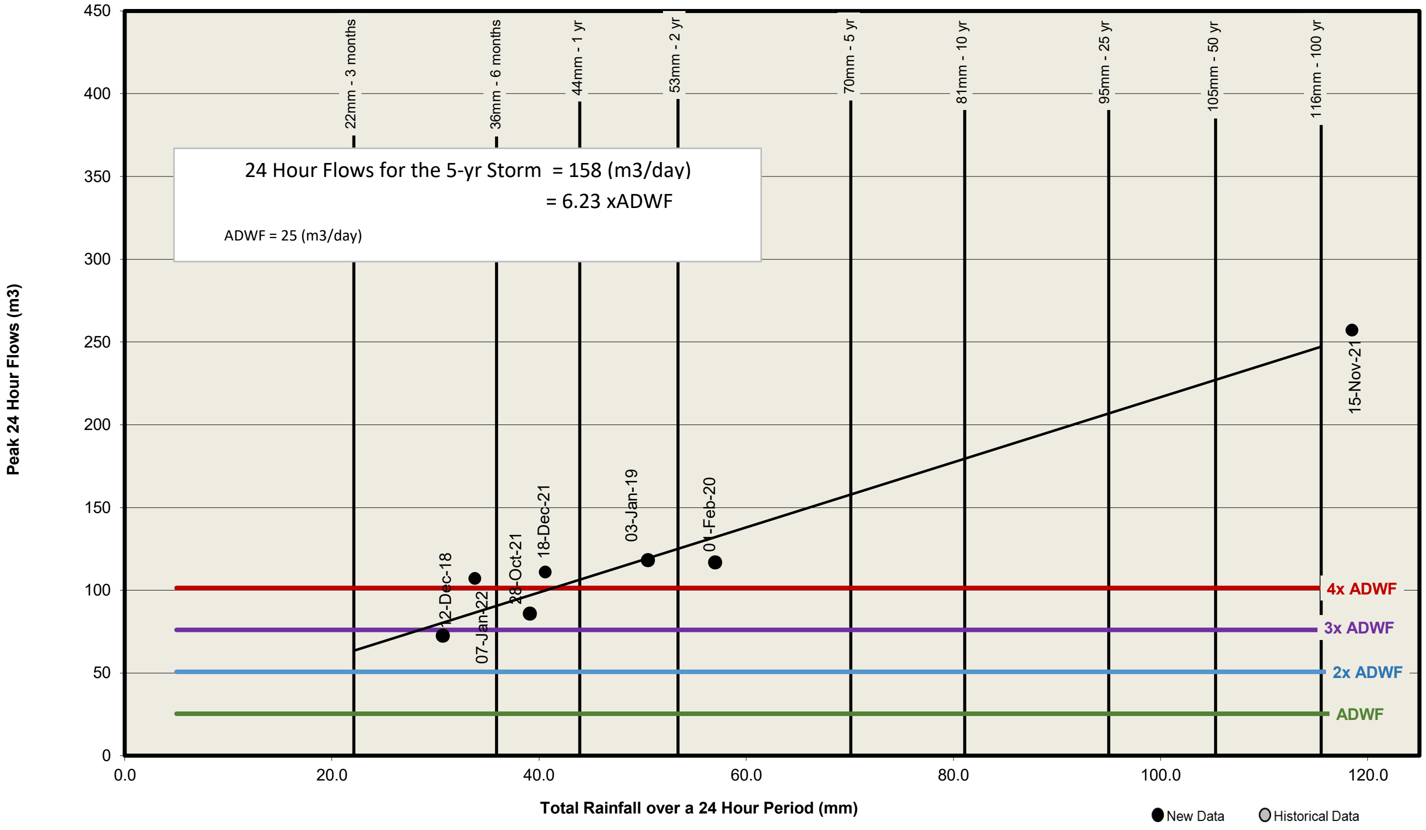


Peak 1hr RDII for the 5yr Storm = 2.2 l/s

Peak 1hr Flow for the 5yr Storm = 3. l/s

Base Sanitary Flow and Seasonal Groundwater = 0.7 l/s

Peak 24-Hour Flows by Storm Event



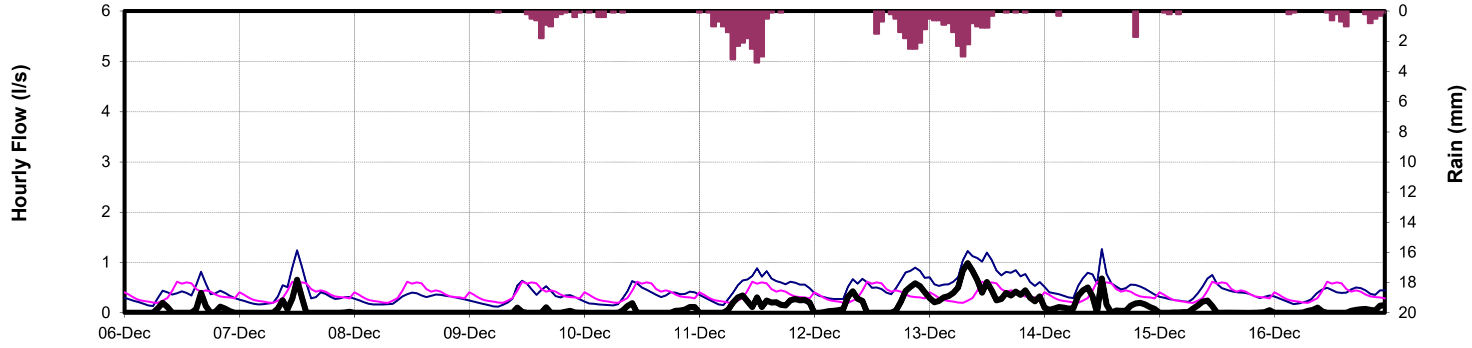
24 Hour Flows for the 5-yr Storm = 158 (m3/day)

= 6.23 xADWF

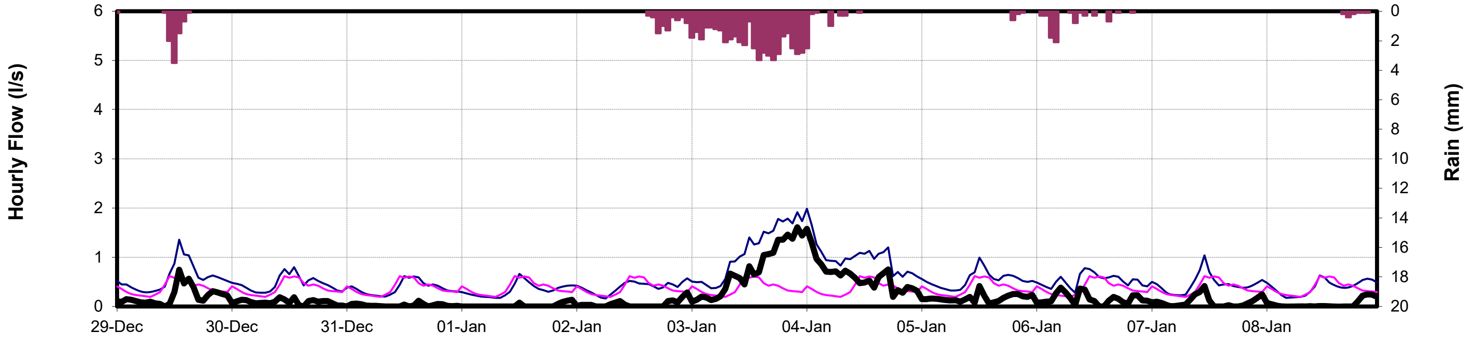
ADWF = 25 (m3/day)

Frost PS (SID7)

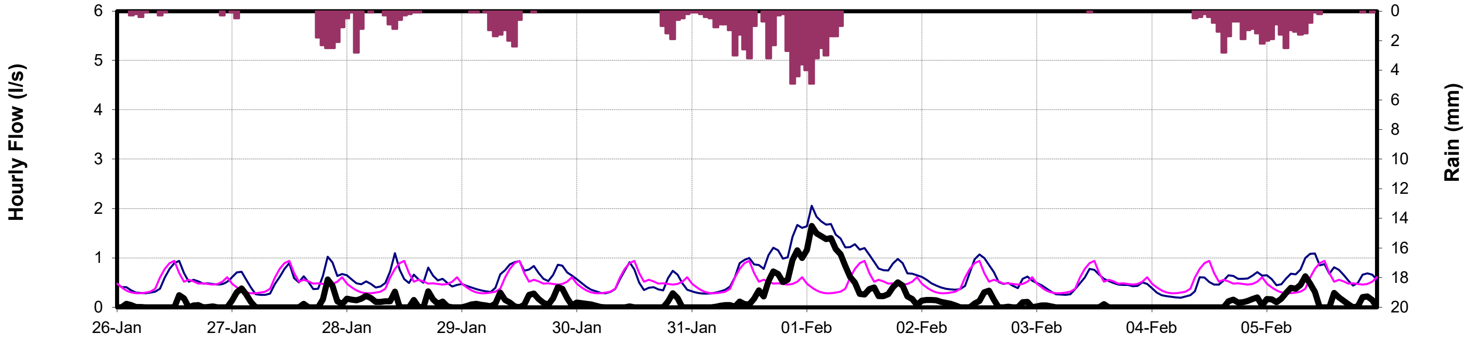
December 6 to December 16, 2018 Storm Events



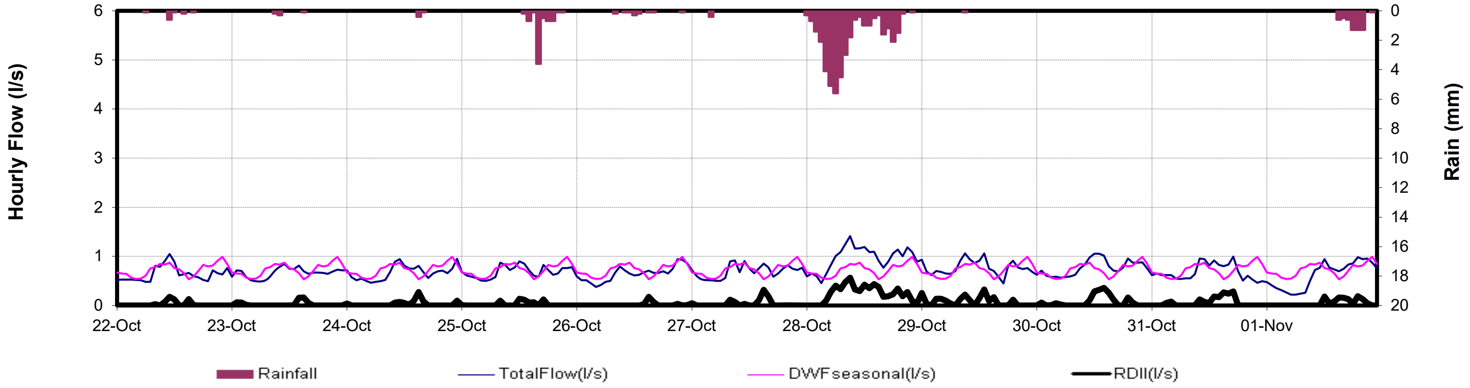
December 29 to January 8, 2019 Storm Events



January 26 to February 5, 2020 Storm Events

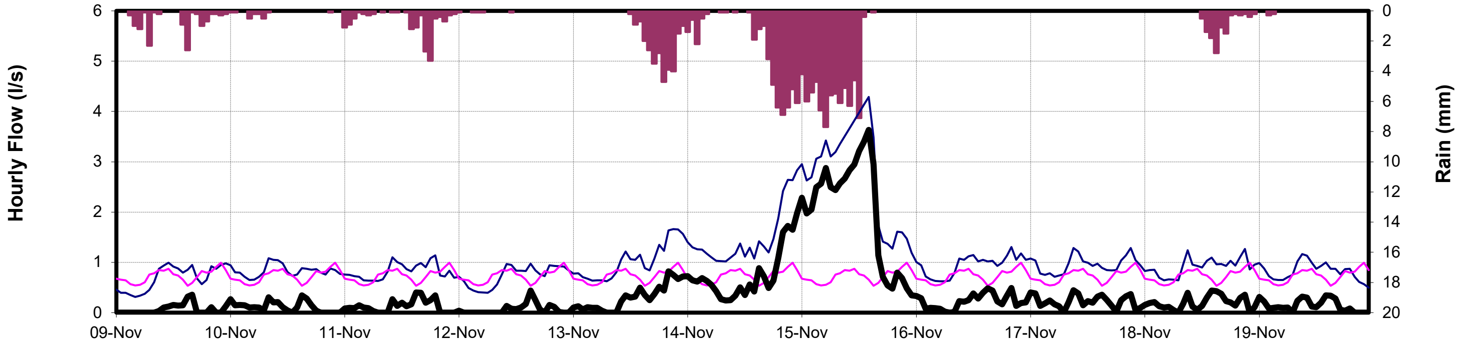


October 22 to November 1, 2021 Storm Events

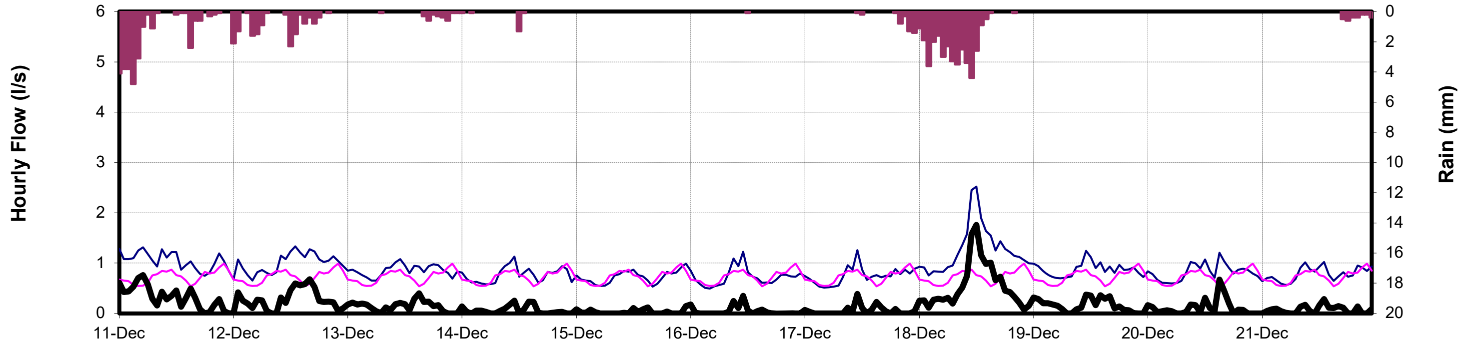


Frost PS (SID7)

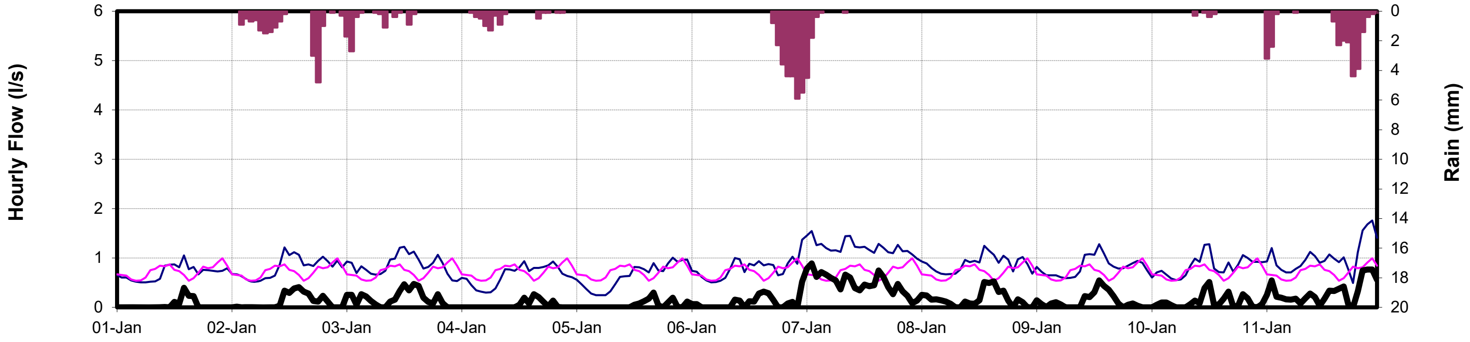
November 9 to November 19, 2021 Storm Events



December 11 to December 21, 2021 Storm Events



January 1 to January 11, 2022 Storm Events



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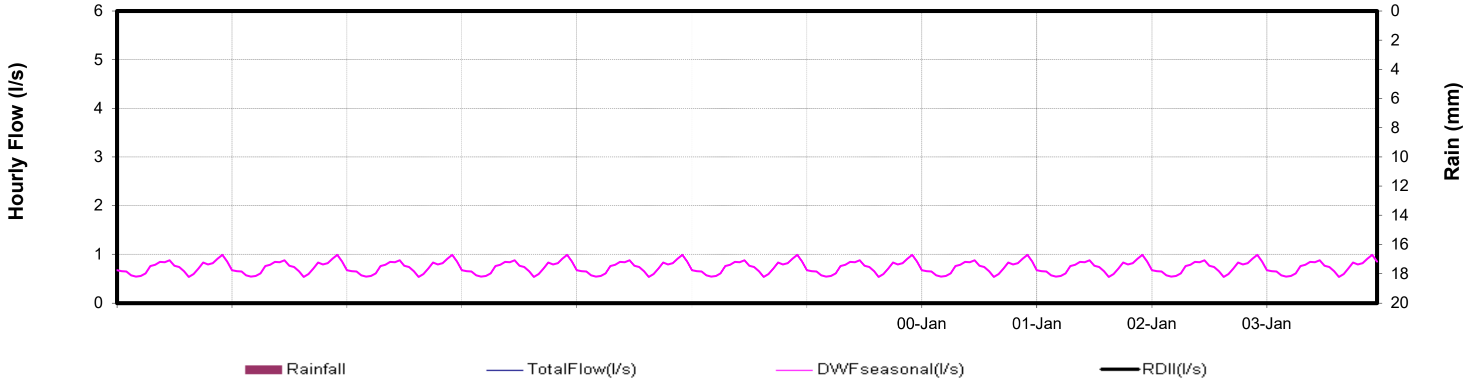

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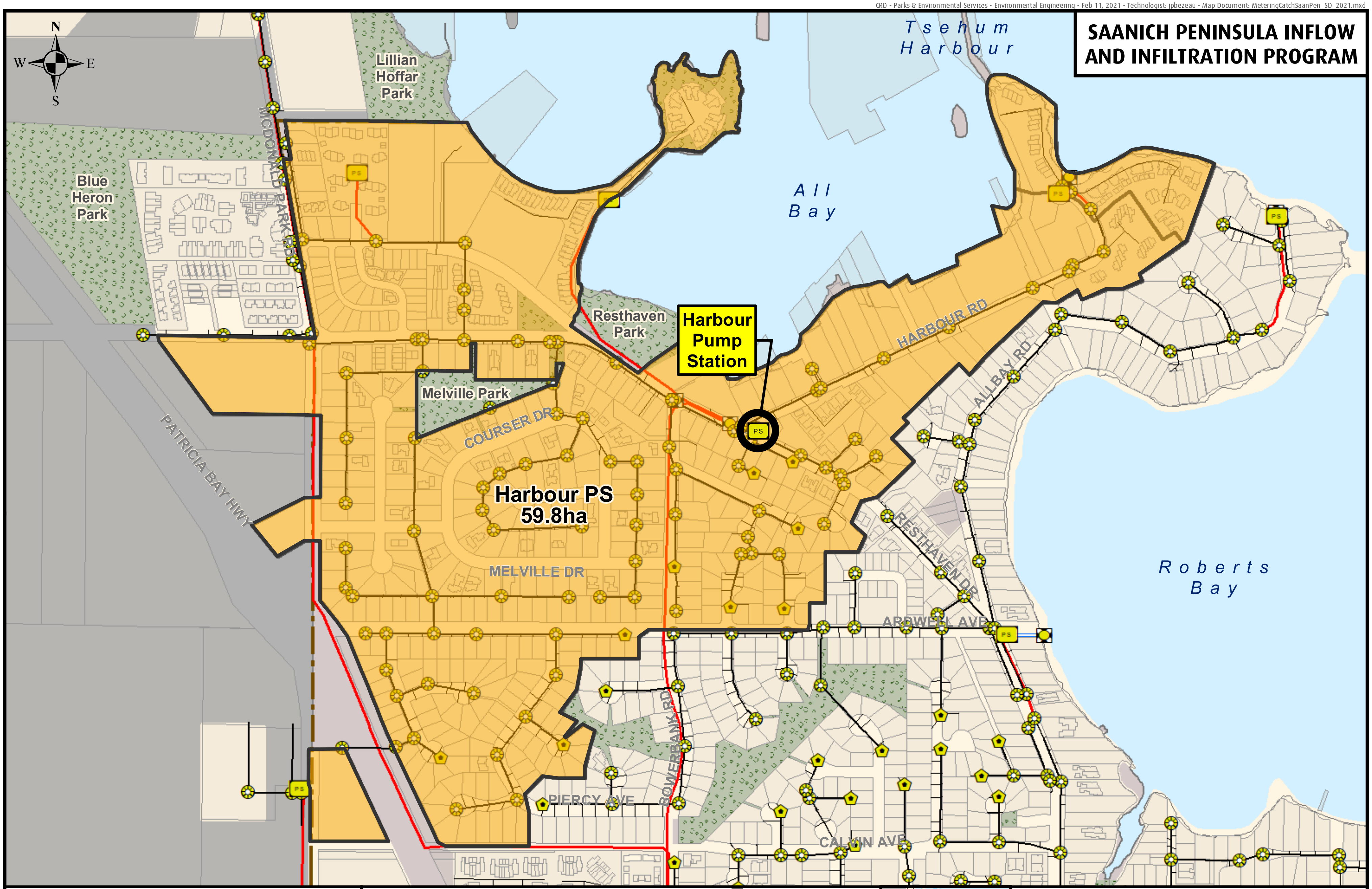
SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 100 200 400

Projection: UTM ZONE 10N, NAD83

Disclaimer

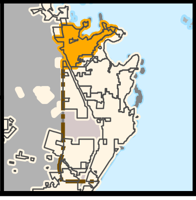
This map is for general information only and may contain inaccuracies.

- ○ Flow Monitoring Location
- ⊛ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◔ Metering Chamber

Sanitary Sewers

- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- 🟧 Catchment Area
- ▨ Non-Sewered Area
- ☐ Lot Lines
- 🟩 Parks
- ▨ Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

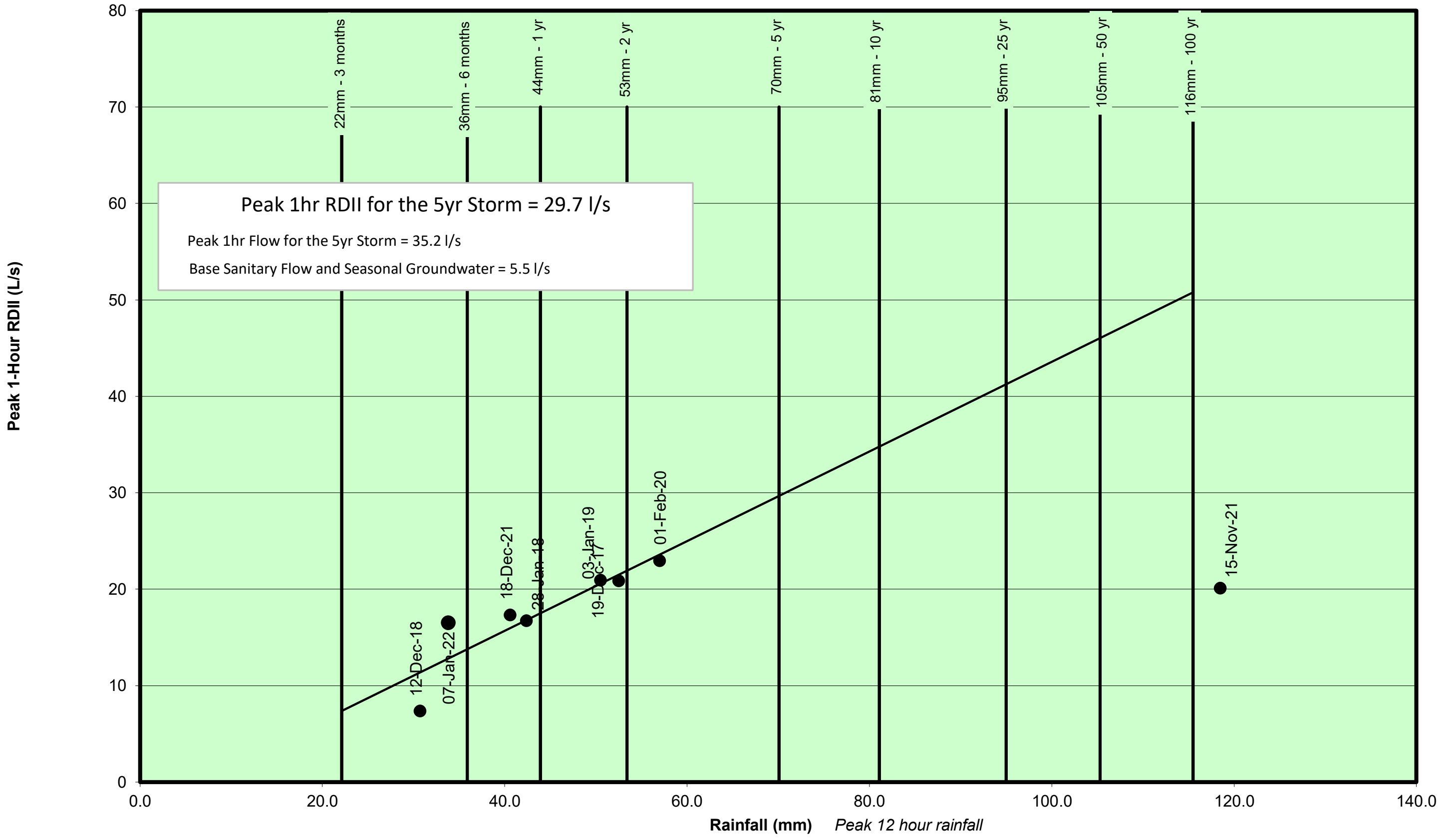
Catchment: Harbour PS

Site Code: SID8

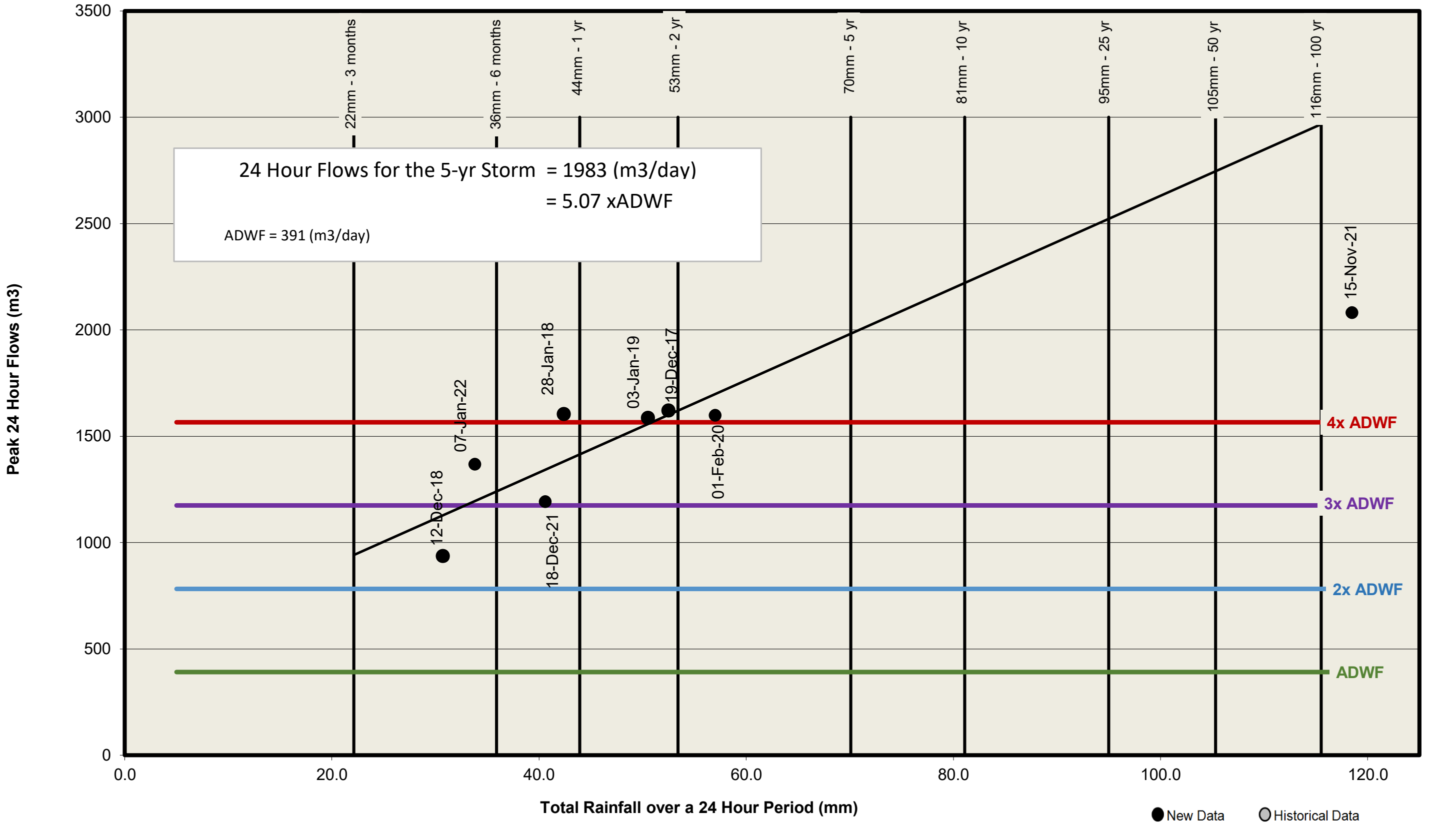
Making a difference...together

Harbour PS (SID8)

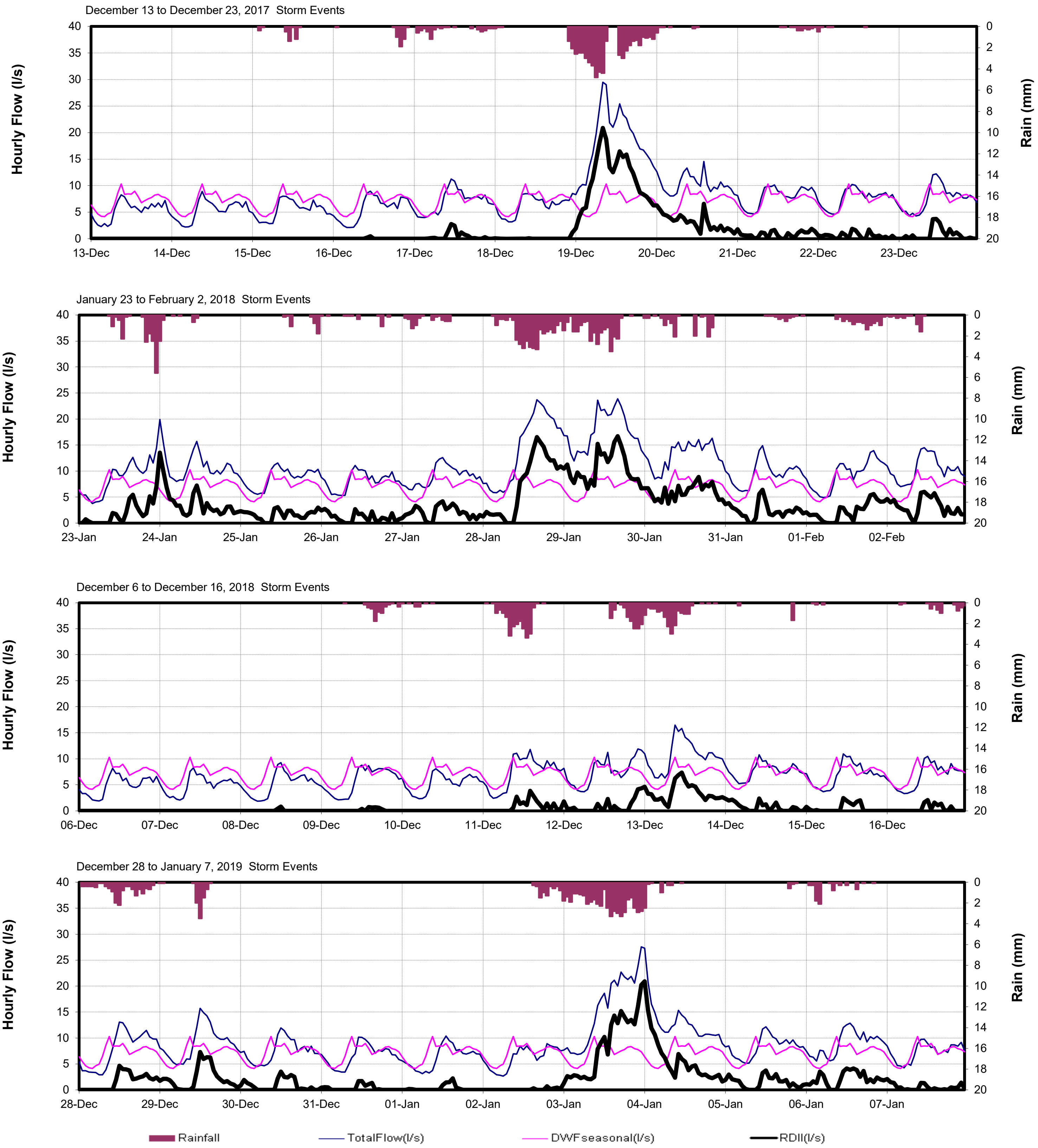
Peak 1-hr RDII by Storm Event



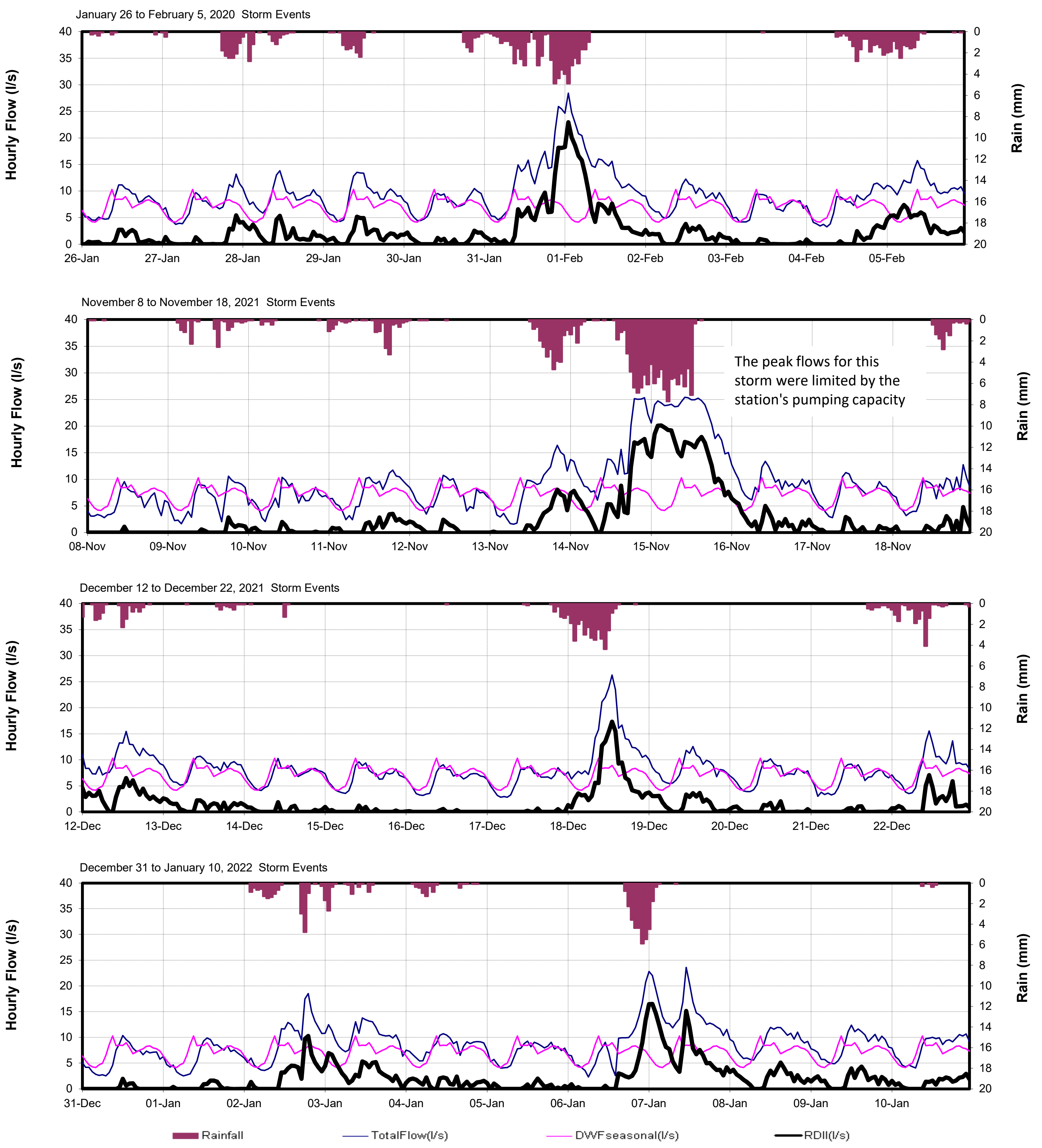
Peak 24-Hour Flows by Storm Event



Harbour PS (SID8)



Harbour PS (SID8)



The peak flows for this storm were limited by the station's pumping capacity

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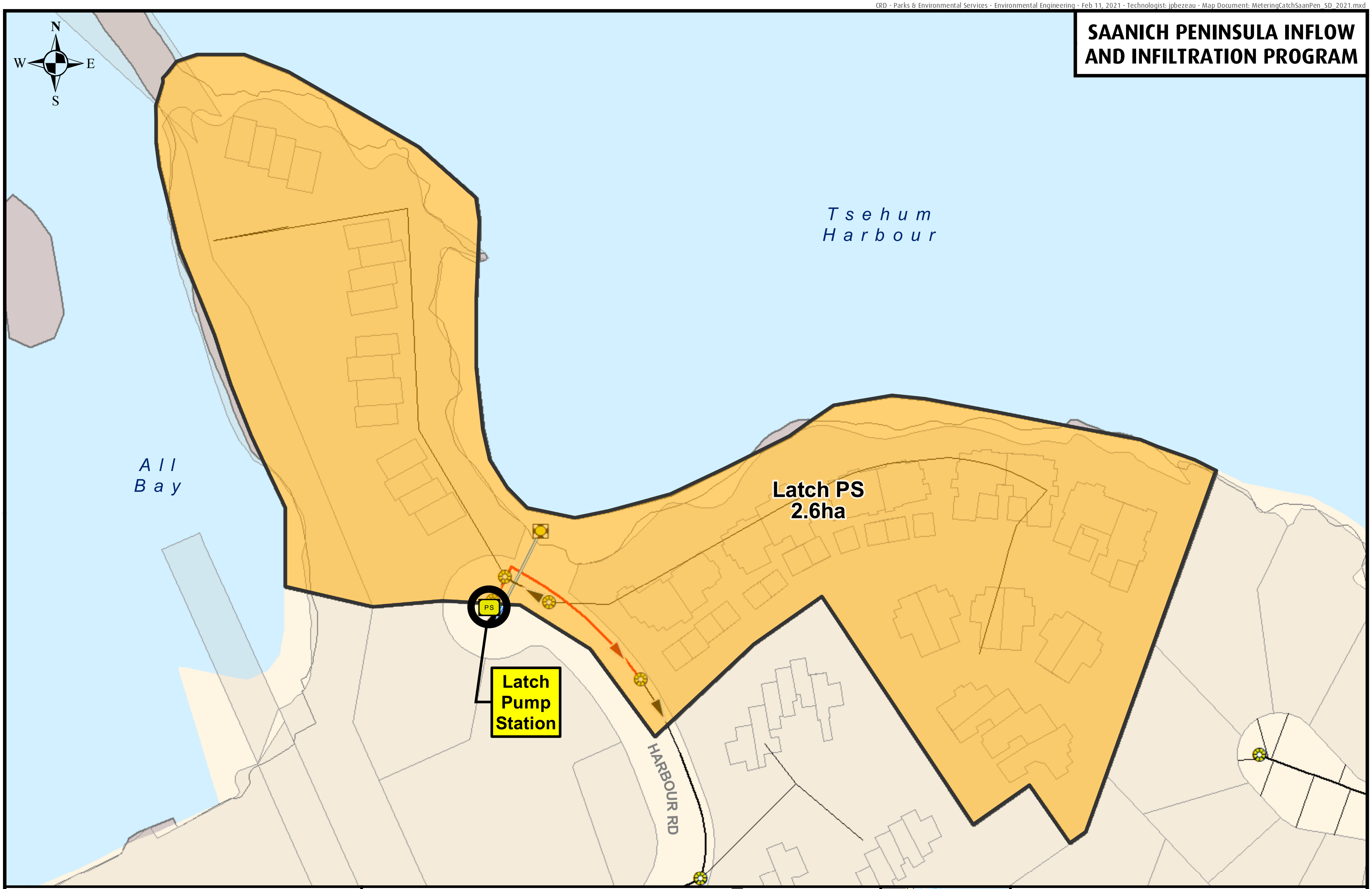
SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres

0 20 40 80

Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
⊛ Manhole
⬟ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
— Gravity Main Installed After 1930
— Gravity Main Installed Before 1930
— Force Main
═ Relief, Outfall, Overflow Sewer
— CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

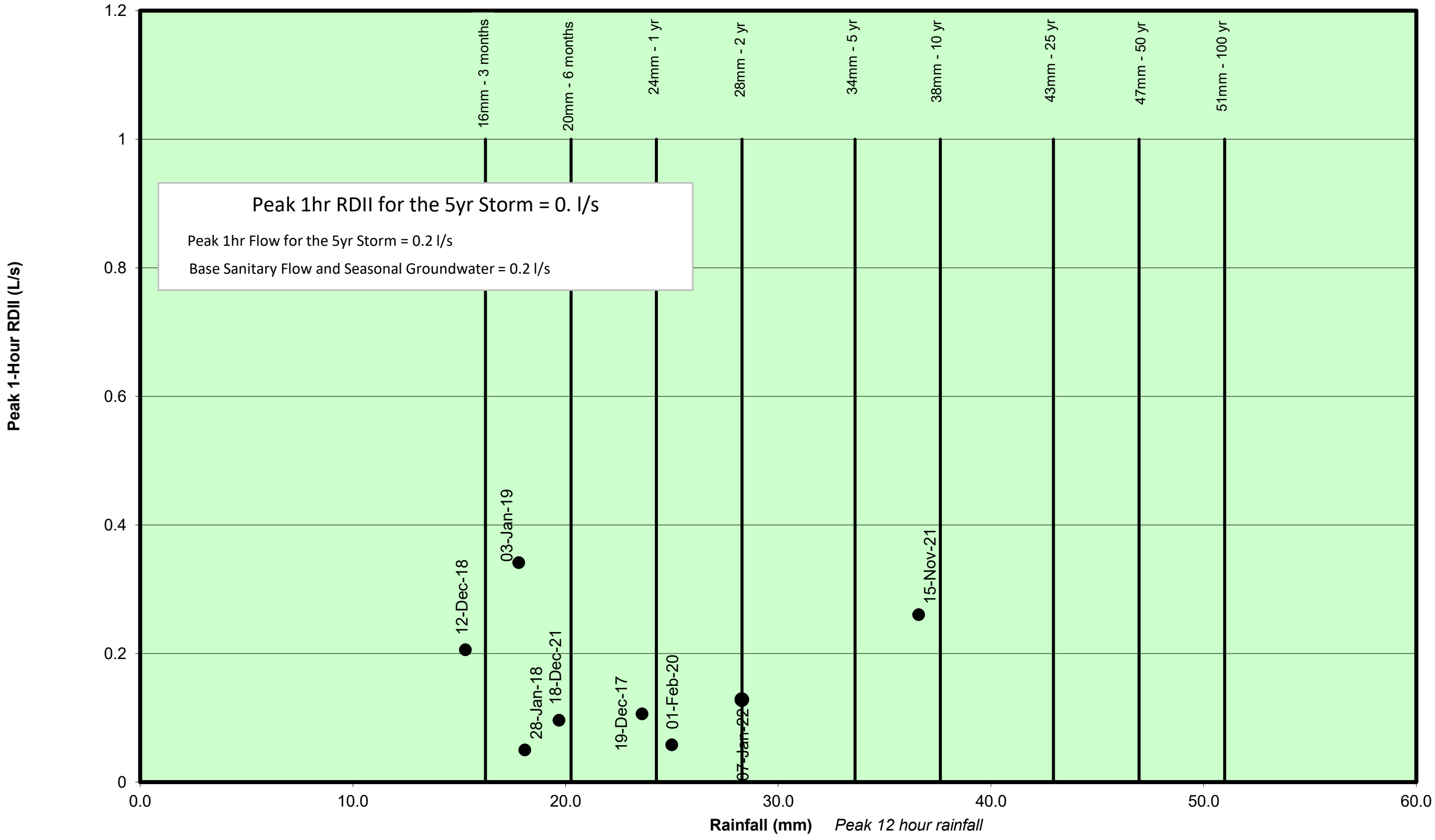
Catchment: Latch PS

Site Code: SID9

CRD
Making a difference...together

Latch PS (SID9)

Peak 1-hr RDII by Storm Event

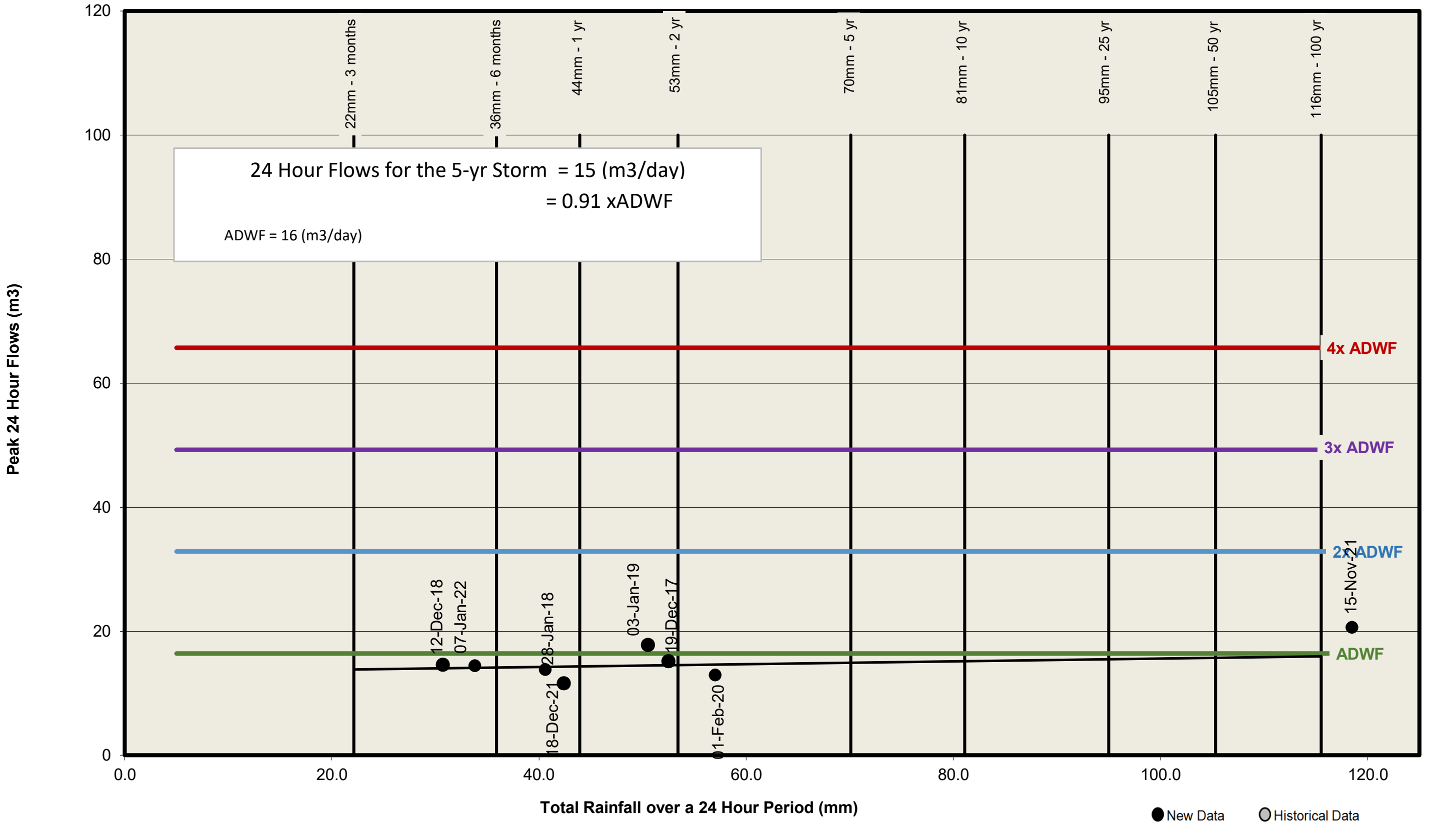


Peak 1hr RDII for the 5yr Storm = 0. l/s

Peak 1hr Flow for the 5yr Storm = 0.2 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.2 l/s

Peak 24-Hour Flows by Storm Event

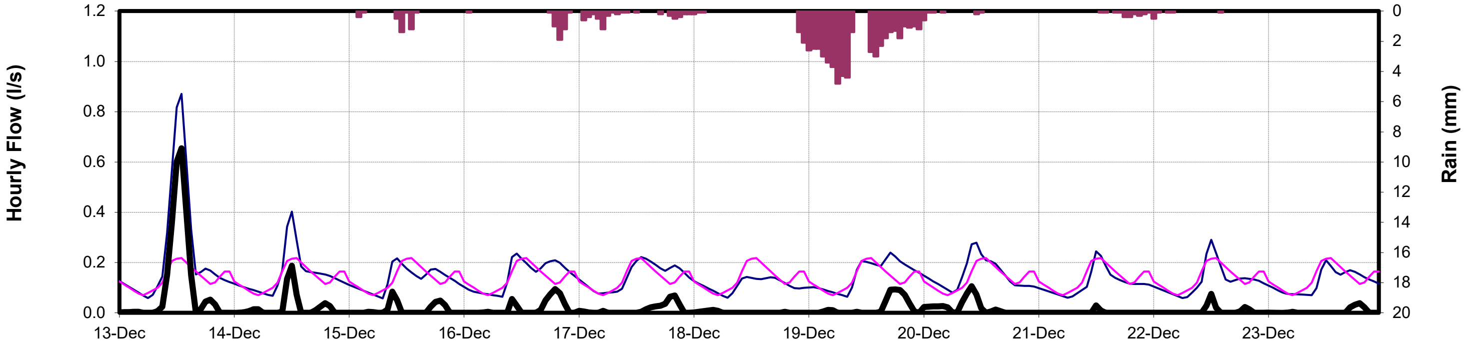


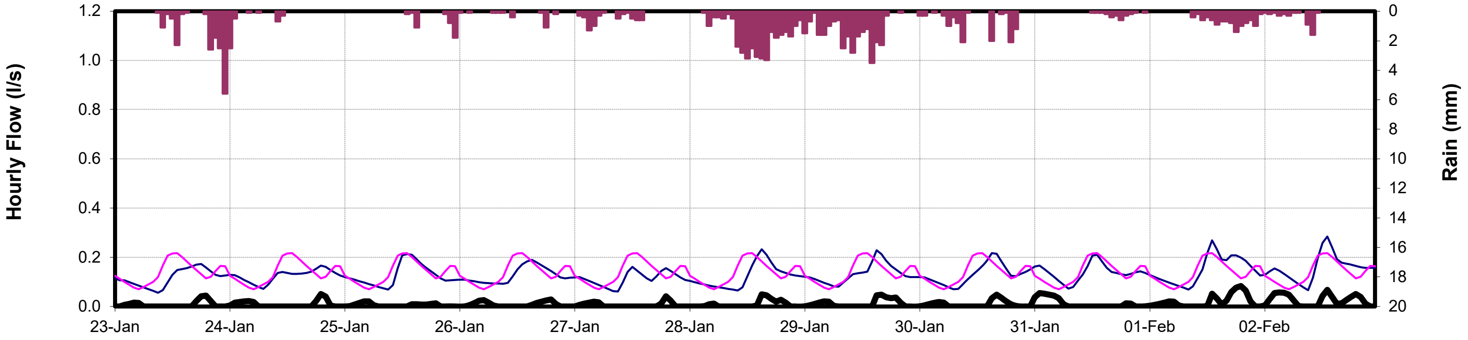
24 Hour Flows for the 5-yr Storm = 15 (m3/day)

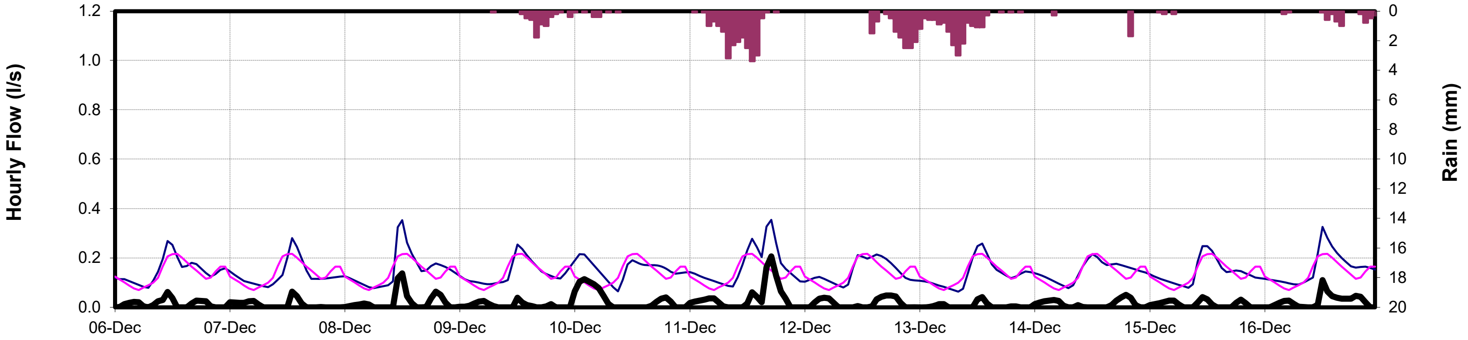
= 0.91 xADWF

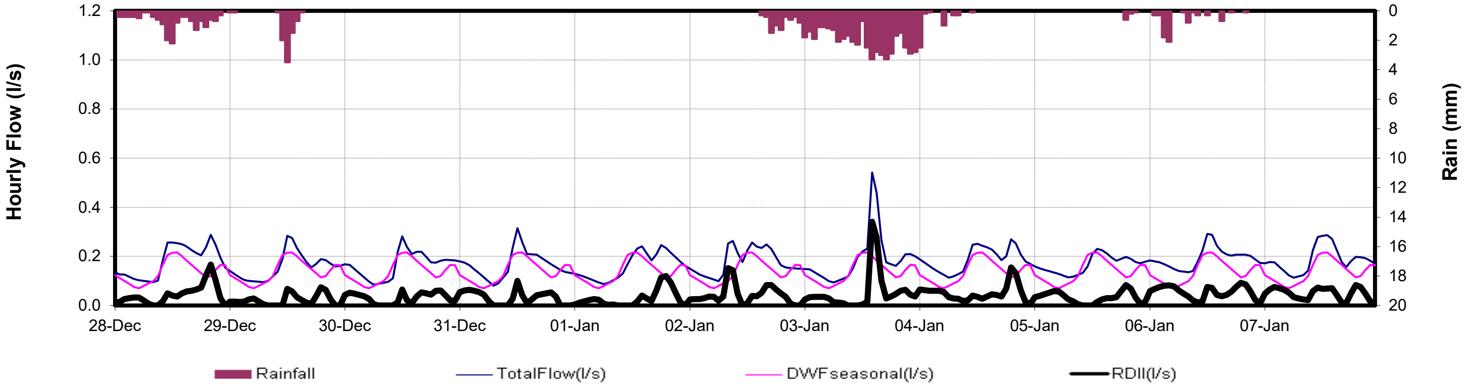
ADWF = 16 (m3/day)

Latch PS (SID9)


December 13 to December 23, 2017 Storm Events

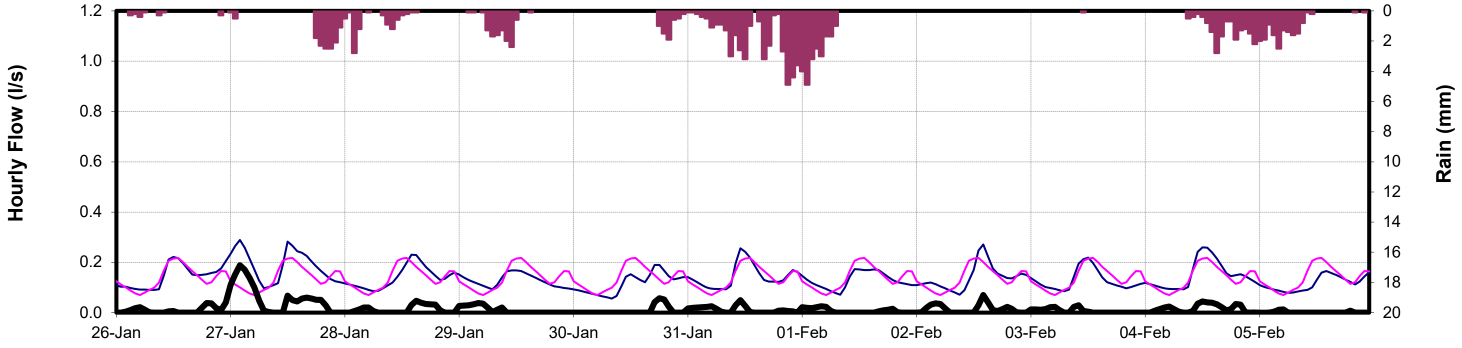

January 23 to February 2, 2018 Storm Events


December 6 to December 16, 2018 Storm Events

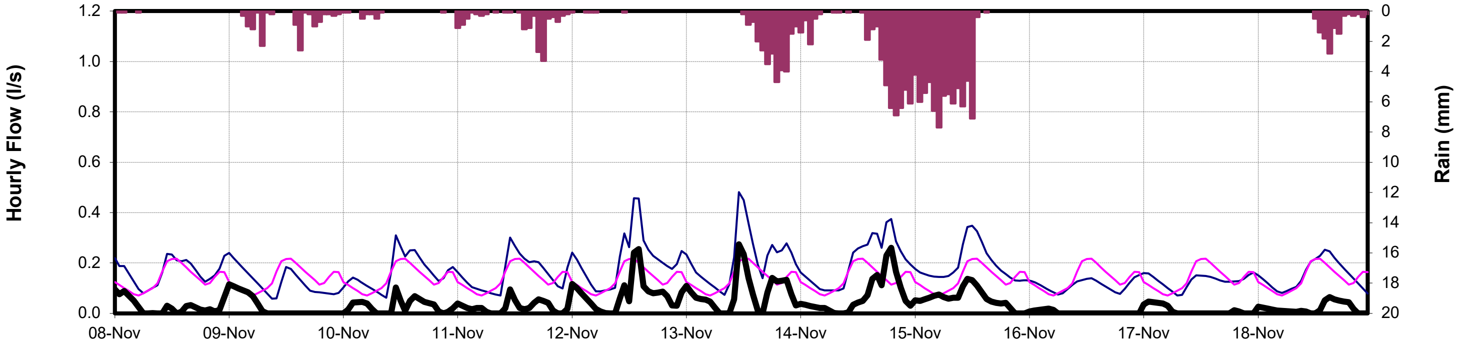

December 28 to January 7, 2019 Storm Events

Latch PS (SID9)

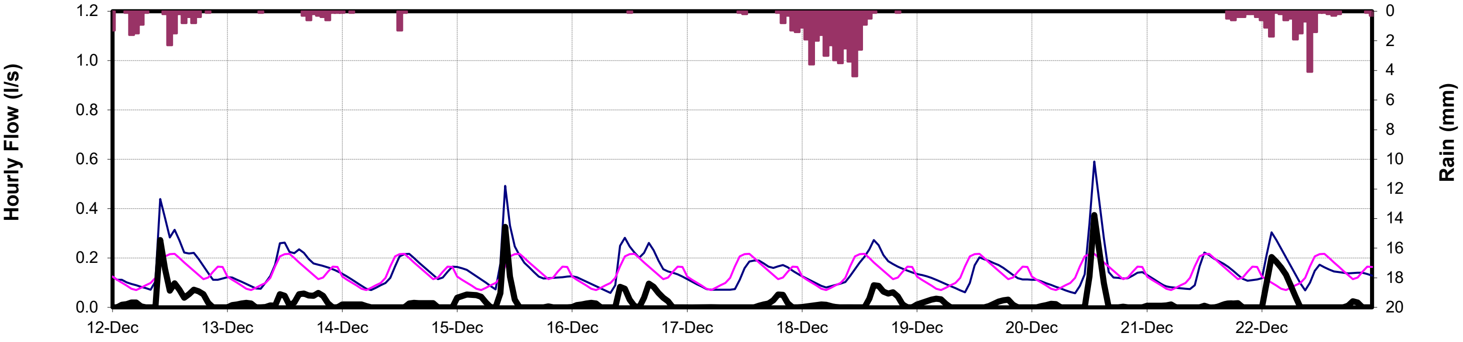
January 26 to February 5, 2020 Storm Events



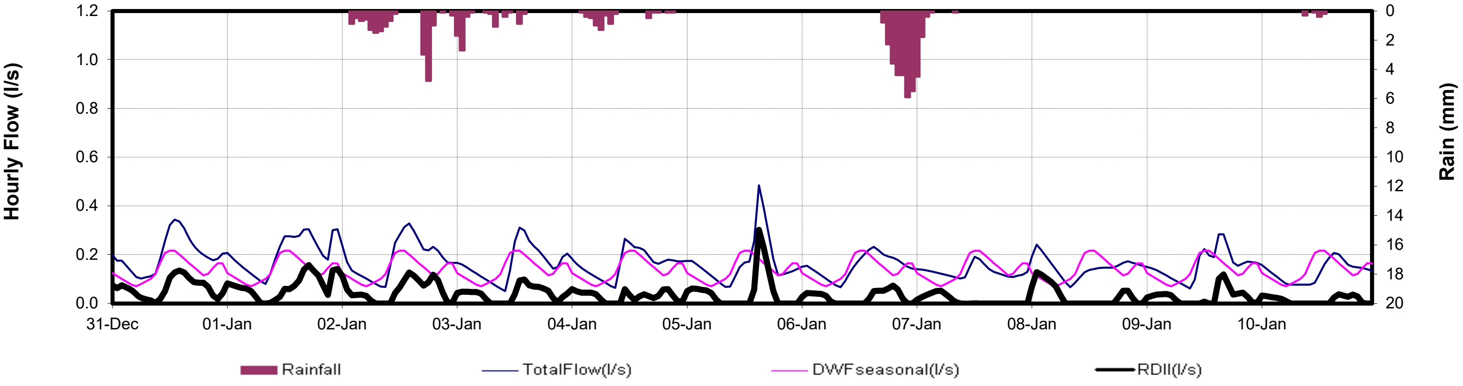
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

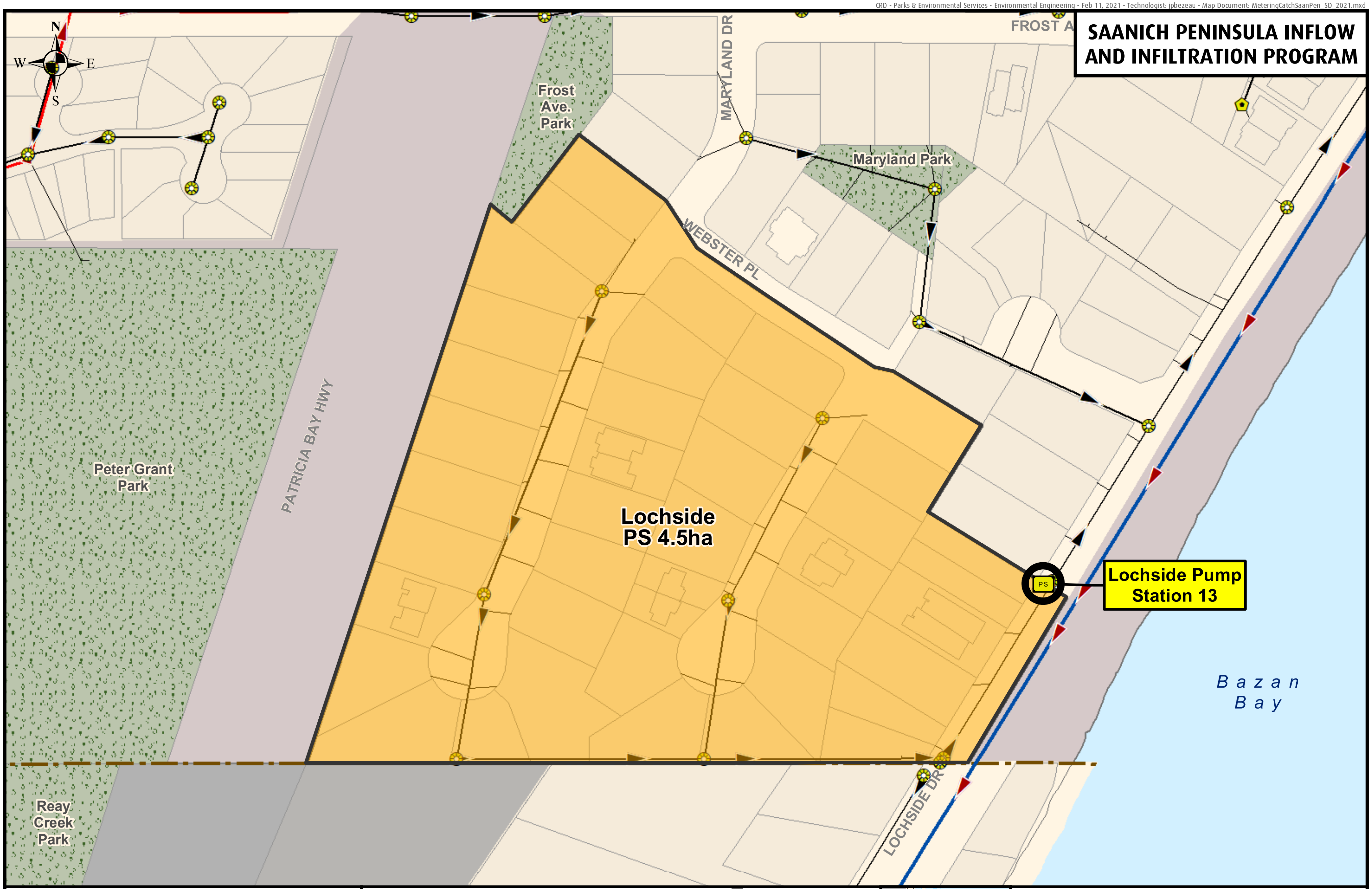


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_SD_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 25 50 100

Projection: UTM ZONE 10N, NAD83

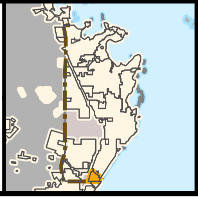
Disclaimer
This map is for general information only and may contain inaccuracies.

○	Flow Monitoring Location
✺	Manhole
⬟	Cleanout
PS	Pump Station
◙	Metering Chamber

Sanitary Sewers

—	Gravity Main Installed After 1930
—	Gravity Main Installed Before 1930
—	Force Main
=	Relief, Outfall, Overflow Sewer
—	CRD Sewer

▨	Catchment Area
▨	Non-Sewered Area
☐	Lot Lines
▨	Parks
▨	Sewered Park Areas
- -	Catchment Boundary
-·-	Municipal, First Nation, or DND Boundaries



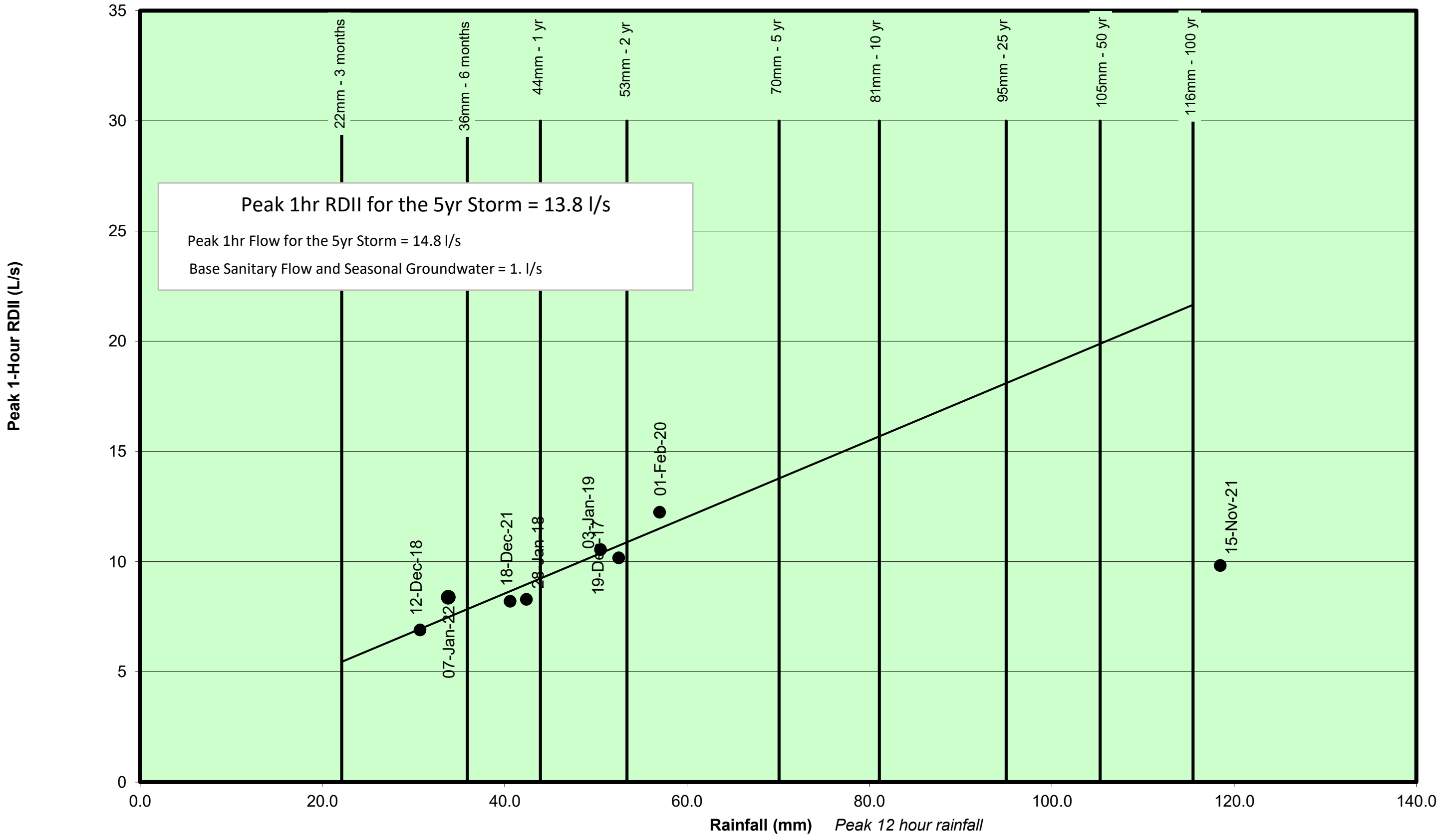
FLOW MONITORING AREA

Catchment: Lochside PS

Site Code: SID10

CRD
Making a difference...together

Lochside PS (SID10)

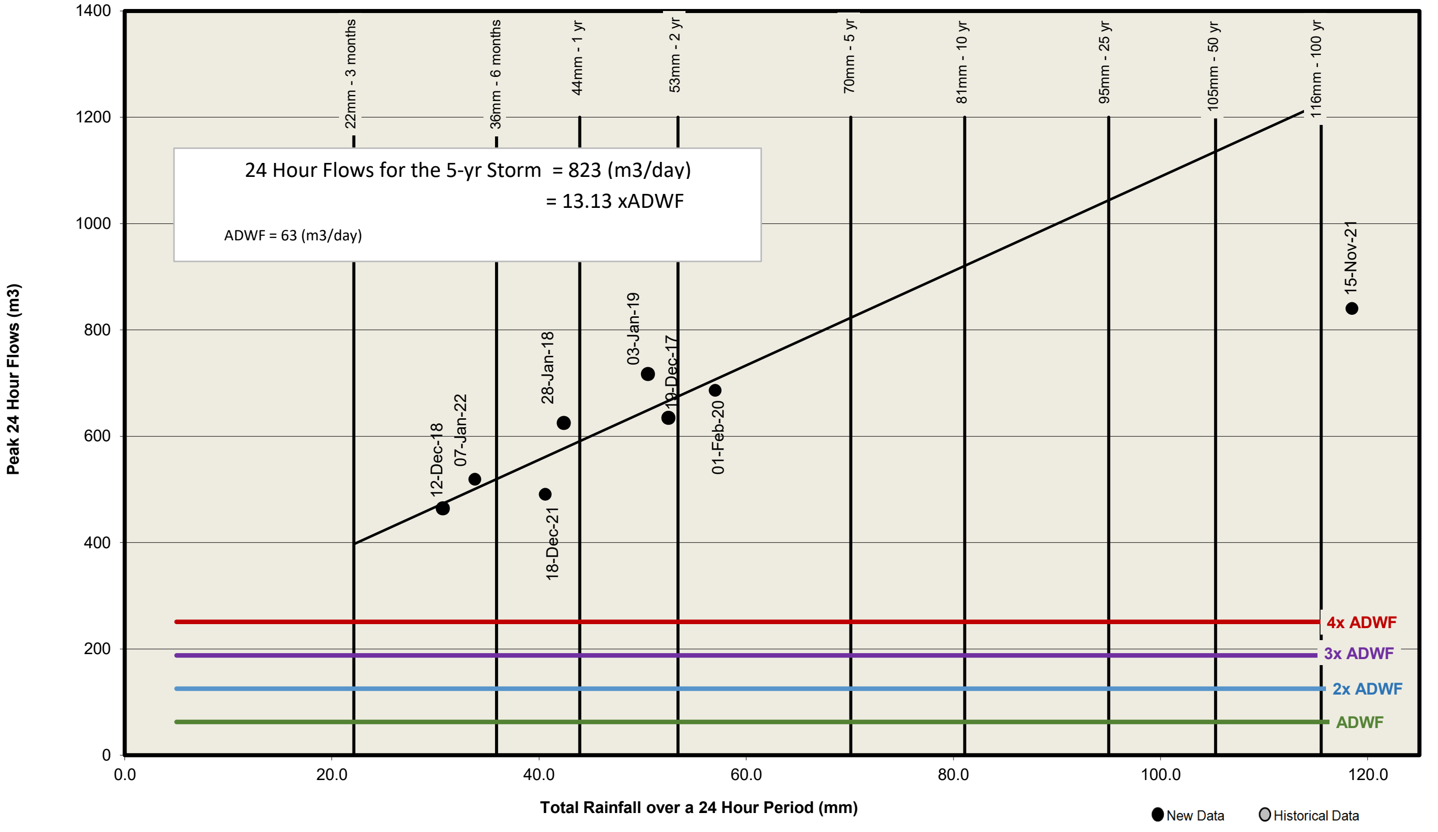


Peak 1-hr RDII by Storm Event

Peak 1hr RDII for the 5yr Storm = 13.8 l/s

Peak 1hr Flow for the 5yr Storm = 14.8 l/s

Base Sanitary Flow and Seasonal Groundwater = 1. l/s



Peak 24-Hour Flows by Storm Event

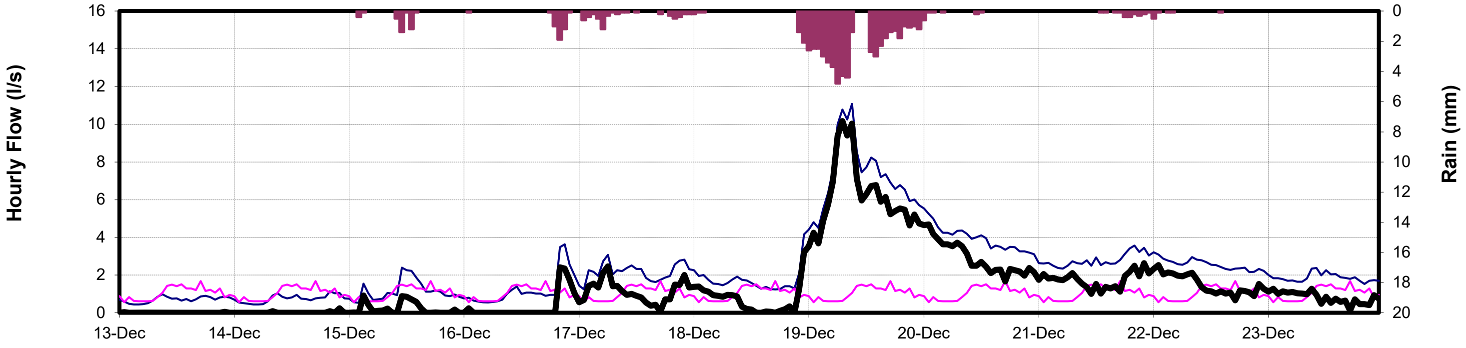
24 Hour Flows for the 5-yr Storm = 823 (m3/day)

= 13.13 xADWF

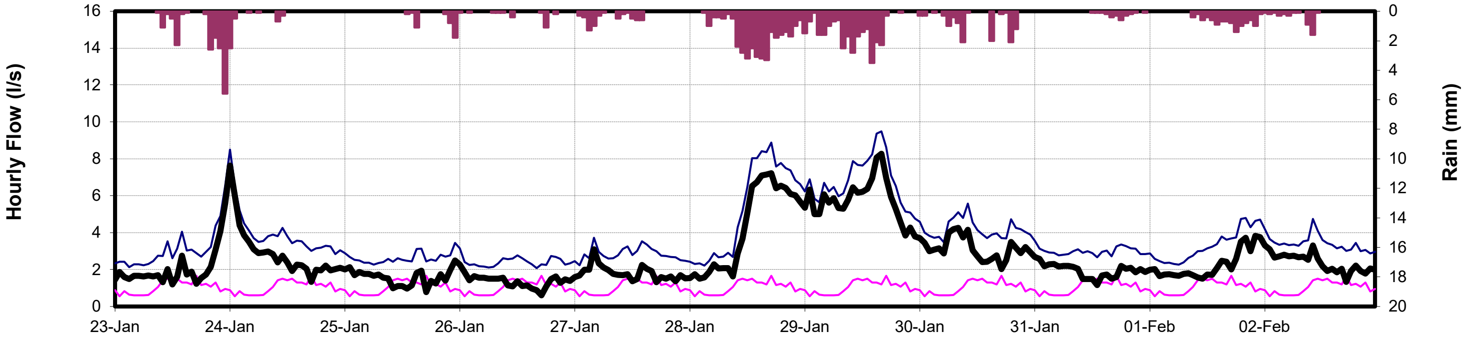
ADWF = 63 (m3/day)

Lochside PS (SID10)

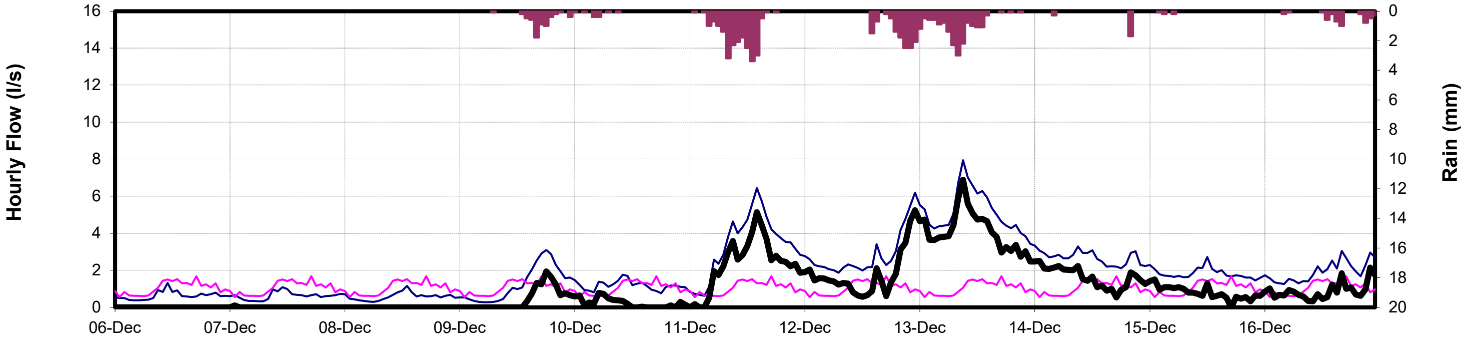
December 13 to December 23, 2017 Storm Events



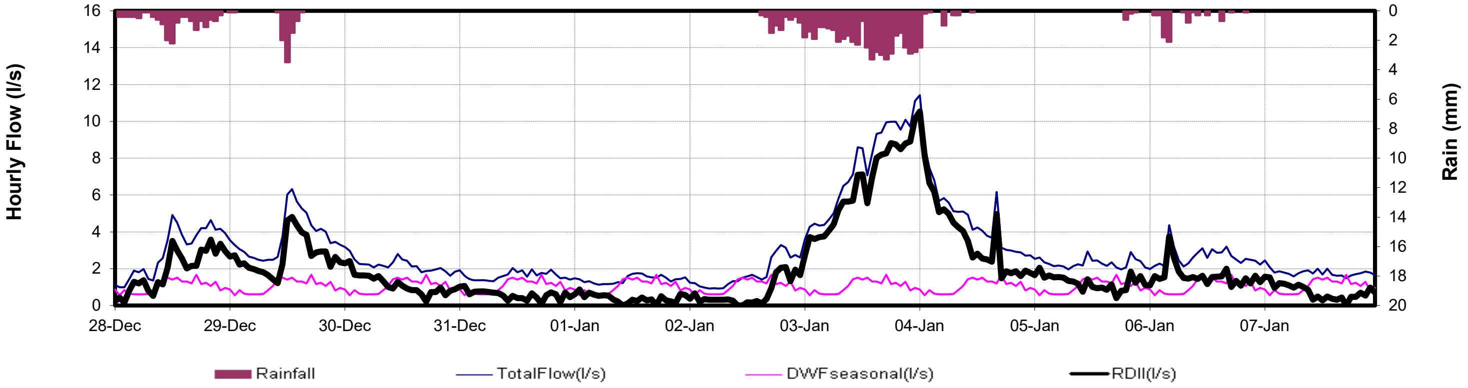
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

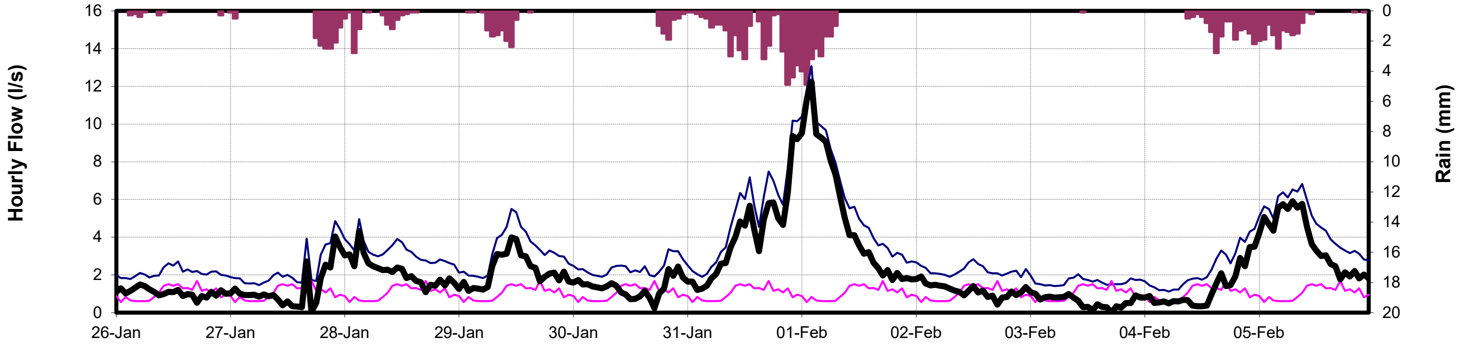


December 28 to January 7, 2019 Storm Events

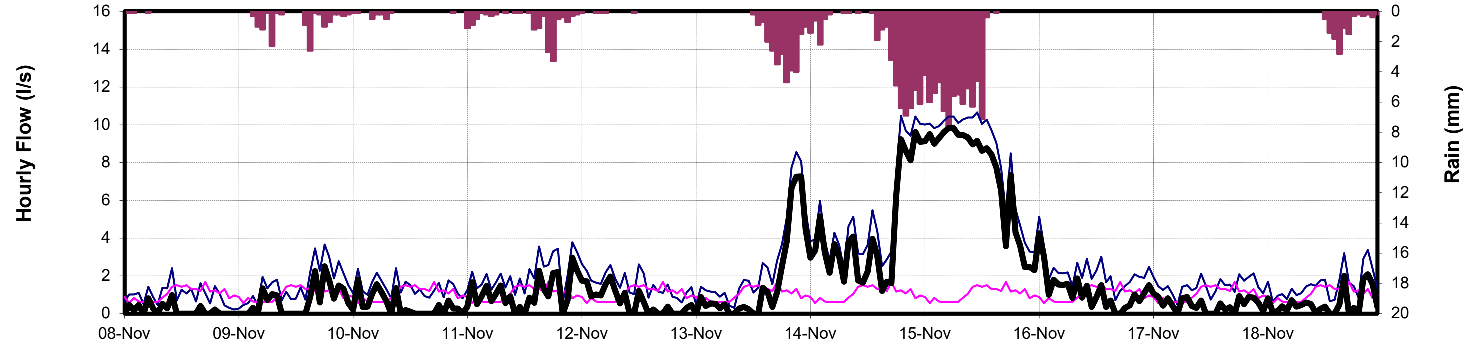


Lochside PS (SID10)

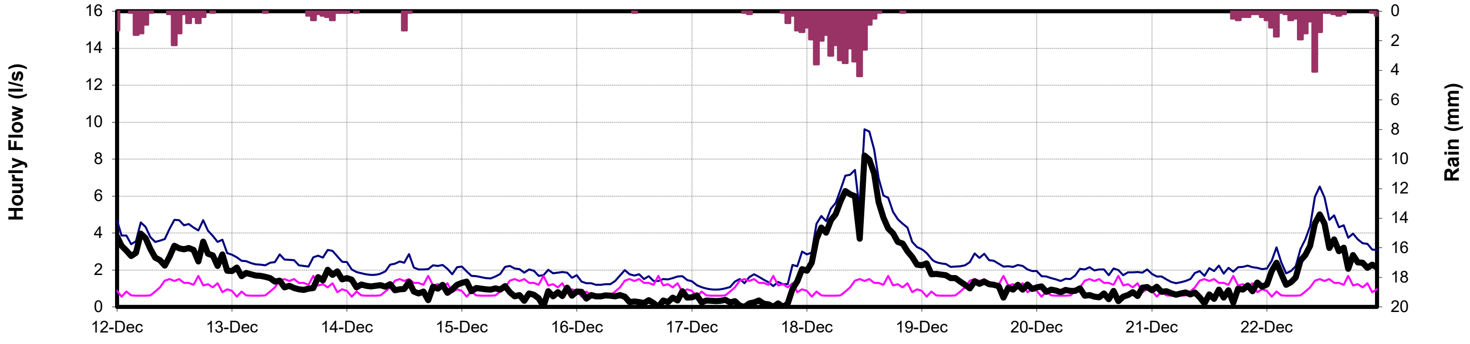
January 26 to February 5, 2020 Storm Events



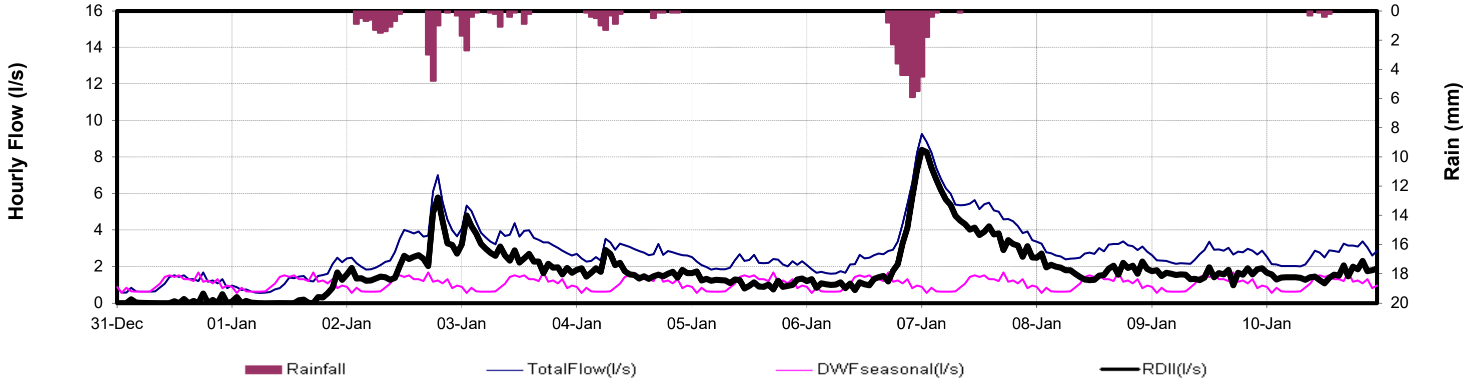
November 8 to November 18, 2021 Storm Events



December 12 to December 22, 2021 Storm Events

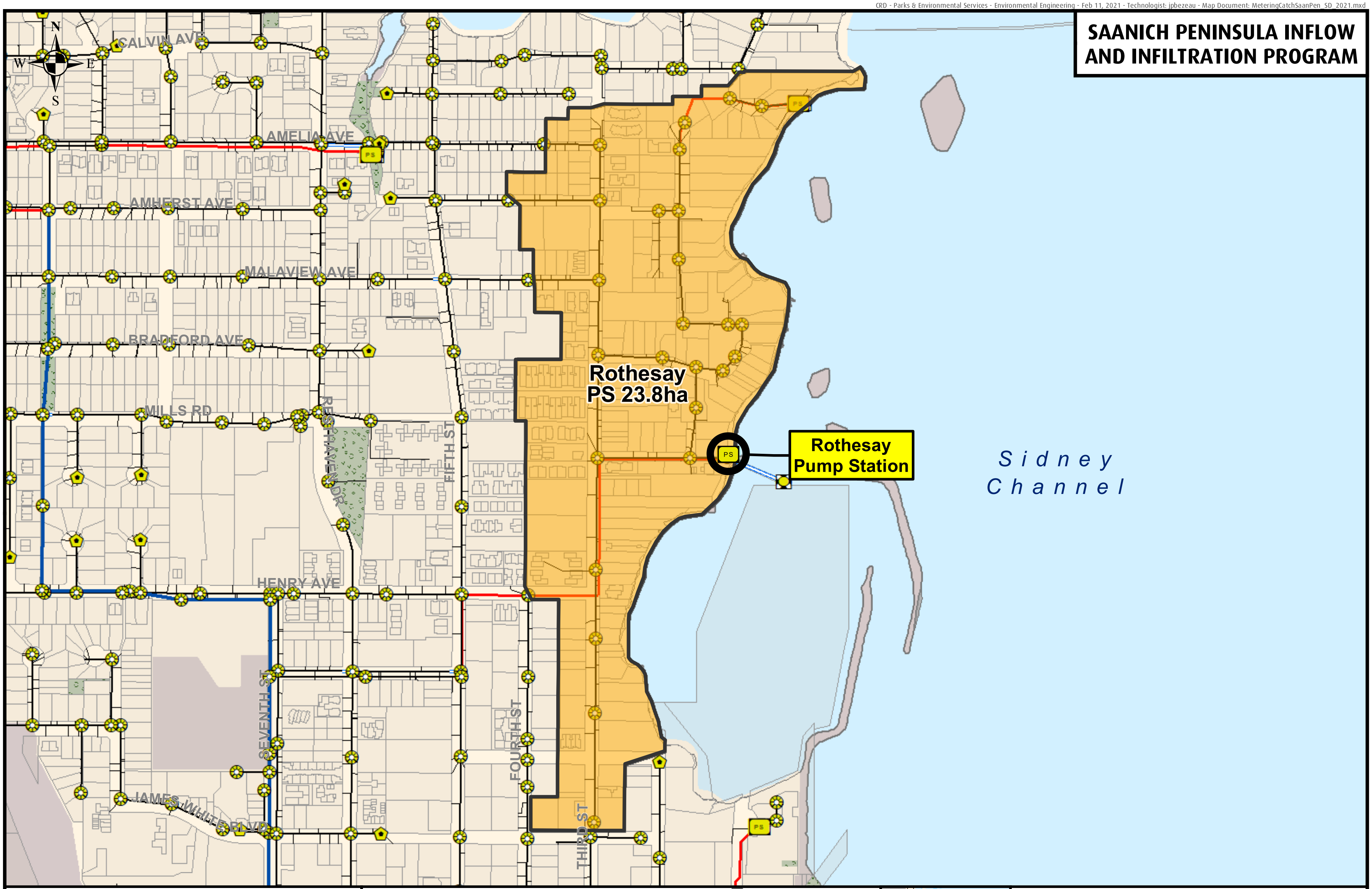


December 31 to January 10, 2022 Storm Events



CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_SD_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



0 100 200 400 Metres

Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○	Flow Monitoring Location
✺	Manhole
⬟	Cleanout
PS	Pump Station
◔	Metering Chamber

Sanitary Sewers

—	Gravity Main Installed After 1930
—	Gravity Main Installed Before 1930
—	Force Main
=	Relief, Outfall, Overflow Sewer
—	CRD Sewer

▨	Catchment Area
▨	Non-Sewered Area
☐	Lot Lines
▨	Parks
▨	Sewered Park Areas
- -	Catchment Boundary
- · -	Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

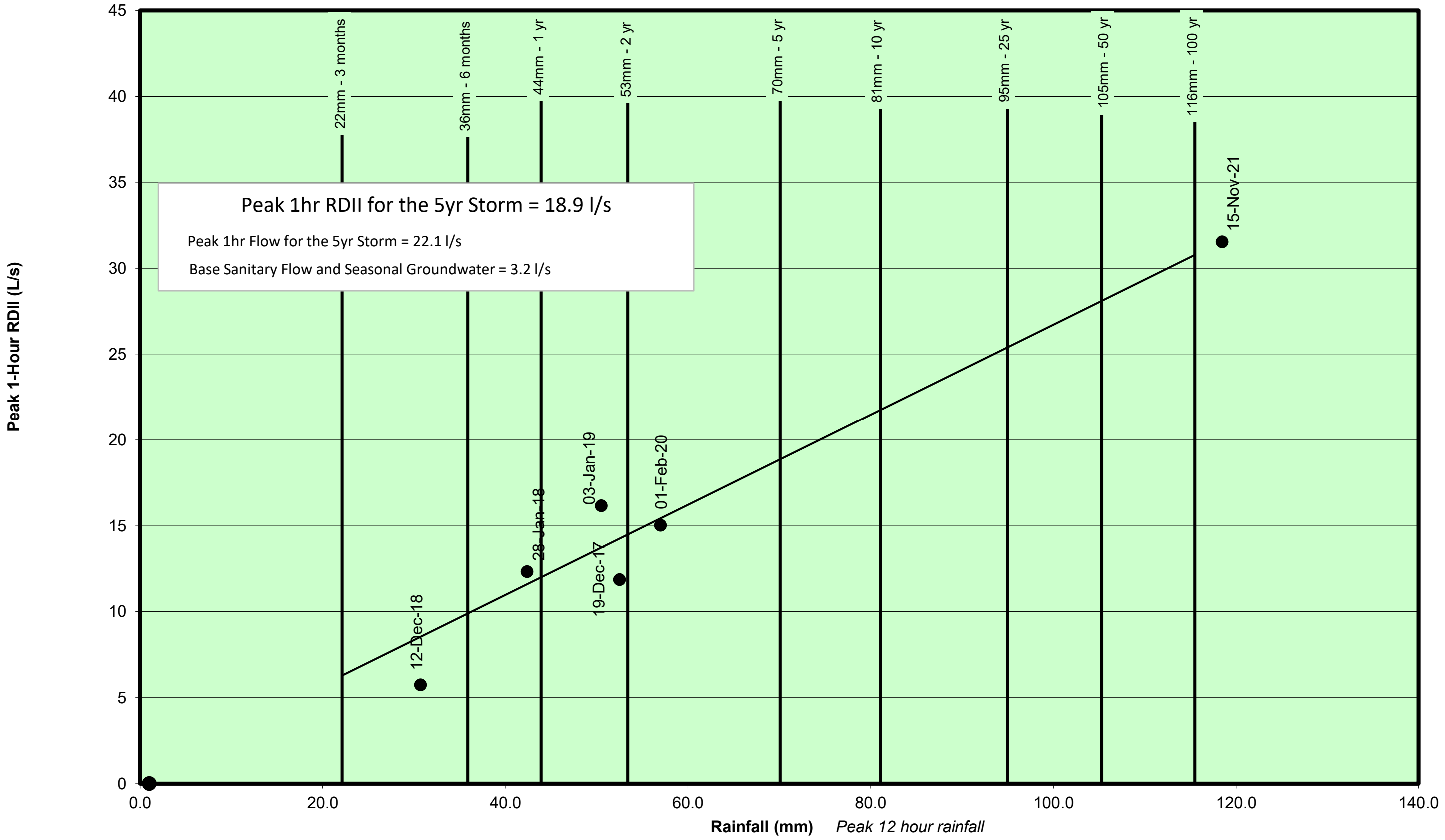
Catchment: Rothesay PS

Site Code: SID12

Making a difference...together

Rothesay PS (SID12)

Peak 1-hr RDII by Storm Event

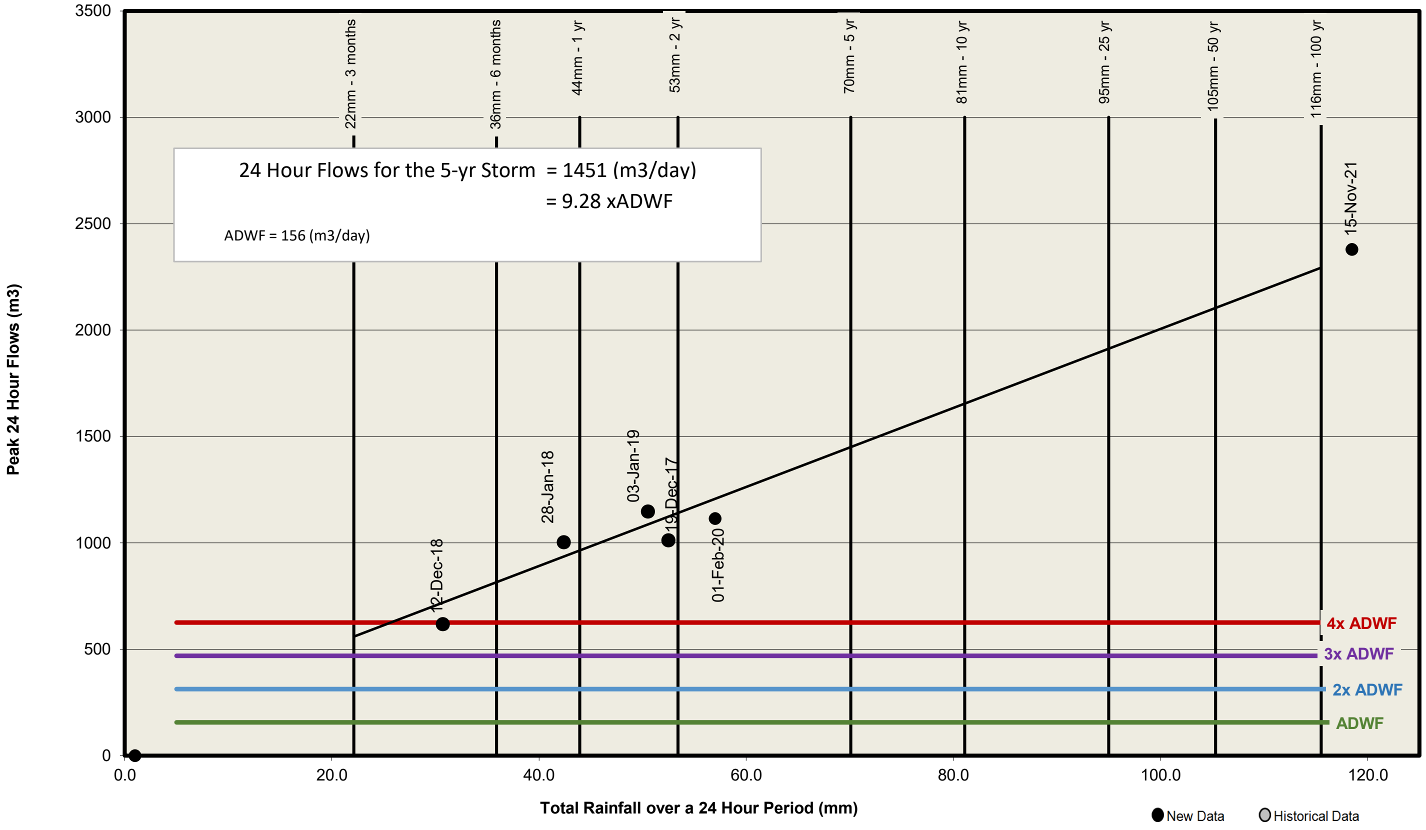


Peak 1hr RDII for the 5yr Storm = 18.9 l/s

Peak 1hr Flow for the 5yr Storm = 22.1 l/s

Base Sanitary Flow and Seasonal Groundwater = 3.2 l/s

Peak 24-Hour Flows by Storm Event

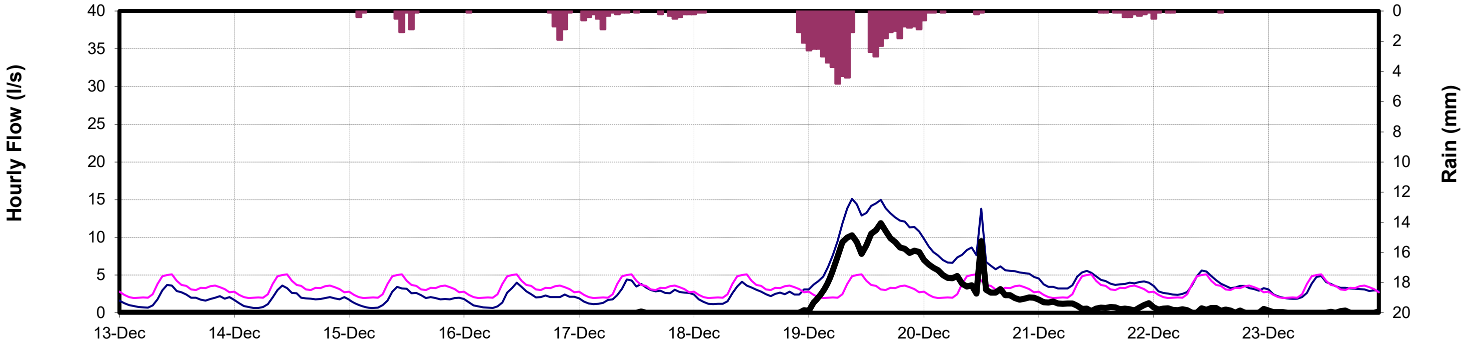


24 Hour Flows for the 5-yr Storm = 1451 (m3/day)
= 9.28 xADWF

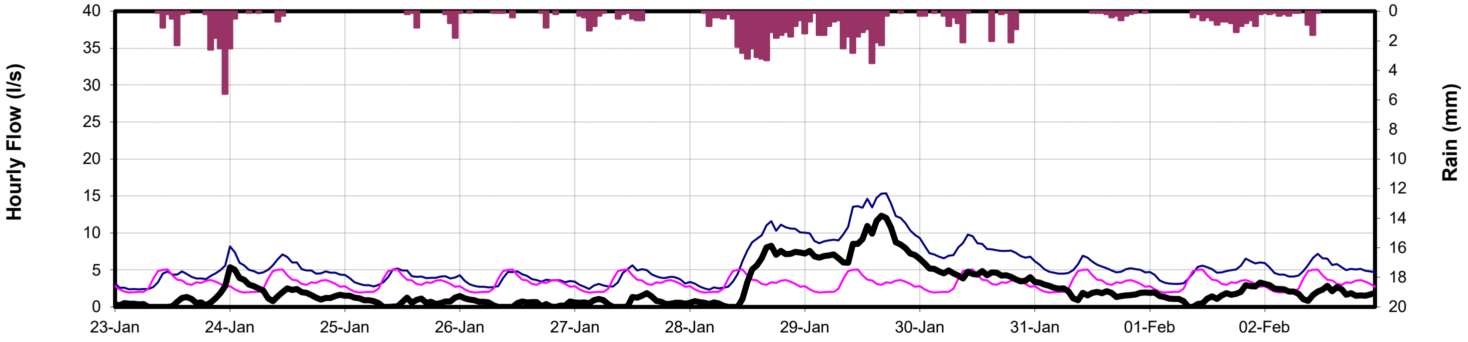
ADWF = 156 (m3/day)

Rothesay PS (SID12)

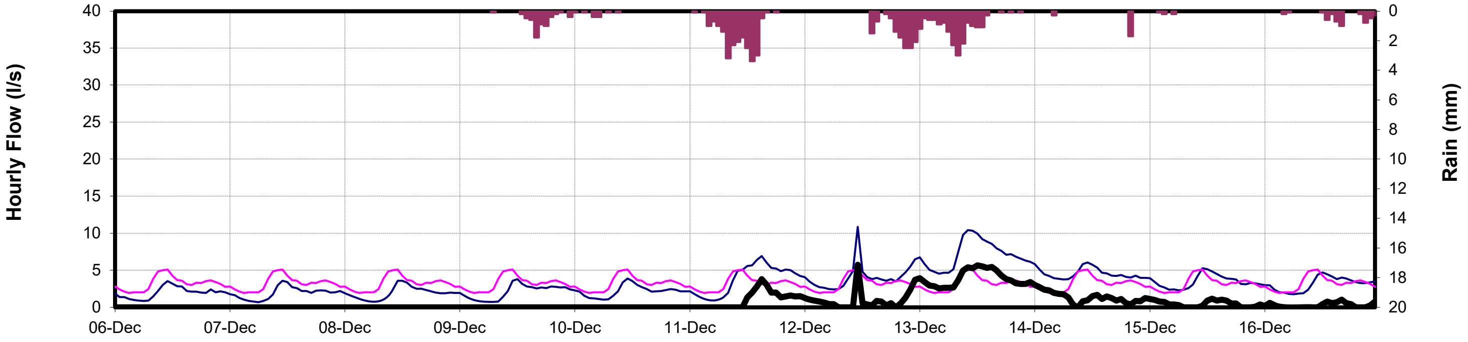
December 13 to December 23, 2017 Storm Events



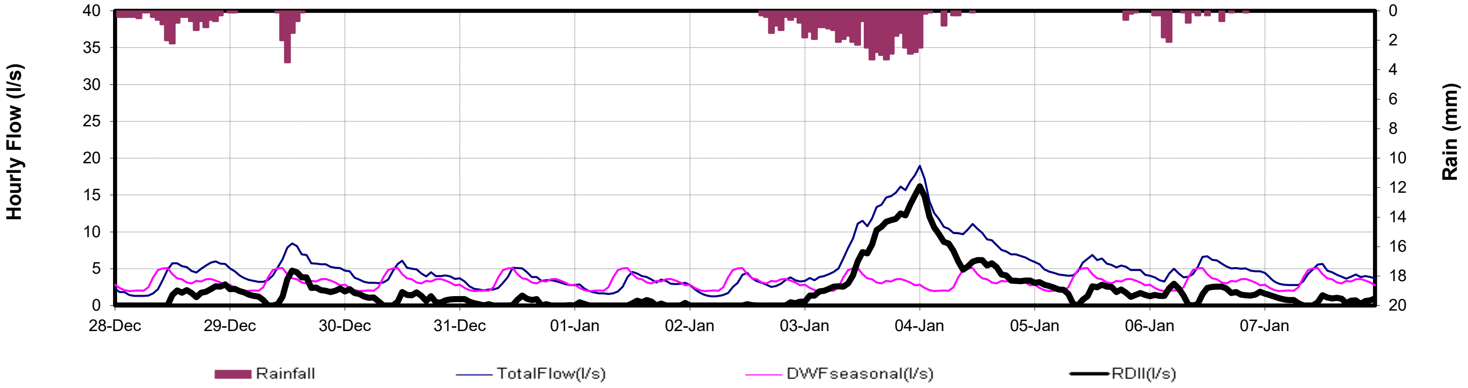
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

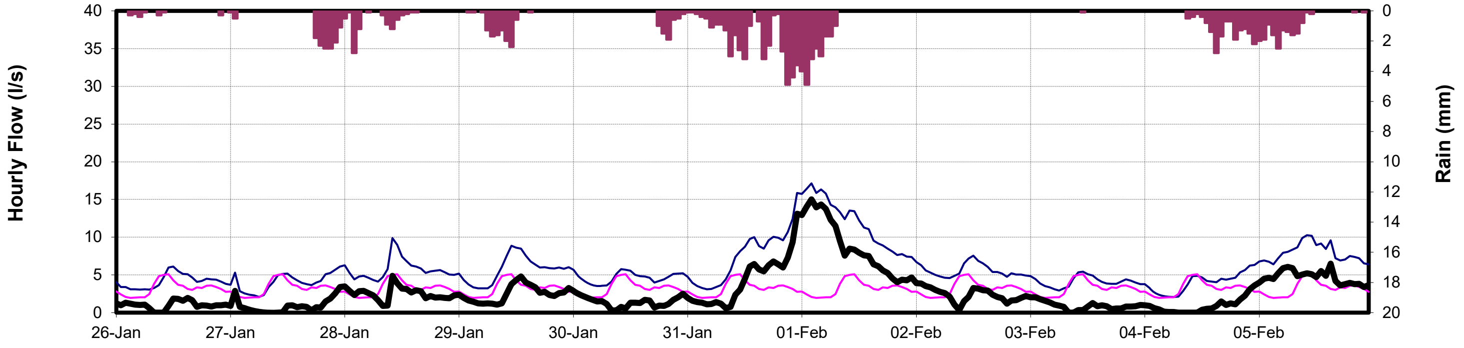


December 28 to January 7, 2019 Storm Events

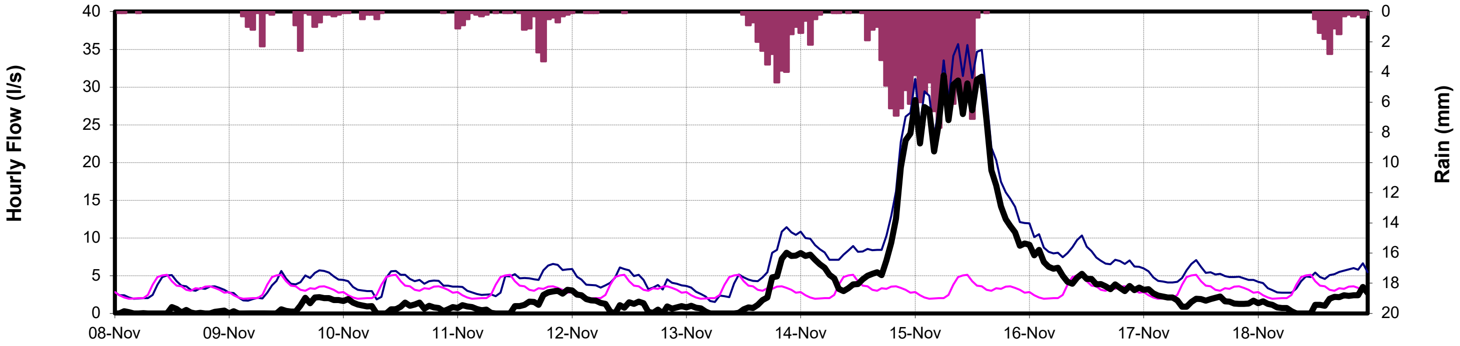


Rothesay PS (SID12)

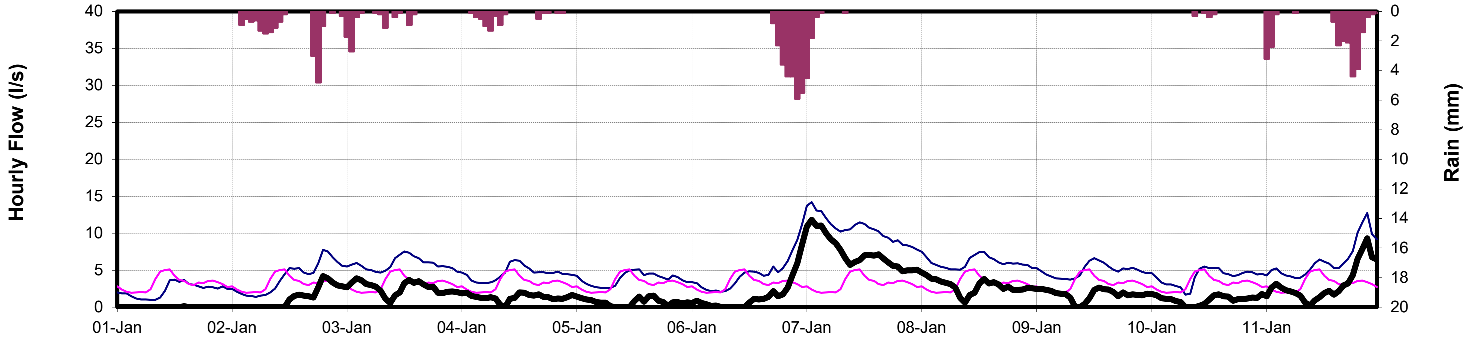
January 26 to February 5, 2020 Storm Events



November 8 to November 18, 2021 Storm Events



January 1 to January 11, 2022 Storm Events



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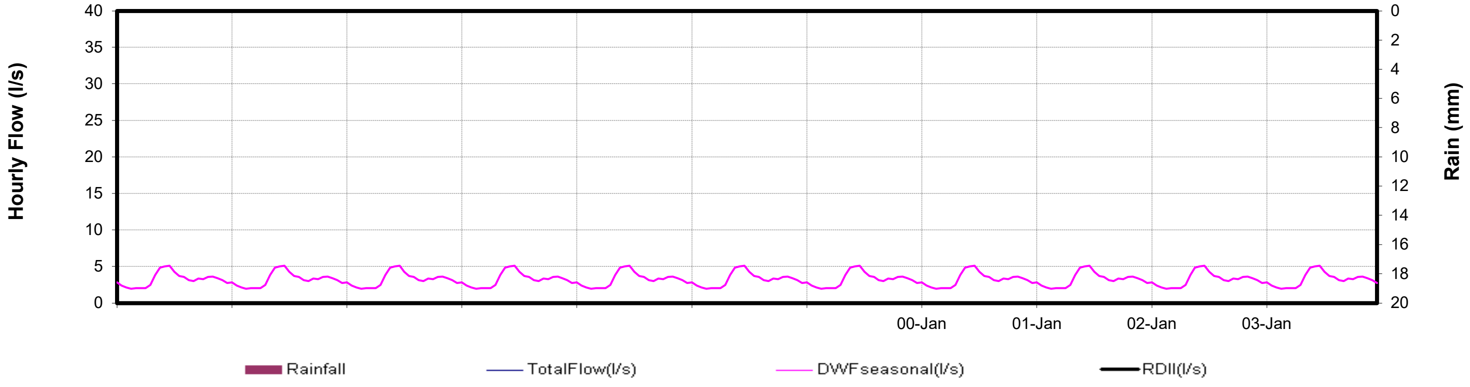

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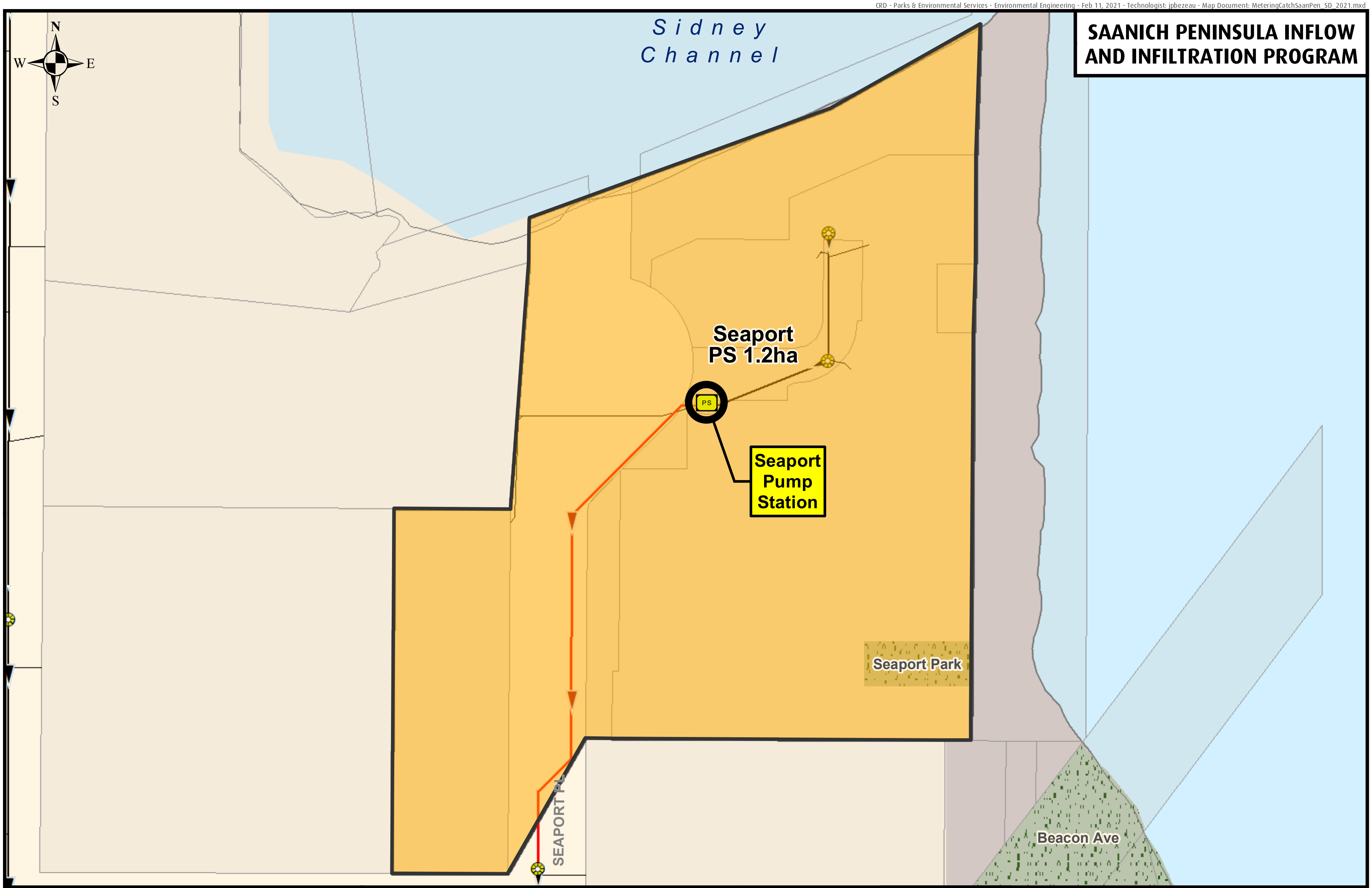
SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 12.5 25 50

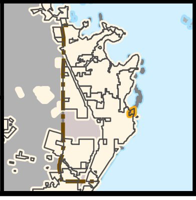
Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

- ○ Flow Monitoring Location
- ✲ Manhole
- ⬟ Cleanout
- PS Pump Station
- ◔ Metering Chamber

Sanitary Sewers
- Gravity Main Installed After 1930
- Gravity Main Installed Before 1930
- Force Main
- Relief, Outfall, Overflow Sewer
- CRD Sewer

- Catchment Area
- Non-Sewered Area
- Lot Lines
- Parks
- Sewered Park Areas
- Catchment Boundary
- Municipal, First Nation, or DND Boundaries



FLOW MONITORING AREA

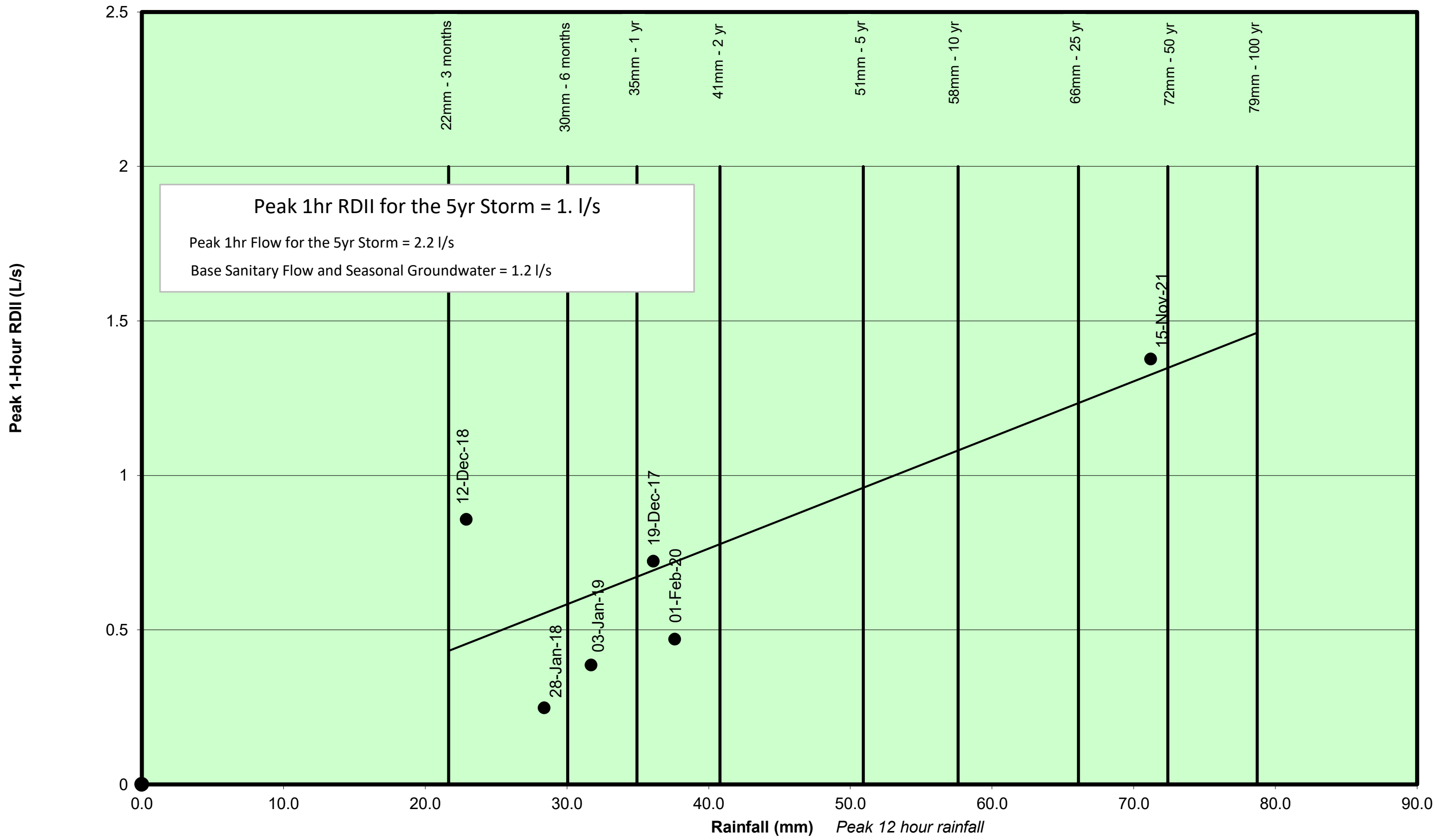
Catchment: Seaport PS

Site Code: SID13

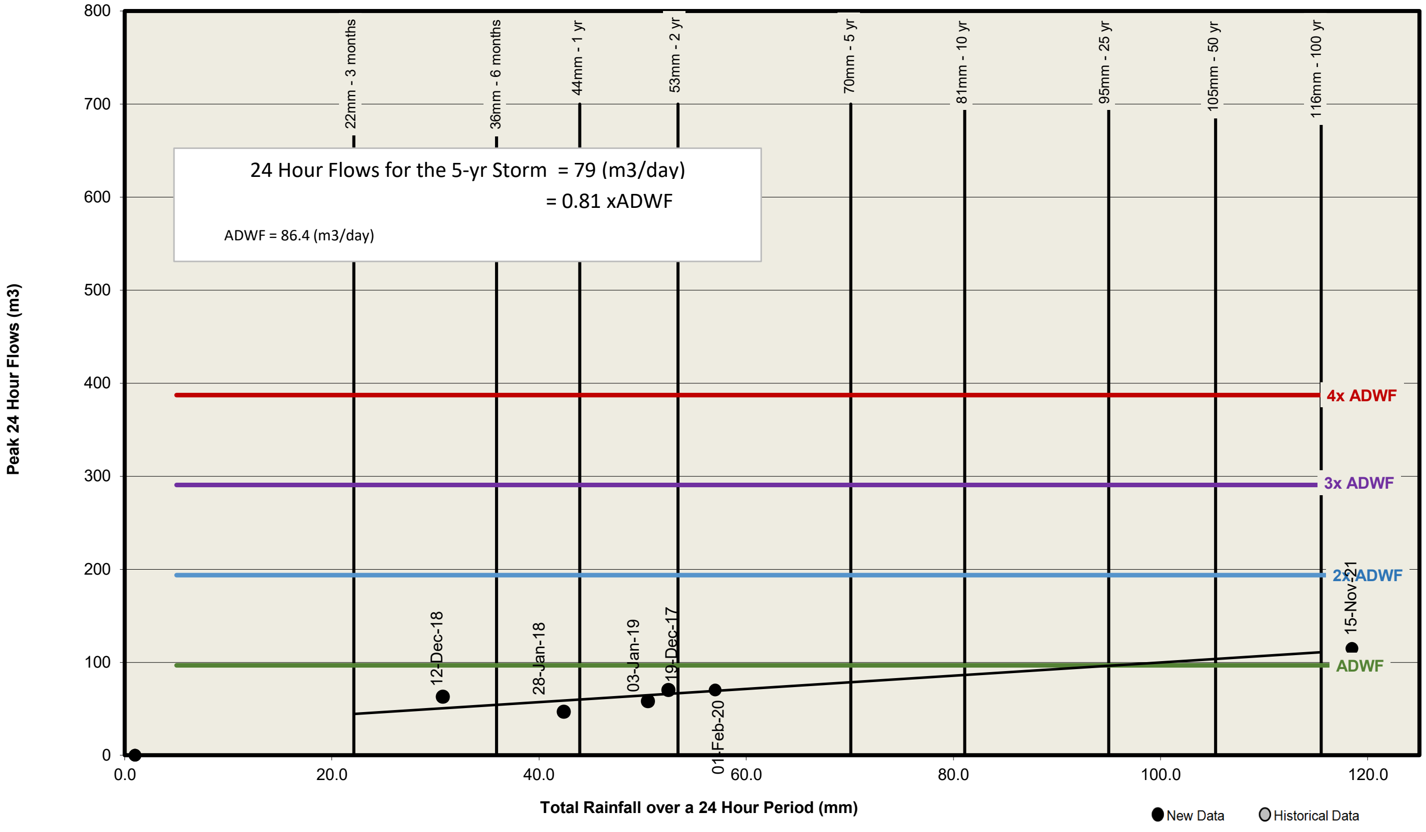
CRD
Making a difference...together

Seaport Pump Station (SID13)

Peak 1hr RDII by Storm Event

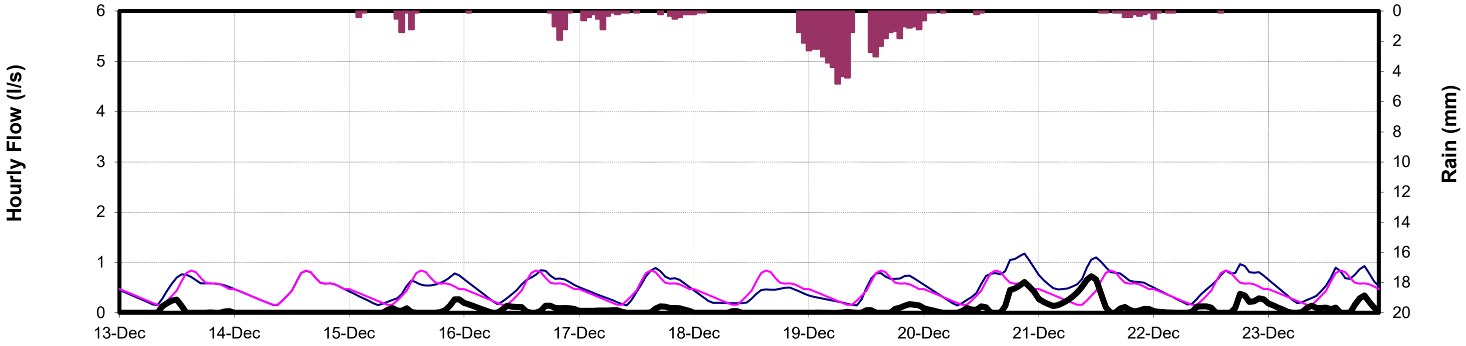


Peak 24-Hour Flows by Storm Event

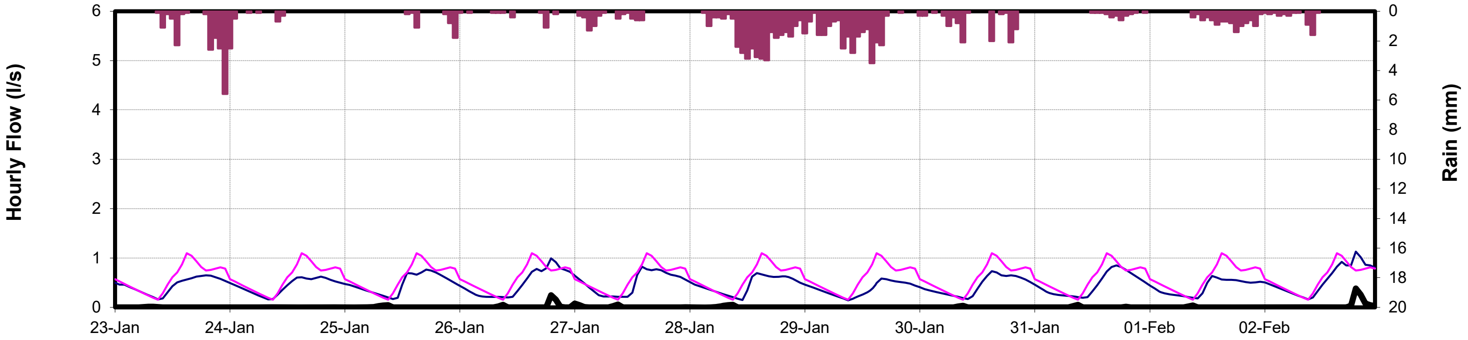


Seaport Pump Station (SID13)

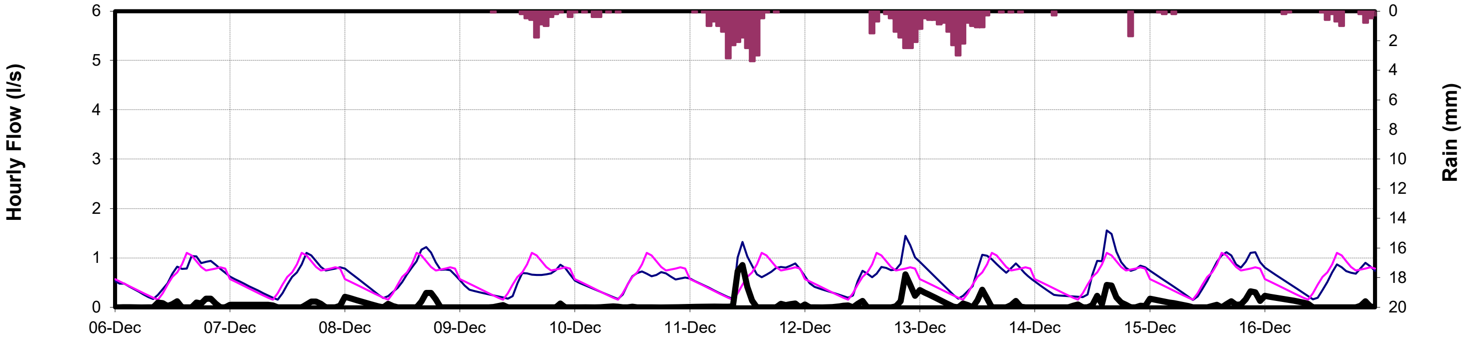
December 13 to December 23, 2017 Storm Events



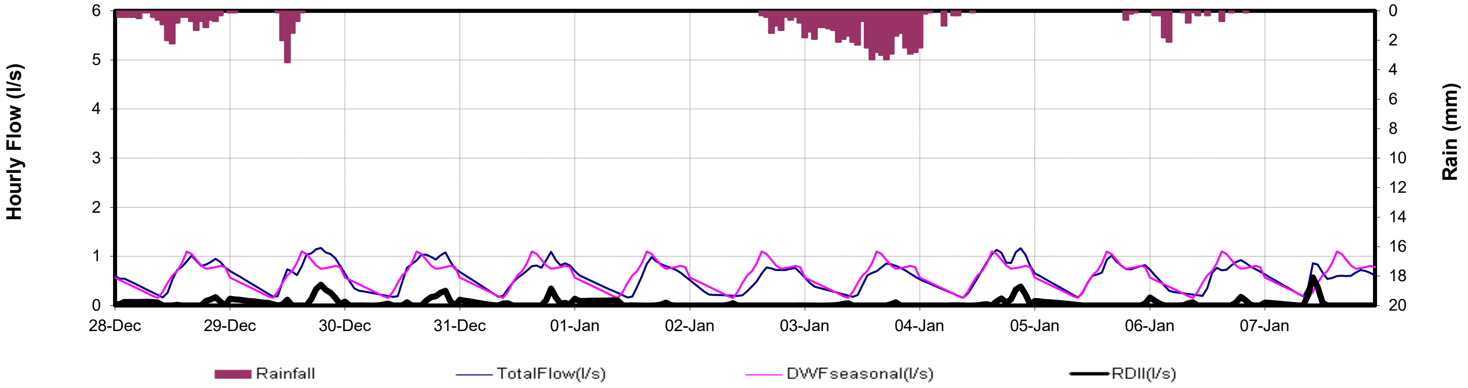
January 23 to February 2, 2018 Storm Events



December 6 to December 16, 2018 Storm Events

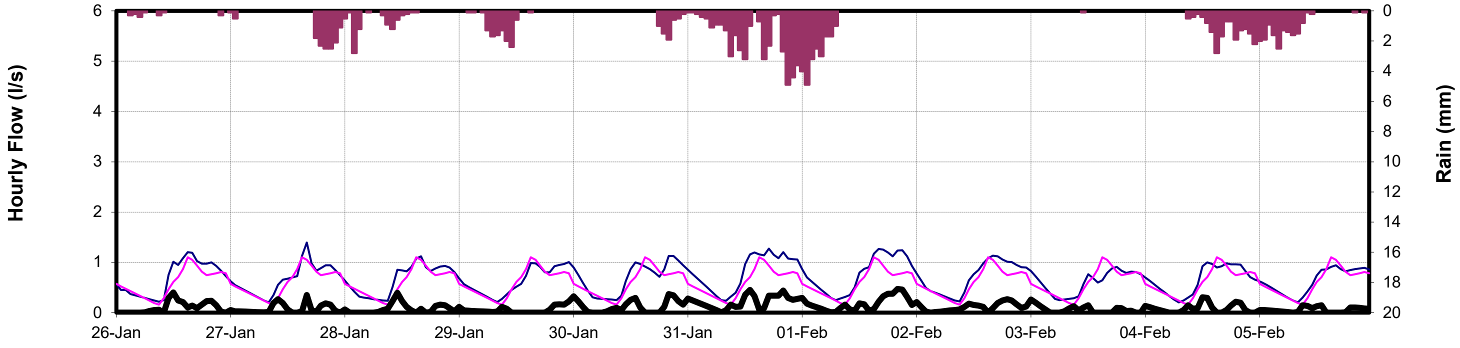


December 28 to January 7, 2019 Storm Events

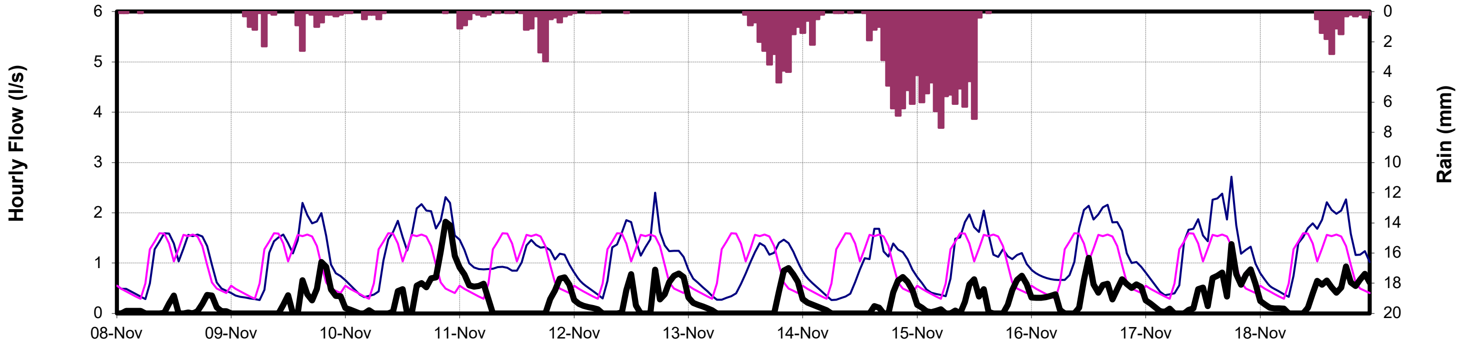


Seaport Pump Station (SID13)

January 26 to February 5, 2020 Storm Events



November 8 to November 18, 2021 Storm Events



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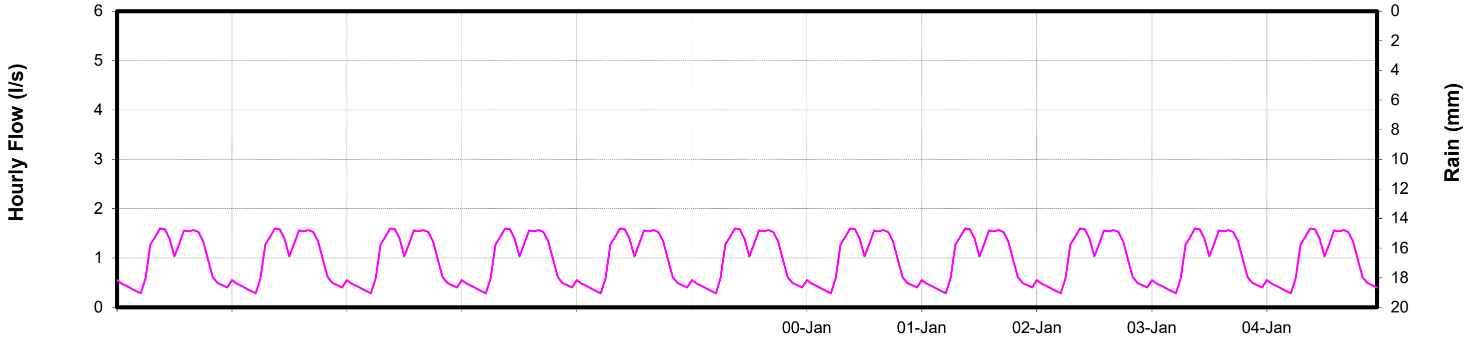

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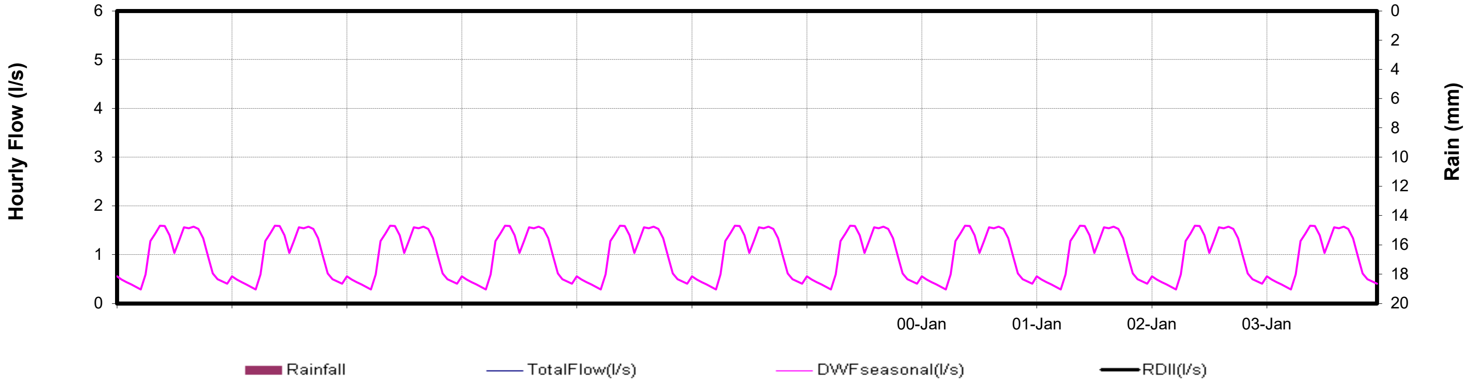

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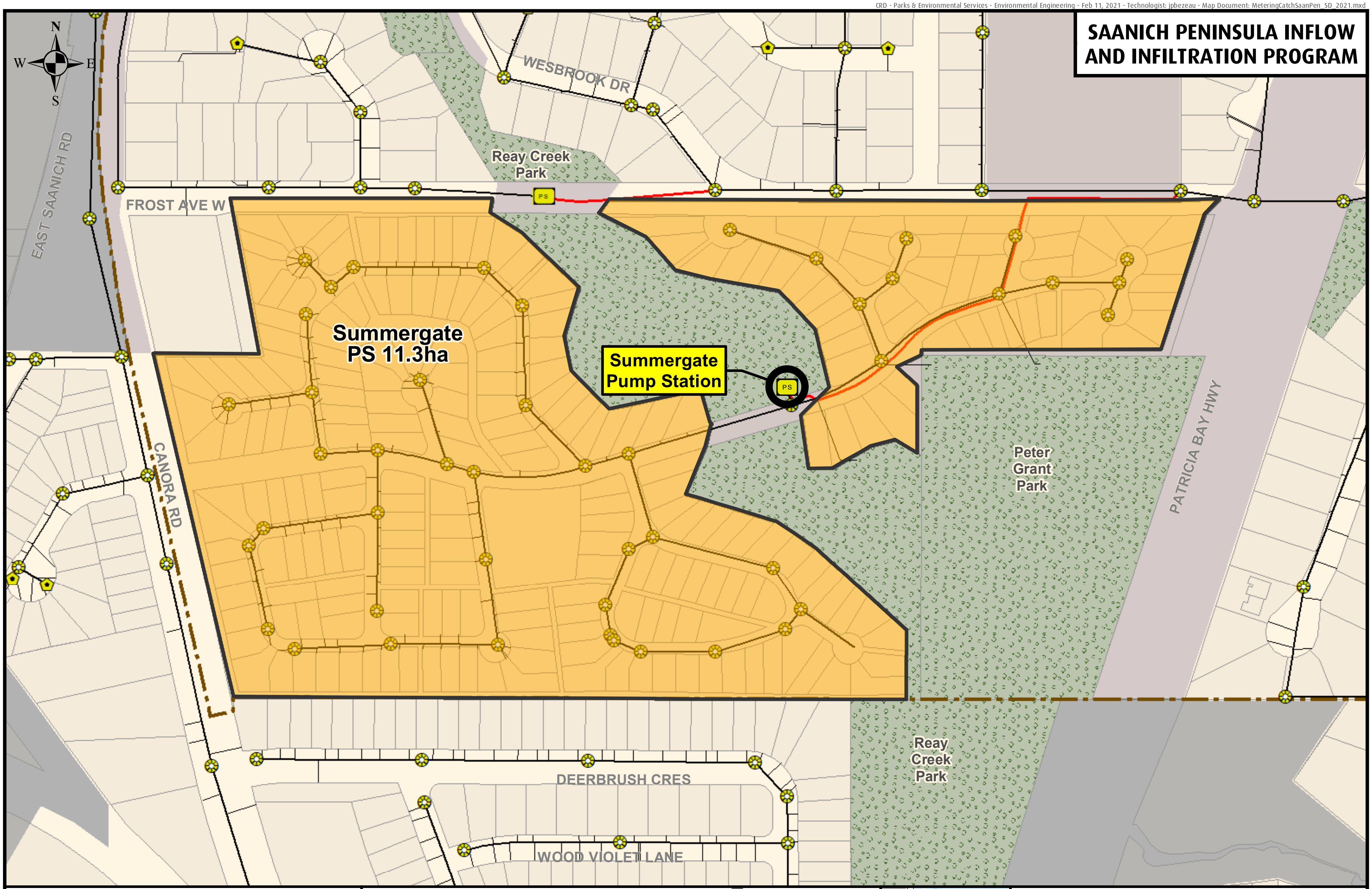
SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 40 80 160

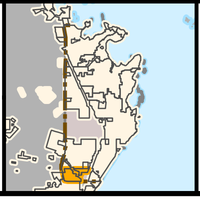
Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
● Manhole
⬟ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
Gravity Main Installed After 1930
Gravity Main Installed Before 1930
Force Main
Relief, Outfall, Overflow Sewer
CRD Sewer

Catchment Area
Non-Sewered Area
Lot Lines
Parks
Sewered Park Areas
Catchment Boundary
Municipal, First Nation, or DND Boundaries



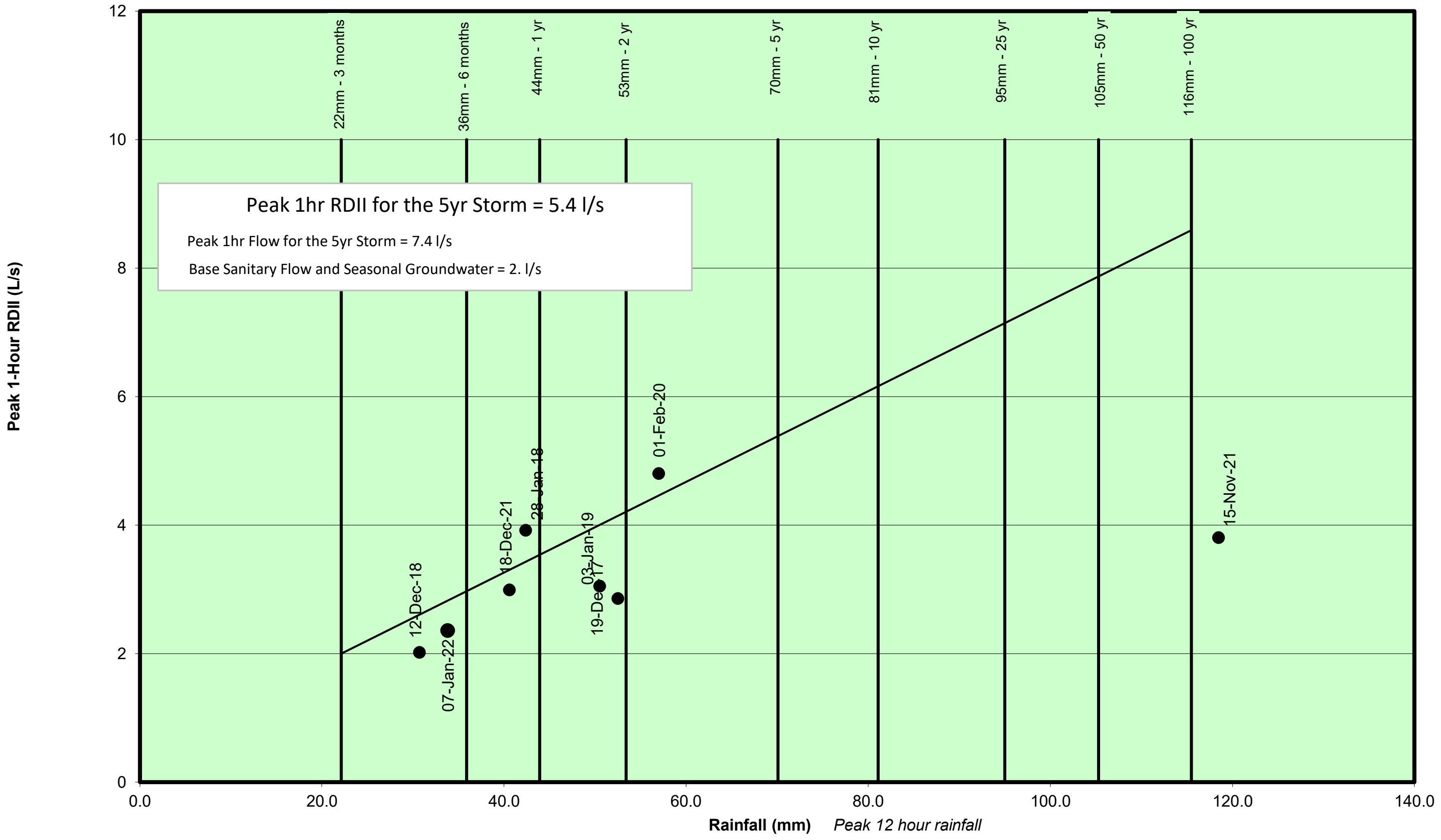
FLOW MONITORING AREA

Catchment: Summergate PS

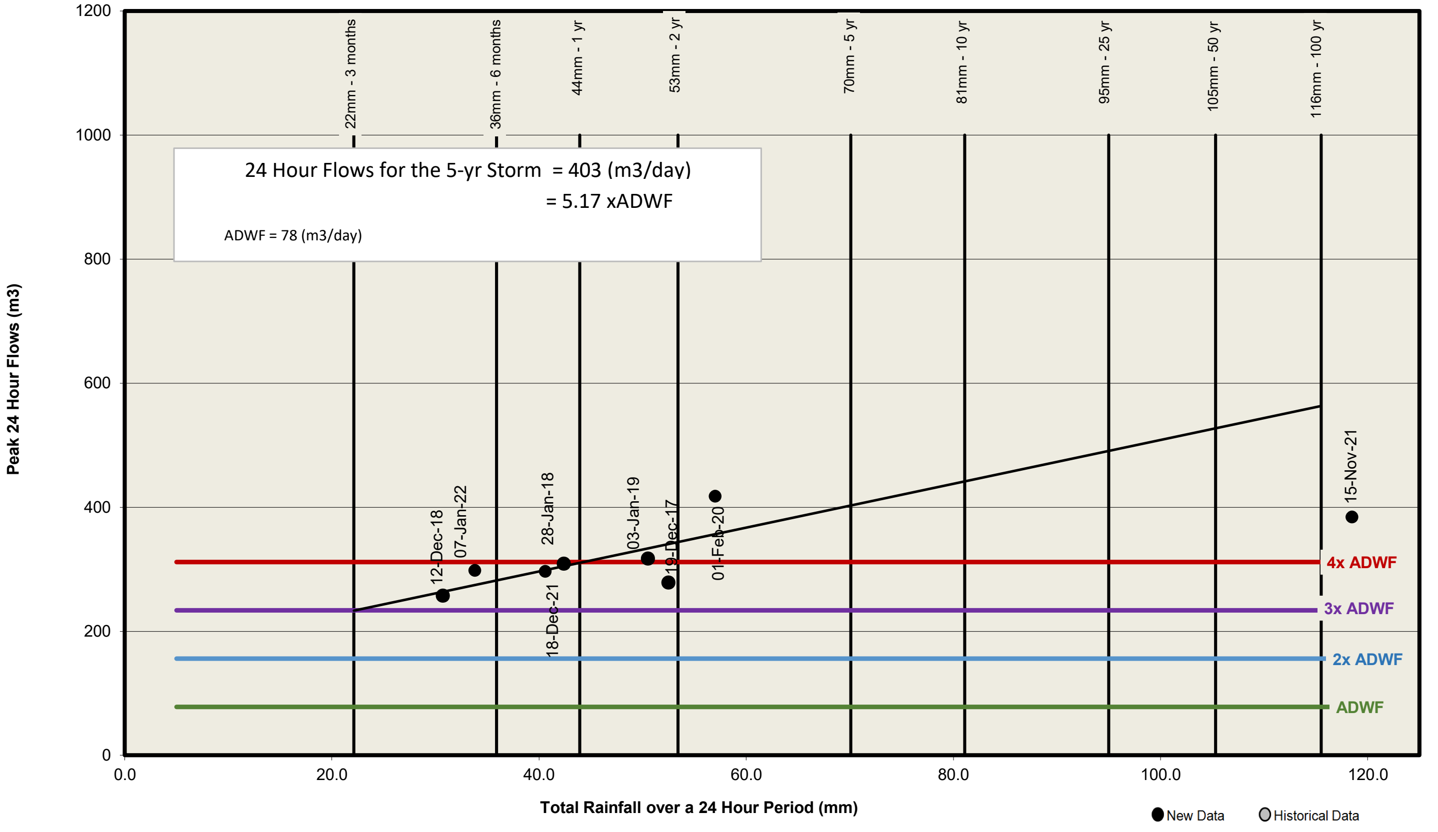
Site Code: SID14

CRD
Making a difference...together

Summergate PS (SID14)



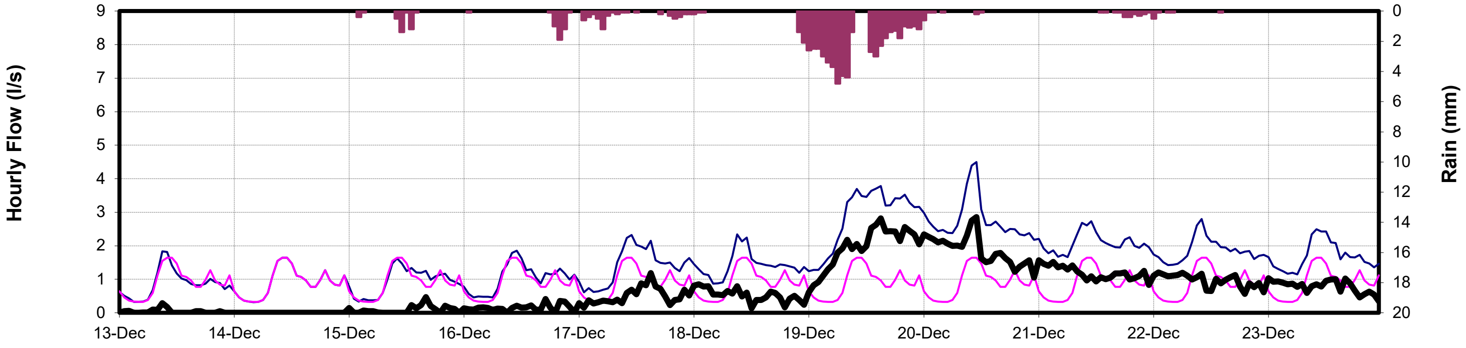
Peak 1-hr Flow by Storm Event



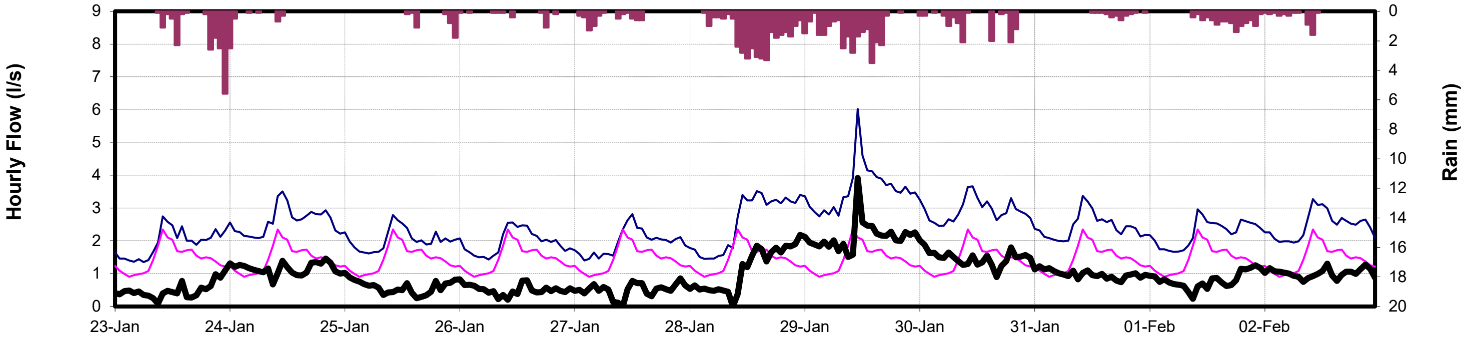
Peak 24-Hour Flows by Storm Event

Summergate PS (SID14)

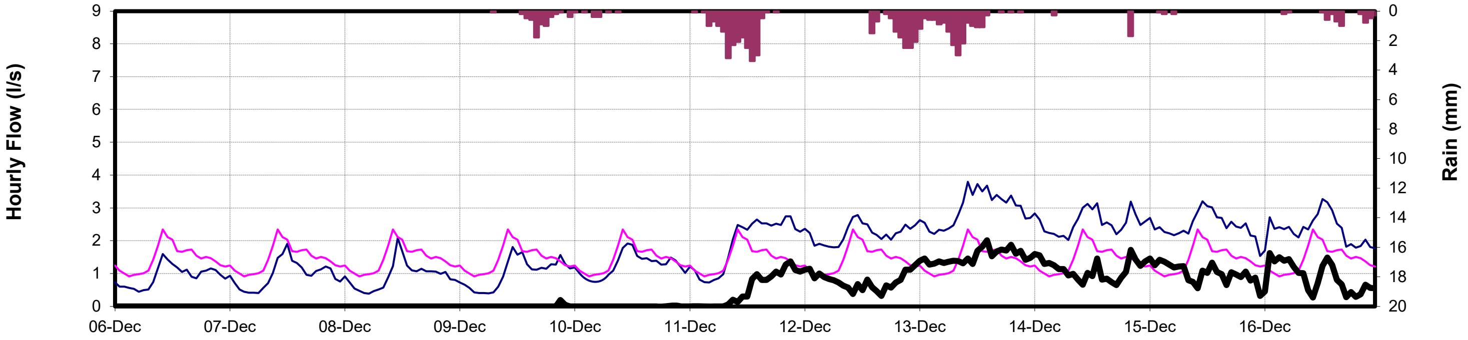
December 13 to December 23, 2017 Storm Events



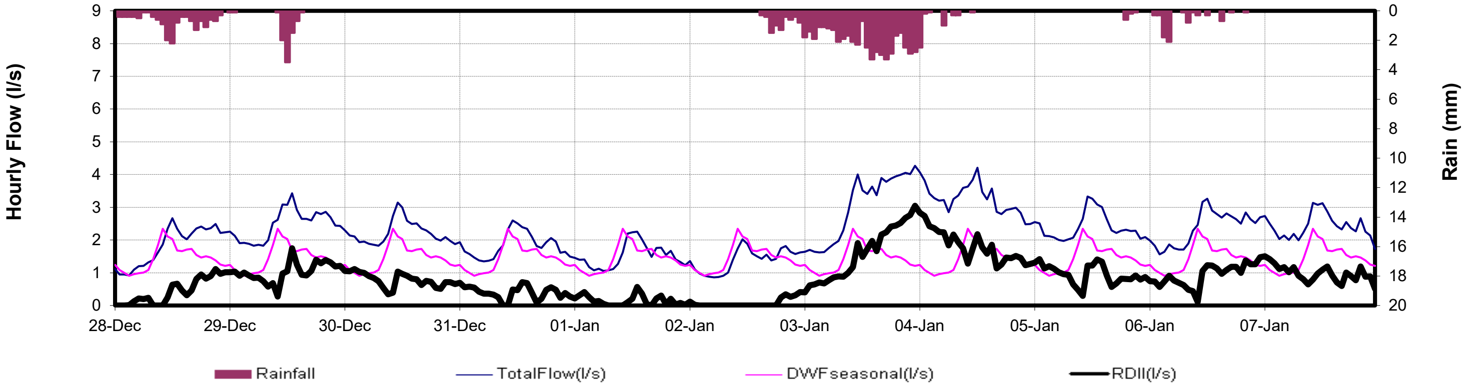
January 23 to February 2, 2018 Storm Events



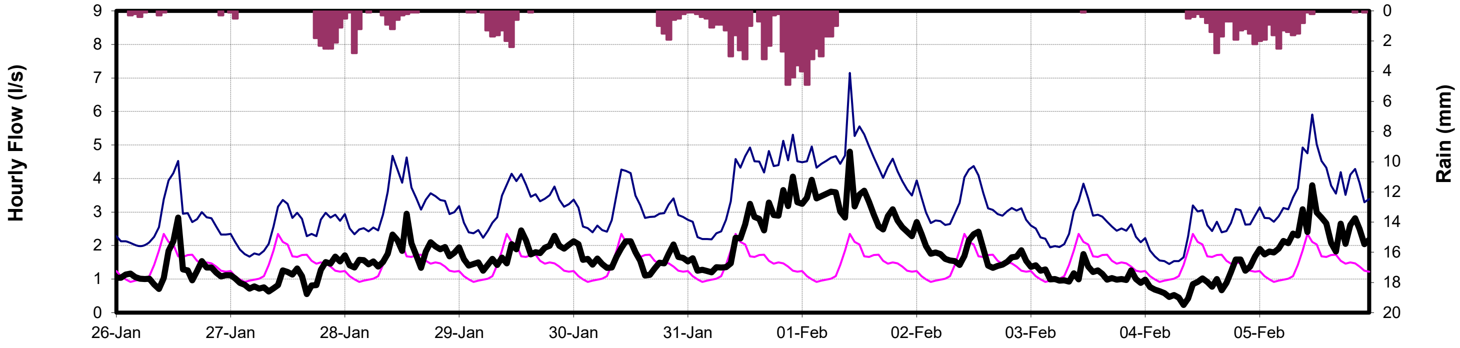
December 6 to December 16, 2018 Storm Events



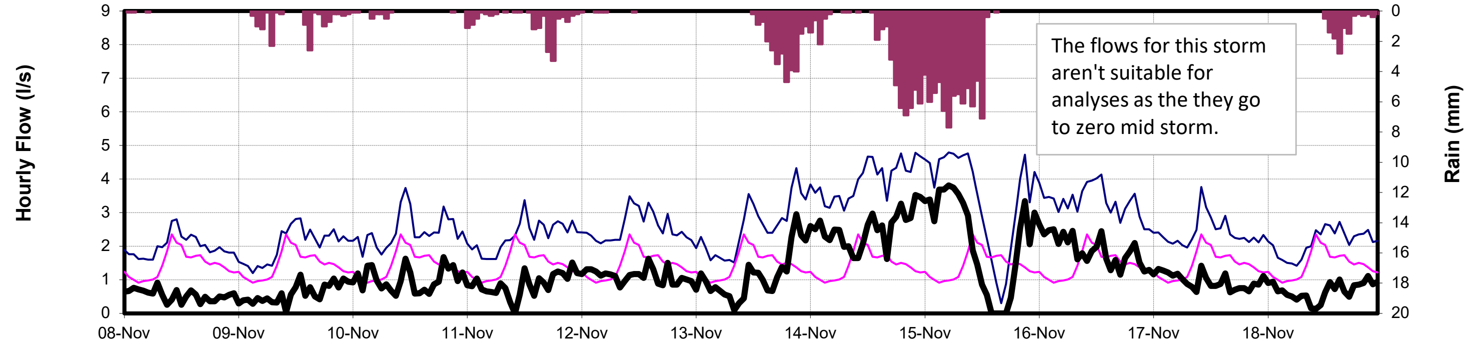
December 28 to January 7, 2019 Storm Events



Summergate PS (SID14)

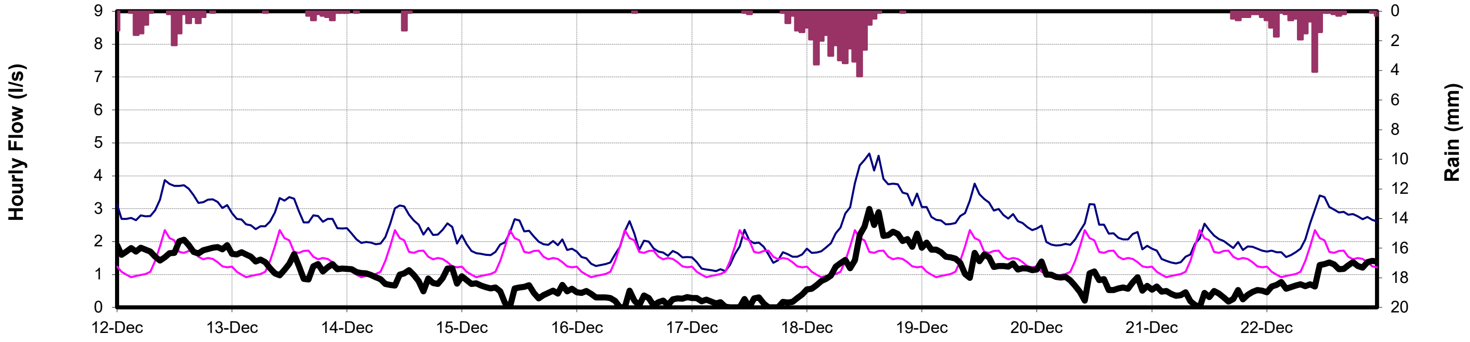


January 26 to February 5, 2020 Storm Events

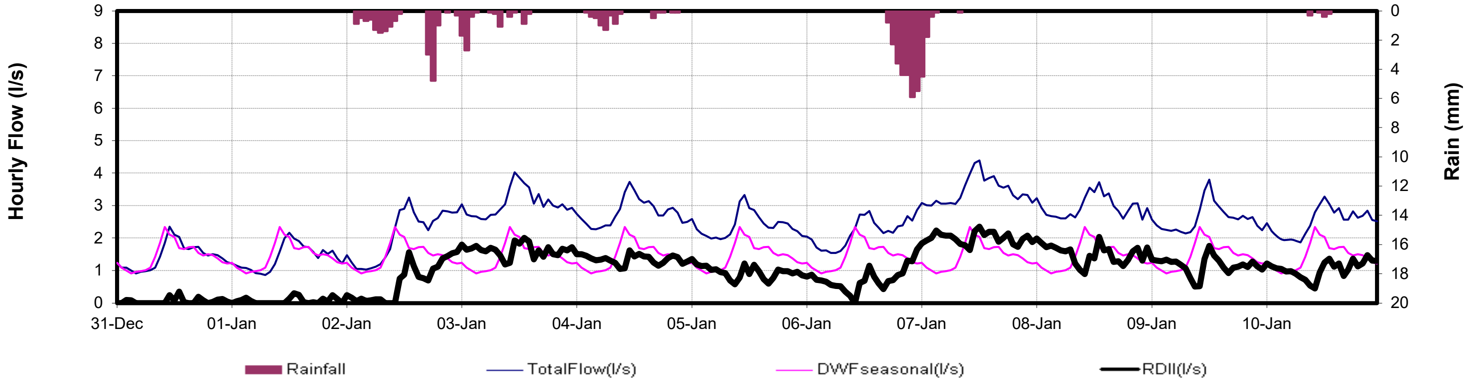


November 8 to November 18, 2021 Storm Events

The flows for this storm aren't suitable for analyses as the they go to zero mid storm.



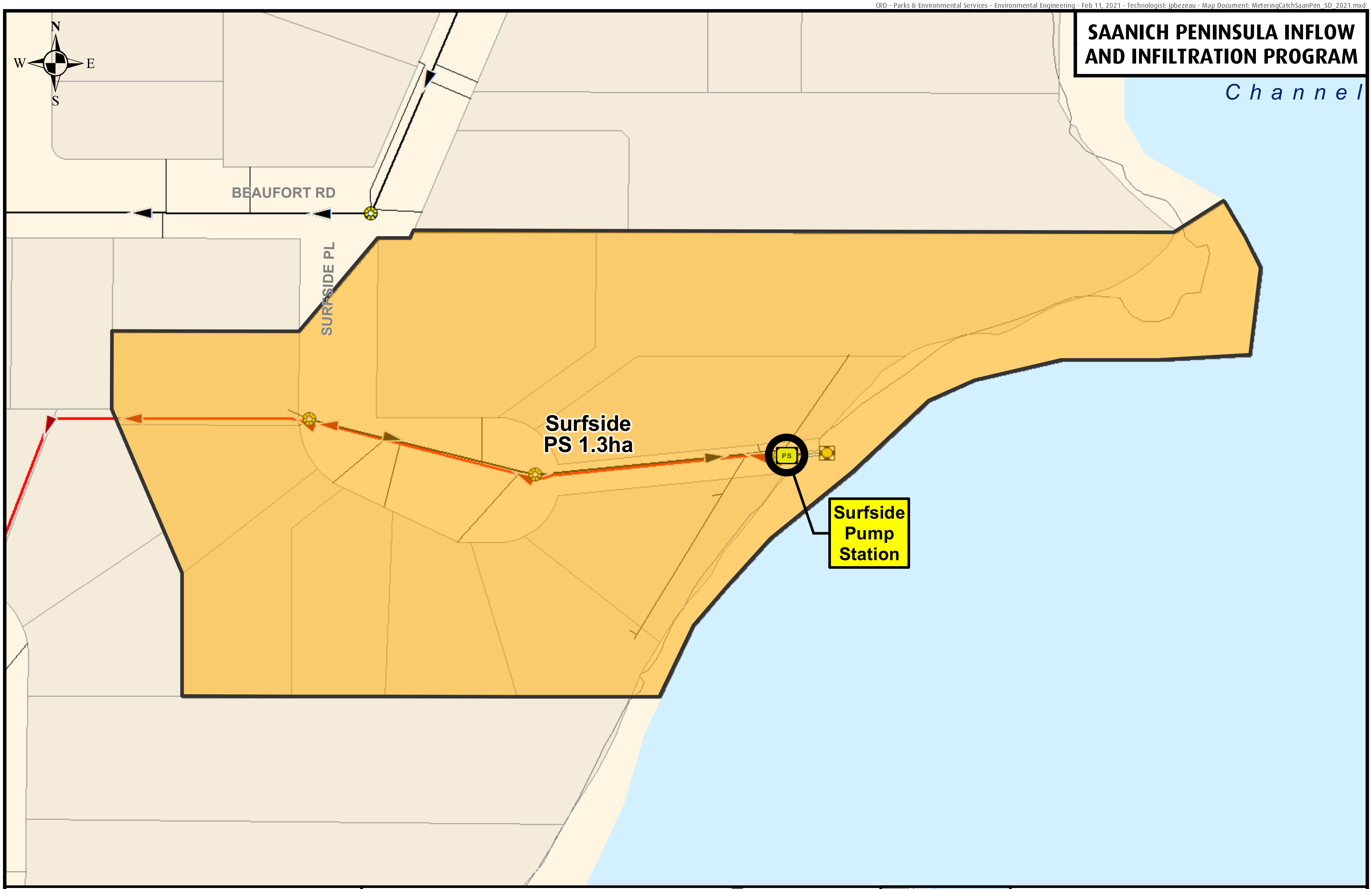
December 12 to December 22, 2021 Storm Events



December 31 to January 10, 2022 Storm Events

CRD - Parks & Environmental Services - Environmental Engineering - Feb 11, 2021 - Technologist: jpbezeau - Map Document: MeteringCatchSaanPen_SD_2021.mxd

SAANICH PENINSULA INFLOW AND INFILTRATION PROGRAM



Metres
0 12.5 25 50

Projection: UTM ZONE 10N, NAD83

Disclaimer
This map is for general information only and may contain inaccuracies.

○ Flow Monitoring Location
⊛ Manhole
⬠ Cleanout
PS Pump Station
◔ Metering Chamber

Sanitary Sewers
— Gravity Main Installed After 1930
— Gravity Main Installed Before 1930
— Force Main
═ Relief, Outfall, Overflow Sewer
— CRD Sewer

▨ Catchment Area
▨ Non-Sewered Area
☐ Lot Lines
▨ Parks
▨ Sewered Park Areas
- - Catchment Boundary
-·- Municipal, First Nation, or DND Boundaries

FLOW MONITORING AREA

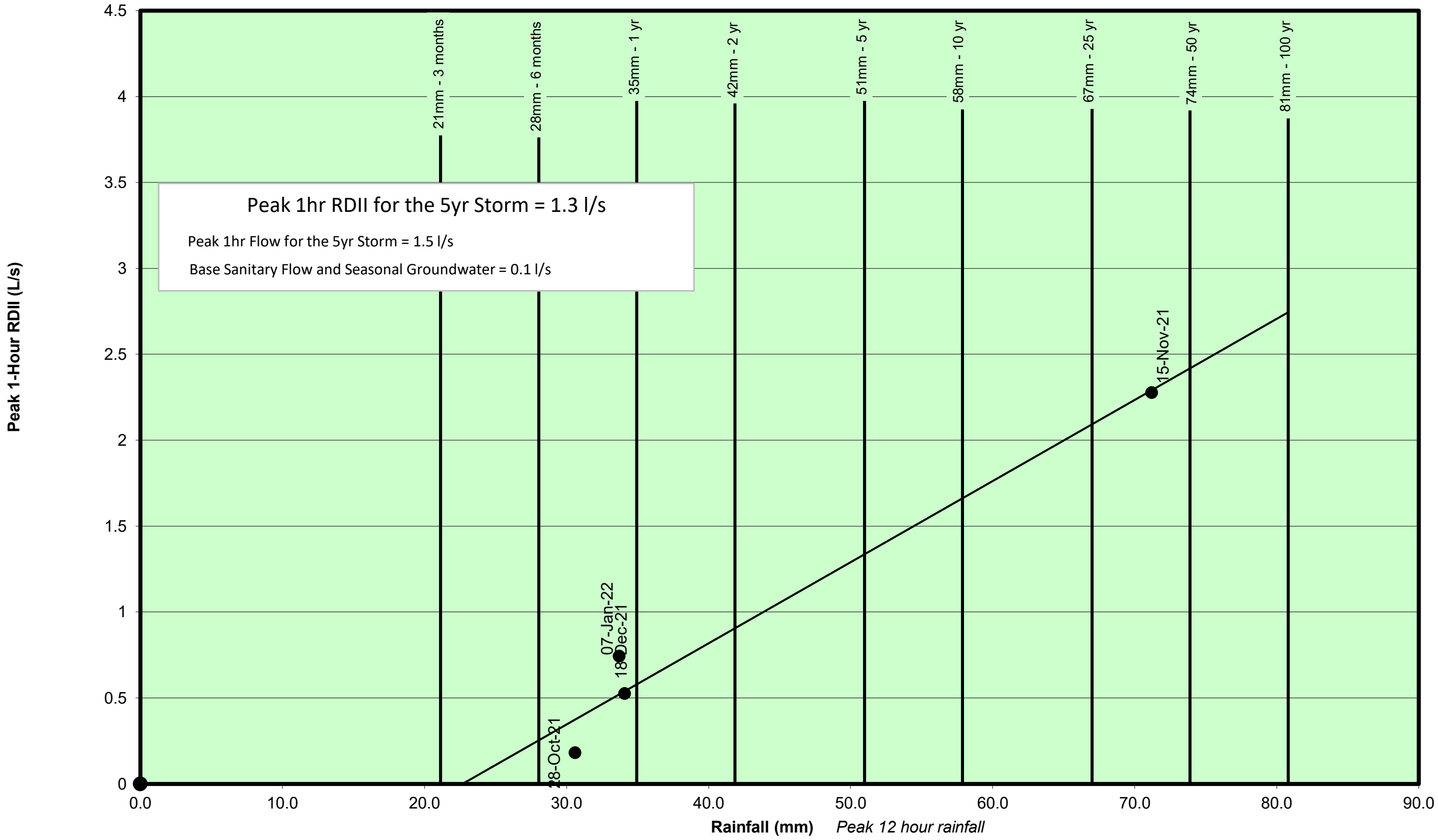
Catchment: Surfside PS

Site Code: SID15

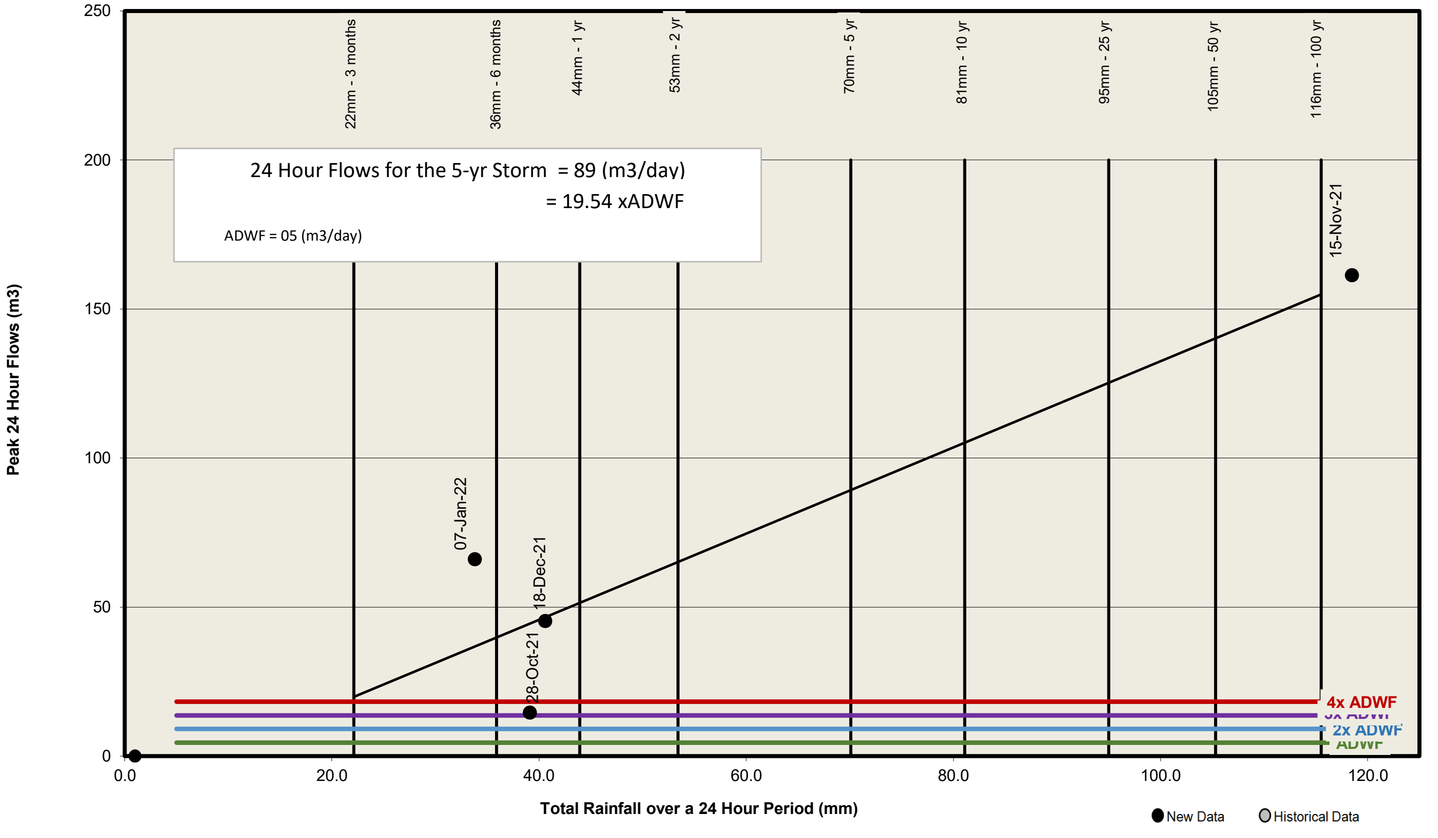
CRD
Making a difference...together

Surfside (SID15)

Peak 1-hr RDII by Storm Event

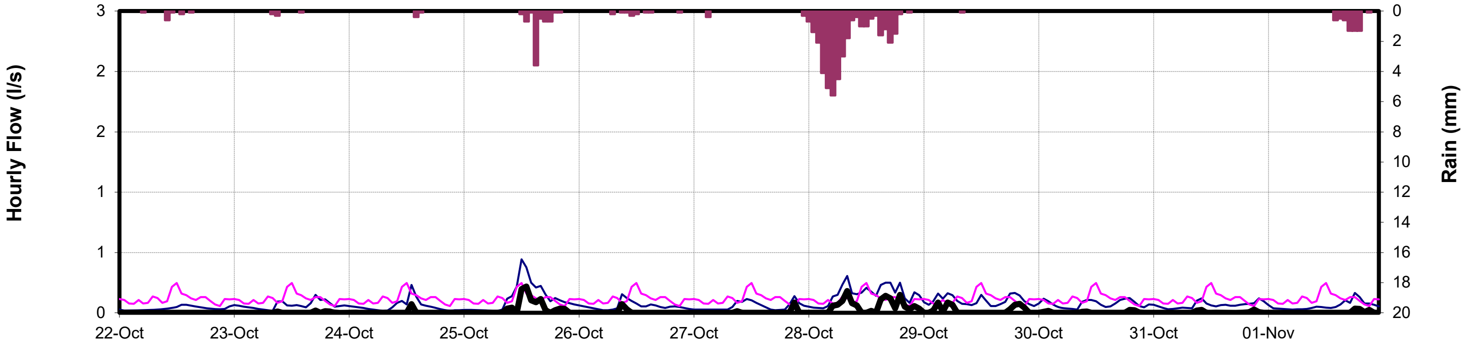


Peak 24-Hour Flows by Storm Event

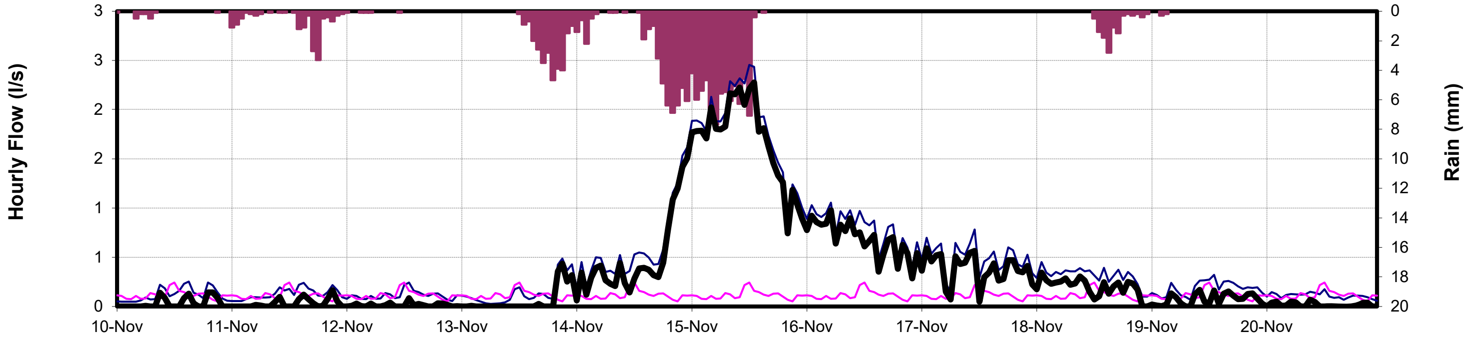


Surfside (SID15)

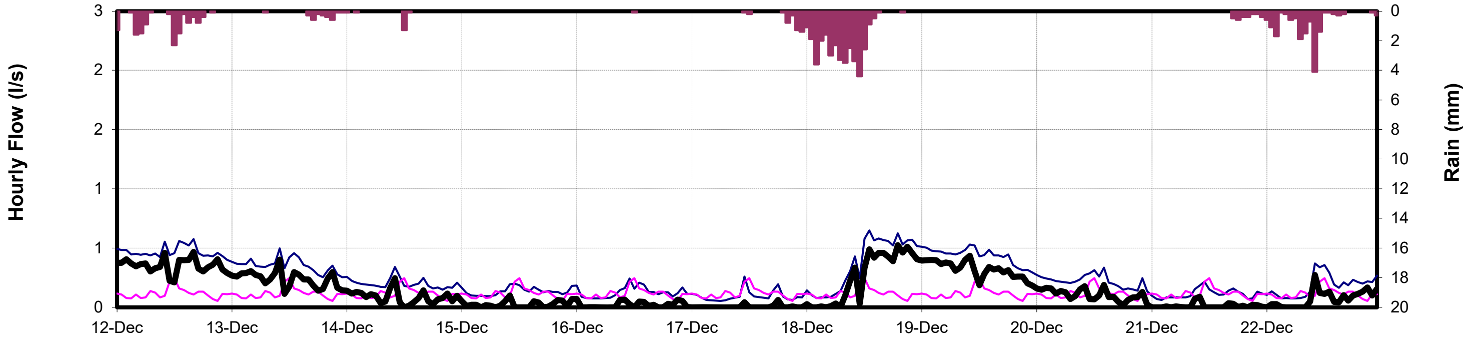
October 22 to November 1, 2021 Storm Events



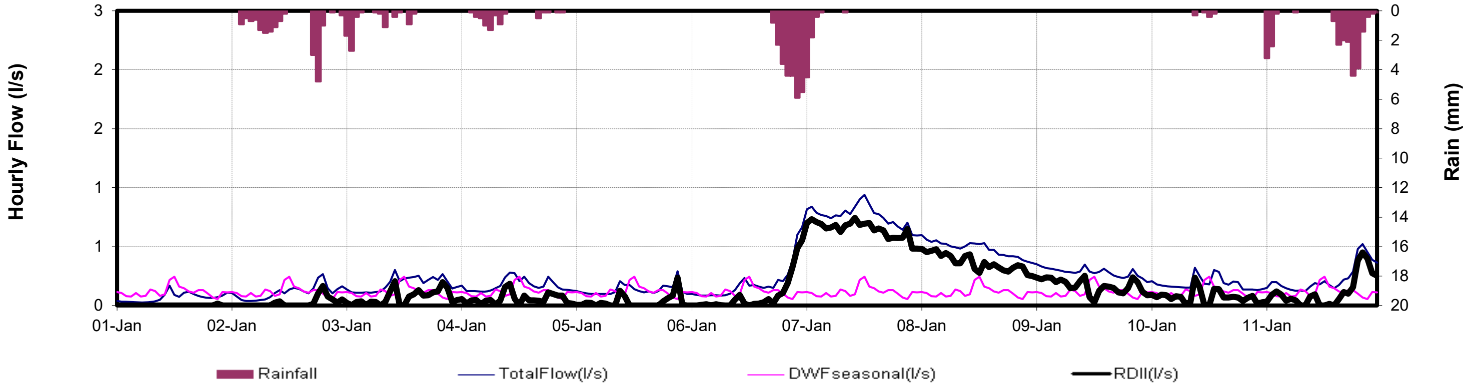
November 10 to November 20, 2021 Storm Events



December 12 to December 22, 2021 Storm Events



January 1 to January 11, 2022 Storm Events

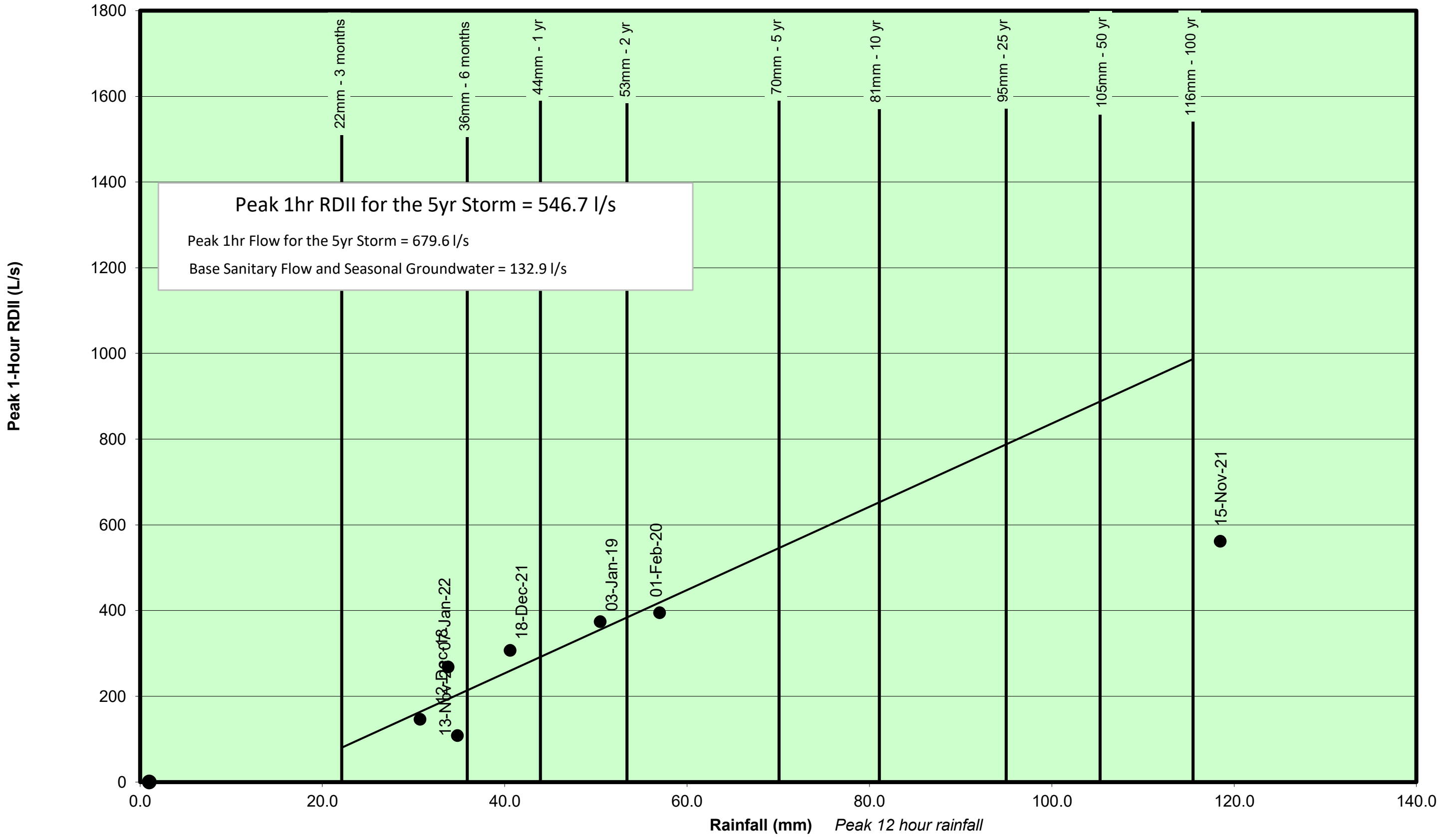


Appendix G:

Other Jurisdictions: Sewer Map, Catchment Stats, Catchments Maps and Flow Charts

Includes:
Treatment Plant Combined Flows
Airport PS #3
Tseycum First Nation
BC Ferries
Institute of Ocean Sciences
Pauquachin First Nation

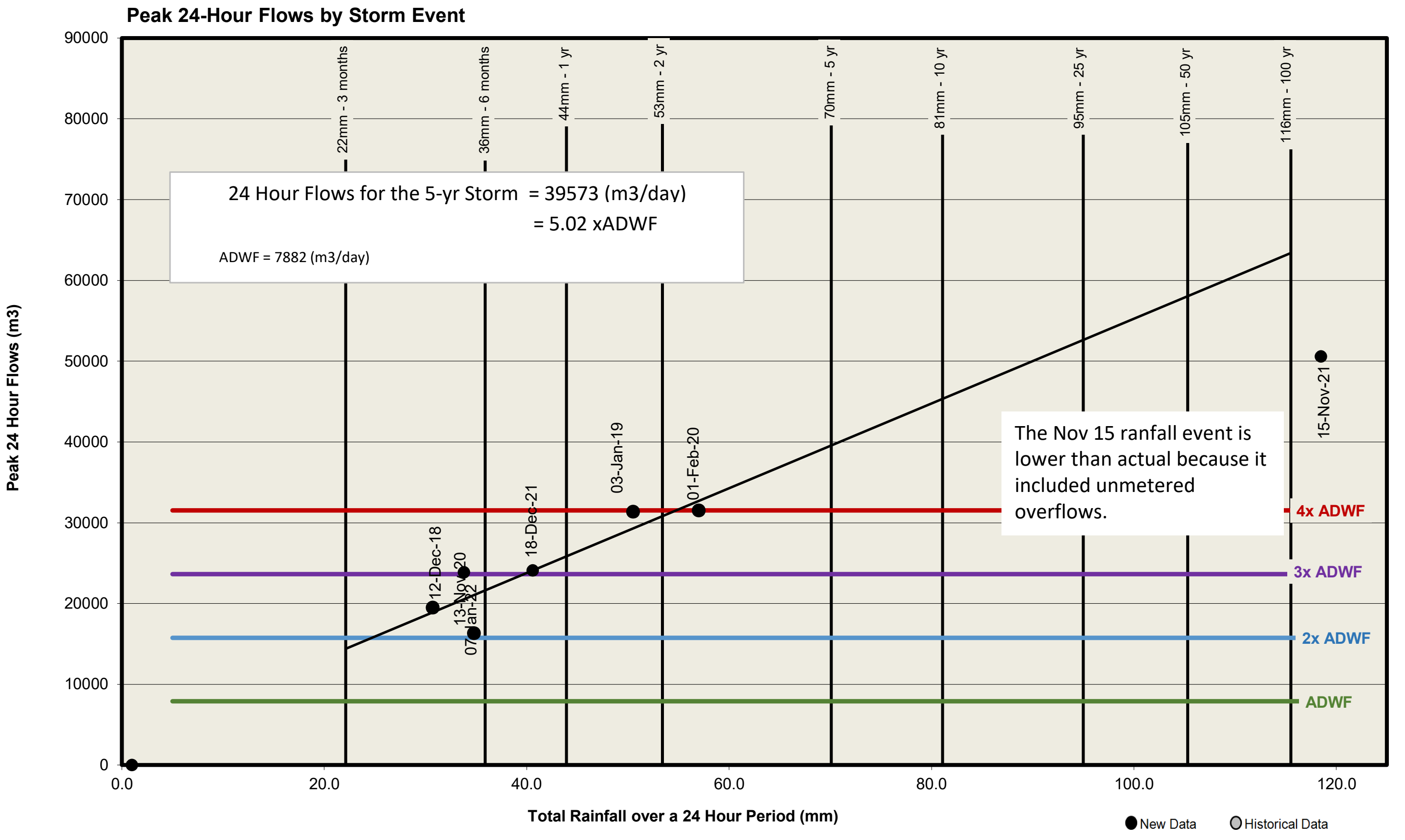
Treatment Plant Combined Inflow



Peak 1hr RDII for the 5yr Storm = 546.7 l/s

Peak 1hr Flow for the 5yr Storm = 679.6 l/s

Base Sanitary Flow and Seasonal Groundwater = 132.9 l/s



Peak 24-Hour Flows by Storm Event

24 Hour Flows for the 5-yr Storm = 39573 (m3/day)

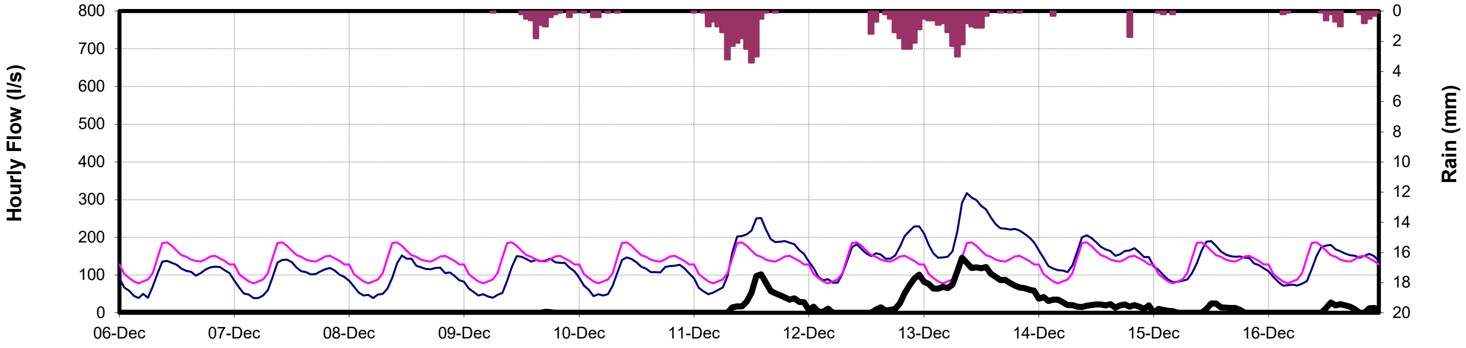
= 5.02 xADWF

ADWF = 7882 (m3/day)

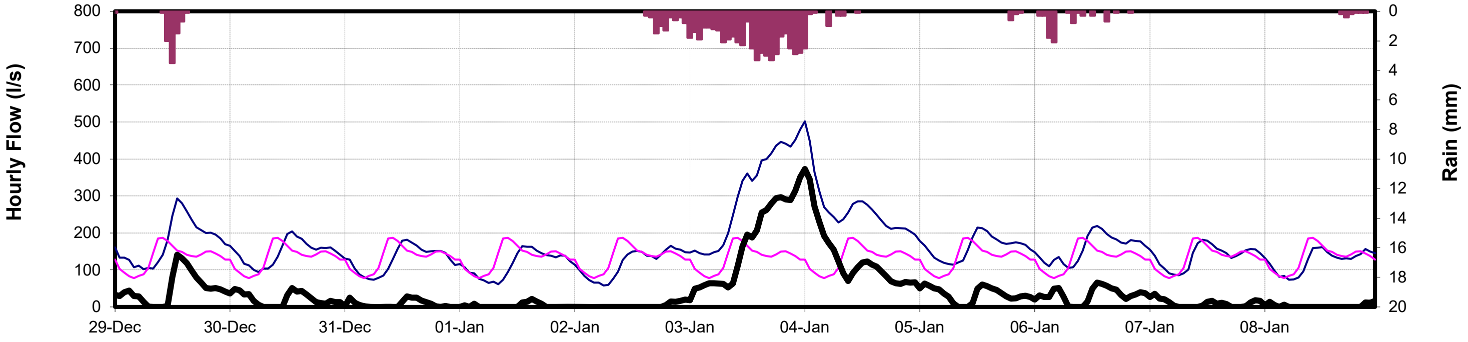
The Nov 15 ranfall event is lower than actual because it included unmetered overflows.

Treatment Plant Combined Inflow

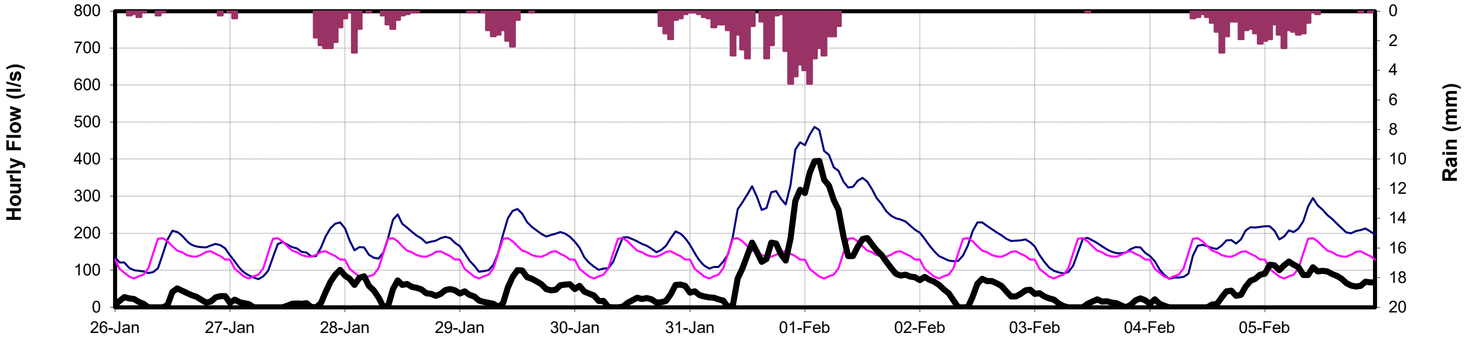
December 6 to December 16, 2018 Storm Events



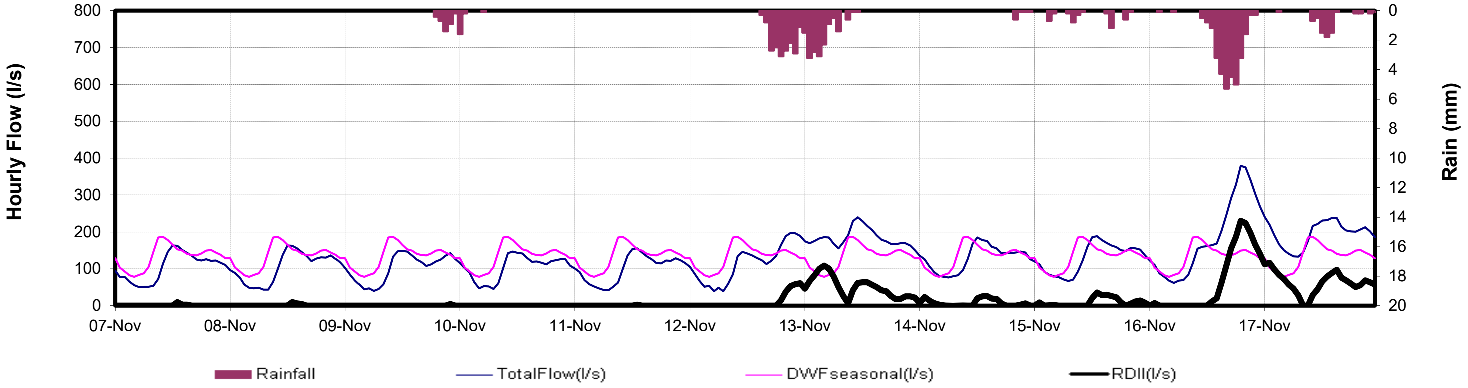
December 29 to January 8, 2019 Storm Events



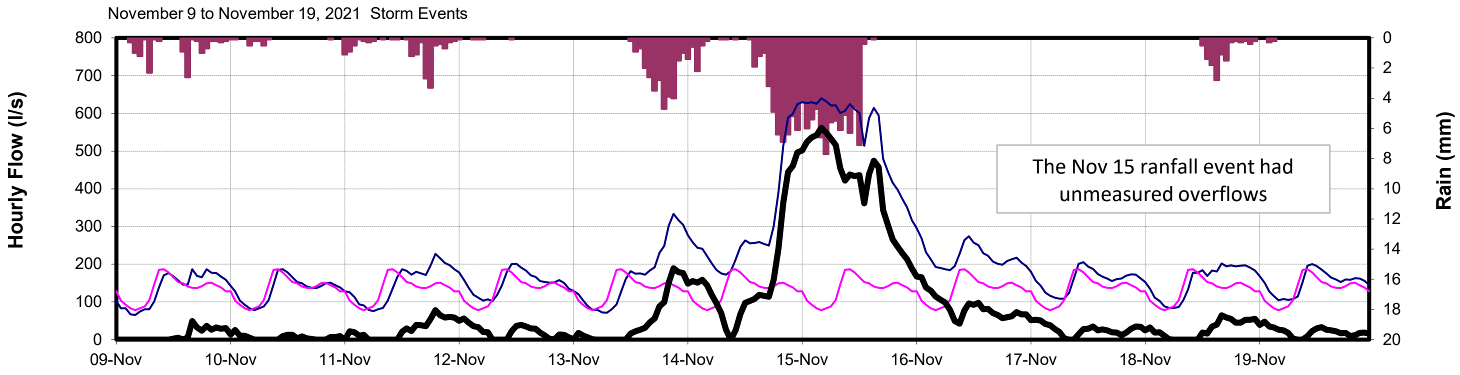
January 26 to February 5, 2020 Storm Events



November 7 to November 17, 2020 Storm Events

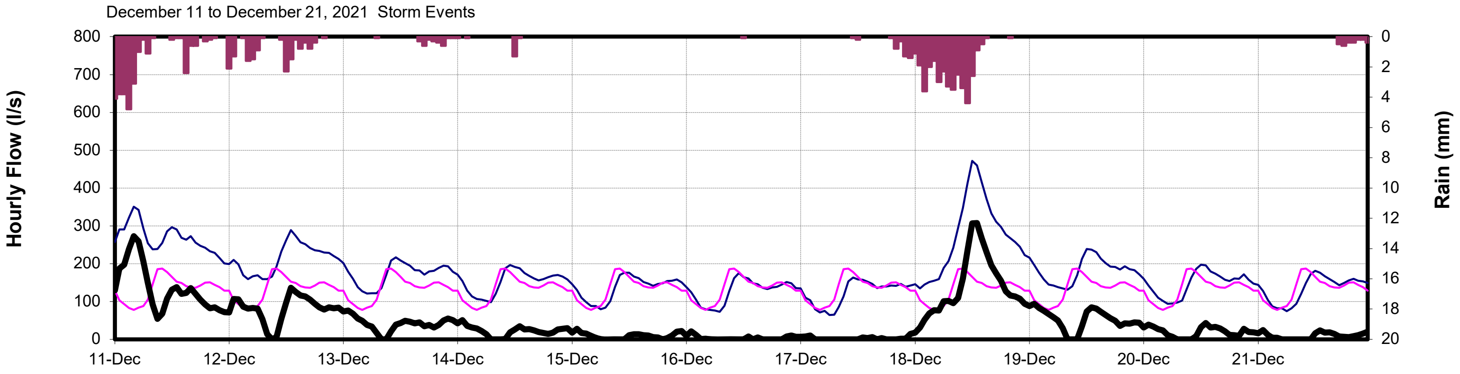


Treatment Plant Combined Inflow

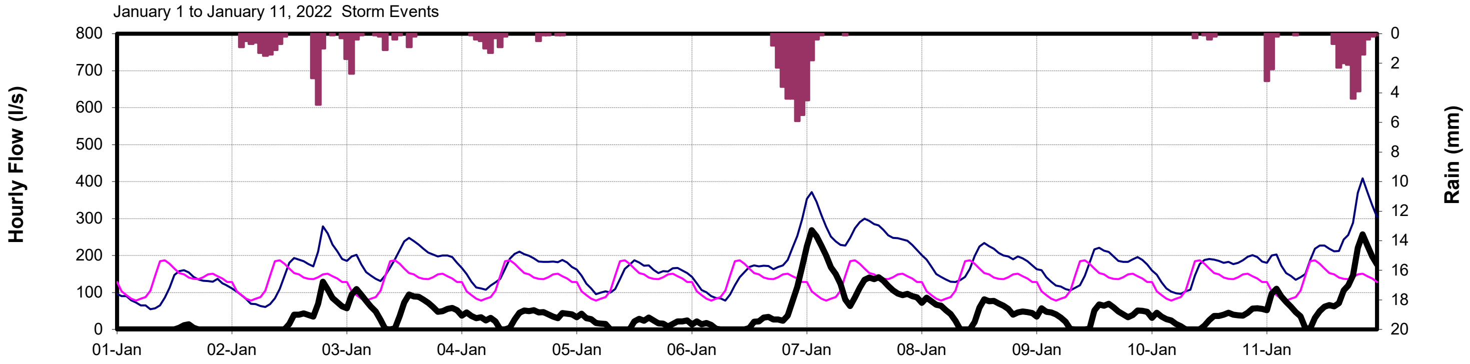


November 9 to November 19, 2021 Storm Events

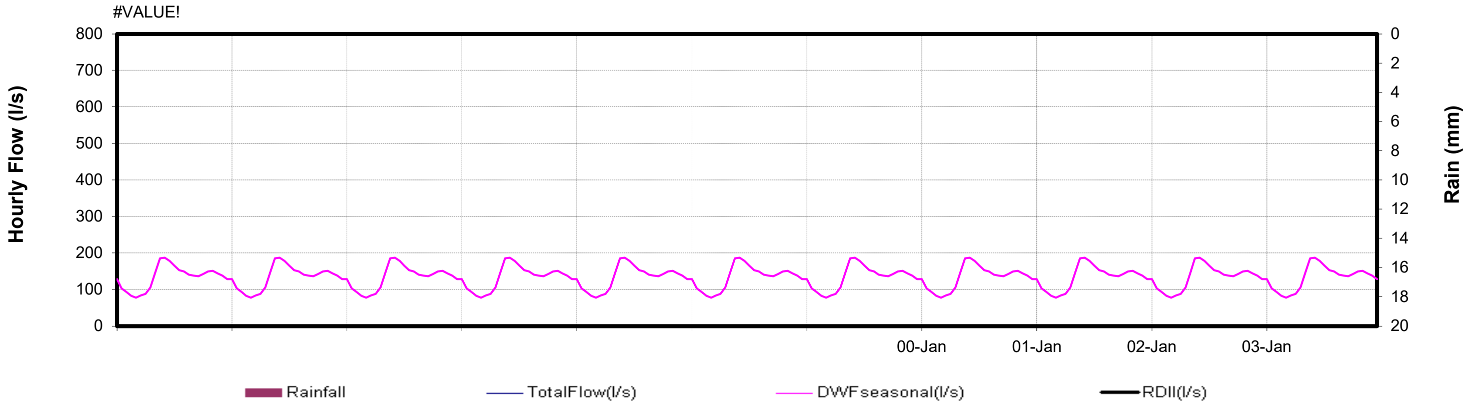
The Nov 15 ranfall event had unmeasured overflows



December 11 to December 21, 2021 Storm Events



January 1 to January 11, 2022 Storm Events



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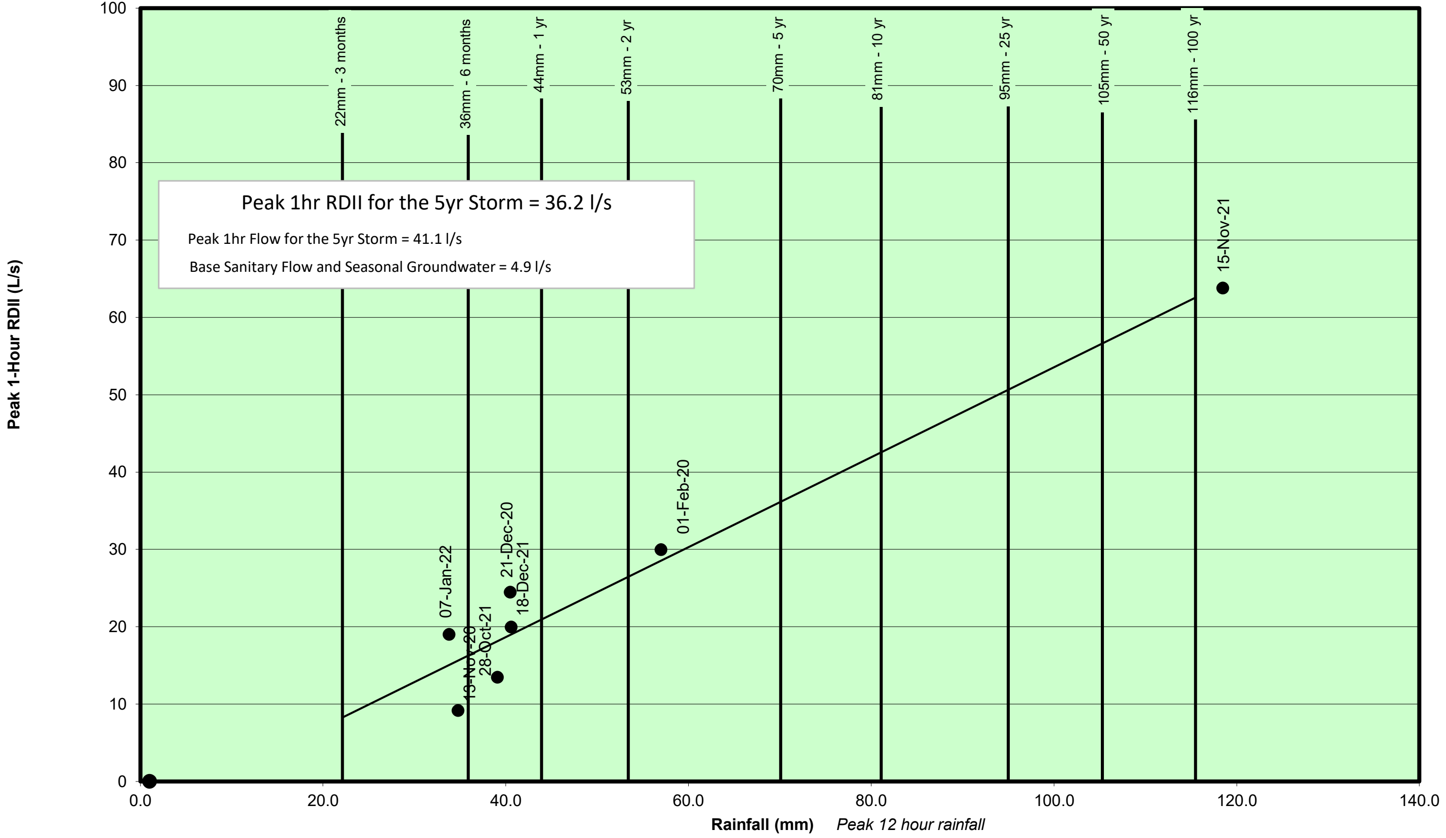
Airport PS3

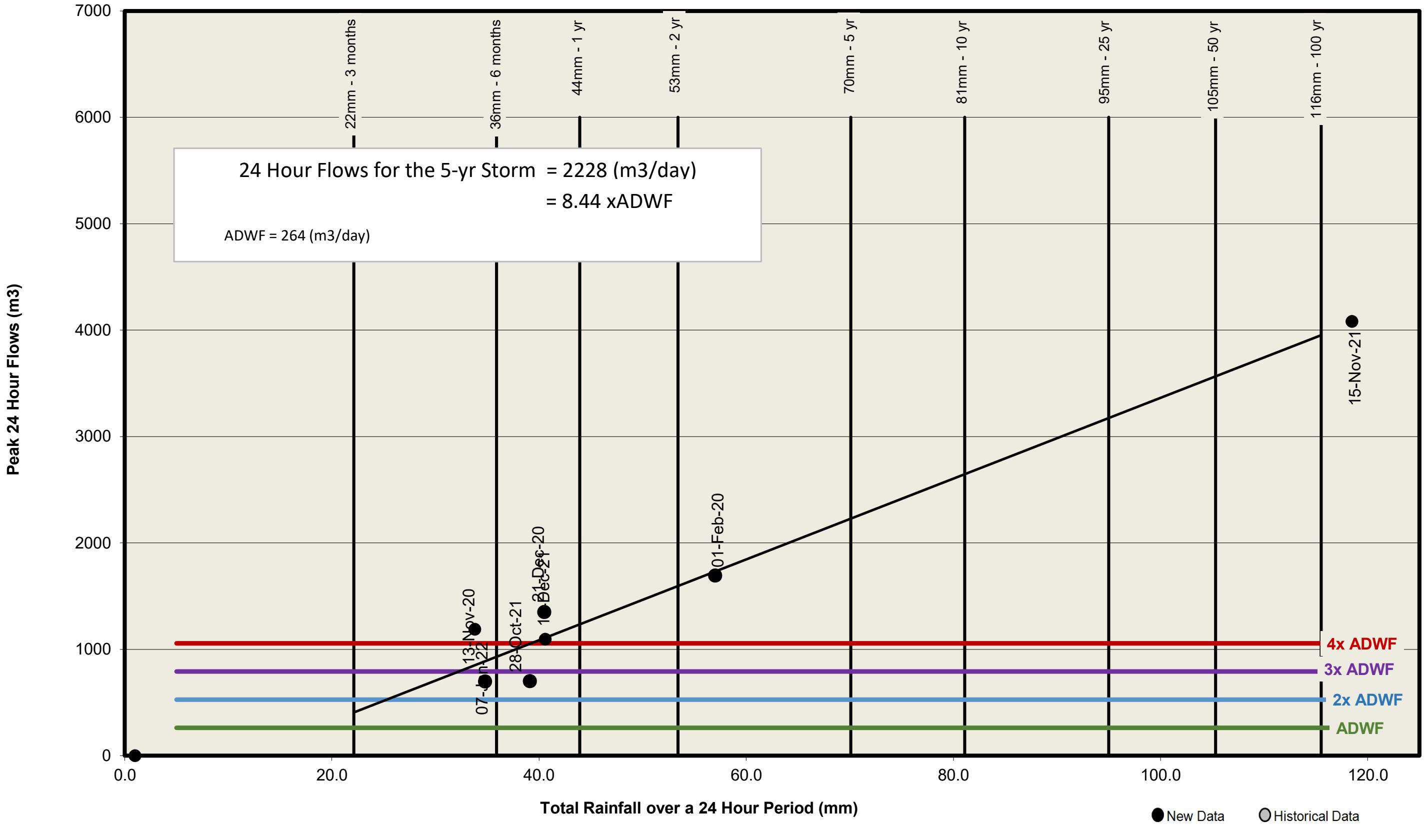


Peak 1-hr RDII by Storm Event

Peak 1hr RDII for the 5yr Storm = 36.2 l/s

Peak 1hr Flow for the 5yr Storm = 41.1 l/s

Base Sanitary Flow and Seasonal Groundwater = 4.9 l/s



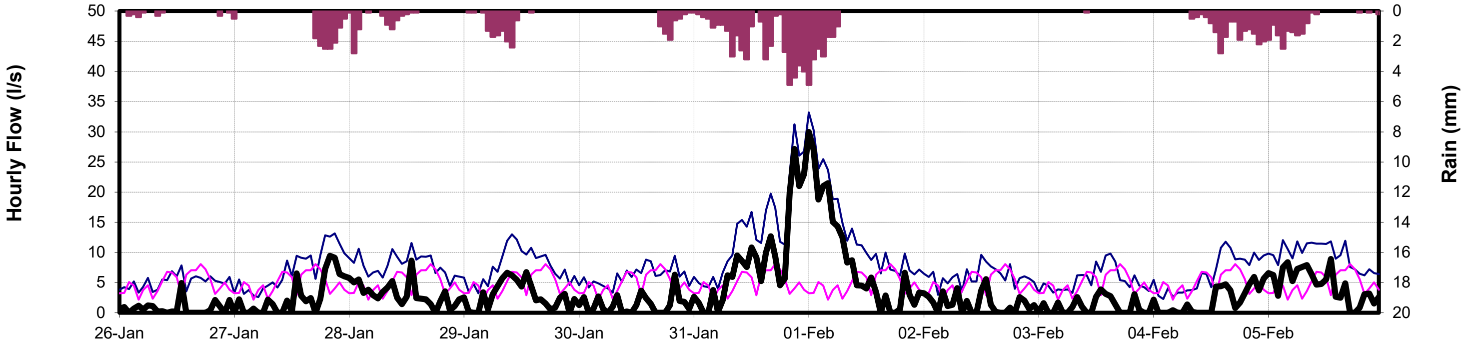
Peak 24-Hour Flows by Storm Event

24 Hour Flows for the 5-yr Storm = 2228 (m3/day)
= 8.44 xADWF

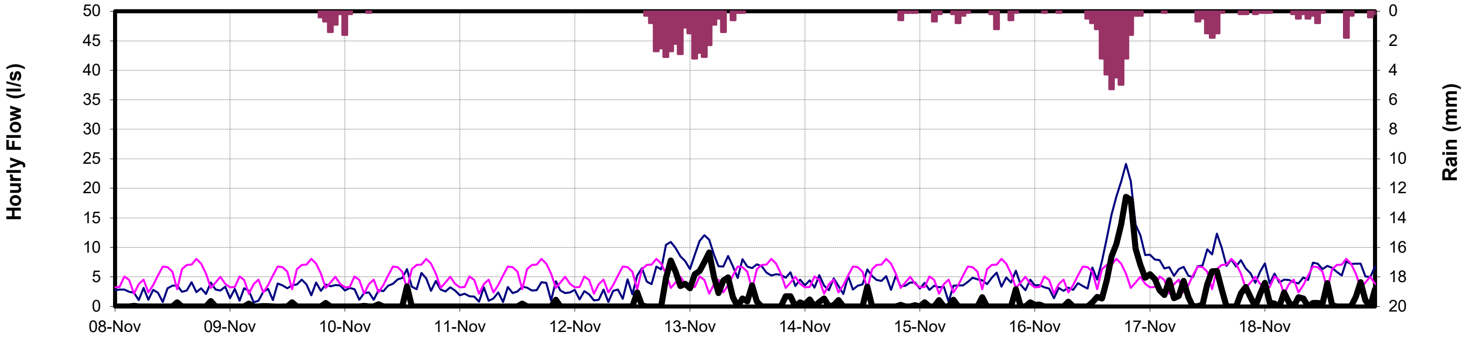
ADWF = 264 (m3/day)

Airport PS3

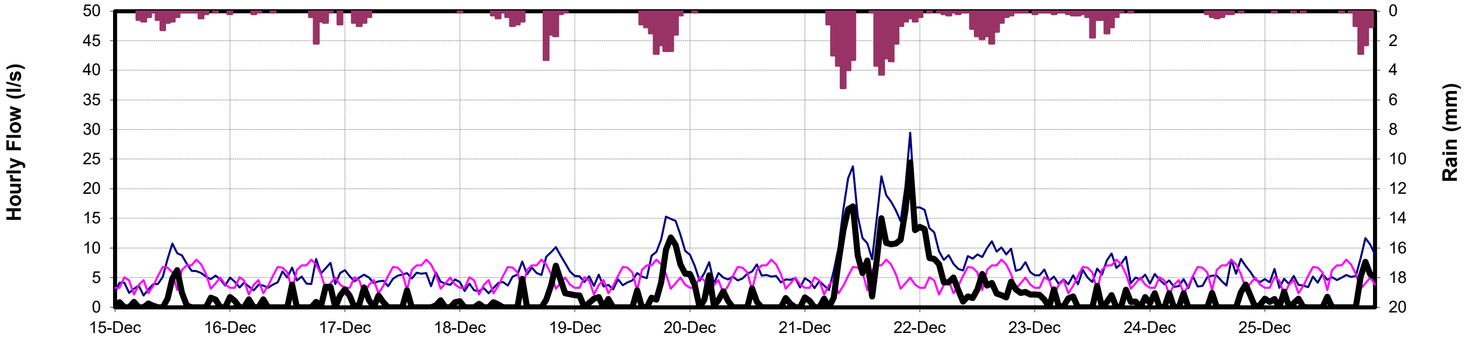
January 26 to February 5, 2020 Storm Events



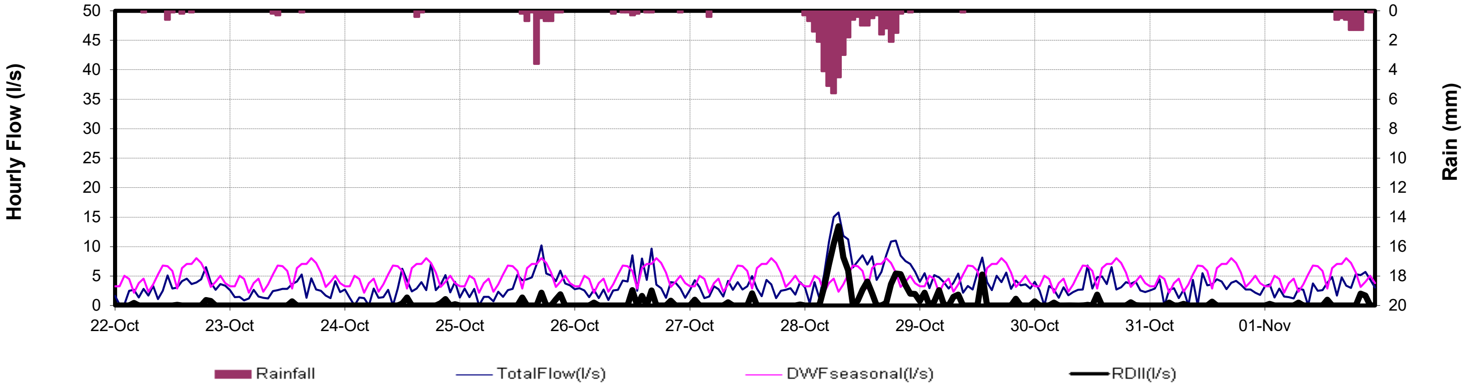
November 8 to November 18, 2020 Storm Events



December 15 to December 25, 2020 Storm Events

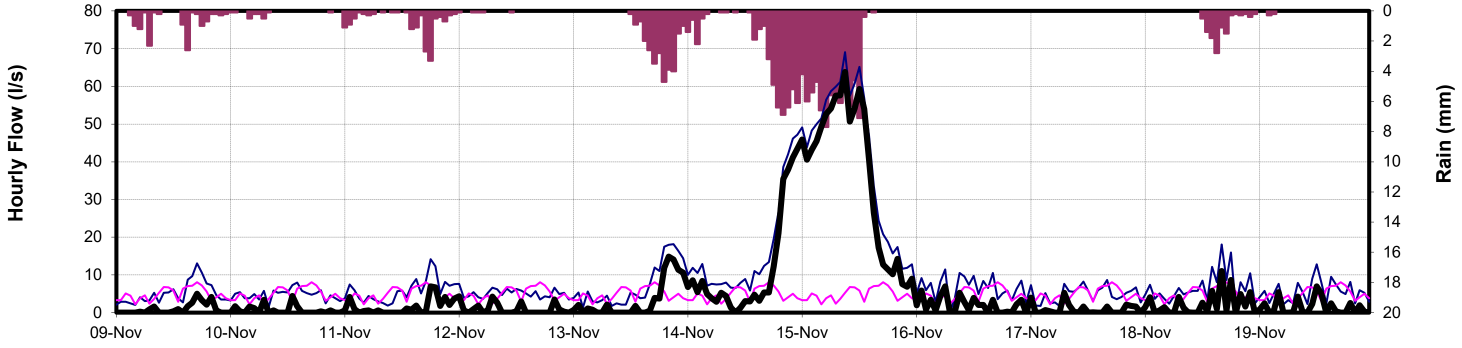


October 22 to November 1, 2021 Storm Events



Airport PS3

November 9 to November 19, 2021 Storm Events



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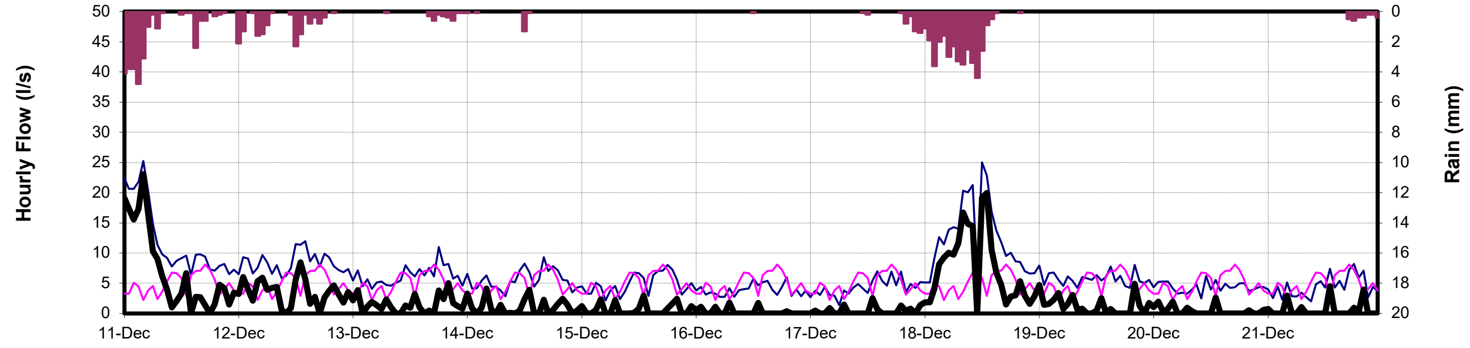
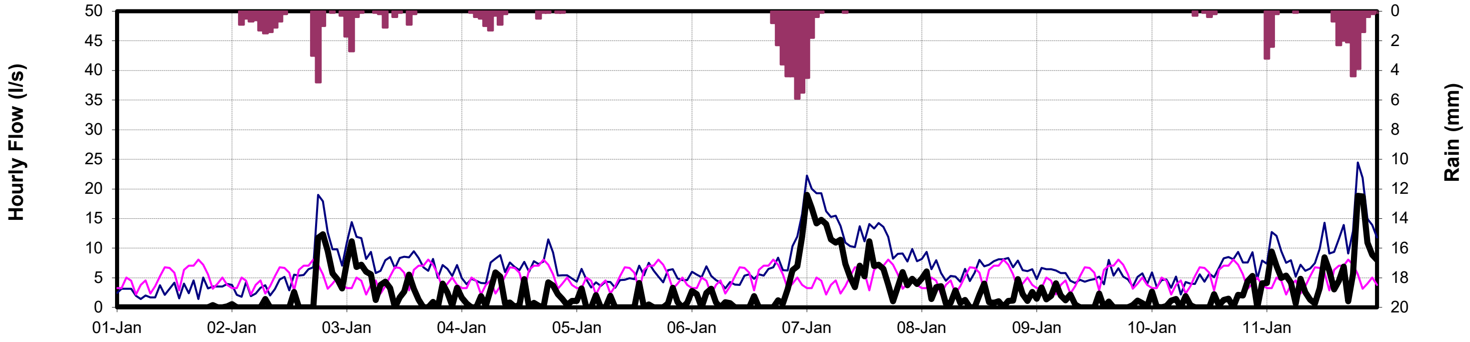


January 1 to January 11, 2022 Storm Events



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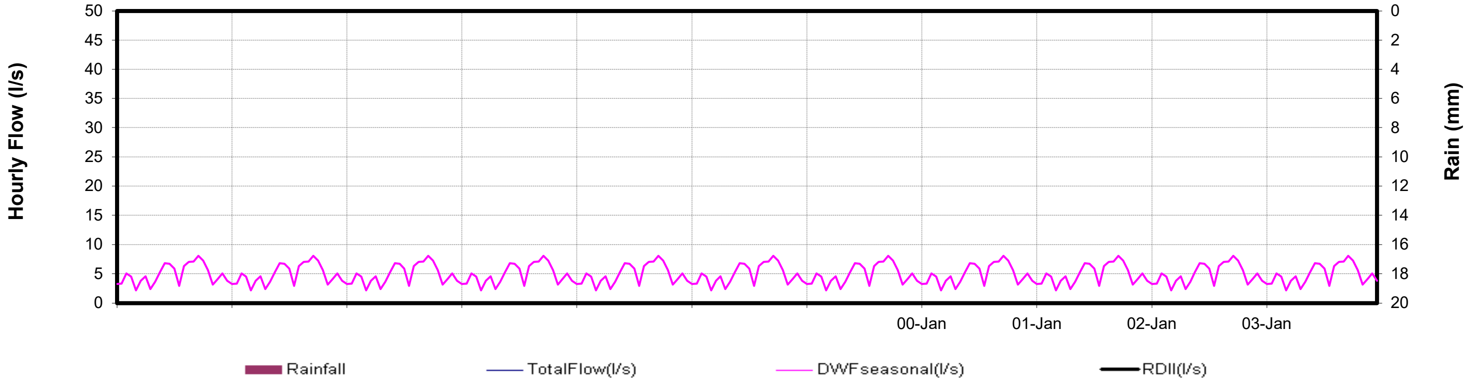
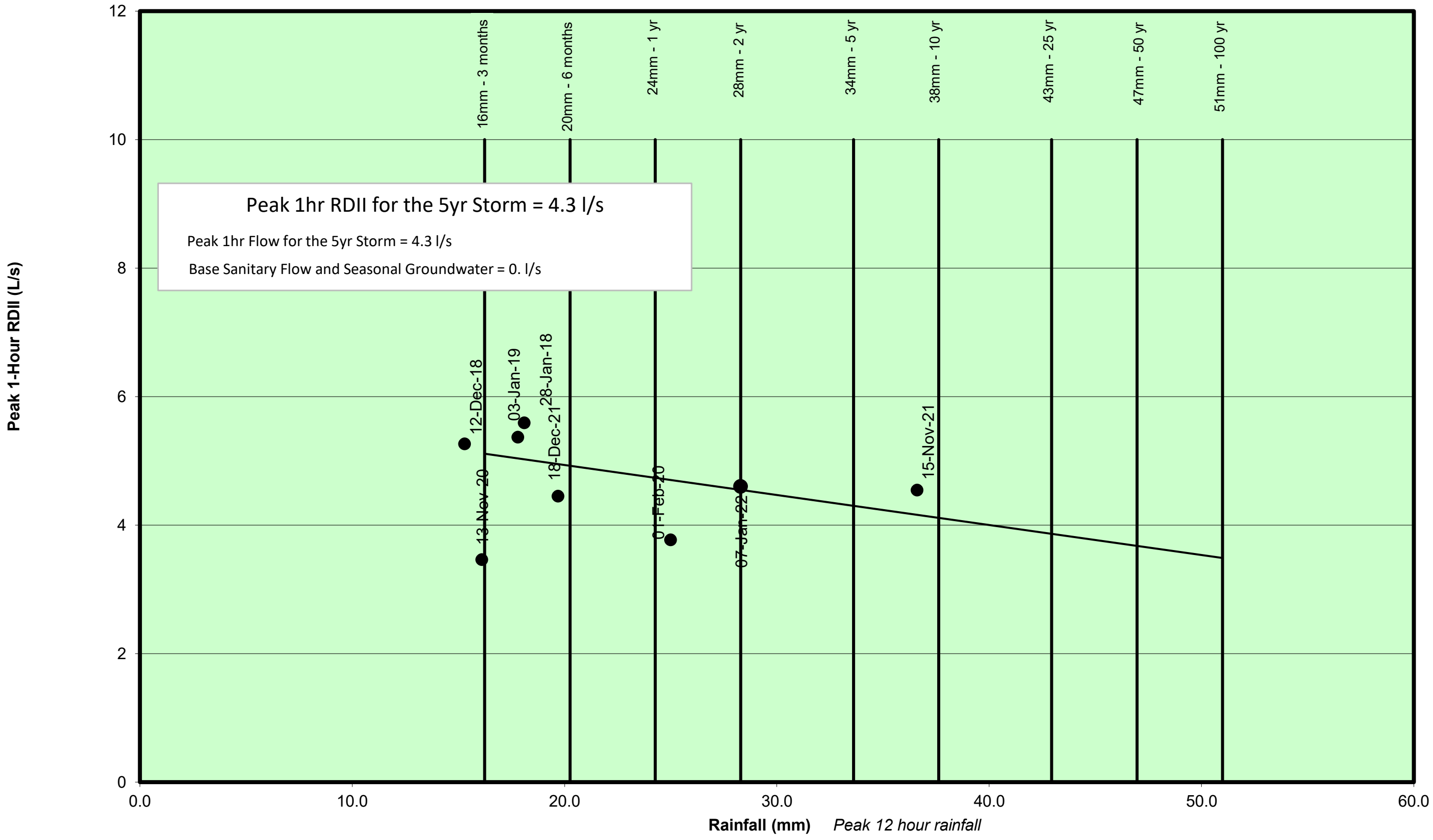
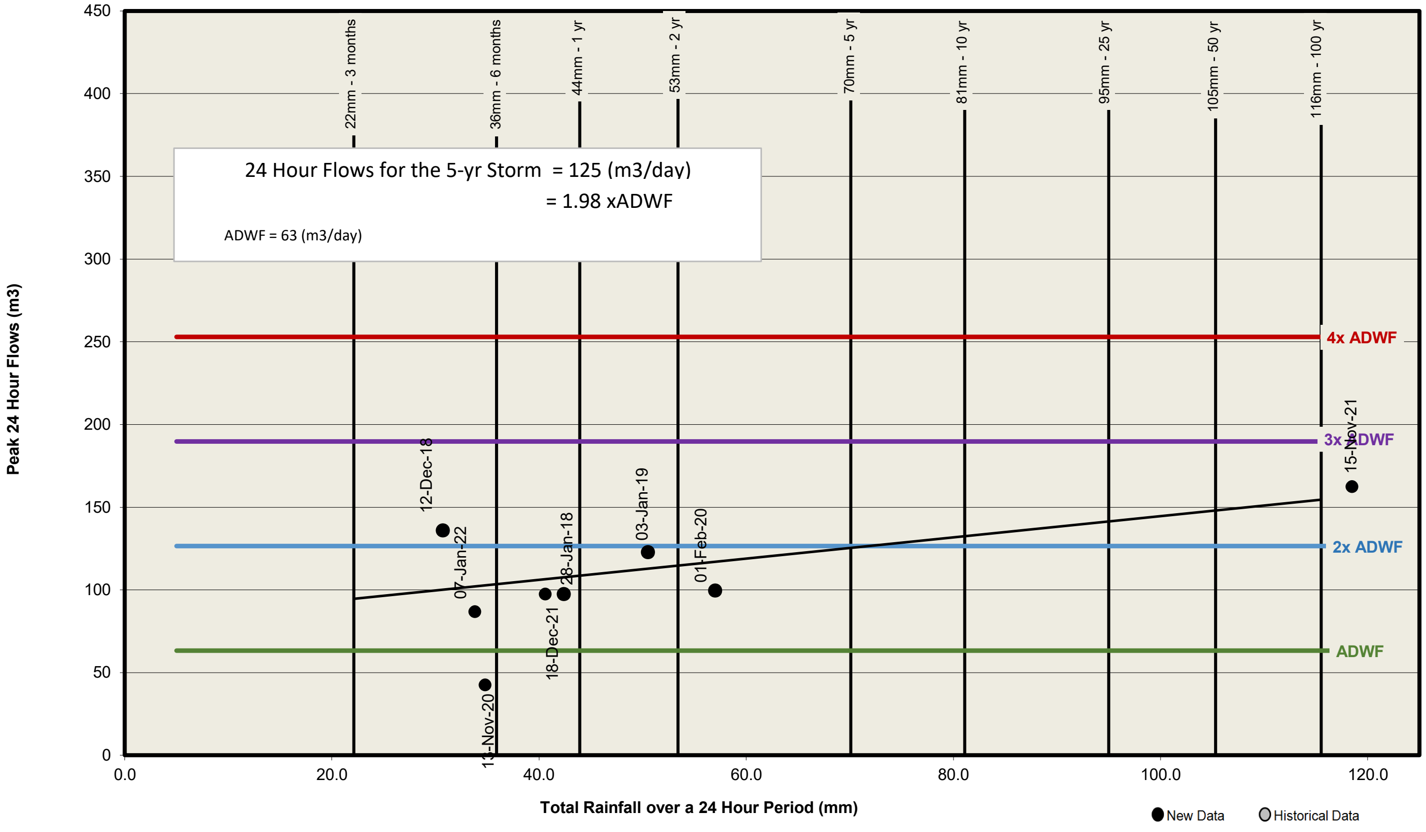


BC Ferries

Peak 1-hr RDII by Storm Event

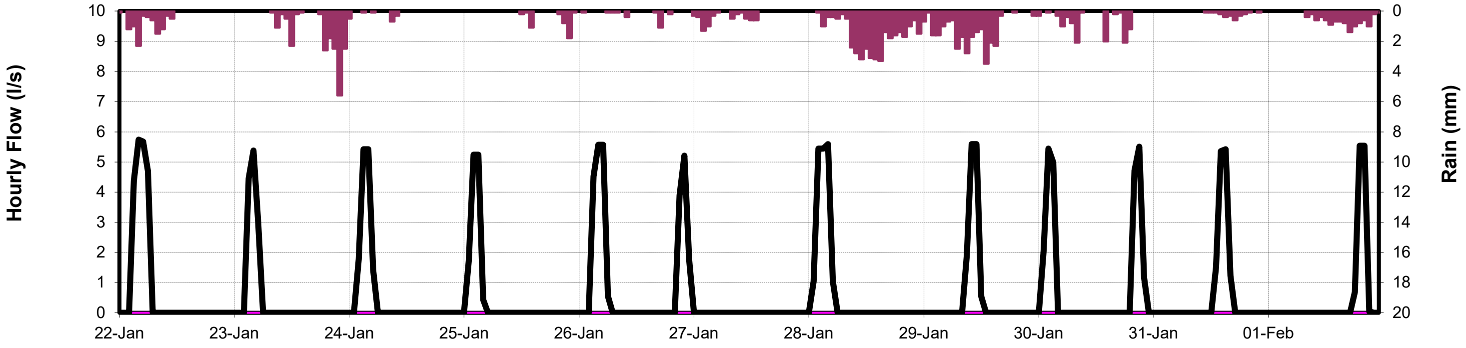


Peak 24-Hour Flows by Storm Event

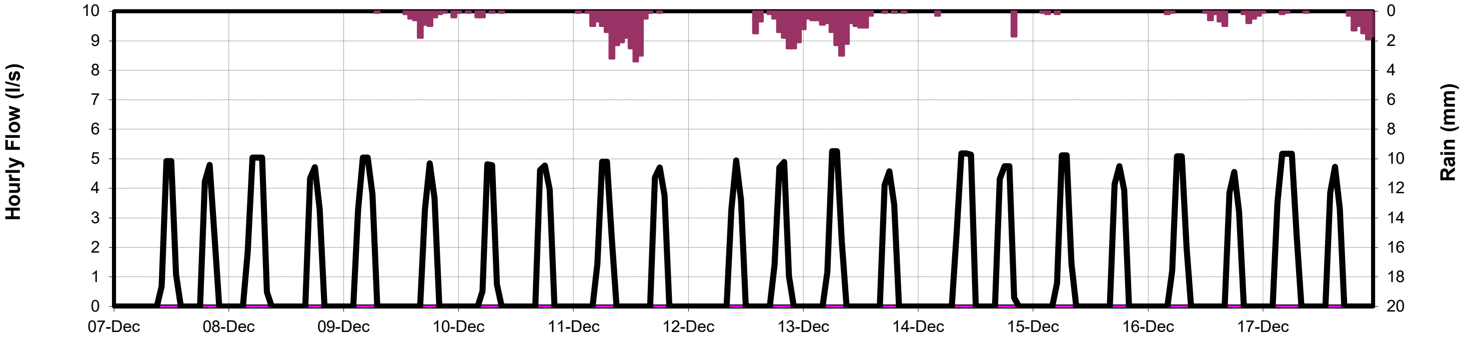


BC Ferries

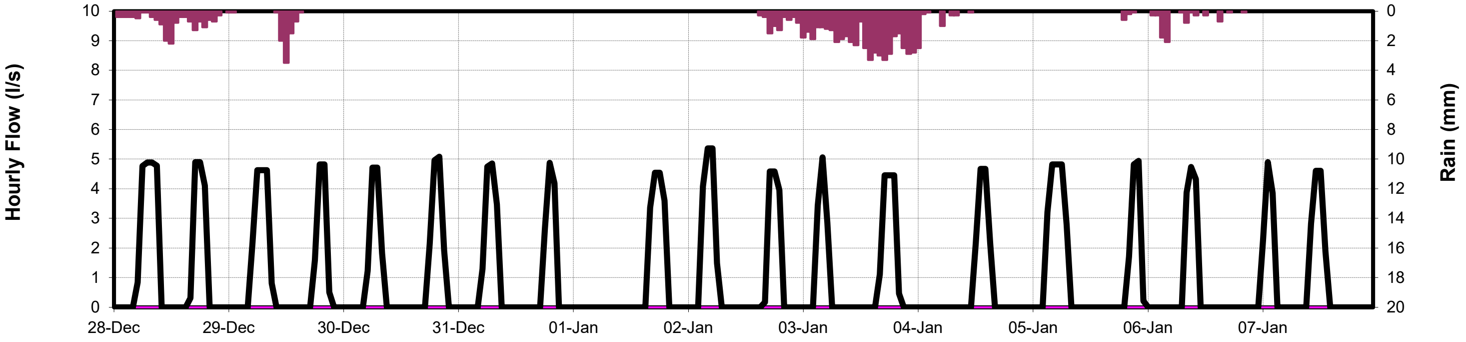
January 22 to February 1, 2018 Storm Events



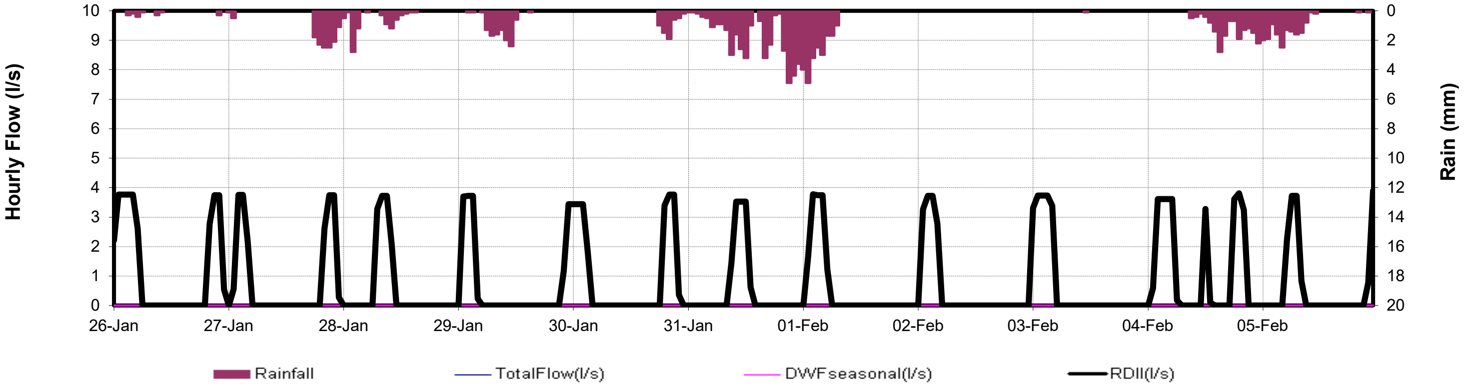
December 7 to December 17, 2018 Storm Events



December 28 to January 7, 2019 Storm Events

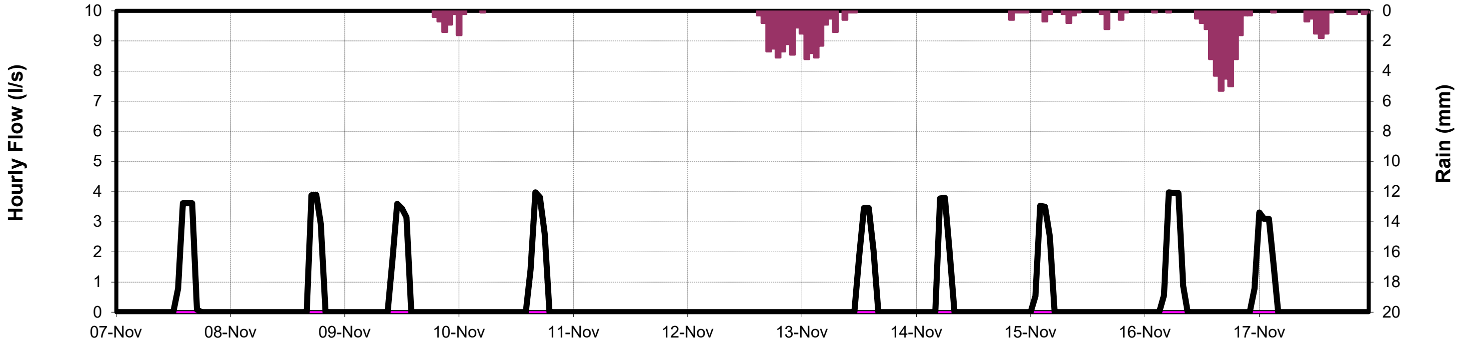


January 26 to February 5, 2020 Storm Events

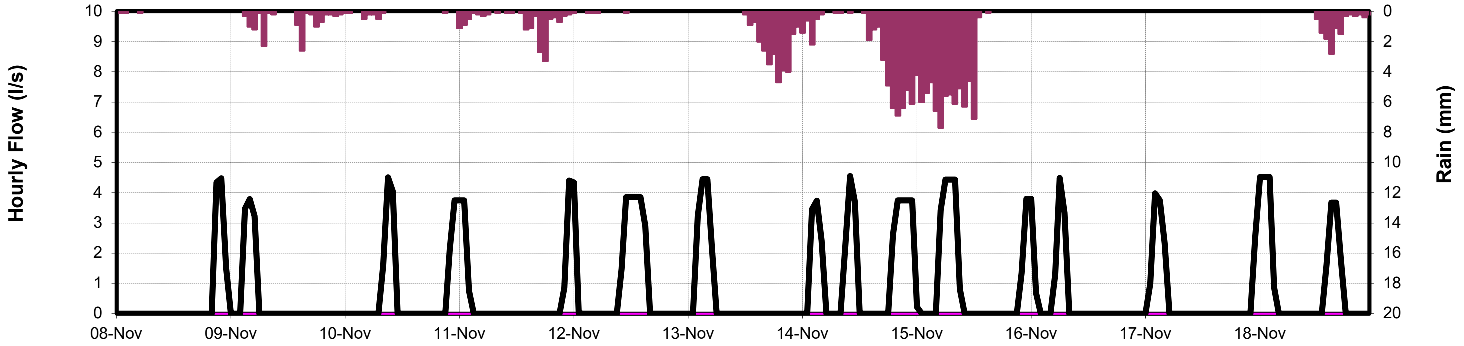


BC Ferries

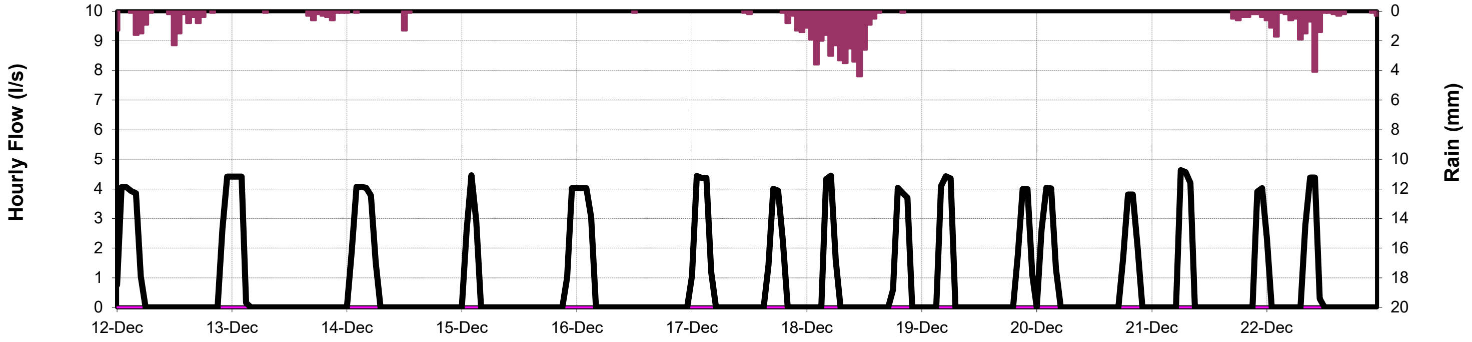
November 7 to November 17, 2020 Storm Events



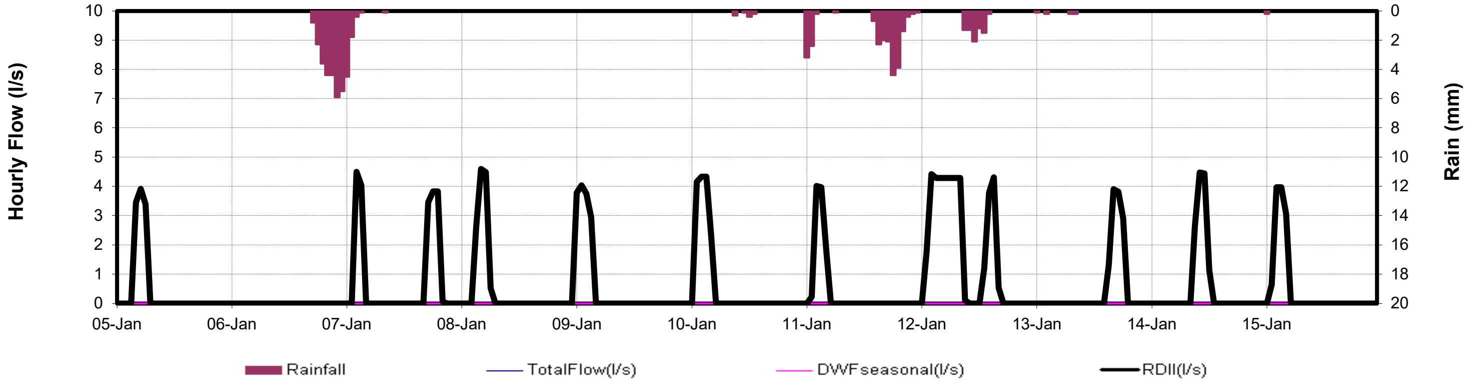
November 8 to November 18, 2021 Storm Events



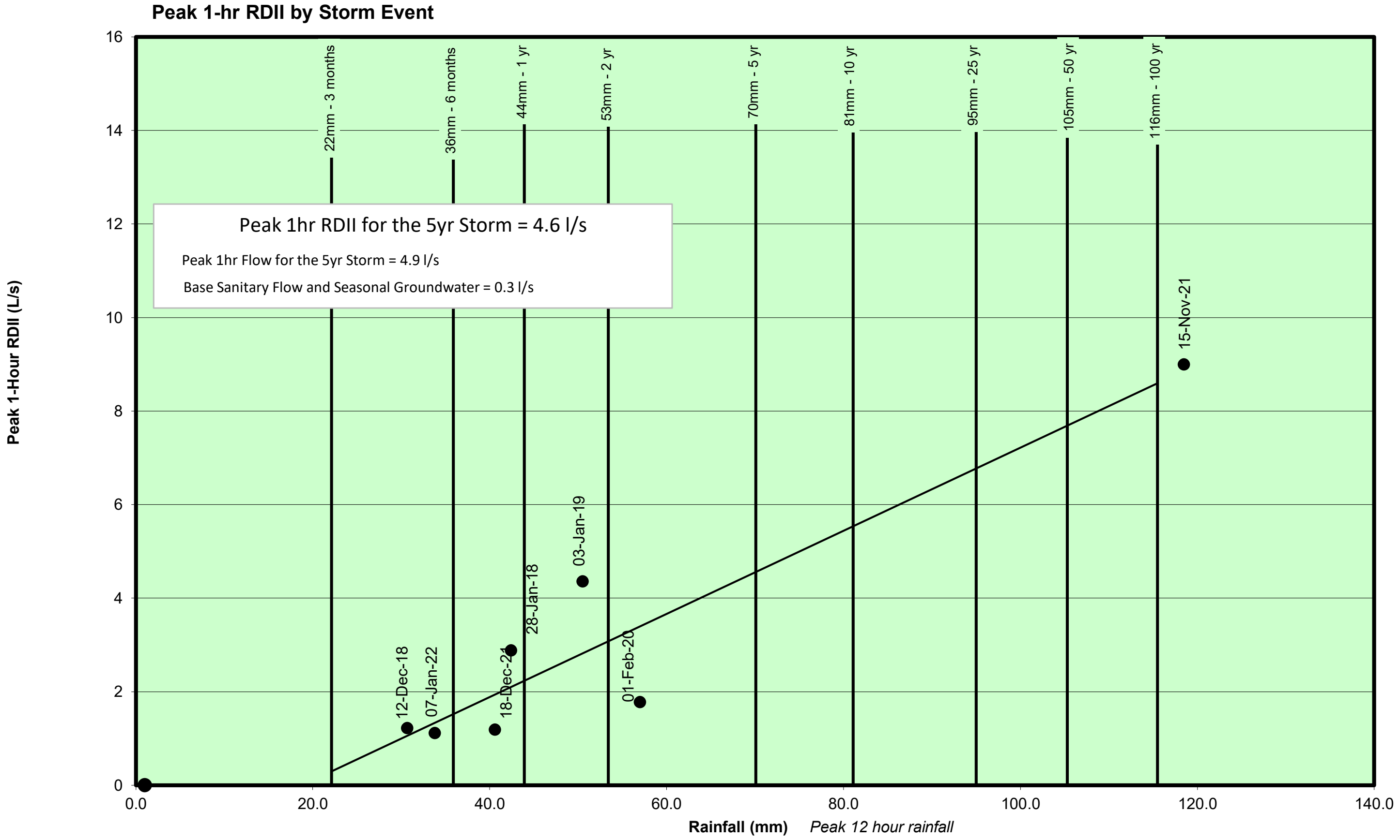
December 12 to December 22, 2021 Storm Events

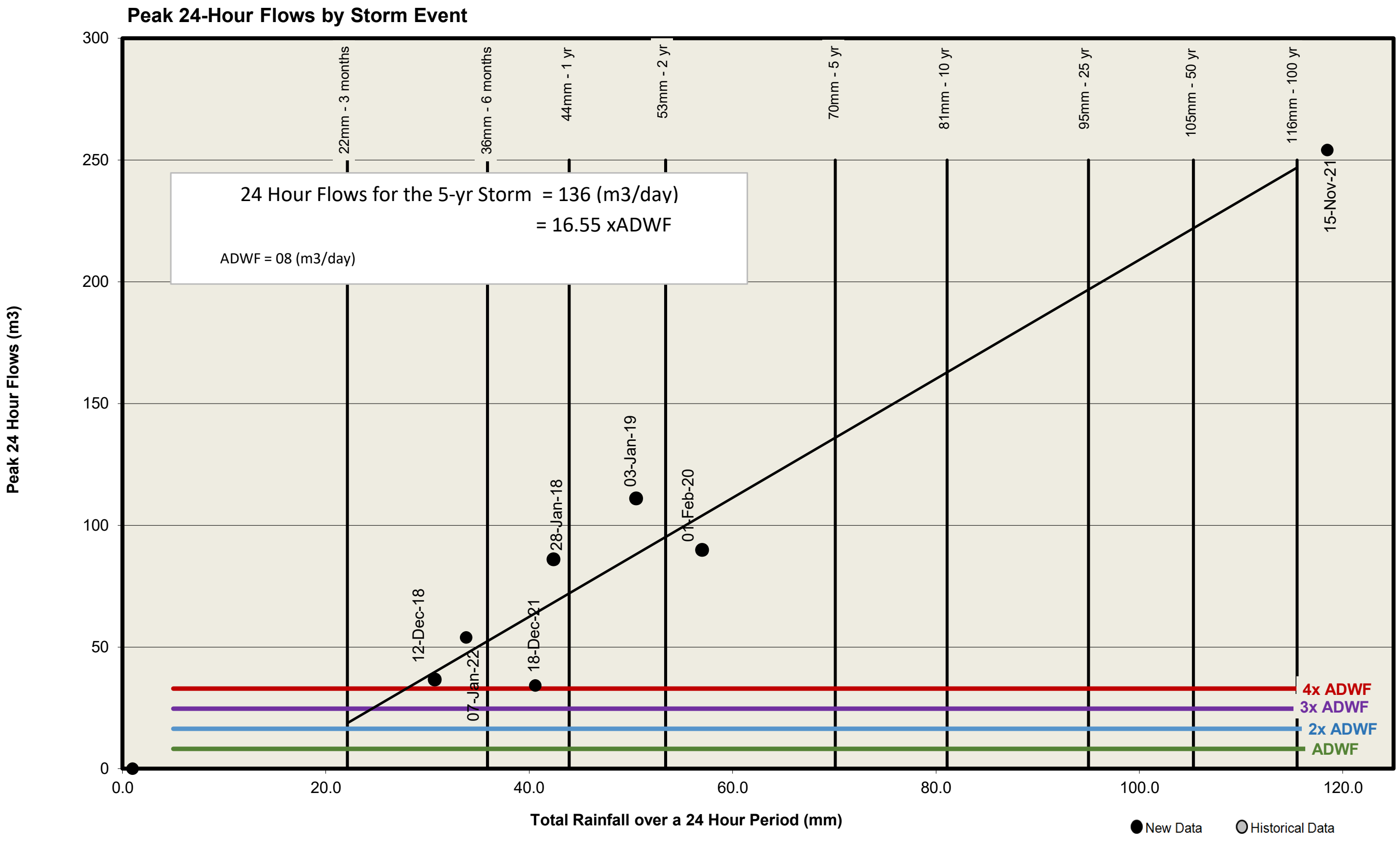


January 5 to January 15, 2022 Storm Events



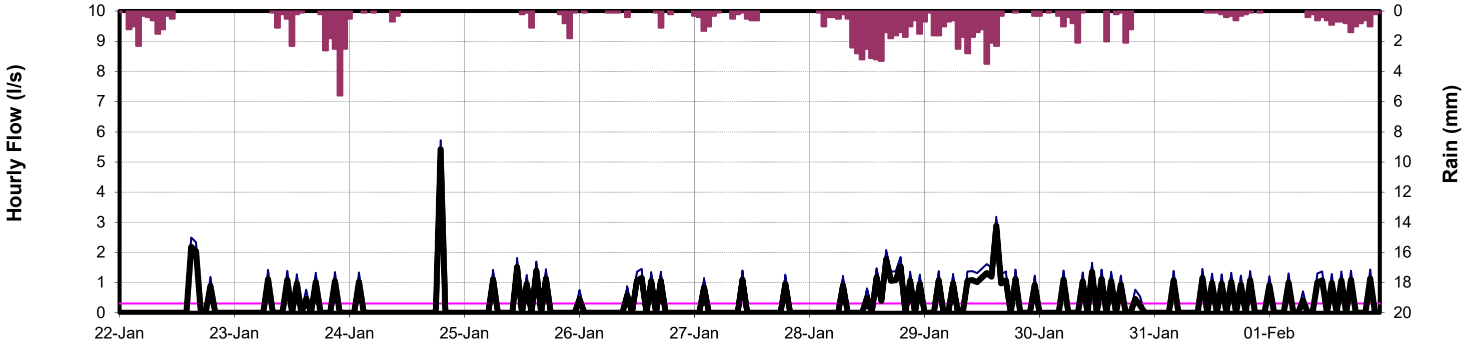
Institute of Ocean Sciences


Peak 1-hr RDII by Storm Event

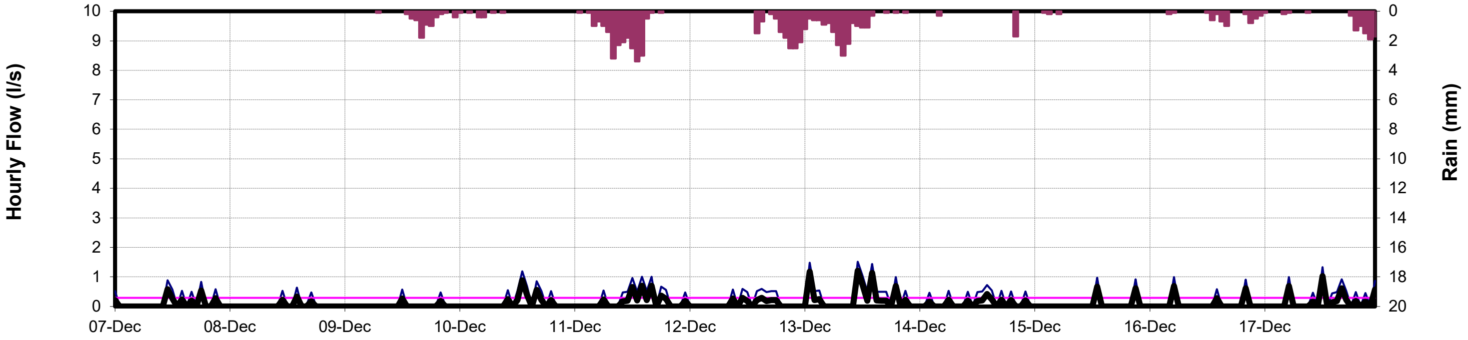

Peak 24-Hour Flows by Storm Event

Institute of Ocean Sciences

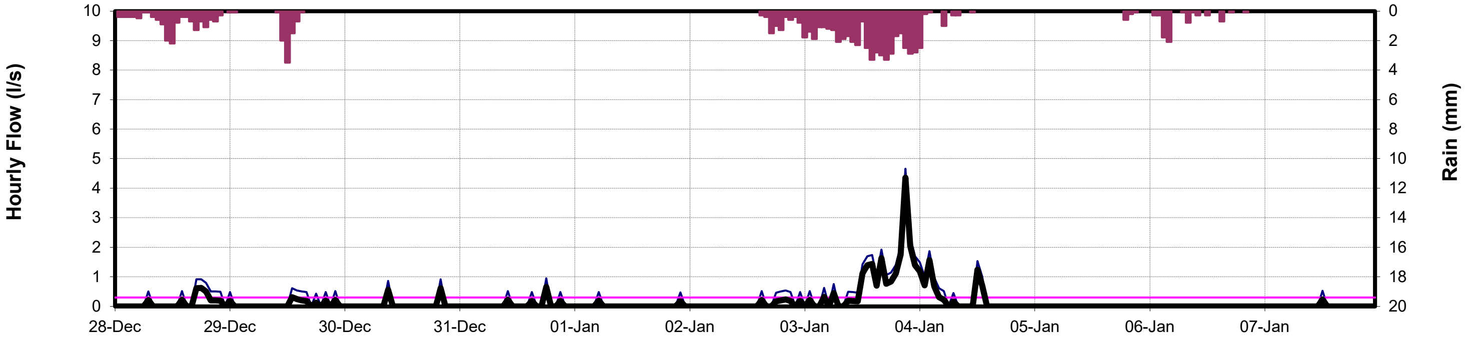
January 22 to February 1, 2018 Storm Events



December 7 to December 17, 2018 Storm Events



December 28 to January 7, 2019 Storm Events



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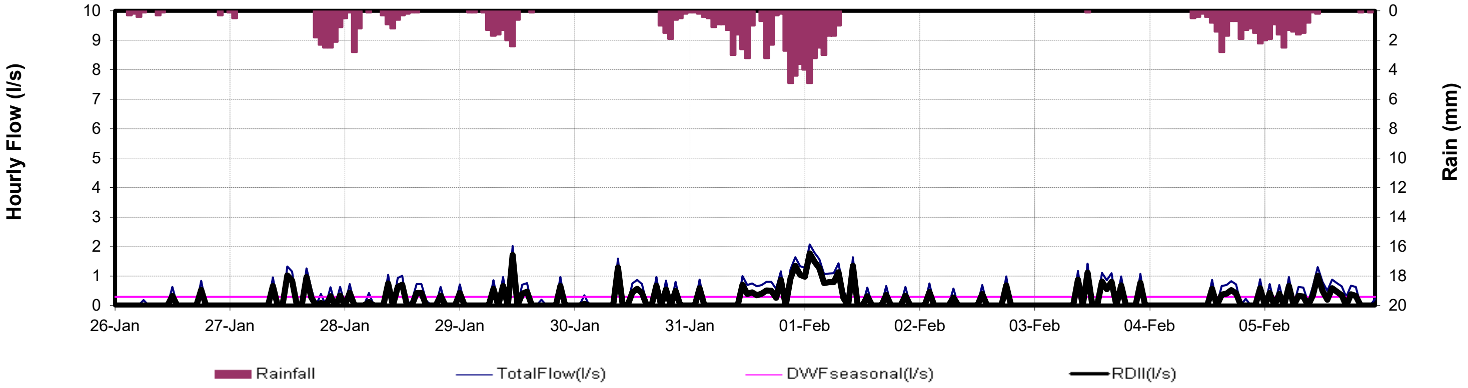
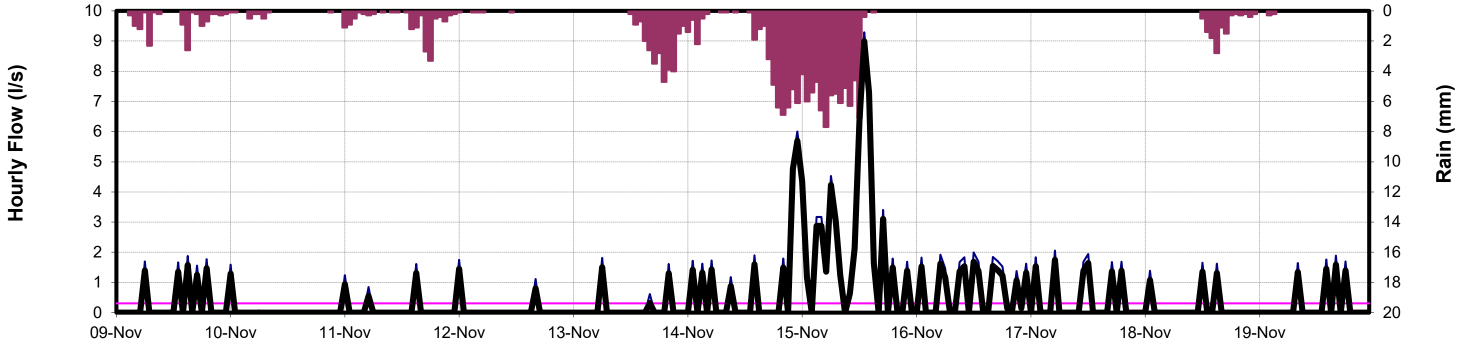
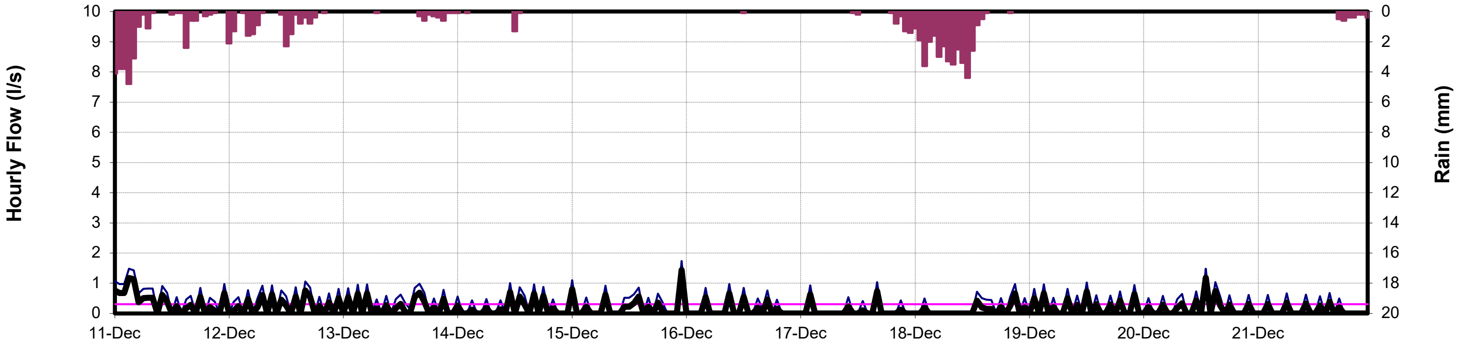


Institute of Ocean Sciences

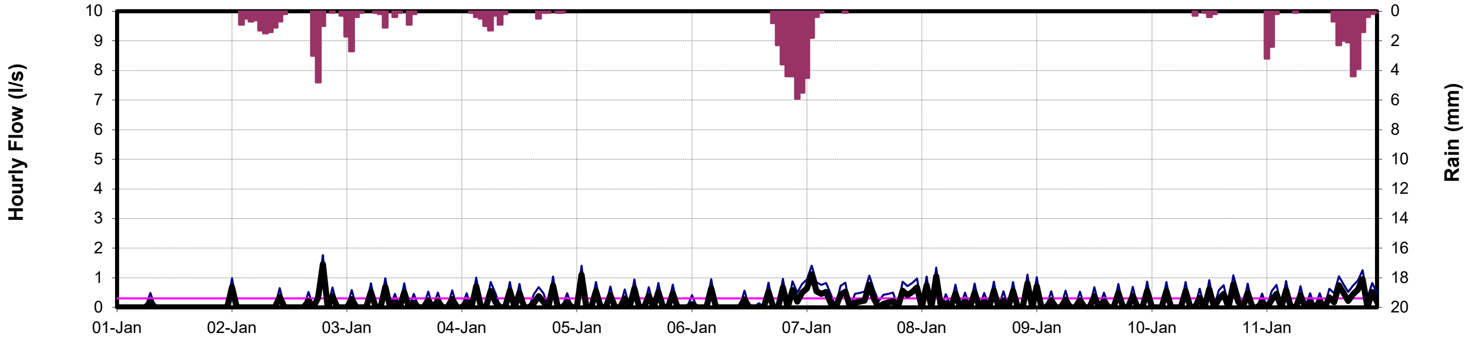
November 9 to November 19, 2021 Storm Events



December 11 to December 21, 2021 Storm Events



January 1 to January 11, 2022 Storm Events



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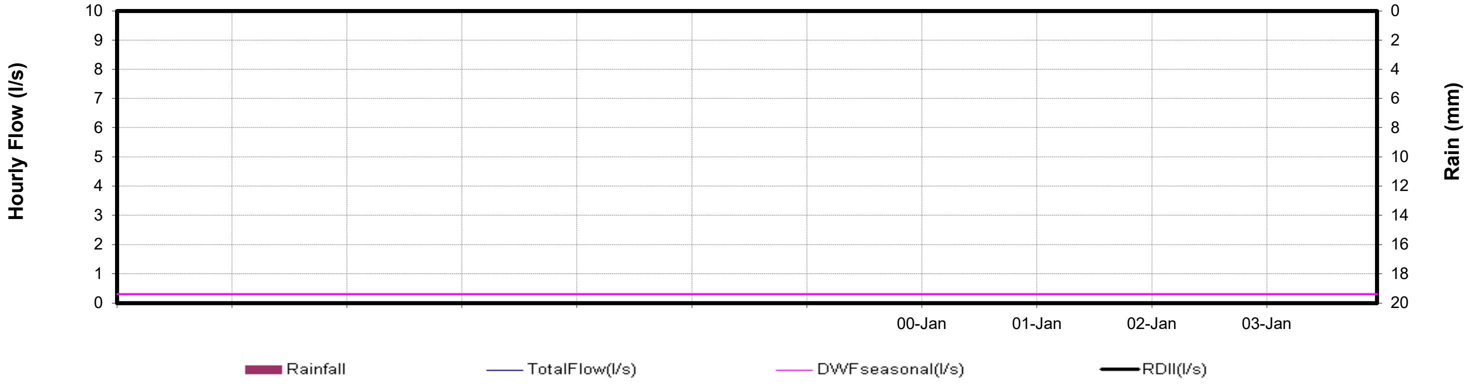
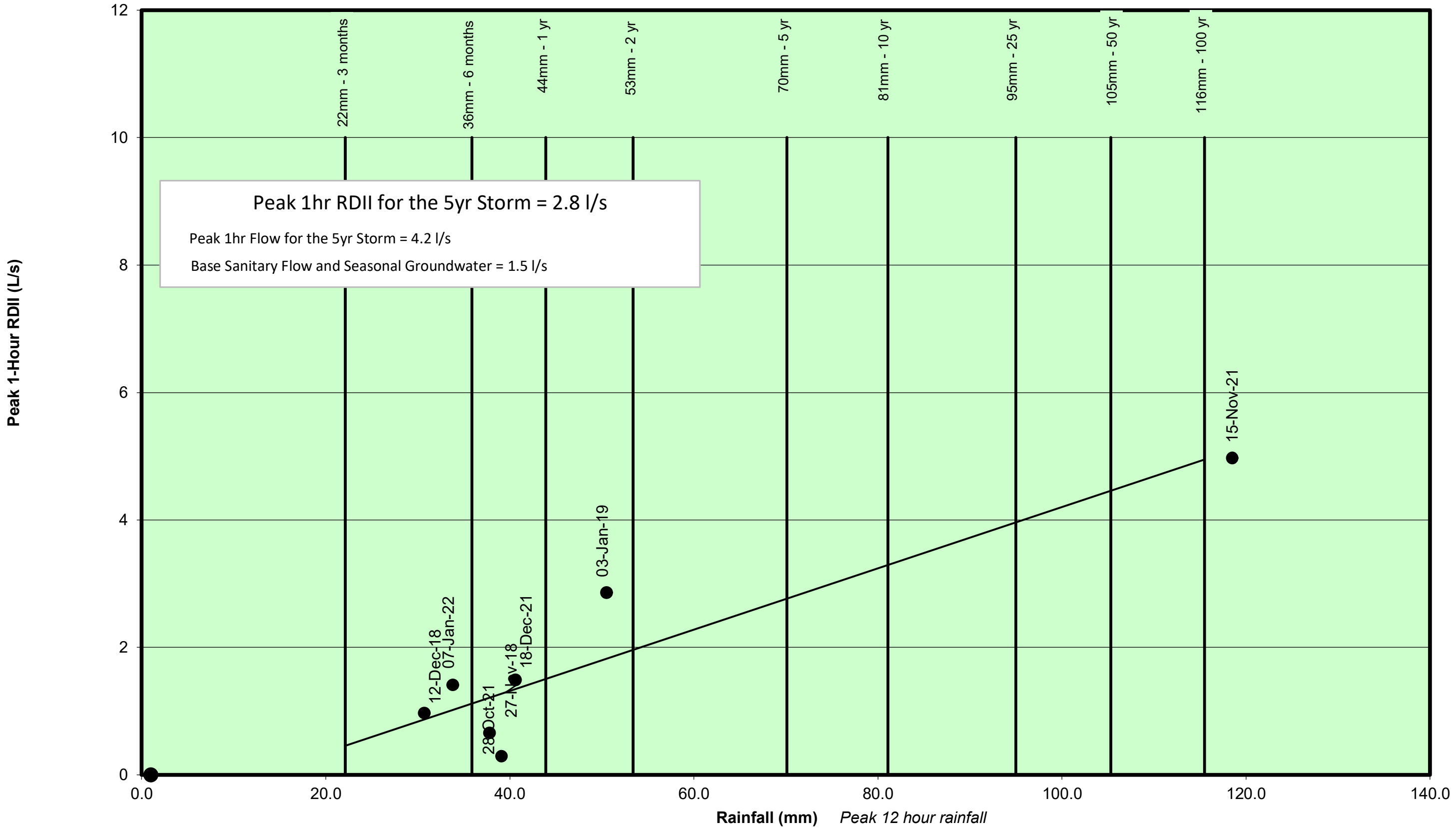
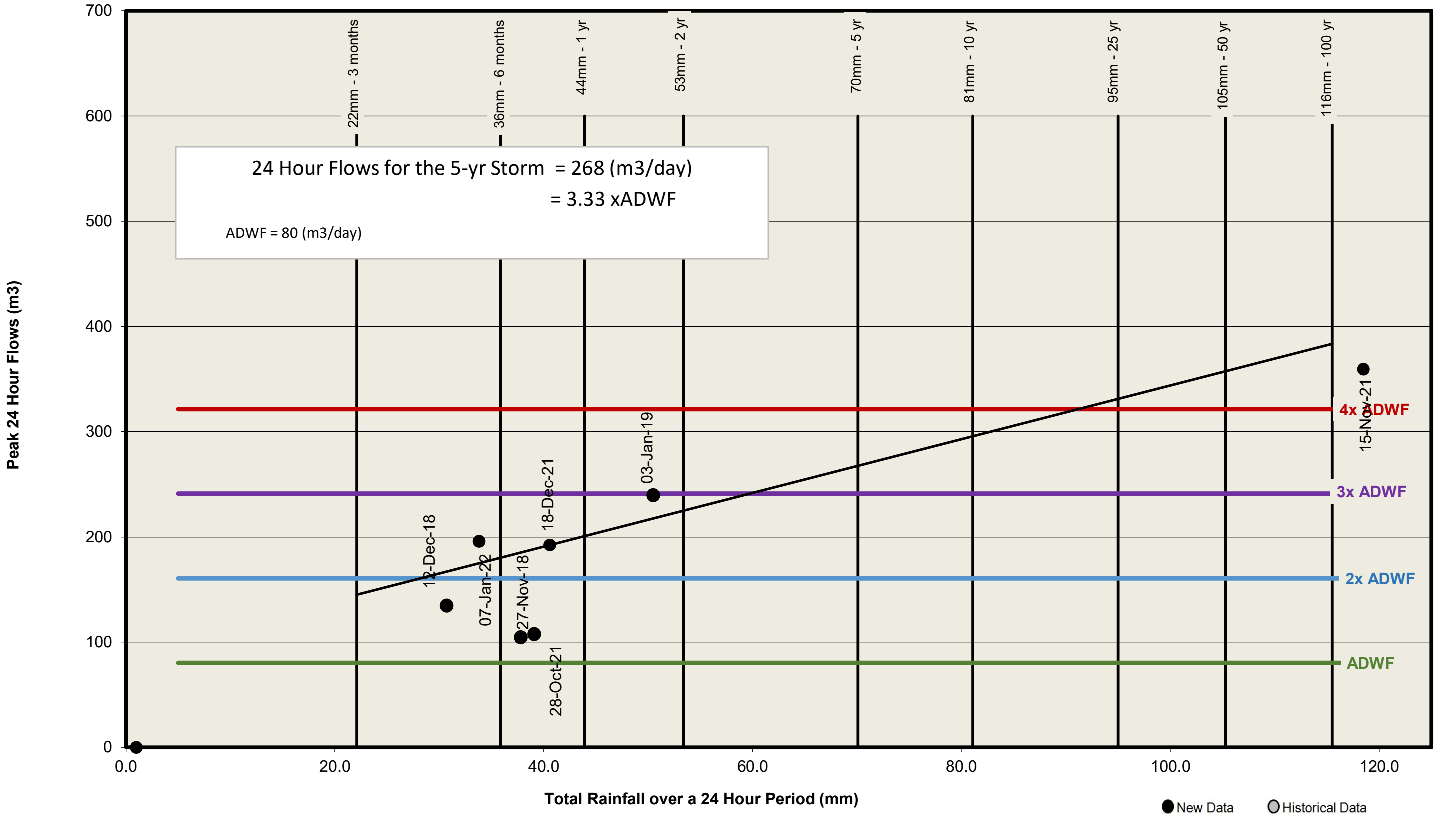


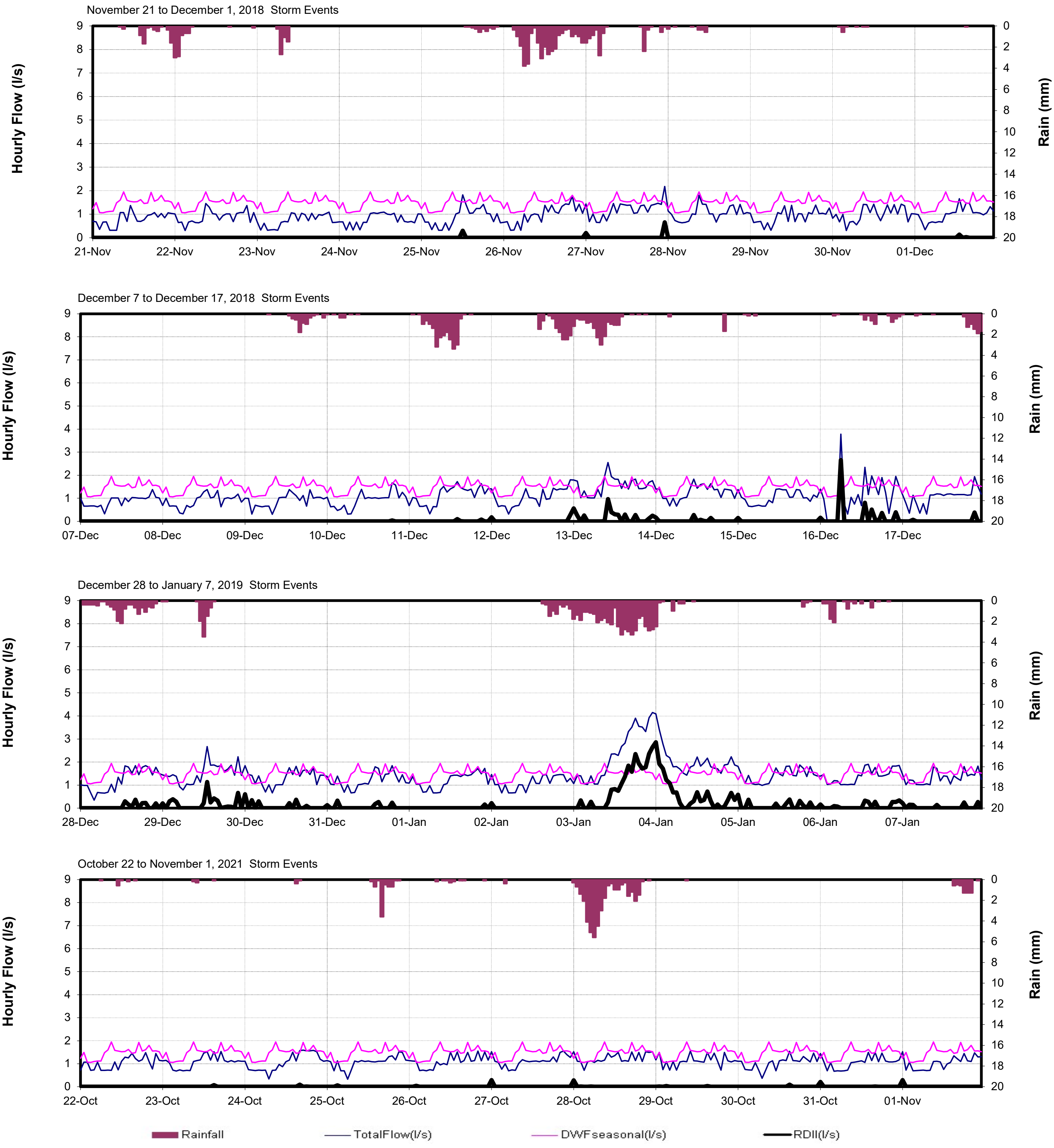
Pauqauchin First Nation



Peak 24-Hour Flows by Storm Event



Pauqauchin First Nation



November 21 to December 1, 2018 Storm Events

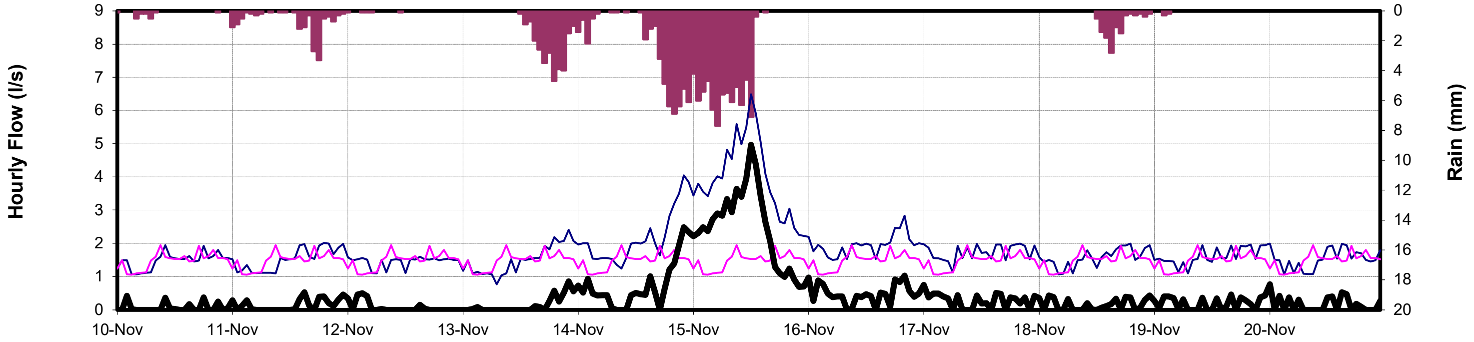
December 7 to December 17, 2018 Storm Events

December 28 to January 7, 2019 Storm Events

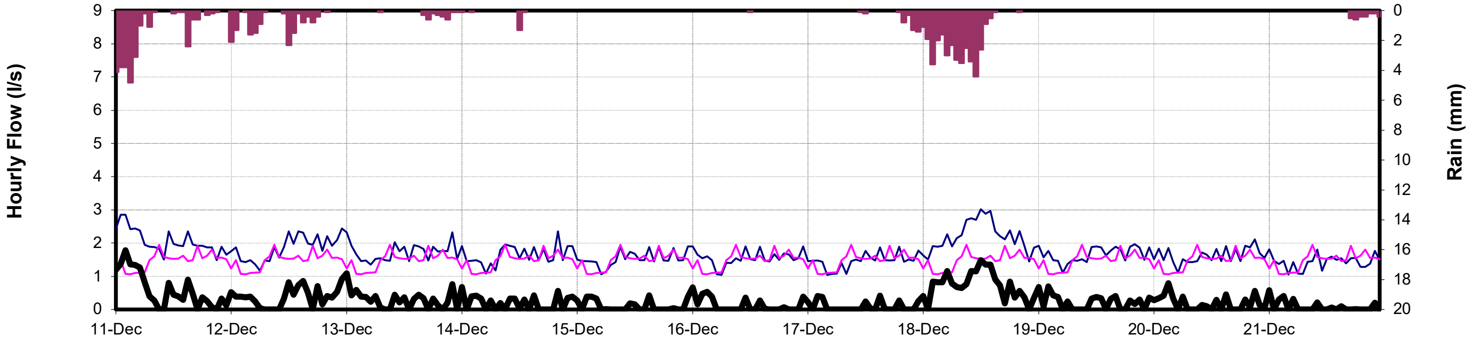
October 22 to November 1, 2021 Storm Events

Pauqauchin First Nation

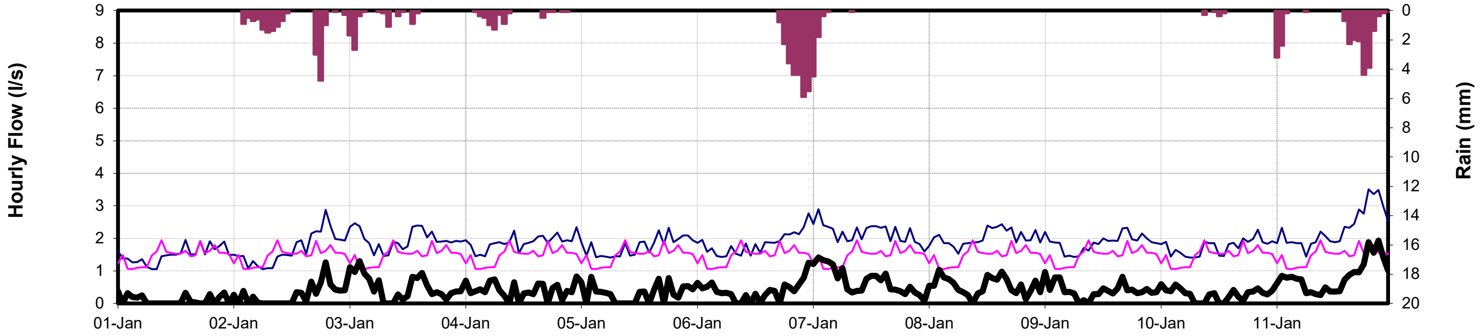
November 10 to November 20, 2021 Storm Events



December 11 to December 21, 2021 Storm Events



January 1 to January 11, 2022 Storm Events



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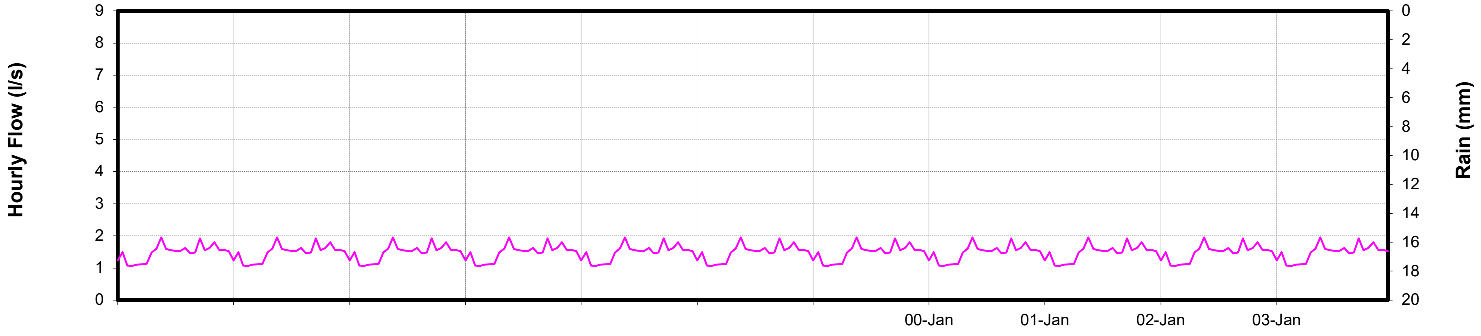
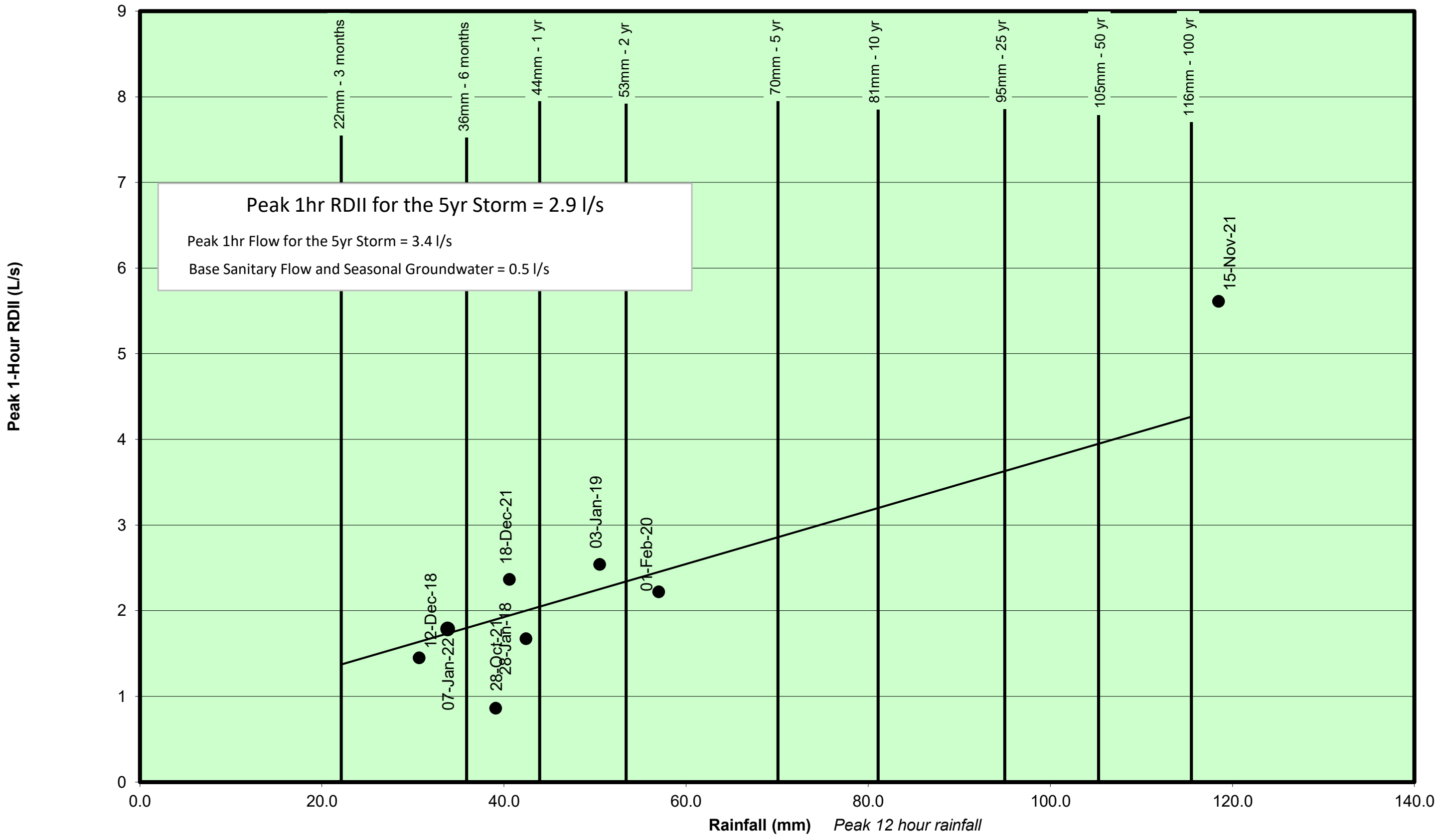


▬ Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Tseycum First Nation

Peak 1-hr RDII by Storm Event

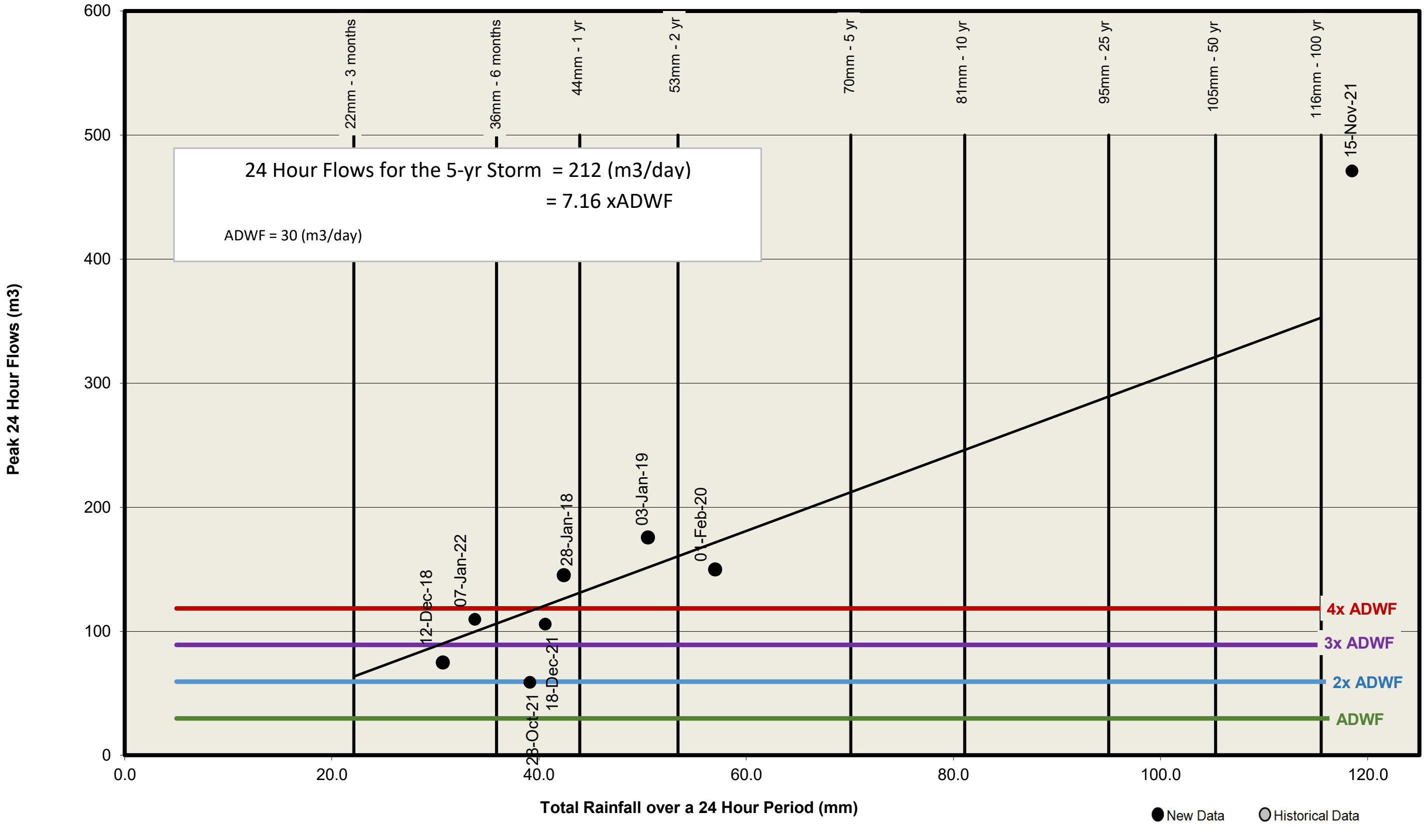


Peak 1hr RDII for the 5yr Storm = 2.9 l/s

Peak 1hr Flow for the 5yr Storm = 3.4 l/s

Base Sanitary Flow and Seasonal Groundwater = 0.5 l/s

Peak 24-Hour Flows by Storm Event

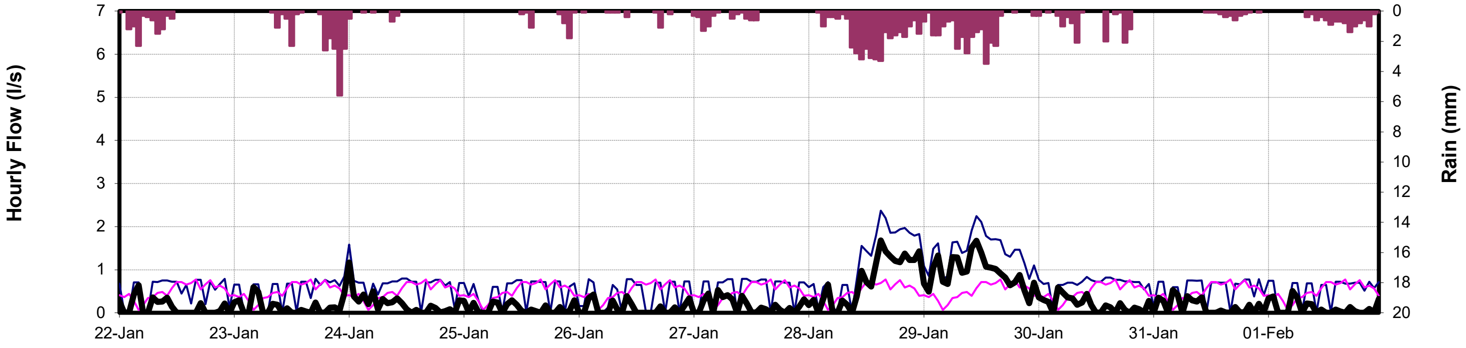


24 Hour Flows for the 5-yr Storm = 212 (m3/day)
= 7.16 xADWF

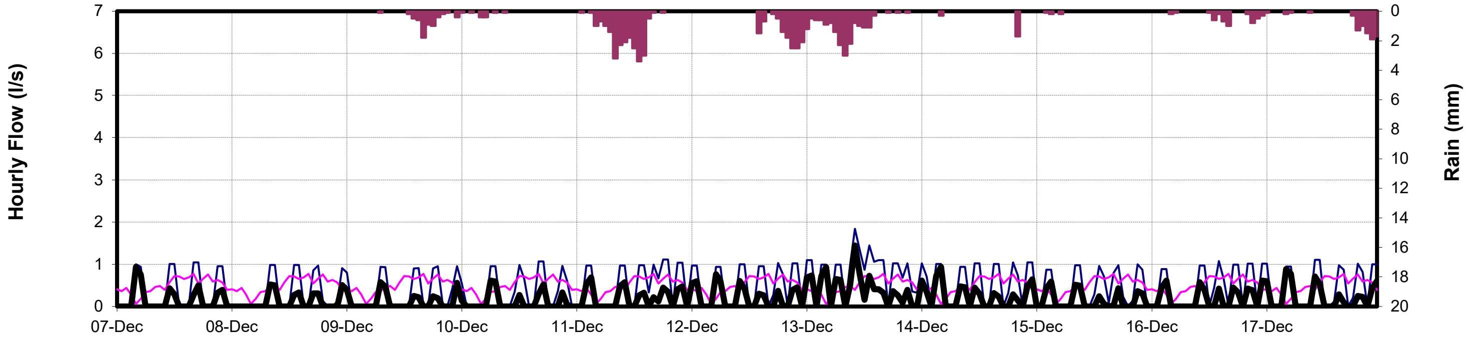
ADWF = 30 (m3/day)

Tseycum First Nation

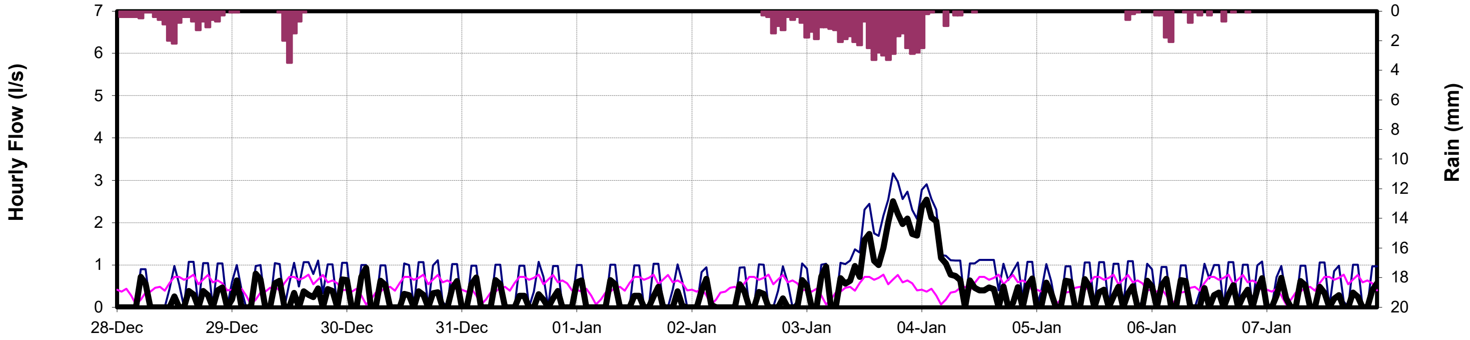
January 22 to February 1, 2018 Storm Events



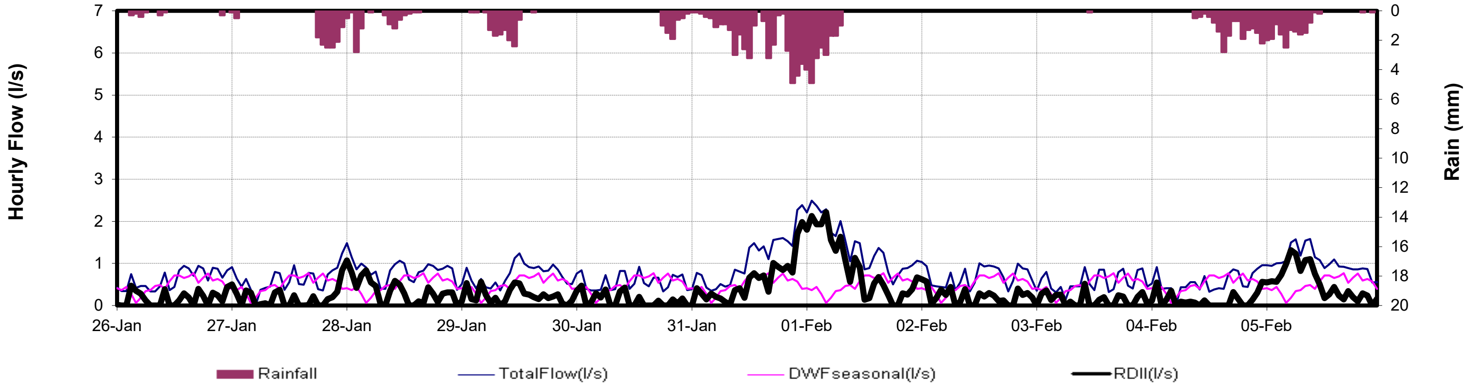
December 7 to December 17, 2018 Storm Events



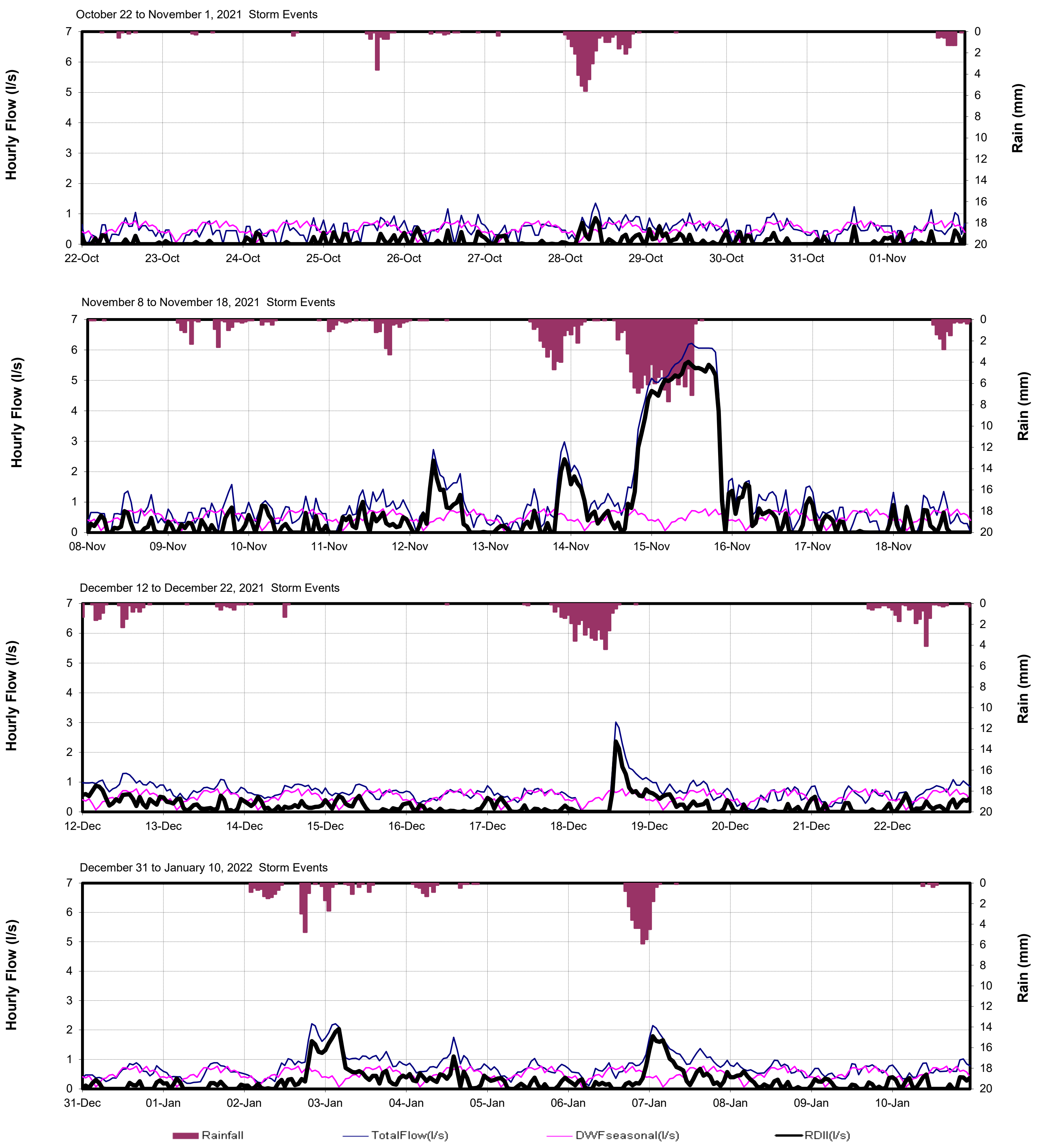
December 28 to January 7, 2019 Storm Events



January 26 to February 5, 2020 Storm Events



Tseycum First Nation



Appendix H:

Summary of Private Property I&I Programs from the USA and Canada

2022 Update on Private Property I&I Programs

*Supplementary research for the 2014 report entitled Private Property Inflow & Infiltration (I&I) Management Options for the **CRD Core Area***

April 2022

Pinna
Sustainability

Memo Contents

1 Scope and Purpose of this Memo

This report is an update to two previous reports commissioned by the Capital Regional District to identify Private Property Inflow & Infiltration (I&I) Management Options for the CRD Core Area ("2014 Report" & "2011 Report"). The 2011 Report included a review of the approaches employed by other jurisdictions in the management of private property I&I (PPI&I), and a review of the legal authority and considerations for adopting these approaches in the CRD context. Then, the 2014 Report highlighted a number of municipalities across Canada and the US that have continued to address private property I&I through various means. This memo serves to supplement the 2014 Report by providing an update that summarizes:

- The key drivers for municipalities that have implemented private property I&I programs.
- Of the programs originally reviewed, the programs that are most relevant to the CRD context, and their key drivers.
- The state of private property I&I programs in Canada, and in particular, a province-by-province summary of activity.
- A high-level review of the prevalence, type and key drivers for private property I&I programs in the United States (US), and in particular, a summary of activity in Washington State.
- A list of good practices being employed in other jurisdictions for managing private property I&I.
- Specific examples of sewer bylaws in Canada that address good practices for managing private property I&I.
- An understanding of how CRD compares relative to other jurisdictions with comparable contexts.

The updated information in intended to support the CRD as it embarks on further discussions among staff and elected officials in determining which approach is most suitable to its context. Appendix A provides an updated version of the table included in Appendix A of the 2011 and 2014 Report(s).

2 2022: Summary of Findings

Research conducted in 2022, including a desktop review and interviews, gleaned the following key findings:

- Most programs identified in 2014 are still in place in 2022. Where programs are no longer running, reasons for de-activation include: the lack of financial resources to continue to support the program, the impacts of the COVID-19 pandemic, and in one case, a program was cancelled for reasons unknown.
- Several jurisdictions highlighted in Appendix A have new programs in place (6 total) where all but one of them is an incentive-based approach. The City of Windsor has adopted a Mandatory Downspout Disconnection Program in targeted areas.
- A few jurisdictions have indicated that the only change to their program includes an increase in the percent or total dollar amount of rebates given. This is to reflect the realities of cost differentials between 2014 and 2022.

- One jurisdiction (Costa Mesa CA) changed their program to be proactive rather than reactive, and now has a CCTV program that they hope residents will participate in every 5 years.
- Due to the COVID-19 pandemic, several jurisdictions are no longer collecting late fees and / or penalties – to lessen the financial hardships already being experienced by residents. Further, the pandemic has shifted some outreach where fewer door-to-door visits are conducted.

The primary drivers of PPI&I programs continue to be those noted next, however, a few jurisdictions have pointed to specific extreme weather events that have triggered ongoing PPI&I work and / or have motivated residents to act by using existing programs.

3 Private Property I&I Program Drivers

As identified in the 2011 Report, BC municipalities have the legal authority to implement numerous types of programs to address inflow and infiltration from private property. To assist with identifying the most appropriate approach(es) for CRD member municipalities, this report seeks to clarify the reasons programs are being implemented in other regions (i.e. what is driving those regions to act) in relation to the types of approaches that are being employed.

Sewer systems in the CRD are "separated" – that is, the sewage is conveyed in a separate network of pipes than the storm water. The only exception is the "combined" sewers in the Uplands area of Oak Bay where the same pipes convey both sewage and storm water. Communities with combined systems have a different set of priorities and drivers, and tend to focus on ways to divert rainwater from the system altogether (e.g. by disconnecting downspouts from the collection system), or ways to minimize damage (e.g. by installing backflow prevention valves). These combined programs are generally not very applicable to the CRD context, so this research focuses on programs that are targeted at separated systems.

Based on the research conducted, it is estimated that less than 5% (and likely closer to 1%) of US municipalities with separated sewers have I&I programs specifically for addressing private property. In Canada there are very few such programs.

The primary drivers for PPI&I programs focused on areas with separated sewers typically fall into one or more of the following:

1. **Senior government requirements**: In numerous municipalities throughout the US, the EPA and/or State authorities have ordered sewer agencies to take action to reduce sewer overflows into fresh water in order to bring them into compliance with the *Clean Water Act*. In many locations, these orders specifically require action to be taken on private as well as public property. This is also the case in a selection of Canadian municipalities that have been ordered to comply with Federal *Fisheries Act* requirements.
2. **Basement backups or flooding**: Many communities across Canada and the US have identified the need to reduce basement backups and flooding that cause damage and

health concerns for private property. Primarily these programs relate to municipalities with combined sewers and focus on disconnecting downspouts from the sanitary sewer system, and/or removing illegal cross connections (when a storm water pipe is connected to a sanitary sewer).

3. **System capacity**: Communities are experiencing system capacity issues, where urban densification and/or new development puts strain on an existing sewer system. This can result in sewage overflows at specific locations during rainfall events. In some places, regional sewer authorities set capacity limits or costs for exceeding certain flow allotments, and this drives municipalities to develop PPI&I programs.
4. **Infrastructure maintenance and treatment costs**: A few municipalities cited that they developed their programs in a proactive manner, as part of long-term maintenance planning and/or to reduce treatment costs. More typically, this driver is a secondary reason or benefit for implementing a program.
5. **Climate change:** Since 2014, extreme weather events, including storms that lead to flooding have been noted in communities in both Canada and the US as contributing to the need for private property I&I programs.

Implementing private property I&I programs can be resource intensive and politically challenging, particularly when significant costs and/or burden are borne by property owners to fix a problem they were not even aware of. The first three drivers listed above are strong enough to support significant PPI&I programs. The fourth driver is weaker and by itself generally is not strong enough to maintain the political support needed for a significant I&I program targeting private property. The fifth driver is new to the report since 2014, and will likely continue to influence the need and desire for PPI&I programs, as the climate continues to change and communities across North America experience an increase in extreme weather events, including heavy precipitation and flooding.

The following table illustrates examples of programs in relation to the primary drivers identified.

Program driver	Examples of programs implemented
1 – Senior government requirements	An ordinance requiring a lateral be inspected and fixed at the point of sale of a property is highly effective, while also placing significant onus on the property owner at a time when they would not normally be undertaking that type of work. Of the over 20 point of sale programs identified across the US, all but two communities are under an order or decree with the EPA to take action to reduce sewage overflows. Other communities under federal orders decided to have the agency undertake the repairs, rather than requiring the property owner to do the work (e.g. Westlake OH and Fort Erie ON), or have insurance programs requiring all property owners participate.
2 – Basement backups or flooding	Many programs driven by a desire to reduce basement backups or flooding have insurance programs in place where an annual fee is added to utility bills and claims are made if a backup occurs. Other regions undertake testing then serve notice to property owners to fix problems identified (e.g. Halifax NS, Kingston ON). Numerous regions provide voluntary incentive programs to install backflow valves or disconnect downspouts to alleviate this flooding.

	One point of sale program was found that was driven by the need to reduce basement backs or flooding (Rock River IL).
3 – System capacity	There are a number of communities in the US that are not under agreements with the EPA, but are facing limits on system capacity. Programs in these areas include one point of sale program (Golden Valley MN), and several with an ordinance requiring inspection and repair of laterals at the time of major renovations (e.g. Lakeport CA, Santa Barbara CA and Ukiah CA). This approach is less onerous for the property owner because they are already engaging in a significant renovation project. One point of sale program was also found that was driven by limitations for new development (Golden Valley MN). At a regional scale where there are system capacity concerns, some regional agencies have set targets for each member municipality, then monitor wet weather flows to see if the targets are being met. If not, communities must respond by creating I&I management plans, increasing spending on I&I reduction efforts, or face surcharges. The result has been municipal programs that include grants for private sewer lateral replacements, targeted inspections followed by orders to do work where needed, and/or point of sale programs (Metropolitan Council of Environmental Services MN, Metropolitan Sewerage District WI).
4 – Infrastructure maintenance and treatment costs	Where the programs are in place in a more proactive manner, the typical form of program is a voluntary approach providing education, rebates, and in some cases, a requirement to inspect and repair laterals during major renovations. Examples include Tacoma WA (requiring education at time of sale), Costa Mesa CA and Brantford ON (incentives for repairs), and District of North Vancouver BC (requiring inspection and repair at time of renovation).
5 – Climate change	Several communities (Windsor ON, Westlake OH, Eagan MN, and Naperville IL) pointed to specific extreme weather events (i.e. heavy rains / flooding) that led to an increase in uptake of existing program offerings. MMSD reported that severe storms (2008 through to 2010) caused thousands of basement backups resulting in the announcement of a regional Private Property I/! (PPII) reduction program and the development of a comprehensive PPII policy.

4 Private Property I&I Programs – Canada

4.1 Drivers for Programs in Canada

Two Canadian municipal private property I&I programs were identified in the 2011 Report: the Town of Fort Erie Extraneous Flow Program, and the City of Thunder Bay Downspout Program. Each of these programs was formed in response to drivers that are not directly applicable to the CRD context. In Fort Erie, the program developed in response to a *Remedial Action Plan* created by Environment Canada and the Province of Ontario that was put into place to protect the Great Lakes from sewer overflows (driver #1 – senior government requirements). Some financial support for the program was also provided by Environment Canada. In Thunder Bay, the PPI&I program focuses on separating combined sewers by disconnecting downspouts.

Additional research was conducted to ascertain how many other communities in Canada have programs or approaches for addressing private property I&I. The research indicates that most of these programs are aimed at reducing basement flooding. The following table summarizes the findings, including a summary of the drivers for the programs, and whether the program focuses on inflow sources (cross connections or combined sewers), or infiltration (leaky laterals). This table has not been updated since 2014.

Province	Program summary and drivers
Newfoundland	None identified.
Prince Edward Island	One program (Charlottetown) focuses on inflow removal in a combined system.
Nova Scotia	One program (Halifax Water) targets removal of improper rainwater connections into the separated system. Focus is on ensuring downspouts connect to the storm water system, and removing cross-connections.
New Brunswick	One program (Moncton) provides rebates for installing backwater valves to prevent basement flooding.
Quebec	One pilot project to disconnect downspouts (Quebec City) from a combined sewer system.
Ontario	Over a dozen programs, and almost all are driven by reducing basement flooding predominately in areas with combined sewers. Some are related to federal requirements to improve Great Lakes water quality. One community cites long-term infrastructure maintenance as the driver (Brantford) and one cites reducing costs for homeowners to do repairs as the driver (Windsor). Several provide rebates for disconnecting downspouts, or for redirecting storm water out of the sewer system. Two provide rebates for fixing sewer laterals (Brantford and Windsor). One provides financing for sewer lateral repairs (Cornwall). One regional I&I reduction strategy that identifies the need to improve private property sewer maintenance, and a commitment to identify an appropriate approach (York).
Manitoba	Provincial grant program currently provides funding to 22 municipalities to provide rebates for installing backwater valves to prevent basement flooding. Winnipeg still has 30% combined sewers.
Saskatchewan	Two programs (Saskatoon and Humboldt) provide rebates for installing backwater valves to prevent flooding. Separated systems in Saskatoon and Regina.
Alberta	One program (Edmonton) for flood prevention on a largely combined system. Also a private insurance program for basement backups. No program for Calgary, which has a separated system.
British Columbia	Two bylaws requiring lateral inspections / repair during major renovations or re-development (North Vancouver and Surrey). On a very small scale, municipalities have completed targeted I&I removal projects to remove cross-connections and repair laterals on private property. Metro Vancouver and CRD have identified policy and legal options for managing private property I&I.

4.2 Summary of Program Activity by Province

The following provides more detail about the programs identified that address private property inflow or infiltration in some form, organized by province. Where programs have elements that may be of interest to the CRD were identified, these were incorporated into the table in Appendix A (and are marked with an asterisk * below). The summary provided in Section 4.2 has not been updated since 2014. Appendix A was updated in 2022.

Newfoundland & Labrador: The Province undertook a study in 2012 to identify location and frequency of CSOs, SSOs and potential solutions, province-wide, in response to the proposed WSER (legislation for Municipal Wastewater Effluent, under the Federal *Fisheries Act*, enacted 2012). No community was identified that had any reference to a private inflow and/or infiltration program (though Mount Pearl has a successful cross connection control project).

Prince Edward Island: The City of Charlottetown was the only community identified with private property program, and it focuses on the removal of inflow sources.

- Charlottetown: Inflow reduction education campaign. The primary purpose is to reduce the numerous illegal connections of inflow identified. Concurrently, the City is working to separate their sewer system.

Nova Scotia: The Province is developing a wastewater standard to address the objectives of the WSER, including an approach to overflows. At a community scale, Halifax has been working to reduce inflow and infiltration since 1999. The utility Halifax Water formed in 2007 and has had a private side program for I&I reduction since 2008. No other communities were identified that have a private property inflow and/or infiltration program in Nova Scotia.

- Halifax Water*: Stormwater Inflow Reduction (SIR) program in place several years with an exclusive focus on private property I&I. The program includes: targeted inspection of private I&I sources through smoke, dye, and CCTV testing; notices to owners where repairs are needed; and follow up notices if work is not completed. A bylaw is in place to enable various forms of enforcement (shutting off water service, issuing tickets, placing property liens). The program previously included CCTV inspections of laterals from the inside of the dwelling, though this was onerous to conduct. The focus of the program is currently only on inflow sources.

New Brunswick: All municipalities are required to develop long-term plans to reduce combined sewer overflows and reduce overflows from infiltration by January 1, 2016. One existing private property program was identified in Moncton.

- Moncton: Backwater valve incentive program ($500 towards installation) to reduce basement flooding. City has both separated and combined sewers.

Quebec: One program was identified in Quebec with respect to private property inflow and infiltration (note: web searches were conducted in English only). This program focused on the reduction of basement flooding.

- Quebec City: Required downspout disconnections for one neighbourhood, funded by the City (launched 2005). Program results: 25% uptake on first round; 60% of remaining on second round; five more rounds, including warnings of $300 fine for not complying, and reached 100% compliance by early 2008. City has primarily combined sewers.

Ontario: Numerous programs were identified in municipalities and/or regions across Ontario, and four of these have been added to the table in Appendix A (as indicated by an asterisk*). Over a dozen programs were identified that addressed private property I&I in some form, and some of these are regional and cover numerous municipalities. Generally the programs are focused on reduction of inflow, and cite the reduction of basement flooding as the primary driver for having a program. The most comprehensive strategy identified for managing I&I was the York region.

- York Region* (Newmarket, Richmond Hill, Vaughan, Markham, and 5 others): Comprehensive I&I strategy addresses public and private sources. Planned and tendered a pilot project to conduct inspections and repairs for 3,000 private laterals to determine most cost-effective method of reducing I&I. After tendering, the Region changed the scope of the project to only focus on the public portion of the lateral due to uncertainties about the legal implications should any damage to private property occur during the project. The strategy also identifies the need to address private property I&I through one or more of the following: increased education, incorporating lateral information into GIS, developing region-wide standards for private side inspections, and investigating long-term program options (including time-of-sale certification of laterals and subsidy programs) – though these have not been implemented to date.
- Brantford*: Grants to replace ageing sewer laterals (50% up to $1,500) started in 2014. City also took back ownership of lateral from property to main effective 2014.
- Windsor*: Grants to replace ageing sewer laterals (up to $2,000 once every 20 years).
- Kingston*: Grant program to reduce basement flooding, and stronger bylaw language adopted in 2012, including enforcement measures if private sewer laterals are not properly maintained.
- Cornwall: Sewer Lateral Replacement Financing Program.
- Niagara Falls: Grants for disconnecting foundation drains (100%), and a free service to inspect the condition of a private lateral upon request. Driven by Federal and Provincial requirements in relation to protection of the Great Lakes basin.
- Port Colbourne: New *Sewer Use Bylaw* supporting an Extraneous Flow Reduction Program enabling the City to undertake inspections of private laterals to identify need for repairs, and to provide grants for some or all of the repair work. Driven by Federal and Provincial requirements in relation to protection of the Great Lakes basin. Combined system.
- Hamilton: Proposed insurance program where residents voluntarily pay a monthly fee for sewer lateral insurance. Generally considered a reactive approach as laterals are fixed after a backup or problem becomes evident.
- Region of Waterloo: Storm sewer inspection program using video to identify areas that require rehabilitation. All storm sewers to be inspected and flushed over five years.
- Several other municipalities: Downspout and foundation drain disconnection programs, including grants to assist with the costs of disconnecting, are quite common across Ontario. Other municipalities include with these programs include Toronto, Ottawa, Halton Region, Region of Peel, Brantford, London, Durham Region, Greater Sudbury, St. Catharines, Vaughan, Welland and Cornwall.

Manitoba: Grant program that provides funding for installation of backwater valves and sump pits is provided to 22 municipalities across Manitoba, and is jointly funded by the two levels of government. Significant focus province-wide is on reducing flooding risks.

- Winnipeg: The City is an early adopter of a bylaw requiring backwater valve installation (1979). City also has a grant program to reduce basement flooding, including backwater valve and sump pit installation rebates. 30% of the city still has combined sewers.

Saskatchewan: Two programs were identified in Saskatchewan, and they focus on reducing inflow. A program was previously available for Prince Albert but no current reference found for this. The focus of these programs is reducing flooding risks.

- Saskatoon: Grant program to reduce basement flooding for backflow preventer installation, foundation drain disconnection, and sump pump installation. Program had general public resistance and slow uptake. All homes built 1965 to 2004 have foundation drains connected to the sanitary system.
- Humboldt: Storm Water Rebate Program is similar to the Saskatoon program and focuses on flood prevention.

Alberta: One private property inflow reduction program was found in Edmonton. In 2011, EPCOR Utilities announced a joint marketing agreement for service line warranties with HomeServe. This is a voluntary insurance program.

- Edmonton: Grant program to reduce basement flooding in place since 1991. City has combined sewers.

British Columbia: Two municipalities in BC require the rehabilitation or replacement of sewer laterals at the time of major renovations and re-developments (e.g. City of Surrey and District of North Vancouver) and some municipalities have “rodding lists” (e.g. City of Vancouver and District of North Vancouver) to perform regular clearing of laterals on the public side.

- District of North Vancouver: all building permits of value greater than $150,000 with connections over 30 years old must demonstrate the lateral meets MMCD or equivalent standards. Also, since the 2011 Report, the District of North Vancouver undertook a project to reduce I&I from private properties in Lynn Creek. Metro Vancouver undertook a study of how to implement a private sewer lateral certification program at the time of property sale, but have not yet taken steps to implement this.
- City of Surrey: all applications for a service connection with a building permit of value greater than $100,000 or where a parcel is being redeveloped must demonstrate their lateral is in good condition (if under 30 years old), or replace it (if over 30 years old). All no-corrode, asbestos cement or clay service pipes of any age or condition must be replaced.
- Metro Vancouver and CRD: both regional districts have reports (including the 2011 Report) that identify the policy options and legal authority for municipalities to develop and implement programs to address private property I&I. Metro Vancouver also has a Sample Bylaw for private sewer laterals.
- Some municipalities have undertaken work on private property laterals to get them into better condition as part of targeted I&I reduction projects (e.g. James Bay in Victoria, Lynn Creek in North Vancouver)

In summary, the vast majority of communities in Canada with private property programs are driven by the need to reduce basement flooding, and a couple of programs are in relation to senior government requirements. The more proactive programs identified that apply to separated sewer systems were in Brantford Ontario – a rebate program for repairing a private lateral, and in North Vancouver and Surrey – bylaw requirements to inspect and/or fix private laterals at the time of renovation or re-development.

5 Private Property I&I Programs – US

5.1 Drivers for Programs in the US

Twelve programs from the US were reviewed in the 2011 Report. This memo clarifies what were the key driving forces for developing the programs (see updates for each program in Appendix A, including a new column "Primary drivers for the program"). The majority of the examples presented in the 2011 Report were driven by senior government requirements (driver #1) because the EPA had issued administrative orders or consent decrees due to violations of the Federal *Clean Water Act*. The others were related to capacity concerns (driver #3) as follows:

- **Senior government requirements** (EPA): McMinnville OR, Berkeley CA, Brentwood and Glendale MO, Austin TX, Miami-Dade FL
- **Capacity** (reduction of sanitary sewer overflows): Santa Barbara CA, Westlake OH, Costa Mesa CA, Naperville IL
- **Regional surcharges** to municipalities for wet weather flows: Eagan and Golden Valley MN (note – these regional surcharges are driven by desire to reduce spills and increase capacity)

This list highlights the primary drivers, although in most cases communities cite numerous drivers for taking action. There are, however, useful examples from communities that are not facing US EPA orders (e.g. Costa Mesa CA, Santa Barbara CA, Metropolitan Council MN communities). Note that all US examples in the 2011 Report have fully separated sewer systems, or where there are combined systems, the focus of the private property program has been on areas with separated systems.

5.2 Summary of Program Types and Drivers by State

In 2014, a high-level scan of programs in place across the US identified upwards of 100 communities with some form of private property I&I program. Without a more in-depth study a more precise estimate is not possible, however the overall number is likely in the hundreds of programs, and not likely to be as high as thousands of programs. For context, that is less than 5% of municipalities, and more likely close to 1%.

In 2014, PPI&I programs were found in 21 states. California municipalities appear to have the most number and types of programs (e.g. required education, renovation ordinance, point of sale ordinance, agency undertaking the work on private property, rebate programs, loan programs). Very little activity was found in the Pacific Northwest other than a required education program in Tacoma, a number of pilot studies in King County, and loan programs for low-income households.

The results of the scan are summarized by state with a brief indication of the type and driver for the programs:

Alabama:	1 EPA order found – agency fixes laterals in examples found
California:	Several EPA orders – most have point of sale programs Non-EPA cities – some have ordinance requirements for renovations (but not for

point of sale), rebates, "required education" (information is provided during real estate transactions on property reports)

Colorado: Basement backup prevention

Florida: EPA order for Miami-Dade – program required property owners to fix problems identified

Illinois: Mostly downspout/foundation drain disconnection programs
Some programs where City does the work to fix laterals on private property

Indiana: Mostly downspout/foundation drain disconnection programs
2 insurance programs (where property owner pays monthly fee, then insurance covers repair/replacement costs if problem found)

Kansas: 1 rebate program
Some downspout/foundation drain disconnection programs

Kentucky: 1 rebate program
1 downspout/foundation drain disconnection program
1 program where the agency fixes private laterals

Michigan: Several programs where the agency fixes private laterals

Minnesota: EPA orders with point of sale ordinances
MCES also has regional requirements related to capacity – 1 city in MCES has a point of sale program due to capacity
1 agency requires property owners to undertake fixes, but agency pays 50%

Missouri: EPA order for St Louis County
Numerous insurance programs

Ohio: EPA orders – 1 agency fixes the private laterals; 1 has a point of sale ordinance
Non-EPA cities have downspout disconnect programs

Oregon: EPA order for McMinnville and city requires property owners to fix problems identified

Pennsylvania: EPA orders – several have point of sale ordinances and/or city inspects and requires property owners to fix laterals

South Carolina: 1 rebate program
1 city that fixes private laterals

Tennessee: 1 city that fixes private laterals

Texas: EPA order for Austin – city requires property owners to fix problems
Dallas also requires property owners fix problems, no EPA order found
2 low income programs
Backflow preventer program

Virginia: 1 Region with municipal flow commitments
1 downspout disconnection program

Washington: Loan and low income programs
King County pilot studies (where County fixed laterals to assess cost effectiveness
Tacoma has a required education ordinance for point of sale, but no requirement to inspect or do work

Wisconsin: Education and loan programs

Wyoming: 1 insurance program

5.3 Washington State Approaches

Of particular interest to CRD are the approaches undertaken by their neighbours in the Pacific Northwest.

King County in Washington State is engaged in a long-term program, in collaboration with local wastewater agencies, to reduce I&I when cost effective to do so in the separated sewer systems.

In 2014, this program had been entirely agency-led and had not put any onus on property owners, other than to obtain their permission to complete the rehabilitation projects. All work and costs were borne by the County. I&I reduction projects involved the rehabilitation of public and private sewers in select basins where expected reductions are deemed to be cost effective (because they will avoid the cost of future storage and diversion needs).

In 2015, the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) I&I Task Force was created to formulate ideas for I&I programs that could benefit the regional wastewater system by looking at long-term solutions to significantly reduce and remove I&I from the sewer system as a whole.

The first phase of this work (2017-2019), which has been completed, was a planning phase and aimed to explore different concepts to reduce I&I programmatically and with a focus on private side sewers. Concepts included region-wide side sewer standards and inspection training, interagency coordination to identify and manage I&I, side sewer inspection and repair programs, and side sewer grant/loan programs. This planning phase resulted in three programs being recommended by MWPAAC for further definition and consideration, they are:

1. Regional sewer and side sewer standards
2. A regional inspector training and certificate program, and
3. A private side sewer inspection program with financial assistance

As of 2022, planning has led to the definition of two program options. The regional best management practices were recommended by MWPAAC for voluntary implementation by component agencies (largely community education) while the training and certificate program was not recommended. The third program listed above was not completed because it is being considered as part of a broader sewer system planning effort.

No programs were found for the City of Seattle, or other municipalities in King County.

The City of Tacoma attempted to proactively implement a time of sale program without a strong driver such as an EPA order. The program lost political support just prior to implementation. Further details are provided in Section 5.2, which highlights some problems communities have faced when implementing these programs.

The result was that, effective 2010, Tacoma realtors are required to provide the City's information package on sewer laterals to both buyers and sellers prior to closing of a property. The City also provides the package to any property owners who request a building permit. The package recommends conducting a sewer lateral inspection prior to completing the purchase or renovation on any home more than 25 years old. The City has levied a few fines against realtors who did not hand out the package, and the homes later encountered sewer problems. Anecdotal information from City staff suggests that there has been an increase in the number of sewer lateral inspections being conducted during real estate transactions. The City has also made information about the condition of sewer laterals available on their property search website, along with all other permit information, and includes age and condition of the lateral where available. City staff continues to review options to further develop programs for I&I removal from private property.

Since 2014, little has changed at the City of Tacoma, however, a conversation with staff at the City revealed that although the realtor program is still occurring, there are few ways to enforce it, and therefore no clear way to know if the program is being implemented. The City did report an increase in residents that are having sewer issues and coming to the City for support, which may be as a result of more frequent wet weather events or turnover of homes in an active real estate market.

6 Example Problems Related to PPI&I Approaches

6.1 Inadequacy of Education Alone

It has been found that education alone is not effective for reducing PPI&I. Some communities that originally opted to pursue purely educational approaches are now finding that it is time to re-evaluate options for further addressing private property I&I.

For example, a 2014 staff report from Laguna Beach City in California states that the City's 10-year awareness program has been ineffective, and it is now seeking to update the program. The program involved educating owners about lateral inspection and maintenance, and encouraging voluntary action. In 2022, the City is implementing a Private Sewer Lateral Repair Program where the City offers an incentive to encourage and assist homeowners with the repair or replacement of their sewer lateral line. The City of Laguna Beach will reimburse up to 50% of the homeowner's cost to repair or replace a private sewer lateral, up to a maximum of $1,600 per residential parcel.

6.2 Loss of Political Support

The City of Tacoma proactively updated their Municipal code to directly address private property sewer laterals (called "side sewers" in Tacoma). This program was originally designed to be more prescriptive by requiring a "Certification of Inspection" be obtained from the City prior to completing a home sale. The intent of the original program was to ensure prospective homeowners understood the current state of the sewer lateral prior to completing the purchase. The City developed the original program based on two years of consultation with the real estate industry and other stakeholders. However, shortly before the ordinance was to come into effect Council directed municipal staff to significantly reduce the requirements of the adopted PPI&I ordinance in response to pressure from real estate agents. No changes to this program have been made since 2014.

6.3 Liability Fears Related to Working on Private Property

The Regional Municipality of York engaged a consultant to conduct a condition assessment, detailed design, contract administration and site inspection services for about 3,000 private property sewer laterals throughout the region (for a value of 1.06 million dollars) in the fall of 2013. However, during early project planning, the regional municipality's legal department became concerned about the potential liabilities associated with working on private property. The project scope was then changed to only include the inspection and rehabilitation of the service lateral (from the main to the property line). The region is currently considering other avenues for evaluating and rehabilitating private sewer laterals, as these have been identified as an important part of their comprehensive I&I reduction strategy.

7 Good Practices for Addressing PP I&I

This section outlines a collection of good practices for addressing PPI&I. It is based on the research conducted for the previous sections of this report and a review of best practice research conducted in other regions.

7.1 Clear Vision, Mission Statement, Goals and Scope

Establishing a well-defined vision, mission statement, goals and scope will support the development of the program, and provide structure at decision-making points. This includes having a strong understanding and agreement on the drivers of the program, and buy in from stakeholders and local government / agencies. The scope can be adjusted over time to meet the needs of the program and jurisdiction.

7.2 Bylaws Pertaining to Private Sewer Laterals

A good practice identified by numerous agencies is to first conduct a review and update of existing bylaws to ensure they are explicit about several important aspects of sewer lateral maintenance. The 2011 Report outlines the options available to municipalities in CRD for managing private sewer laterals, and also provides a sample bylaw that was developed for Metro Vancouver municipalities (attached as an appendix to the 2011 Report).

Appendix B contains sections from Canadian municipal bylaws relating to PPI&I. It demonstrates how PPI&I approaches can be implemented through bylaws and is organized by the following key elements:

- **Responsibility of owner** – to clearly state property owner responsibilities in maintaining laterals
- **Cleanouts required** – to assist with future testing and access, some municipalities require cleanouts be added under certain trigger conditions
- **Entry and testing** – to state the legal authority for the municipality to enter private property to conduct testing, and to undertake work; this section usually identifies part or all of the process to be followed (e.g. type of communication, amount of advance warning provided)
- **Require fix of defects** – to state the legal authority for the municipality to require property owners to fix defects; this section usually identifies the circumstances that will trigger this requirement

- **Require inspection for renovation or new construction** – a special condition currently found in two bylaws stating laterals must be tested and/or fixed when undertaking major renovation or new construction
- **Fees, recovering costs** – to state the authority for municipality to do the work then recover the costs from the property owner
- **Financial assistance, monetary incentive** – to identify the purpose and authority to provide financial assistance for fixing laterals; note that many grant programs don't explicitly identify this in their bylaws
- **Enforcements, penalties** – to clearly state the enforcement approach and penalties that may ensue for non-compliance

This summary of key elements of a sewer lateral bylaw is not exhaustive (see the 2011 Report for a more extensive list and description). It does highlight the need for clearly stating the municipal authority to enter onto property, test, inspect, require fixes, charge fees and enforce penalties for non-compliance.

7.3 Testing Private Property I&I

With respect to entry and testing, no Canadian bylaws reviewed provided details of the method of testing or inspection that would be conducted (though this is present in several US ordinances reviewed). Several municipalities in Canada do have testing programs primarily employing smoke testing to ascertain whether inflow sources are illegally connected to the sanitary sewer system. Municipalities that have undertaken smoke testing for this purpose have outlined their testing policies and procedures on their website. These procedures include providing notice to property owners with dates and times of upcoming smoke testing, providing notice to emergency services (fire, police) of the location, dates and times of smoke testing, and providing answers to Frequently Asked Questions with the notice and on their websites.

Examples of the notices and/or procedures for conducting smoke testing programs include:

- London ON: Report from staff to Council Committee outlining the procedures to be followed and an example public notice to be provided to property owners.
- Markham ON: Website provides overview of purpose, links to sewer bylaw and requirements being tested, maps of program areas to be checked, links to Council Minutes relating to the program, other educational information, and a rebate program to assist with disconnecting downspouts and/or installing rain barrels.
- Halifax NS: Written notice of smoke testing is provided to properties in advance of testing, police and fire is notified each day prior to testing.
- Regional District of Nanaimo BC: RDN notice of smoke testing listing specific times and dates that testing will be conducted in specified locations for the purpose of identifying cross connections.

Examples and links of notices / procedures conducted since 2014 can be found in Appendix C.

7.4 Standards, Guidelines and Policies

In addition to reviewing and updating bylaws, many communities also review and produce or update standards for construction of private sewers, guidelines for executing private property rehabilitation, and policies that ensure standards and guidelines are applied consistently.

The region of King County developed a comprehensive set of Standards, Guidelines, Procedures and Policies for use in long-term I&I control (2004). The document addresses both public and private infrastructure, and is based on the first five years of experience in I&I control projects. The 15 policies are designed to support the application of standards and guidelines in I&I control projects, and address the issues of: funding, public education, access to private property, inspection, permitting, liability, and storm water drainage. The County plans to review and update the document as needed following the completion of larger scale projects, which have just come to completion.

The Region of York is developing region-wide standard procedures for private side inspections, including notification materials and consent/ waivers. They plan to use a standard ROE (Right of Entry) form across the region, to be signed by the property owner.

For agencies that issue a sewer lateral certificate of compliance, more recent programs are distinguishing between watertight laterals (which receive a 25-year certificate) and laterals in good condition (which receive a 10-year certificate). To receive a 25-year certificate, laterals must pass a hydrostatic pressure test. 10-year certificates are issued to laterals that pass a CCTV inspection.

In 2018, the CSA Group published Z800-18- Guideline on Basement Flood Protection and Risk Reduction to provide guidance on making homes safer and more resilient against flood-related events. The guideline, a response to the effects of the changing climate has the goal of helping people “feel safer in their homes through flood protection and avoid the high costs associated with repairs”. In addition to providing measures that can be taken in existing, new, rebuilt and renovated houses under the National Building Code of Canada (NBCC) Part 9, the guideline also serves as the basis for the curriculum of a new training course for home inspectors.

7.5 Communications and Education

Education alone will not result in noticeable changes in I&I; however, all agencies agree it is essential to have a strong focus on this when implementing any program. Effective campaigns in Canadian communities have occurred in conjunction with targeted programs that have strong regulatory backing cited in the communications material.

In Halifax, the utility (Halifax Water) contacts property owners requiring them to take action on their improperly connected downspouts or cross-connections when smoke testing reveals problems. The program initially had an uptake rate of approximately 40% of property owners that responded to Halifax Water's communications. This rate increased to 90% uptake last year after improvements were made in the communications methods, including:

- Improvements in customer care, including longer hours of availability (to 8pm) and email communication,
- Increased staff,
- Virtual open houses where residents are asked to be proactive, and
- Addition of door-to-door knocking when staff is already out in a neighbourhood.

Other communities such as Tacoma have taken advantage of natural times to communicate with property owners and provide education about I&I – at the time of property transfer (through realtors) and at the time of major renovation (through the City building permit department).

Lateral certificates are another tool used to educate the public on their responsibility to maintain their private property laterals. In general, lateral certificates certify compliance for a period of time (e.g. 10 or 20 years). The City of Lakeport CA has a voluntary certification program for this purpose.

7.6 Checkpoints for Long-term Maintenance

Communities under EPA orders to reduce inflow and infiltration are typically required to put into place ordinances that ensure private laterals will be inspected and rehabilitated at regular checkpoints on an ongoing basis, in addition to taking immediate actions to reduce sewer overflows. This demonstrates a good practice for long-term maintenance, which is also being implemented by some communities more proactively. Checkpoints (or triggers) for inspection are typically one or more of the following:

- When a property is re-developed
- When obtaining a building or plumbing permit exceeding a particular value
- At a particular age of lateral (e.g. laterals 25 years old)
- When a property changes use (e.g. from residential to commercial)
- Time of sale of property, name change on municipal / utility account (not common in proactive programs)
- When work is being conducted in the area on community roads / laterals

These are typically designed to try to align with commitments to regular inspection on the public infrastructure. The use of the age of lateral checkpoint is more common with commercial properties. York Region, Halifax Water and Metro Vancouver are investigating options to put a longer-term checkpoint into place. Both Halifax Water and Metro Vancouver have had preliminary discussions with the real estate industry regarding the option to include the condition of the sewer lateral on property disclosure statements.

7.7 Data Collection and Management, Including Defined Performance Measures

Developing data collection approaches, and defined performance measures that align with the vision of a program will help ensure the sustainability of the program. In addition to the tracking information noted next, communities should develop approaches to track program information, including, the number of laterals inspected / repaired on an annual basis and the cost of implementation to the community.

Communities are tracking information about the condition of private laterals and incorporating the data into broader sewer information systems. For example:

- The City of Kingston used a GIS overlay of the location of flooding complaints to target their program efforts towards those catchments.
- The City of Tacoma publishes known information about private sewer laterals along with permit information for all properties in the city, publicly accessible through a web-based interface.

- The Region of York plans to develop an inventory through a review of historic plumbing records, combined with all new inspections conducted to better understand the state of the private system.
- Many communities are monitoring I&I rates before and after rehabilitation work.

These good practices are being demonstrated in various programs throughout Canada and the US. To date, no region in Canada has put in place a comprehensive program that incorporates all of these elements.

7.8 Program Management, Sufficient Staffing, and Acceptable Technologies

Communities implementing I&I programs should have strong program management processes in place, and knowledgeable staff to spearhead the program. In most cases, jurisdictions involved in this review had one person who was the lead on the I&I programs, and could ensure its effective delivery. Prior to implementation, a decision about who manages the program should be determined, including whether it is internal or external (i.e. a consultant) and if it is internal, choosing an individual to champion the program.

Appropriate practices and technologies relevant to the type of I&I program that will be implemented also need to be identified. These might include written policies and procedures, technical specifications, approved methods and materials, and inspection criteria. Further, appropriate and efficient tracking mechanisms should be adopted such as databases and websites.

Appendix A – Survey of I&I Programs in Other Jurisdictions – Updated 2022

Key findings and updates to Appendix A (2022):

- Six new programs in place:
    - Basement Flooding Grant (Brantford ON)
    - Mandatory Downspout Disconnection (City of Windsor)
    - Sewer Lateral Repair Program (Brentwood, MO)
    - Sewer Inspection Rebate Program (Costa Mesa, CA)
    - Sewer Lateral Inspection Program (Santa Barbara, CA)
    - Sanitary Sewer Backflow Prevention Device Program (Naperville, IL)
- Four programs no longer running:
    - Due to COVID-19 Pandemic (City of Kingston)
    - Lack of funding (Santa Barbara, CA)
    - Lack of enforcement / no political well (Miami-Dade, FL)
    - Reasons unknown (Golden Valley, MN)
- Sewer rates for residents remain the same regardless of age of home – some communities charge different rates based on home type (i.e. house / condo / townhome).
- Where testing of private laterals occurs during routine testing on the public side, the following measures are put in place to eliminate liability:
    - Written permission is required from the property owner (Miami Dade)
    - Property owner is notified of requirement for inspection to occur (Santa Barbara)
    - Private property testing is support by an ordinance or bylaw (Town of Fort Erie, Halifax, Santa Barbara)
- Drivers remain the same, no indication that political will is causing any programs to be cancelled or delayed. Extreme weather events / adaptation to climate change has emerged as a driver since 2014.
- Rebates including total dollar amounts and percentages have increased slightly in some communities to reflect the realities of increased costs.
- Several communities have put a hold on penalties due to COVID-19 pandemic and financial hardships already being experienced by residents.

Jurisdiction	Program Approach	Program Description	Primary Driver(s) for Program	Program Impacts	Program Costs and Source of Funding	References
CANADA						
Town of Fort Erie, ON **Population 30,000** Program for separated system	Incentive Approach	**Grants to Property owners** for the costs of repairs made to reduce extraneous flow. 100% reimbursement to a maximum of: ○ $100 for the removal of roof leaders from the sanitary sewer ○ $500 for the removal of existing sump pump connections from the sanitary sewer ○ $2,500 for the removal of foundation drains connections from the sanitary sewer ○ $1,500 for the repair or replacement of a leaking private sewer lateral ○ $1,000 for the installation of an approved backflow prevention device	History of overflows to environment: in 1987 the Niagara River was designated an Area of Concern in the Great Lakes Basin by the International Joint Commission. In response, Remedial Action Plan created by Environment Canada and Province of Ontario. Snowmelt events have led to loading and trucking sewage out of overloaded pump stations.	90% inspections now complete. Residential: 24% infrastructure failures found in inspections Public: < 5% infrastructure failures Over 3 years the Town reduced extraneous flow from about 60% to about 40%. Now working to reduce from 40% to 20%.	Costs: 1. Crescent Park: Overall cost $211,743 to date. Approx $850/lateral, includes public side inspections. 2. Outside of Ward 3: Overall cost: 221,516 to date. Approx $990/lateral, includes public side inspections. Funding: ○ Annual budget deliberations ○ Federal funding (2007 $130,000; 2008 $80,000) ○ Regional funding	Extraneous Flow Reduction Subsidy Program By-Law 68-06 Being a By-Law to Regulate the Management of a System of Sewer Works and Drainage Works (3.8.5)
	Targeted Inspection Approach	**Inspection Requirements from Municipality** to customers to arrange for in-home inspections to complete a video of all private side sanitary sewer laterals. Program targets inspections to most flood-prone areas.				
	Regulatory Approach	**Sewer Bylaw** specifies: ○ Owner must allow access to building or premises for inspection, maintenance, repair ○ If problem identified, owner is notified to fix. Owner will pay costs incurred directly, or it will be added to the tax roll for the property. If a lateral is found to be non-compliant, the Town may terminate water service or				

Jurisdiction	Program Approach	Program Description	Primary Driver(s) for Program	Program Impacts	Program Costs and Source of Funding	References
		perform the necessary repairs if the owner does not after sufficient notice. The Town may then recover the full cost of the work from the owner through municipal taxes.				
City of Thunder Bay, ON **Population 110,000** Program for combined system	Incentive Approach	2020 Residential Drainage Rebate Program**:** ○ Targets areas that experienced sewage-flooded basements during heavy rainfall events, particularly in older residential/commercial neighbourhoods where downspout connections to the sanitary sewer (instead of storm sewers) were most common. ○ The City contracted with a private not-for-profit organization, EcoSuperior Environmental Programs, to aid property owners: • Sump Pump - 50% of the invoiced cost up to a maximum of $1,500.00 including labour, materials, permit and taxes • Backflow Prevention Valve - 50% of the invoiced cost up to a maximum of $1,750.00 including labour, materials, permit and taxes • Disconnect Weeping Tile - 100% up to a maximum of $500.00 including labour, materials, permit and taxes • Installation of new Storm Sewer Connection - 50% of the invoiced cost to a maximum of $1,500.00 including labour, materials, permit and taxes • Rain Barrel Program was introduced as one alternative to redirect downspouts. The City offered 45-gallon rain barrels with a $20 discount, available only to city residents with a water account	Alleviating basement flooding: reduce inflow and infiltration with significant focus on reducing inflow sources. Prior to the program, 70 100 basements would flood several times per year. Information provided in 2022 indicates that uptake of the program has slowed in recent years – this may be in part due to the pandemic, and it could also be as a result of the fact that many homes have already completed upgrades.	Information from the 2014 report indicated that, in total, 786 properties were identified, 64% of which complied and disconnected their downspouts from the sanitary sewer. Those properties not able to disconnect (for various reasons), are being dealt with as road/ infrastructure upgrades occur. Estimated savings of $980,000 from reduction of inflow and infiltration from 2000 to 2006. In 2021, 27 applications for the Drainage Rebate program were received. In total, there have been 800 applications to the program since it began.	Property owner pays. Estimated savings of $17,000/year which would have historically been paid out in overtime to deal with rainstorm events (based on 2 events per year). Estimated cost savings from reduced insurance claims is approximately $60,000/year.	Melissa Davidson / melissa@ecosuperior.org Lindsay Menard / lindsay.menard@thunderbay.ca
City of Brantford, ON **Population 98,000** Separated system	Incentive Approach	**Private Sanitary Sewer Lateral Replacement Grant Program**: In 2014 the City began offering a grant of 50% up to $1,500 to replace an ageing sewer lateral. The intention is to proactively prevent backups and to benefit overall I&I reduction. Note that the City also took back ownership of the laterals from the property line to the main effective 2014. This is the only grant program for laterals in Canada found that applies where the property owner is only responsible for the lateral to the property line. **Basement Flooding Prevention Grant:** Provides up to $2000 to help lower the risk of flooding, eligible work includes; disconnecting downspouts, disconnection of weeping tiles from sewer and reconnection to sump pump, and installation of a backwater valve. Only available to homeowners in North-East Flood Remediation Study Area.	Proactive program to prevent sewer backups into homes, and to benefit the overall I&I reduction goals of the City.		Since the Program was established in 2014, $435,000 in grant funding has been provided for a total of 333 grants. Staff are recommending $50,000 to be approved to allow this successful Grant Program to continue in 2019.	Staff report – Funding for Private Sanitary Sewer Lateral Replacement Grant Program Basement Flooding Prevention
City of Kingston, ON **Population 123,000**	Incentive Approach (inflow)	As of winter 2022, this program has been suspended: **Preventative Plumbing Program**: to reduce basement flooding: provide a grant to disconnect downspouts, sumps, weeping tiles. ○ Grant program does not cover lateral repairs, but will cover a video inspection of lateral. ○ Program manager actively identifies catchments with high flooding, sends letters to property owners, then goes door-to-door. Where external visual inspection is not enough, a CCTV is offered to determine if any illegal connections.	Reduce risk of sewage backup to homes and secondary driver is reducing strain on whole system, particularly by eliminating illegal connections.	Since the program began in 2012, $1,610,000 in financial assistance has helped 1,050 Kingston homeowners, including with the removal of 163 illegal connections to the sanitary system [statement from 2018].		Bylaw 2008-192
	Regulatory Approach (laterals)	**Bylaw** for maintenance of laterals: ○ Updated bylaw in 2012 to include enforcement option for City to disconnect water for not repairing structural defects within 30 days of written notice. ○ As of 2014, City has new enforcement tool to issue tickets ($200) for non-compliance.				

Jurisdiction	Program Approach	Program Description	Primary Driver(s) for Program	Program Impacts	Program Costs and Source of Funding	References
City of Windsor, ON **Population 233,800** Separated and Combined system	Incentive Approach	Grant program for replacement of old sewer laterals. ○ Grants to replace sewer laterals that are over 20 years old and in disrepair ($2000, $4000 or 50% on arterial/collector roads). ○ City created a pre-qualified list of private drain connection contractors that are eligible for the grant. ○ City also has an "Eeling program" where the City conducts clean-outs up to 3 times in a 24-month period for free, as long as the clean-out is for City tree roots.	Property owner is responsible for the sewer lateral up to the main. This program assists owners with rehabilitation costs, and with free eeling related to City tree roots.	Properties per year that obtain the rebates: 2018: 110 2019: 79 2020: 85 2021: 72 Approximately 700 to 1,100 properties per year participate in the Eeling program to remove tree roots from laterals.		Bylaw 4921 for Servicing of Private Sewer Connections By-law 26-2008
	Regulatory Approach	Mandatory downspout disconnection program for certain areas. Exemptions will be made on a case-by-case basis.	Due to recent flooding			
Halifax Water, NS **Population 414,800** Separated, except in some older parts (program applies to separated)	Regulatory Approach: Mandatory Inspection Program	**Private Property Inspection Program**: The Stormwater Inflow Reduction (SIR) program includes smoke, dye and CCTV testing of private laterals to identify sources of inflow, or significant infiltration if found. ○ Where repairs needed, notices given to owners to fix; follow up notices given if work not completed. ○ Bylaw in place that enables various forms of enforcement: may shut off water, issue tickets, or put liens on properties (where funds are owing). ○ Program targets both residential and ICI; tends to focus more heavily on ICI. Target properties chosen each year by evaluating multiple criteria in a matrix. ○ Future plans: investigating options for point-of-sale requirements or other trigger (e.g. age of home/lateral); have had early discussions with realtor association regarding property disclosure forms.	Reducing overflows, system capacity and, later, in response to WSER (legislation for Municipal Wastewater Effluent, under the Federal Fisheries Act, enacted 2012).	Uptake significantly increased over the years, likely due to improvements in customer service and communication. Employed enforcement measure of shutting off water once (for a cross-connection, and only after years of discussion). Incident received a lot of media, and has likely led to increased uptake, particularly with ICI customers.	Funding: Utility operating budget	Halifax Regional Municipality Charter, sections 13, 61, 64, 79 Patricia Isnor / 902-483-8187
Regional Municipality of York, ON **Population 1.11 million** Separated system	Comprehensive I&I Strategy and Pilot Projects	In 2014, York Region was planning to conduct pilot studies to test effectiveness of specific rehabilitation techniques and methods, then will determine best management approaches moving forward. ○ Municipal programs: some local programs funded by developers in exchange for allocation of new units of development. In 2018, York Region launched a private-side I&I reduction pilot project in partnership with the local municipalities in two study areas. 63% of residents in the pilot study areas engaged with the Region and its representatives, resulting in 42% of residents signing up to participate in property inspections.	Sanitary sewers located on private properties make up more than 50% of York Region wastewater conveyance system in length. Experience in other municipalities has indicated that I&I sources on the private side can contribute 60%-80% of I&I in a wastewater system.	With information gathered in the pilot study, the Region is committed to support local municipalities in the development and implementation of new private-side programs, through a toolkit consisting of: • Standardized materials and messaging across the Region as education and outreach is critical to drive citizen participation • Program models that can be customized for program planning and initiation • Analysis of results through Region's flow monitoring program • Administrative processes and applications	2014 Budget: Estimated private side remediation program budget of $10 million for Phase 2 (inspecting and re-lining ~3,000 private sewer laterals)	2021 York Region Inflow and Infiltration Reduction Strategy Update
USA						
City of Lakeport, CA **Population 4,900** Separated system	Regulatory Approach: Inspection with Permits and Certificate Program	**Requirement for Certificate with Permit**: Ordinance requires private laterals be cleaned, inspected and tested for I&I by the owner at predetermined events – including when applying for a building or plumbing permit. 25-year certificate for watertight laterals, 10-year certificate for CCTV tested. Option to fine a noncompliance fee.	Reducing overflows to fresh water lake. No EPA order.			Ordinance 872 (2008)
City of Glendale, MO **Population 6,000**	Targeted Approach	**Refuse Bill (insurance program)** – added $7 to quarterly bill and saved in a separate fund for a Sewer Lateral Repair Program (1997). ○ Assistance for residents who have to pay for sanitary sewer lateral repairs between its connection with the sewer main and the house connection.	Regional: St Louis City began a sewer lateral insurance program in 1989. Most municipalities in the County followed, including Glendale	2,600 households and average around 90 applications per year, of that about 80% require repair.	Funding: Refuse bill every three months Property owner's annual contribution	tjones@glendalemo.org Sewer Lateral Repair

Jurisdiction	Program Approach	Program Description	Primary Driver(s) for Program	Program Impacts	Program Costs and Source of Funding	References
Separated system		○ The program does not pay for the cost of sewer cleaning to remove tree roots or buildups, rather that is the responsibility of the property owner/resident. ○ The program pays for point-of-break repairs, which means that the portion of the pipe that is defective is repaired. ○ Residents will be reimbursed up to $3000/year. If a problem is found, the CCTV video inspection will be paid for by the program.	in 1997. Note: The EPA issued orders to the regional sewer agency in 1994 due to CSOs and in 2007 due to continued overflows and basement backups; though it's unclear the level of contribution from Glendale.		is $50/year that is billed quarterly in increments on the City's sanitation bill ($12.50/quarter). $112,500 is collected annually as part of this program.	Program
City of Brentwood, MO **Population 8,000** Combined & separated systems	Incentive Approach	**Sewer Lateral Repair Program:** effective January 1, 2020 ○ For non-emergency repairs, property owner is responsible to obtain a minimum of three quotes ○ Intended to assist property owners who have continuous sewer blockages and no sanitary sewer service. Not to be used to satisfy a home sale contingency. Repair cost limit up to $3,500 remains – repairs above the $3,500 are the responsibility of the owner.	US EPA issued a CSO control policy in 1994 (applies to combined areas only – includes St Louis City). St Louis City began a sewer lateral insurance program in 1989. Most municipalities in the County followed, including Brentwood in 1997. In 2007, EPA issued MSD (the regional sewer agency) an Administrative Order due to continued overflows and basement backups.		2014 Information: Funding: $120,000 is collected annually as part of this program. Property owner's annual contribution is $28/year. In 2010, voters agreed to raise this to $50/year.	Sewer Lateral Repair Program
		(Program no longer running): Reimbursement to 100% (insurance program) – when a blockage or sinkhole is noticed by the property owner, the owner must call the Sewer Hotline, the City sends a company out to check the problem and if there is a problem, the City will pay to have it fixed. Residents are reimbursed up to 100%.				
City of Golden Valley, MN **Population 21,600** Program for separated system	Incentive Approach	**[No longer running, not able to find reason why] Grant Program:** ○ 2008 - Grants for lesser of $1,000 or 50% of the actual cost for separation. ○ 2009 - Grant for lesser of $2,000 or 50% of the actual repair cost. ○ Both programs ended May 2009 (no more funds).	City had been receiving surcharges from MCES, but since implementation of Point-of-Sale Program, the City is no longer receiving the surcharges.	57% properties have reached compliance More than 90% of the homes that are inspected need some kind of repair. Staff with the City review the real estate listings to ensure that all the homes for sale, have been inspected. Real estate agents and title companies now know about the program and support the City in making residents aware of the requirements. Review by outside consultant concluded that efforts in Golden Valley were successful in reducing the 10-year peak hour flow by 24%.	Costs: 2008 – 6 residents received a total of $2,982.75 from the foundation drain separation program. 2009 – 56 residents received a total of $82,745.38 from the service lateral grant program. Funding: Incentive funds from regional authority (MCES) grant program. Property owners pay required inspection fees: $250 residential, $750 non-residential.	City Code Chapter 3, Section 3.31
	Regulatory Approach	**Point-of-Sale Program (Jan 2007):** ○ Requires all properties to pass a sanitary sewer inspection and obtain a certificate before selling, advertising for sale, or transferring title. ○ Failure to comply may result in monthly utility bill charges ($500-$1,000) and possible loss of water service.				
	Targeted Approach	**Private Property Inspections** ○ Free inspections are conducted when the City is doing work in the area, and then homeowners can choose if they want to do the repairs at that time, or not.				
City of McMinnville, OR **Population 34,000** Program for separated system	Incentive Approach	Programs have not been updated since 2014 – currently looking into whether they should increase 10% up to amount, and the fine of $50/month. **Monetary Incentive**: part of the private sewer lateral replacement program. ○ Reimbursed 10% of their construction cost up to a maximum of $250. ○ To be eligible, property owners must construct an acceptable lateral replacement within the 90-day grace period. **Interest Program**: property owners who may have trouble finding financial assistance through banks or other lending agencies. ○ Interest shall accrue on the balance due at the prime interest rate plus 3.5%. It is important to note that this is not a "low interest" loan.	US EPA: City has been directed by EPA and the Oregon Department of Environmental Quality (DEQ) to control the overflow of untreated sewage into the Yamhill River, which occurs frequently during the rainy season.	In 2019, there was about 300 laterals inspections with approx. 100/150 of those needing repair.	Property owner pays to replace defective private sewer laterals.	Josh Adelman Josh.Adelman@mcminnvilleoregon.gov
	Regulatory Approach	**Repair Enforcement with Financial Penalty** ○ Problem laterals are identified by the City and property owners informed of responsibilities by letter. 90 days to repair/replace lateral or fine of $50/month. ○ Non-compliance accumulates and lien is placed on the property. ○ Properties will not be randomly selected for evaluation. The properties evaluated will usually be part of a comprehensive pipeline repair project where City pipes are				

Jurisdiction	Program Approach	Program Description	Primary Driver(s) for Program	Program Impacts	Program Costs and Source of Funding	References
		repaired first.				
City of Westlake, OH **Population 34,000** Program for separated system	Education	Information brochure providing information on sanitary sewer back-ups, and storm water infiltration.	After a major rain event in 2008, Engineering Department created a Mitigating Wet or Flood Basements Brochure			Mitigating Wet or Flooded Basement Brochure
	Targeted Approach	**Rehabilitation Program** undertaken in 8 basins. ○ Started in 1992 by only public side rehab, but still had flooding. Decided private side must also be rehabilitated. ○ 2014: completed 8 basins in total since 1992.	Flooding of streets and yards during intense rainfall events and surcharging of sanitary sewers within basements. Westlake has joint treatment with City of Rocky River, which received an Administrative Order from the EPA in 2009; unclear level of contribution from Westlake.	1992 – inspected, re-grouted and fixed as needed private laterals where dye in sewer. 2001 – re-lined private laterals. I&I was 80% reduced in the area. 2004 – re-lined private laterals, as well as manhole sealing and tight seal at mainline/ lateral interface. I&I was 95% reduced in area. Complaints reduced or non-existent. 2007 – similar to above. Complaints reduced, no flow data yet available. 2014 – 816 homes inspected; 417 repaired.	Costs: 1992 – $338,000 and only $5,000 under property owner responsibility. Funding: 1992 - property owners paid private portion. 2001-2007 - City decided to fund all private property costs in future projects because the private portion was estimated to be approx 1.5% of the project cost. Total Costs (up to 2014): $2.3 million (3.3 million "total")	
City of Eagan, MN **Population 67,400** Program for separated system	Incentive Approach	**Inspection Program:** ○ City pays 50% of required repairs. ○ Property owner may elect to have all or part of their portion levied as a special assessment against the property over 5 years at 4% interest. ○ Utility staff inspect for I&I sources when installing a water meter.	Regional surcharges from MCES if peak flows are not reduced (see MCES below). Focus is on disconnecting improperly connected sump pumps and drainage systems. A significant rainfall event resulted in excessive peak flow allocations to the regional collection system and treatment plant owned and operated by MCES. The addition of I&I into the sanitary sewer system was straining the City's equipment and infrastructure, resulting in higher sewer rates.	The City was able to inspect 99% of the private properties in less than five years. The inspections found that 5% of local properties had one or more factors contributing I&I to the sanitary sewer system: 850 repairs were made. Since the inception of the program, the City has seen a decrease of nearly 10% in wastewater being sent to its wastewater treatment facility - saving hundreds of thousands of dollars each year. The City also reduced sewer rates for its customers.	The City pays for inspections done by the company the City contracted with. If a homeowner chooses to have a plumber of their choice do the inspection they are responsible for the cost of the inspection.	City Code Section 3.40 to add Subdivision 10 City of Eagan Program Documents
	Regulatory Approach	**Monthly Fines on Utility Bills:** ○ Fines for non-compliance - a utility surcharge of $150 per month (single family residential) or $500 per month (non-single family residential). ○ City inspects properties in identified neighbourhoods. ○ Required inspections followed by Corrective Work Order / Compliance Certificate.				
	Education	**Public I&I Education Program:** ○ Education program before starting the private inspections. ○ Included newsletter articles, public meetings and spots on ETV (Eagan's TV stations).				
City of Berkeley, CA **Population 103,000** Program for separated system	Regulatory Approach	**Sewer Lateral Certificate** - prior to selling a property – including condominiums and other developments with shared laterals – are required to obtain a Sewer Lateral Certificate (SLC) under the following conditions: 1. By close of escrow for the transfer or sale of property (with some exceptions), unless a 6-month extension is granted prior to closing; OR 2. When obtaining a Building Permit for construction or remodel value over $60,000; OR 3. When the City finds that the private sewer lateral may be a public nuisance; OR 4. When a property owner elects to repair or replace their private sewer lateral. *In 2007, 250 properties had closed escrow without obtaining a Sewer Lateral Certificate (SLC). Subsequently, the property owners were issued a Notice of Violation and corrective action is required to fulfill the requirements of BMC 17.24. By end of 2007, 53% of these complied. Enforcement proceeding with remainder.*	US EPA order to East Bay MUD. It is estimated that half of the water that enters the City's sewer during wet weather comes from private property sewer lines, downspouts and yard area drains. Bylaw is for protecting the water quality of creeks, watersheds and the San Francisco Bay.	First year (Oct 2006 – Oct 2007): 1,251 applicants. 84% of properties issued certificates upon submittal and remaining issued deficiency notices. ○ 65% property transfer trigger ○ 14% major renovation trigger ○ 21% voluntary or unidentified After 1st year 80% of laterals were out of compliance. At current rate, will take 30 years to complete all work. .	As of January 1, 2022, the fee for private sewer lateral inspections will be $190. As of January 1, 2022, the fee for a private sewer lateral certificate will be collected in the amount of $150 as authorized by City Council Resolution 63, 262-N.S. The City offers a loan program to assist Berkeley low-income property owners to comply with BMC 17.24 requirements for private sewer laterals – this loan programs comes with several conditions	Berkeley Municipal Code, Chapter 17.24
City of Costa	Incentive	**No longer running: Sewer Lateral Assistance Program (up to 2017)**	The program was changed from the	Between 60-75 applications per year since	$150,000 per year in grants; $50,000	Resolution No.

Jurisdiction	Program Approach	Program Description	Primary Driver(s) for Program	Program Impacts	Program Costs and Source of Funding	References
Mesa, CA **Population 116,500** Program for separated system	Approach	Rebate 50% up to $1,250 for inspection, repair or replacement of lateral. *Recommendations* ○ Public Outreach Program was successful ○ Public readily gave permission for entry ○ Lateral renewal program was cost effective ○ Proposed to expand program to all 500 critical basins with excessive RDII 2014: SLAP program is still in place **New since 2017: Sewer Inspection Rebate Program:** The Costa Mesa Sanitary District (CMSD) is offering rebates to eligible residents who perform a closed-circuit television (CCTV) video of their sewer lateral or install a clean-out. Homeowners may participate every five years and are only eligible for one rebate payment (CCTV or cleanout installation). CCTV from a ground level clean-out to CMSD main = up to $200.00 CCTV from a roof vent or toilet flange to CMSD main = up to $250.00 Installation of a ground level clean-out (requires permit) = up to $500.00	SLAP to the SIRP because SLAP was retroactive, and SIRP is proactive which supports property owners in doing a CCTV on their laterals every 5 years. To prevent sewer backups and spills. “Sewer spills cause very expensive damage to the interior of a house and the environment, particularly the beaches.”	2018.	per year for staff costs No new information on project costs since 2014 report.	2007-742
City of Naperville, IL **Population 147,500** Program for separated system	Incentive Approach	**<u>Sanitary Sewer Backflow Prevention Device Program:</u>** Allows residents and business property owners to install the backflow prevention device of their choice, with the City reimbursing 50% of the cost.	Heavy rainfall events, and storm water causing backups in basement dwellings and businesses.	After significant rain event in 2017, approximately 80% of houses took advantage of the program.	Approximately $20,000 - $50,000 per year.	Chris Myers 630 420 6682
	Targeted Approach	**<u>Targeted Program:</u>** ○ Private lateral rehabilitation in high priority sewer basins (10 targeted areas). ○ Areas are selected by the following criteria: 1. Customer service calls; 2. Rain events; 3. Flow monitoring; and 4. Maintenance schedule.	Capacity: Flood situations force lids off of manholes leading to the combining of storm and sanitary flows, and to treatment plant being over capacity.		$2 million for sewer rehabilitation $4 million for the entire program Capital Budget	
City of Tacoma, WA **Population 212,000** Separated system	Incentive Approach	**<u>Residential Sewer Conservation Loan:</u>** The first of its kind Washington, covers up to 90 percent of side sewer repair or replacement costs. The loan features an interest rate at two percent below the prime rate (with a min of 4%) on loan amounts between $1,000 and $10,000. The loan is secured through a security interest (lien) on the project property. Side sewer repair or replacement must be for an existing structure. Applicants must apply for the loan before the side sewer replacement or repair is complete. Late fees waived and payment deferment plans have been made available during the COVID-19 pandemic.	Environmental compliance Effort to prevent back up into the sanitary systems. Opportunity to switch from septic to sewer when appropriate.		$500,000 in 2001 which was sufficient funds – currently the program is very sustainable with those receiving loans being required to begin payback within a month (and up to 10 years).	Stephanie Seivert sseivert@cityoftacoma.org Tacoma Municipal Code Chapter 12.08.720
	Regulatory Requirement for Education	**<u>Required Education Program</u>** Starting in 2010, real estate professionals are required to provide a side sewer educational flyer to buyers and sellers they are representing prior to the closing of a property. The City also provides the flyer to all permit applicants. The flyer recommends property owners locate and determine the condition of a side sewer.	Proactive program to complement public side efforts to reduce I&I.	No formal tracking of program impacts. Anecdotal information indicates that in the last few years (2019 and on) more new homeowners are contacting the City to participate in the loan program – coordinator of program(s) wonders if the real estate agents are no longer giving out the flyers. No real way to enforce the program.	Minimal	
City of Santa Barbara, CA **Population 420,000** Program for	Incentive Approach	**<u>No longer running, due to lack of funds: Grant Program:</u>** ○ $150 for inspection; Up to $2,000 or 50% for repair; permit fees waived ○ Low-interest loans for those needing financial assistance.	Spill prevention / reduction of sewage spills into storm drains *(no reference to EPA order found)*. Recent (2012) settlement with Channel keepers re: Clean Water Act will require the City to spend an additional $4.5 million over the next	Inspections: 1306 (residential), 313 (commercial), 29 (condo) from Jan 2007 to Feb 2010 ○ 930 residential laterals repaired over same period ○ 983 certificates issued over same period	Far more expensive than anticipated (> $600K in first year – 3 times more than estimated). Since January 2007, total program cost of $2,470,000: ○ < 1% ($7,600) for lateral	Municipal Code Chapter 14.46
	Regulatory Approach	**<u>Not currently running, due to COVID-19: Enforcement Program:</u>** ○ City identifies problem laterals & provides notices requiring repair. ○ City notifies property owner & required to fix or $150 penalty & referral to attorney’s				

Jurisdiction	Program Approach	Program Description	Primary Driver(s) for Program	Program Impacts	Program Costs and Source of Funding	References
separated system		office for enforcement. ○ Commercial properties required to inspect every 10 years.	5 years to improve its sewage system, reduce sewage spills; with a focus on those with highest risk of leaking into storm drains.	Over 95% have reach compliance	inspections only ○ 73% ($1,800,000) for lateral repair incentives ○ 11% ($270,000) for waived permit fees charged to our section. Does not include any additional costs of resources, marketing or legal fees. Capital Program Funding.	
	Education	**Certificate Program:** ○ Zoning Information Report (ZIR) at time of sale indicates if Certificate obtained & advises buyer of responsibility.				
		Sewer Lateral Inspection Program: ○ Property owners are responsible for maintaining the sewer lateral, or sewer pipe, that connects their house or building to the public sewer main. ○ Required to hire a City Certified CCTV Inspector ○ May receive notice from the City to indicate that requirement of inspection. Trigger for this include: defect identified through City sewer line, a Private Lateral Sewer Discharge originated on the property, application for a construction building permit.	The goal of the SLIP in 2022 is to eliminate private sewer spills in the city.	Program just started in July 2021 – so far about 30 homes have participated.		Sewer Lateral Inspection Program
City of Austin, TX **Population 950,800** Program for separated system	Incentive Approach & Regulatory Approach	**Financing (loan) Program** available with a minimum amount of $1000, and a maximum amount of $3000. ○ Available to homeowners of detached, single family dwellings or owner-occupied duplex with an active Utility account. ○ Prior to construction, the lateral must have been inspected – final installation must be inspected and approved by the Utility. ○ Utility buys down interest rate on the loan. ○ The Housing & Planning Department provides free replacement or repair of these lines for eligible Austin Water customers of a single-family home or duplex whose household income is 100% or less than the area Median Family Income (MFI). **Fines for Non-Compliance:** ○ City identifies with inspection and sends letter requiring fix within 120 days. Fine up to $500 per offense (each day non-compliant is a separate offence).	US EPA Administrative Order requiring City to take measures to prevent sewage overflows (1999). Also cite desire to reduce costs.	Private Lateral Grant Program started in 2013 and to date there have been just over 200 private lateral replacements completed in this grant program. No monitoring but have noticed an anecdotal change in areas where City grant program has been implemented.	Annual cost for the Private Lateral Grant Program is about $180,000 with total costs to date approximately at $1,000,000.	Ordinance No. 20070125-007 Greg Kirton
Milwaukee Metropolitan Sewerage District (MMSD), WI **Population 1.1 million** Primarily separated system (~6% combined)	Regional Targets and Required Compliance Plans Approach	**Regional I&I Targets (Limits)** and Community Compliance Requirements: ○ Made long-term peak wet weather management plan that sets standards for expected flows at each "metershed", then identifies if standard is exceeded, and requires offending municipality to create a plan that will bring it into compliance. Within 1.5 years, 8 municipalities had been notified of non-compliance and were creating flow reduction plans. ○ In 1998 MMSD adopted rules that municipalities must develop and implement an I&I management plan; and must enforce prohibited connection ordinances. ○ Region created a Policy Document for I&I funds clearly establishing the rational for private property I&I work, and what is eligible for funding. ○ Region has also aggressively pursued education program with respect to basement backups, including website and video.	Historically has had settlement with EPA/DNR for SSOs (early 2000s). Created a 2010 Facility Plan, then later a 2020 Facility Plan to reduce SSOs. Federal grant provided for private property efforts. Severe storms (2008 through to 2010) causing thousands of basement backups resulted in MMSD announcing a regional Private Property I/! (PPII) reduction program and developed a comprehensive PPII policy.		Program was authorized with an expected total budget through 2020 of $62 million.	MMSD 2020 Facilities Plan Private Property I&I Policy Documents and Work Plan
King County, WA **Population 1.5 million** Separated systems except in some parts of Seattle	Agency led Inspection and Rehabilitation Projects	**Rehabilitation Projects where Cost Effective**: Started Regional I&I Control Program in 2000 – now in place 22 years. ○ Completed several pilot projects and assessed cost effectiveness ○ Evaluate projects on a case-by-case basis to determine cost effectiveness ○ Developed standards, guidelines and policies for lateral inspection and remediation ○ Found that basins with I&I less than 3 gallons per minute per property were not good candidates (too many properties would have to be rehabilitated to achieve target reductions In March 2022, King County published several updates and resources on their website, including a Side Sewer Best Management Practices (BMP) Toolkit, a Know Your Sewer System card, and 2 technical reports: Final Regional Best Management Practices	King County and City of Seattle agreement to upgrade combined sewers under settlement with US EPA in 2013.	Data collected indicates large percentage of I&I originates from private property. Recently completed larger scale I&I control project (Skyway) that tested assumptions from the smaller pilot projects. Found the I&I reductions were much lower than predicted, but still significant.	6-year control study of 10 pilot projects cost $41 million. Combined funding from King County and local agencies.	Executive's Recommended Regional I&I Control Program (2005) Task 600 Private Side Sewer Program Identification and Relevance

Jurisdiction	Program Approach	Program Description	Primary Driver(s) for Program	Program Impacts	Program Costs and Source of Funding	References
		Development and Final Inspector Training and Certification Program Development.				to the King County Wastewater Service Area
Miami-Dade County, FL **Population 2.4 million** Program for separated system	Regulatory Approach & Targeted Approach	**<u>Enforcement Program:</u>** ○ Identified private property defects through smoke testing and property owners were required to make repairs to their laterals as required by Miami Dade County Ordinance. ○ The County simply the property owners and they made repairs to the system. ○ Subsequent re-smokes of the area verified if the repairs were completed. *<u>Insurance Issues:</u> minor property damages usually the result of testing and or repair crew equipment that have inadvertently encroached on private property and damaged easement and ROW areas.* **<u>Comprehensive Lateral Pilot Program (began in 2004)</u>**: $13 million dollar project designed to determine if a private lateral testing and inspection program was a viable solution to the reduction of peak flow. Update from 2006: • Public outreach was conducted to receive permission from property owners – approximately 96% agreed to have their sewer inspected (about 70% of total responses) • Private side laterals which failed were televised and smoke tested to prove to the property owner that they were defective Update from 2022: • Program is no longer running, as the County has no way to enforce the program and the political will to fund it is not there.	Series of US EPA Consent Decrees (1994/5 and 2013) in relation to sewer spills. 2013 Consent Decree requires substantial repair of 3 WTPs and sewer system at an estimated cost of $1.6 billion (Miami-Dade County Clean Water Act Settlement).	Enforcement Program was 85% effective. Average of over 700 lateral replacements per year. Average daily flow: 116 MGD's in total reduction (over a 14 year period). CLIP: Inspected 6,749 laterals. 85% effective in repairing laterals (repaired / replaced over 1200 laterals). Estimated cost to pump and treat $8,645/GPM. Estimated cost for mainline inspection/repair $362/GPM (23 times more cost-effective than pump and treat). Estimated cost for lateral inspection/repair $2,308/GPM (about 3.7 times more cost effective than pump and treat). Total Program $1,011/GPM removed.	Both programs funded by combination of: Bond Funds, Capital Revenue Funds, and O&M Funds. Overall cost of the enforcement program is now over $400 million dollars. Cost of the 43 basin CLIP program approx. $13 million: ○ $4m - mainline inspection/ repair ○ $4m - lateral inspection ○ $4.5m - lateral repair ○ $0.5m - admin costs NOTE: lateral inspection / repair includes public side upper lateral Funding: $1 million dollar grant for the implementation of the CLIP program.	
Metropolitan Council of Environmental Services (MCES), MN (Twin Cities) **Population 3 million +** Program for separated system	Regional Targets and Surcharge Approach	**Regional Surcharge**: MCES continuously monitors volumes of wastewater from municipal systems, and requires the municipalities to reduce peak flows to the regional collection system, or charges them. ○ 1993 – 2003 MCES provided grants to communities to reduce I&I, but not sufficient ○ In 2006 instituted surcharge for clear water; communities that have I&I reduction plans can opt out of the surcharge in order to make investments in I&I reduction (must match or exceed surcharge) ○ In 2014, a significant wet period followed by a storm, resulted in 46 communities exceeding I&I goal peak flows, resulting in each having to develop a work plan that required completion in 4 years. ○ MCES is now working to promote more efforts by communities on private property I&I ○ Eligible private property I&I mitigation activities included sewer lateral repair or replacement and / or disconnection of foundation drains. Property owners can apply for reimbursement by MCES of actual costs (up to $2,000) for qualifying repairs of sewer laterals.	History of working to improve water quality in the Mississippi has led to implementation of more proactive approaches. Capacity concerns in certain locations (e.g. Golden Valley). Also SSOs, private property spills, using up capacity for future growth.		I&I reduction is funded by communities with amounts equivalent or exceeding avoided surcharges. 2013 received $1,000,000 in grants for local I&I reduction programs. In recent years, grant funding administered by MCES for private property I&I mitigation activities has been limited to $900,000 per year.	<u>Water Resources Management Policy Plan</u>

Appendix B – Bylaw Examples (Canadian)

Responsibility of Owner

Sample Bylaw, Metro Vancouver (2011 Report, Appendix H):

> *PART 2 – (6) to (9) – Required Maintenance Standard*

Town of Fort Erie Bylaw 68-06:

> *3.8.2 Every owner shall maintain their private sewer lateral or private sewage collection system and private drainage lateral or private drainage or storm water management systems, including appurtenances connected thereto, in good working order and condition, and adequately protected from blockage and freezing. Private sewer laterals and private sewage collection systems shall be maintained free from drainage and storm water inflow and infiltration.*

Halifax Water Rules and Regulations for Water, Wastewater and Stormwater Services:

> *64.(1) The Commission may from time to time undertake testing or inspections to identify and locate connections that convey stormwater into a wastewater facility.*
> *(2) No person shall, without the prior written approval of the Commission connect, cause to be connected, or allow to remain connected to a wastewater facility or plumbing installation, any piping fixtures, sump pumps, downspouts, fittings appliances or like equipment or device in a manner which allows or may allow stormwater to ingress or flow into a wastewater facility.*
> *(3) The Commission may direct a person to discharge stormwater to a stormwater system, a surface area or watercourse.*
> *(6) The Commission may determine, in its discretion, that this Section does not apply to existing premises connected to an existing combined sewer system or to new premises intended to be connected to a combined sewer system, provided that those premises are not serviced or able to be serviced by a separate stormwater system.*

Cleanouts Required

Sample Bylaw, Metro Vancouver (2011 Report, Appendix H):

> *PART 2 – (10) to (12) – Cleanouts Required [optional]*

Town of Fort Erie Bylaw 68-06:

> *3.8.4 Inspection tees shall be installed in all private sewer laterals at the expense of the Owner as specified in Appendix "1" attached hereto, and shall be maintained in good order and accessible at all times, and free from drainage water inflow and ground water infiltration.*

Entry and Testing

Sample Bylaw, Metro Vancouver (2011 Report, Appendix H):

> *PART 2 – (14) to (17) – Entry and Testing by City*

City of Kingston Sewer bylaw 2008-192:

> *<u>14.1 Inspection powers</u>*
> *The Operating Authority or any person designated by it as inspector for purposes of this by-law may, at reasonable times enter onto any land on which the City supplies sewer services for the following purposes:*
>
> > *a) to inspect, repair, alter, or disconnect the sewer lateral or storm sewer lateral, machinery, equipment and other works used to supply sewer services to the building or land;*
> > *b) to inspect, install, repair, replace or alter any related metering equipment;*
> > *c) to inspect the discharge of any matter into the sewage system of the City or into any other sewage system the contents of which ultimately empty into the municipal sewage system and may conduct tests, measure flow and take samples for this purpose; or*
> > *d) to investigate or determine if this by-law, an order, or condition to any permit or agreement is being complied with.*
>
> *<u>14.4 Entry on land – notice requirements</u>*
> *Whenever an inspector exercises a power of entry pursuant to this By-law, the inspector shall:*
>
> > *a) provide reasonable notice of the proposed entry to the occupier of the land by personal service or prepaid mail or by posting the notice on the land in a conspicuous place for three consecutive days prior to entry;*
> > *b) where the proposed entry is an inspection to determine compliance with this By-law the inspector must provide reasonable notice by means of personal service only;*
> > *c) in so far as is practicable, restore the land to its original condition where any damage is caused by the inspection; and*
> > *d) provide compensation for any damage caused and not remedied.*

Halifax Water Rules and Regulations for Water, Wastewater and Stormwater Services:

> *61.(3) The Commission may require a wastewater or stormwater service connection to be inspected and brought into compliance with these regulations.*
> *64.(1) The Commission may from time to time undertake testing or inspections to identify and locate connections that convey stormwater into a wastewater facility.*

Town of Fort Erie Bylaw 68-06:

> *3.8.7 Every Owner shall, at all reasonable times and upon reasonable notice given and request made, allow and provide access to their building or premises to the Engineer for the purpose of conducting a compliance inspection and taking corrective action, and/or to carry out work, all as permitted under this Schedule, the Ontario Building Code, or the Municipal Act 2001.*
> *3.9.1 The Engineer and/or Chief Building Official or any person duly authorized by the Corporation shall be allowed access to a building or premises, at all reasonable times, and upon reasonable notice given and request made to the Owner, Operator or Customer, for the purpose of inspecting, maintaining, repairing, disconnecting or reinstalling a sewer service connection or drainage service connection as permitted by this Schedule or by the Ontario Building Code or by the Municipal Act 2001.*

City of Brantford Sewer System Regulation – Use:

ARTICLE 11 POWER OF ENTRY AND INSPECTION

11.1 The City may enter upon any part of a property at any reasonable time, to inspect the discharge of any substance into the sewage works or storm sewers and may conduct tests and take samples of the discharge.

11.2 The City's power of entry described in subsection 11.1 may be exercised by an employee, officer or agent of the City, including a municipal by-law enforcement officer.

11.5 When entering a property in accordance with articles 11 and 12 of this by-law the person exercising the power of entry shall provide identification to any person requesting identification during the course of the inspection and,

- *a) may be accompanied by a person or persons under his or her direction; and*
- *b) shall not enter or remain in any room or place actually used as a dwelling unless one of the conditions set out in section 437 of the Municipal Act, 2001 are met.*

11.6 When entering a property in accordance with articles 11 and 12 of this by-law the exercise of such powers shall be limited to reasonable times, unless an emergency situation requires otherwise.

11.7 For the purposes of an inspection to determine compliance with this by-law or any order issued under this by-law or to otherwise enforce this by-law a municipal by-law enforcement officer may,

- *a) access any drain pipe, interceptor, maintenance access hole, catch-basin or other discharge point connecting, directly or indirectly, to the sewage works or storm sewers, including by making or requiring necessary excavations;*
- *b) make and record observations, such as by taking photographs, notes, video recordings and sound recordings;*
- *c) require the production for inspection of documents or things relevant to the inspection;*
- *d) require information from any person concerning a matter related to the inspection;*
- *e) alone or in conjunction with a person possessing special or expert knowledge make examinations or take tests, samples or photographs necessary for the purposes of the inspection.*
- *f) inspect and remove documents or things relevant to the inspection for the purpose of making copies or extracts; and*
- *g) do such other things that are reasonably necessary for an enforcement officer to effectively carry out the inspection.*

11.8 A demand by a municipal by-law enforcement officer to respond to reasonable inquiries under subsection 11.7 (e) or to produce documents under subsection 11.7 (f) may be made by telephone, letter or e-mail and such demand shall be deemed to be made in the course of an inspection.

11.9 No person shall refuse or neglect to give, produce or deliver any access, information, document or other thing that is requested by a municipal by-law enforcement officer carrying out an inspection.

11.10 No person shall hinder or obstruct or attempt to hinder or obstruct the City, its municipal by-law enforcement officers, employees or agents from carrying out any powers or duties under this by-law.

Require Fix of Defect

Sample Bylaw, Metro Vancouver (2011 Report, Appendix H):

> *PART 3 – (18) to (20) – Certificate Required – Identified Defect*

City of Kingston Sewer bylaw 2008-192:

> *3.2 Maintenance of sewer lateral – Owner*
> *Every Owner of a property to which sewer service is provided shall be responsible for the maintenance, repair, and replacement of the sewer lateral from the building to the property line. Any and all structural defects of a sewer lateral shall be repaired by the Owner of the property being serviced. Should the City become aware of any such structural defect, and upon written notification to the Owner, the said structural defect is not repaired within thirty (30) days of the date of the notification or within such time as the Operating Authority may deem necessary, then the City may turn off the municipal water supply to the property. If the City is ordered to restore the water supply, then the City may repair the structural defect in the sewer lateral pipe at the Owners expense. In so doing the City of Kingston shall only reinstate the property to a safe condition and all final restoration shall be the Owners responsibility. The City of Kingston shall not be held responsible for any damages to the Owners property arising from such work such as damage to root systems or other landscaping features located along the sewer lateral. If flushing or rodding of a sewer lateral is required to remove an obstruction located anywhere between the building and the sewer lateral stub, the Owner or occupier shall be solely responsible for the cost of removing the obstruction.*

Town of Fort Erie Bylaw 68-06:

> *3.8.5 Should a leakage occur from a private sewer lateral or private sewage collection system, or from a sewage holding tank, or from a septic tank system or any other private sewage treatment system; the Owner shall be bound to take corrective action and to complete the repairs of the said leakage, at the Owner's expense, within seven (7) calendar days after being duly notified by the Corporation of such leak detected. In the event of non-compliance with this provision by the Owner, the Corporation may at its sole discretion exercised by the Engineer, discontinue the supply of water from the Water Works until the Owner has made the necessary repairs. All repairs are to be inspected and approved by the Chief Building Official prior to backfill.*

City of Brantford Sewer System Regulation – Use:

> *ARTICLE 12 ORDERS*
> *12.1 Where the General Manager has reason to believe that a contravention of this by-law has occurred, the General Manager may issue and serve an order requiring the person who has contravened the by-law or who has caused or permitted the contravention or the owner or occupier of the property on which contravention of the by-law occurred to discontinue the contravening activity.*
> *12.2 Where the General Manager has reason to believe that a contravention of this by-law has occurred, the General Manager may make an order requiring the person who has contravened the by-law or who has caused or permitted the contravention or the owner or occupier of the property on which contravention of the by-law occurred to do work to correct the contravention.*
> *12.3 Where a person is issued an order described under sections 12.1 and 12.2 and in the opinion of the City fails to do a matter or thing required by the order by the date specified in the order, the City may cause the matter or thing set out in the order to be done at the person's expense.*

> *12.4 For the purpose of doing any matter or thing under section 12.3, employees of the City and any contractor, consultant or other person authorized by the City may enter upon the property referred to in the order at any reasonable time.*

Require Inspection for Construction, Renovation or New Connection

Sample Bylaw, Metro Vancouver (2011 Report, Appendix H):

> *PART 3 – (21) to (23) – Certificate Required – Construction, Renovation or New Construction*

District of North Vancouver bylaw 6656:

> *14. Re-Use of Existing Sewer Connections*
>
> *All building permits of value greater than $150,000 will require a new sewer (sanitary) connection unless:*
>
> > *(a) the existing connection(s) is less than 30 years old;*
> >
> > *(b) a current video inspection meeting MMCD or equivalent standards is undertaken by a qualified inspector and provided to the District; and*
> >
> > *(c) the video inspection establishes to the satisfaction of the Director that the connection(s) is in good condition with no defects.*

City of Surrey bylaw 16611, 2008:

> *39. When an application for a service connection accompanies a building permit with the construction value greater than $100,000 or where a parcel is being redeveloped, the following shall apply to the service connection and the building sanitary sewer:*
>
> > *(a) if the service connection and building sanitary sewer is less than 30 years old, the owner must provide a video inspection and recommendation for the City to review. The owner shall repair or replace the connection if the City determines that the connection is not adequate for service or has excessive damage;*
> >
> > *(b) if either the service connection or the building sanitary sewer is 30 years old or older, a replacement or new service is required;*
> >
> > *(c) all no-corrode, asbestos cement or clay service pipes of any age or condition shall be replaced;*
> >
> > *(d) any shared service connections and building sanitary sewer shall be replaced; and*
> >
> > *(e) all costs associated with the above are the responsibility of the owner.*
>
> *The General Manager, Engineering may waive part of the above requirements if the General Manager, Engineering deems the cost of the replacement excessive.*

Fees, Recovering Costs

Sample Bylaw, Metro Vancouver (2011 Report, Appendix H):

> *PART 5 – (51) – Fees*

Town of Fort Erie Bylaw 68-06:

> *3.9 Compliance Inspections and Corrective Actions*
>
> *3.9.2 Any costs incurred by the Corporation in conducting inspections and subsequent reporting or in effecting any corrective action, shall be payable to the Corporation by such Owner, Operator or Customer; and if not paid, the costs shall be added to the tax roll for*

the property and collected in the same manner and with the same priority as municipal taxes.

Financial Assistance, Monetary Incentive

Sample Bylaw, Metro Vancouver (2011 Report, Appendix H):

PART 5 – (52) to (63) – Financial Assistance and/or Monetary Incentive for Voluntary Inspection and Repairs

City of Brantford Program (not in the bylaw – text from website):

Private Sanitary Sewer Lateral Replacement Grant Program

This is a financial assistance program for homeowners to help offset costs for the replacement of old sanitary sewer laterals on private property. This incentive program is being offered in the interest of helping homeowners prevent or reduce the occurrence of sewer blockages.

City of Windsor bylaw 4921 (n.b. the owner is responsible for the lateral to the main):

PART B – SEWER CONNECTION REPLACEMENT POLICY

1.REPLACEMENT

The City will provide a sewer replacement rebate for a complete sewer replacement calculated as follows:

1. Where there is a fronting Public Sewer that can be used in a complete sewer replacement, the City will provide a rebate being the lesser of the following:

  (i) The amount set out in the City's Schedule of Fees, as amended from time to time. It is the intention of this provision that the City's Schedule of Fees will be the relevant rate,

  (ii) Fifty Per Cent (50%) of the total cost of the complete replacement,

  (iii) The unit cost (being the total cost divided by the total length) multiplied by the length of the replacement on the public highway.

Enforcement, Penalties

Sample Bylaw, Metro Vancouver (2011 Report, Appendix H):

PART 6 – (64) to (74) – Failure to Comply – Offence and Penalties

Halifax Water Rules and Regulations for Water, Wastewater and Stormwater Services:

Offences

79. Where the Commission believes that a person has contravened any provision of these regulations, it may commence proceedings by issuing a Summary Offence Ticket in accordance with the Nova Scotia Summary Proceedings Act.

Suspension or Refusal of Service

13.(3) In the event of a violation of these Regulations by a person or Customer, including liabilities and obligations owed to the Commission by any Customer under a private contract for services entered into between the Commission and such Customer, the Commission may refuse or immediately suspend service to such Customer, and may continue such refusal or suspension until the violation has been cured.

Town of Fort Erie Bylaw 68-06:

> *<u>3.9 Compliance Inspections and Corrective Actions</u>*
> *3.9.3 Should any Owner or Operator or Customer of a service connection refuse entry to any authorized officer, inspector, employee or Agent of the Corporation for the purposes of any compliance inspection, maintenance, repair, disconnection or reinstallation and/or other corrective action, under the provisions of this Schedule or the Ontario Building Code, or the Municipal Act, 2001; the Corporation may, at its sole discretion exercised by the Engineer, on the provision of seven (7) calendar days notice, discontinue the supply of water to the Owner or Operator or Customer of the service connection until such required inspection and corrective action or required work has been completed to the satisfaction of the Corporation.*

Appendix C – References and Links

All references in Appendix C have been updated in 2022.

Examples of smoke testing notices and procedures for Canadian municipalities:

City of Sarnia: Sanitary sewer smoke testing

City of Thunder Bay: Sewer smoke tests

Regional District of Nanaimo: Sewer Line Smoke Testing

Region of Peel: Sanitary sewer smoke testing

Township of Guelph: Sanitary Sewer Smoke Testing

Canadian references and links:

City of Brandon: 2021 Flood Protection Subsidy Program

City of Brantford: Water, Wastewater and Stormwater Master Servicing Plan Update – 2051 Amendment

City of Brantford: Private Sanitary Sewer Lateral Replacement

City of Cornwall: Sewers and Sewer Laterals

City of Charlottetown: Inflow Reduction Program

City of Halifax: Water By-Law

City of Halifax: Stormwater Inflow & Infiltration

City of Kingston: Grant program

City of Kingston: By-Law NO. 2008-192

City of Moncton: Backwater Valve Incentive Program

City of Windsor: Eeling Program

City of Windsor: By-Law Number 9-2019

Halton Region: Enhanced Basement Flooding Prevention Subsidy Program

Newfoundland & Labrador: Final Report Study on Identification and Characteristics of Sewer Overflows in Newfoundland and Labrador.

Niagara Falls: Avoiding Sewer Backups

Town of Fort Erie: By-Law NO. 68-06

York Region: Inflow / Infiltration Reduction Strategy: Industry Best in Class Review

York Region: Inflow / Infiltration Reduction Strategy

Kesik, T. (2015). Best Practices Guide: Management of inflow and infiltration in new urban developments. Institute for Catastrophic Loss Reduction. Available at: https://www.researchgate.net/publication/280558457_Best_Practices_Guide_Management_of_Inflow_and_Infiltration_in_New_Urban_Developments

Kovacs, P., Guilbault, S., & Sandink, D. (2014). Cities adapt to extreme rainfall; Celebrating local leadership. Institute for Catastrophic Loss Reducation. Avalable at: http://www.iclr.org/images/CITIES_ADAPT_DIGITAL_VERSION.compressed.pdf

Sandink, D. (2013). Urban flooding in Canada; Lot-side risk reduction through voluntary retrofit programs, code interpretation and by-laws. Available at: http://www.iclr.org/images/Urban_Flooding_in_Canada_-_ICLR_-_2013.pdf

US References and Links:

City of Berkeley, CA: Sanitary Sewer Program

City of Costa Mesa, CA: Sewer Inspection Rebate Program

City of Des Peres, MO: Lateral insurance program

City of Florissant, MO: Sewer Lateral Insurance Program

City of Glendale, MO: Sewer Lateral Repair Program

City of Laguna Beach, CA: Staff report

City of Portland, OR: Waste Discharge Permit

City of Portlan, OR: Private Sewer Connections – Article

City of Tacoma, WA: Required realtor package

City of Westlake, OH: Lessons learned during sewer rehabilitation on public and private property

King County, WA: http://www.kingcounty.gov/environment/wastewater/II.aspx

Milwaukee Metropolitan Sewerage District (MMSD): Municipal PP I&I Resource Page

San Francisco Public Utilities Commission, CA: Sewer Lateral Program Financial Plan