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Regional Source Control Program

2017 Annual Report

Parks & Environmental Services | Environmental Protection

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REGIONAL SOURCE CONTROL PROGRAM
2017 ANNUAL REPORT

EXECUTIVE SUMMARY

Introduction

The Capital Regional District (CRD) Regional Source Control Program's (RSCP) goals are to protect sewage collection and treatment facilities, public health and safety, and the marine receiving environment by reducing the amount of contaminants that industries, businesses, institutions and households discharge into the district's sanitary sewer systems. Source control is widely accepted as a cost-effective and essential first step in sewage treatment in all major urban areas throughout North America.

The program regulates approximately 2,000 businesses through industrial wastewater discharge permits, authorizations and 11 sector-specific codes of practice (CoP).

2017 Program Activities

The RSCP continued to apply a "sector-by-sector" approach to CoP inspections, focusing on the mechanical, car wash, fermentation and food services sectors. Overall compliance rates for CoP, permitted industrial facilities and facilities operating under authorizations were 96% in 2017.

The main activities and accomplishments of the program in 2017 are outlined below.

Industrial, Commercial and Institutional Liquid Waste Regulation

- Sector-by-sector inspections included the mechanical, car wash, fermentation and food services sectors.
- 1,067 CoP inspections conducted.
- 767 food services operations were inspected, with an additional 170 follow-up visits for compliance and/or further support.
- 67 automotive (mechanical) repair sector, 26 vehicle wash, and 21 fermentation operation inspections were conducted.
- All permit inspections scheduled at the beginning of 2017 were completed within the year.
- Six new permits were issued (total of 41 active) and 11 new authorizations were issued (total of 92 active).

Monitoring

- Monitoring targets set for 2017 were achieved.
- On average, there were 2 scheduled audit monitoring events per permit.
- The program focused on the fermentation sector, with follow-up compliance monitoring also conducted at 1 dry cleaning facility, which had exceedances in 2016.

Enforcement

- Five tickets were issued under the CRD Ticket Information Authorization (TIA) Bylaw, all to food services operations.

Contaminants Management

- Staff continued to conduct research into emerging contaminant characterization of fermentation, particularly for microbreweries with an eye towards contaminant loadings and consistent requirements across sub-sectors.

- Staff refreshed the existing Medications Return Program in response to a request from Saanich Peninsula Wastewater Committee to explore areas to increase protection of wastewater dewatered sludge and biosolids.
- Staff commissioned a study by Royal Roads University (RRU) Environmental Science undergrads to research the effectiveness of dry cleaning treatment works used within the CRD.
- The program issued a letter to all waste discharge permit and authorization holders requesting safety data sheets of all industrial process chemicals and cleaning agents.

Contaminant Reductions

- For the 9th consecutive year, Ganges Wastewater Treatment Plant mixed liquor results met the Class A criteria for all metals, including mercury. Saanich Peninsula Wastewater Treatment Plant dewatered sludge monitoring was started in 2013 and all results up to and including 2017 have also met the Class A criteria for metals.

Significant Incident Response

- There were 6 significant incidents formally reported: 2 involving fats, oils and grease (FOG) build-ups; one involving fuel oil and another involving discoloured discharge at CRD pump stations; 1 involving a sewer overflow due to discharge from a construction site; and 1 involving suspended solids entering storm sewer from a sanitary cross-connection.

Residential Outreach

- Staff partnered with the Vancouver Island Health Authority and the Health Products Stewardship Association to launch a new campaign to increase public awareness and participation in the BC Medication Return Program. This campaign, and past initiative, maintains the region's high rate of proper disposal per capita. Approximately 11.5 tonnes of medications were collected in the region, one of the highest rates of return in BC.
- Staff developed new engagement and behaviour change tools for the Clean Green 2.0 campaign, which focuses on environmentally-safe alternatives to household cleaners.

Business Outreach

- Inspectors continued to deliver program outreach material to local businesses, including RSCP sector-based posters and guidebooks.
- Staff continue to maintain and, when necessary, update sector-based posters, guidebooks and webpages.

Initiatives

Program staff undertook the following initiatives:

- worked with municipal staff to resolve various FOG blockages in sewers.
- completed a water audit for a post-secondary institution, conducted audits for 3 small franchise/retail/office space audits, and completed detailed follow-ups for 3 previously audited facilities.
- commissioned a study by RRU Environmental Science undergrads to research the effectiveness of dry cleaning treatment works used within the CRD.
- collaborated with other CRD program and municipal staff to investigate sewer and storm discharges from the "wet-cutting" sector.
- collaborated with municipal business licensing staff to share new business information for review against permitting requirements.
- worked with BC Ministry of Environment and Climate Change Strategy (MOE) staff to ensure consistent interpretation and application of BC Hazardous Waste Regulations with RSCP permittees.

- participated in the CRD Planning & Protective Services “Linkage Committee” to explore opportunities for integrated messaging across the organization.
- developed and co-hosted a Source Control symposium at the 45th annual British Columbia Water and Wastewater Association Conference & Trade Show in Victoria, BC.

Program Planning and Development

- The program hired a consultant to review the CRD Sewer Use (Bylaw No. 2922) and suggest improvements since the last amendment in 2006. Staff will revise the Sewer Use Bylaw, which is anticipated to launch in late 2019.

Performance Measures

- The percentage of businesses with a rating of “overall compliance” was 96%.
- For the 9th consecutive year, the percentage of mixed liquor and dewatered sludge samples that met Class A standards for metals was 100%.

Wastewater Trend Assessment – Macaulay and Clover Points

- Staff retained a consultant to complete a detailed statistical assessment of the 1990-2015 wastewater data in 2017, with results confirming patterns observed in the previous trend assessment (up to and including the 2011 data). The current trend assessment found that concentrations were typically higher at Macaulay Point than Clover Point, but due to higher flows at Clover, the opposite pattern was observed for contaminant loadings.
- Metal and conventional parameters have been more frequently detected in the wastewater samples than in the past, but with metals generally exhibiting decreasing concentrations and loadings over time, and conventional parameters generally exhibiting slightly increasing concentrations and loadings. The increasing conventional parameter trend is largely attributable to water conservation measures that have been making the sewage more concentrated. Organic parameters have also generally experienced decreasing trends in detection frequency, concentrations and loadings. There were a few examples of priority pollutants that experienced increasing concentrations or loadings over the time period, but overall, the assessment provided additional evidence of stable or decreasing concentrations and loadings of contaminants in the Macaulay and Clover wastewaters.
- Program staff discussed assessment findings with internal marine monitoring staff to determine the need for additional regulatory requirements and/or educational outreach for the few contaminants that experienced increasing trends.

Wastewater Trend Assessment – Saanich Peninsula

- Trend assessment of wastewater quality indicated generally decreasing concentrations and loadings over the 2000-2015 time period, with similar trends to the previous assessment. The data indicate significant trends in detection frequency for approximately 20% of the frequently detected parameters, most notably general increases in detection frequency for metals and conventional parameters, and decreases for organic parameters.
- Increased frequency over time appears to be related to improved analytical methods; however, some elevated detection limits were observed in recent years for organic parameters (e.g., di-n-butyl phthalate). The results are incorporated into the overall marine monitoring program to evaluate contaminant trends associated with the wastewater system.

REGIONAL SOURCE CONTROL PROGRAM
2017 ANNUAL REPORT

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

REGIONAL SOURCE CONTROL PROGRAM
2017 ANNUAL REPORT

1.0 INTRODUCTION

Source control is a waste management strategy aimed at reducing the amount of contaminants that industries, businesses, institutions and households discharge to sewers. In 1993, the Capital Regional District (CRD) committed to the development and implementation of a region-wide source control program and adoption of a Sewer Use Bylaw (Bylaw No. 2922) under the *BC Environmental Management Act*. The bylaw is the main regulatory instrument for source control in sanitary sewer systems, creating a level playing field for businesses and institutions throughout the district. The program also develops fact sheets, provides technical guidance and promotes best management plans (BMP).

The goals and objectives of the CRD's Regional Source Control Program (RSCP) (the program) are documented in the Saanich Peninsula Liquid Waste Management Plan (1996) and the Core Area Liquid Waste Management Plan (2000). The most recent independent review of the program was completed in June 2015 (KWL 2015).

The program goals are as follows:

- protect the marine receiving environment adjacent to the CRD's sewage outfalls
- protect sewage facilities belonging to the CRD and its member municipalities
- protect the health and safety of sewage workers and the general public
- protect the quality of sewage sludge and biosolids
- protect treatment plants against upsets
- consistently apply the program for all users of CRD sewage facilities

The Core Area Liquid Waste Management Plan (LWMP) and Saanich Peninsula LWMP contain commitments to prepare an annual report on the RSCP for submission to the CRD Board and the BC Ministry of Environment and Climate Change Strategy (MOE). This annual report presents a summary of program activities and accomplishments for the period January-December 2017, and provides a brief account of initiatives planned for 2018.

Source control is a key component of effective wastewater treatment and will form an integral part of the core area wastewater treatment strategy moving forward. The current program meets or exceeds Canadian best practices for source control and the CRD is a nationally recognized leader in this field.

2.0 BACKGROUND

2.1 Policies and Procedures

The following policies and procedures are used to provide guidance and ensure fair and consistent application of the CRD Sewer Use Bylaw and associated enforcement, cost recovery and monitoring activities.

2.1.1 Policies Approved by the CRD Board

- Regional Source Control Program Enforcement Policy
- Regional Source Control Program Fees and Charges Policy
- Sewer Use Bylaw Process of Review
- Regional Source Control Program Code of Practice Management Policy – Food Services

2.1.2 Operating Procedures

- Sampling and Analysis Procedure Manual
- Analytical Result Reporting Procedure
- Non-domestic Waste Discharge Reporting Procedure
- Significant Incident Reporting Procedure
- Procedure for Managing Contaminated Water Produced During Firefighting Operations in the CRD

The policies and procedures are periodically updated to reflect changes within the program.

2.2 Sewage Collection Areas and Sewage Facilities

The CRD Sewer Use Bylaw applies to any discharge of non-domestic waste into a sewer that is connected to a sewage facility operated by the CRD. The RSCP is designed to ensure that the bylaw and its associated policies and procedures are applied consistently within the separate collection areas for these sewage facilities.

The CRD owns and operates 8 wastewater treatment plants, as shown in Table 1. Four of these plants—Macaulay Point, Clover Point, Saanich Peninsula and Ganges—receive significant industrial, commercial or institutional wastewater flows, while the remaining 4 are small plants receiving mostly residential flows.

The sewage flows into each treatment plant are reported in the annual compliance monitoring reports for CRD sewage outfalls.

The 10 CRD municipalities, 3 electoral areas and 6 other participating areas with sanitary sewers were regulated under the RSCP in 2017. Estimated annual sewage flows contributed by each participating area, over the period October 1, 2016-September 30, 2017, are listed in Table 2.

Table 1 CRD Treatment Plants and Sewage Collection Areas – 2017

CRD Sewage Treatment Plant	Sewage Collection Areas
Macaulay Point	Victoria (west), Esquimalt, Saanich (west), View Royal, Colwood, Langford, Department of National Defence (DND), Esquimalt First Nation, Songhees First Nation
Clover Point	Victoria (east), Oak Bay, Saanich (east)
Saanich Peninsula	Sidney, Central Saanich, North Saanich, Pauquachin First Nation, Tseycum First Nation, Institute of Ocean Sciences
Ganges	Township of Ganges (Salt Spring Island Electoral Area)
Maliview	Maliview area (Salt Spring Island Electoral Area)
Schooner Way	Buck Lake area (Southern Gulf Islands Electoral Area)
Canon Crescent	Magic Lake Estates (Southern Gulf Islands Electoral Area)
Port Renfrew	Port Renfrew (Juan de Fuca Electoral Area)

Table 2 Annual Sewage Flows 2016-2017

Participant	Estimated Annual Flow (m^3/year)*	Percentage of Total Flows
Saanich	9,519,763	26.68
Oak Bay	3,026,216	8.48
Victoria	12,523,977	35.10
Esquimalt	2,217,351	6.21
View Royal	847,419	2.38
Colwood	1,117,514	3.13
Langford	2,313,223	6.48
Sidney	1,462,104	4.10
Central Saanich	1,402,683	3.93
North Saanich	490,948	1.38
Esquimalt First Nation	17,818	0.05
Songhees First Nation	231,025	0.65
Pauquachin First Nation	35,511	0.10
Tseycum First Nation	11,509	0.03
Institute of Ocean Sciences	3,067	0.01
Department of National Defence	154,538	0.43
Ganges Sewer	159,549	0.45
Maliview Sewer	18,123	0.05
Magic Lakes Estates Sewer	103,868	0.29
Port Renfrew Sewer	22,861	0.06
Total Flow	**35,679,068**	**99.99%**

Note:
*Yearly flows cover the period October 1, 2016-September 30, 2017

3.0 REGIONAL SOURCE CONTROL ACTIVITIES AND ACCOMPLISHMENTS – 2017

RSCP activities and accomplishments in 2017 are discussed under the following broad groups of activities:

- industrial, commercial and institutional liquid waste regulation
- enforcement
- contaminants management
- contaminant reductions
- significant incident reporting
- outreach
- data management
- revenue and expenditures
- planning and development
- performance measures

3.1 Industrial, Commercial and Institutional Liquid Waste Regulation

3.1.1 Regulatory Background

The Sewer Use Bylaw (CRD Bylaw No. 2922) serves as the main regulatory instrument for source control within CRD sanitary sewer systems. The bylaw specifies the various regulatory conditions under which facilities must operate if they discharge non-domestic waste into a sanitary sewer. The regulatory conditions for businesses include operation under waste discharge permits, authorizations or sector-specific Codes of Practice (CoP). Under the RSCP Enforcement Policy, staff make reasonable efforts to resolve issues through cooperative measures. Where education proves ineffective, punitive measures are available including tickets under the Bylaw.

Following adoption of the Sewer Use Bylaw in August 1994, the RSCP focused primarily on identifying, inspecting, assessing and permitting larger industrial facilities, and preparing authorizations for smaller commercial and institutional dischargers operating within the district. This process was largely completed over the period 1995-1998. Waste discharge permits require ongoing management, inspection and periodic amendment to accommodate changes in site-specific processes, practices and discharge conditions. New businesses continue to be assessed for operation under permits or authorizations each year. For further information on permits and authorizations see sections 3.1.2 and 3.1.3.

In 1998, the focus of the program shifted toward development, adoption and implementation of CoP, each as a separate schedule in the Sewer Use Bylaw, which regulate discharges from larger numbers of smaller commercial and institutional facilities operating in the district. The first regulatory CoP, considered unique in North America, were adopted in 1999 and inspections and enforcement for these codes commenced the following year. By the end of 2003, 11 CoP had been adopted. All codes were developed using extensive stakeholder involvement to help ensure their practicality and acceptance within each sector. For further information on CoP, see Section 3.1.4.

The Sewer Use Bylaw and its associated policies and procedures have been amended periodically during the first 12 years of the program, largely to accommodate adoption of CoP, but also to add new restricted waste limits and a structure for cost recovery. In 2016, staff began the process of assessing and reviewing the Sewer Use Bylaw to ensure it continues to provide an adequate level of protection.

3.1.2 Waste Discharge Permits

Waste discharge permits are site-specific regulatory documents, issued to businesses or institutions under the CRD Sewer Use Bylaw, that outline requirements for wastewater pre-treatment, effluent quality, monitoring and reporting. Waste discharge permits are issued to facilities or operations that discharge significant non-domestic wastewater flows (greater than 10 m^3/day) or wastewater containing high loads of restricted wastes or specified chemical contaminants into the sanitary sewer. Table 3 provides a summary of waste discharge permit activity in 2017.

Table 3 Summary of Waste Discharge Permit Activity in 2017

Waste Discharge Permit Activity	2017
Permits active (at year end)	41
New permits issued	6
Permits closed	9
Permits amended	5
Permit site inspections (including evaluations for new permits)	75

At the end of 2017, there were 41 active waste discharge permits being managed by RSCP staff. The majority of these permits were ongoing, with no expiry date. Six new temporary permits were issued: 3 for short-term discharges of cruise ship grey and black wastewater to sanitary sewer; 1 of which expired unused, and 3 for excavation dewatering.

Permit management activity includes reviewing discharger self-monitoring reports on a monthly or quarterly basis, preparation of compliance letters, meetings and regular phone contact with permittees and site inspections. Permit managers are also responsible for comparing CRD audit sampling data to permittee self-monitoring data and submitting permit fee billing information to CRD Finance.

All permit inspections scheduled at the beginning of 2017 were completed within the year. Throughout 2017, inspection staff continued their permit confirmation process, which will likely take several years to complete. This includes conducting investigations into potential new non-domestic waste discharge permits or authorizations in known “hot spots” within the region (e.g., industrial parks), or those identified through municipal engineering department contacts or business licensing staff.

3.1.3 Authorizations

Letters of authorization are issued under the Sewer Use Bylaw in cases where overall contaminant loads to sanitary sewer are low or where discharges are predicted to have a minimal impact on collection and treatment systems and/or the receiving environment. Authorizations contain site-specific discharge requirements and best management practices designed to decrease the impact of the discharge or limit the potential for illegal discharges. They are normally issued without expiry dates. Some authorizations have self-monitoring and/or reporting requirements.

Authorizations are commonly issued to regulate unusual discharges or discharges from small groups of similar operations, such as ship and boat waste facilities, funeral homes, and sani-dumps. They can also be issued to businesses where a CoP is either planned or under development, or where requirements differ from those specified in a code (e.g., an alternative treatment technology, such as an automatic grease recovery device in a food services business rather than a grease interceptor).

Inspections are carried out on a periodic basis by RSCP staff with an emphasis on those authorizations, which had previously been regulated under permits or those, which include operations discharging priority contaminants. Table 4 summarizes authorization activity in 2017.

In 2016, all of the recreation facilities that were previously regulated under the Code of Practice for Recreation Facility Operations were moved to authorization. This move was due to the high variety of discharge practices occurring, and this code will, therefore, be repealed from Sewer Use Bylaw No. 2922 in the next amendment.

Table 4 Summary of Authorization Activity in 2017

Authorization Activity	2017
Authorizations active (at year end)	92
New authorizations issued	11
Authorizations closed or transferred to codes or permits	8
Authorizations amended	7
Authorization site inspections (including evaluations for new authorizations)	76

At the end of 2017, there were 92 active waste discharge authorizations being managed by RSCP staff. The majority of these were ongoing, with no expiry date. Eleven new authorizations were issued over the year: 2 for short-term discharges of wastewater created during the installation of cure-in-place lining for municipal water pipelines, 2 food production facilities, 1 recreation facility, 1 printing facility with alternative treatment works, 1 ship and boat waste facility, 1 stone cutting facility, 1 kitchen equipment cleaning company, 1 temporary permit for the discharge of recalled product, and 1 aviation wash treatment facility.

3.1.4 Codes of Practice

3.1.4.1 Background

The CRD has made commitments in the Core Area LWMP and Saanich Peninsula LWMP to the development and implementation of CoP to regulate non-domestic waste discharges from commercial and institutional sectors to the district's sanitary sewers. The RSCP defines CoP as “regulatory documents containing mandatory sanitary sewer discharge standards for specific industrial, institutional or commercial sectors.” Table 5 lists the 11 CoP in effect.

CoP include mandatory requirements for waste treatment, inspection, maintenance and record keeping for businesses and institutions discharging non-domestic wastes to sanitary sewer. They are believed to be among the first of their type to be adopted in North America. RSCP staff have prepared plain language guidebooks for each code sector explaining the applicable regulations and providing best management practices to help businesses achieve compliance and improve environmental performance. These guidebooks are also accessible through the program’s webpage.

Table 5 Summary of RSCP Codes of Practice (Bylaw No. 2922)

Code of Practice	Adoption Date
Food Services Operations	November 24, 1999[1]
Dry Cleaning Operations	November 24, 1999[2]
Photographic Imaging Operations	November 24, 1999
Dental Operations	November 22, 2000
Automotive Repair Operations	December 12, 2001[2]
Vehicle Wash Operations	December 12, 2001[2]
Carpet Cleaning Operations	December 11, 2002
Fermentation Operations	December 11, 2002
Printing Operations	December 11, 2002
Laboratory Operations	December 10, 2003
Recreation Facility Operations	December 10, 2003

Notes:
1 Code amended December 2001 and March 2003
2 Code amended December 2003

3.1.4.2 Code of Practice Inspection Summary – 2017

In 2017, the RSCP continued to emphasize customer service and support as part of CoP inspections, in addition to ensuring compliance with the CoP requirements. This involves making every effort to educate regulated operations, provide guidance, and in some cases feedback through lab analysis of effluent quality, sometimes at the cost of multiple visits to the same establishment.

Five inspectors conduct the CoP inspections, in addition to managing the RSCP permits and authorizations. During front-line interactions with businesses, the inspectors can also provide auditing and reporting services for other CRD programs, technical services for other Parks & Environmental Services projects or programs, as required, and participate in the development and implementation of outreach initiatives.

Table 6 provides a summary of CoP inspection activity in 2017. The sector estimates shown in the table are the numbers of active operations estimated within each sector at the beginning of each year. The total number of site inspections (1,067 in 2017) includes first (or primary) inspections within an inspection cycle and repeat (or follow-up) inspections to confirm compliance status.

Table 6 Summary of Code of Practice Activity in 2017

Code of Practice (Est. Sector Size – 2017)	% of Sector Inspected in 2017
Automotive Repair (202)	33%
Carpet Cleaning (34)	9%
Dental (124)	0.8%
Dry Cleaning (7)	14%
Fermentation (21)	100%
Food Services (1225)	77%
Laboratory (22)	18%
Photographic Imaging (67)	8%
Printing (21)	10%
Recreation Facility (na**)	na
Vehicle Wash (38)	68%

Notes:

*Includes both primary and repeat inspections. Some inspections were conducted on facilities that were deemed, through the inspection to have "no regulated waste". In that case, the facility would not be included in the sector size estimate, but the inspection would be counted.

**All existing recreation facilities previously regulated under CoP were moved to individual authorizations in 2016.

The "sector-by-sector" review process includes inspecting all the businesses due for an inspection in each sector for baseline compliance, reviewing the CoP for any necessary amendments or updates, and updating data for new and/or newly sewered facilities. Sectors of focus in 2017 were automotive (mechanical) repair, vehicle wash, fermentation, and food services. Other sectors were visited only for "follow-up" inspections.

The inspection team utilized program spatial tools for planning the inspections in broad geographic areas, working each sub-region as a team. The businesses inspected were comprised of those within the existing Cross Connection and Regional Source Control Information Management System (CRIMS) database, and also facilities identified through an online search, cross-referencing the CRD Cross Connection Control (CCC) Program and a BC Assessment code query.

Starting in 2016, dischargers operating treatment works on site were inspected annually or biennially: automotive (annually), dental (biennially) and dry cleaning sectors (annually starting in 2018). This change was based on risk associated with priority contaminants. The non-discharging businesses in these sectors (i.e., sending business waste for off-site treatment or operating as a storefront) will be inspected every 3-5 years.

Expanding on the work characterizing distillery wastewater in 2016, a review of the remainder of the sub-sectors of the fermentation sector was completed. Wastewater strength from u-brews and microbreweries operating under the CoP and breweries operating under permit were compared.

The RSCP sponsored a student project with the RRU Environmental Science Program to investigate operational effectiveness of commonly used dry cleaning wastewater treatment units. The research showed a key element in improving the performance of tetrachloroethylene (PERC) capture and re-use, and will serve to inform businesses in better waste management practices.

Rigorous food service inspections are a constant every year, due the sector's large size (>1,200 regulated businesses) and potential to impact sewer infrastructure through grease blockages. Of the 937 inspections conducted, 170 were repeat inspections. The majority of those repeat inspections focused on assisting the facility to comply with regulatory requirements, such as proper maintenance of existing grease interceptors (GI).

In response to a gap in understanding of the new definition of confined spaces, a consultant was hired to do a hazard assessment of GI located in crawl spaces and small basements throughout the CRD. Sites were categorized and low or moderate hazards and staff were trained in proper WorkSafeBC procedures for entry.

3.1.5 Coordinated Inspections

3.1.5.1 Coordinated Significant Incident Responses

There were 6 significant incidents formally reported: 2 involving fats, oils and grease (FOG) build-up, 1 involving fuel oil and another involving discoloured discharge at CRD pump stations, 1 involving a sewer overflow due to discharge from a construction site, and 1 involving suspended solids entering storm sewer from a sanitary cross-connection.

3.1.6 Monitoring

RSCP staff carried out the following types of monitoring in 2017: permit compliance, authorization compliance, CoP and key manhole monitoring. All wastewater samples collected in 2017 were analyzed by a contract laboratory using standard analytical procedures specified in the RSCP Sampling and Analysis Procedure Manual. Monitoring of dewatered sludge produced at the Saanich Peninsula Waste Water Treatment Plant (SPWWTP) commenced in March 2013. Table 7 provides a summary of RSCP monitoring activity in 2017.

Table 7 Summary of RSCP Monitoring Activity in 2017

Monitoring Events	2017
Permit compliance	61
Authorization compliance	22
Code of practice	8
Key manhole	19
SPWWTP influent	8
SPWWTP dewatered sludge	12
Ganges influent	1
Ganges mixed liquor	12

3.1.6.1 Permit Compliance Monitoring

Businesses operating under waste discharge permits are required to carry out self-monitoring of their wastewater for a range of parameters on a specified regular basis. This data is normally submitted to RSCP staff on a monthly or quarterly basis for compliance assessment. An important component of the RSCP is the collection and analysis of audit samples from each permitted site twice per year. This is done to verify compliance and confirm that the self-monitoring data being submitted are representative of discharges from each permitted site. RSCP staff normally collect these samples throughout the year following a pre-arranged schedule. Additional sampling events are carried out, as necessary, on suspected problem discharges from permitted sites.

The average number of scheduled audit events per permit in 2017 was 2. The goal of collecting audit samples from each permitted site twice per year was achieved at all but 1 permit site (due to ongoing issues with the site's communication of its activities to RSCP staff). Two permit sites were sampled 3 times, due to their enforcement status as discharger under review (DUR). One permit site was sampled 4 times, due to unusual fluctuating results in their effluent quality.

The environmental science officer responsible for managing a specific permit reviews the data submitted by the permittee. If a significant difference is detected between permittee self-monitoring results and RSCP audit results, the permittee is contacted and an investigation into the discrepancy is initiated.

The majority of all audit results obtained in 2017 were not significantly different from self-monitoring results reported from the same site. This indicated that most of the self-monitoring results being submitted by permittees had been collected and analyzed in an appropriate manner, as required by each permit.

Since RSCP audit monitoring is carried out in accordance with strict quality assurance procedures, it provides reliable information when calculating characteristic contaminant levels or loads for a particular industry or business type. This information is useful for planning purposes in specified collection areas.

3.1.6.2 Authorization Compliance Monitoring

Monitoring was carried out in 2017 at 19 businesses operating under authorizations with self-monitoring requirements, with 3 follow-up visits conducted at 2 business with initially high sample results. The RSCP monitoring provides, at minimum, an annual check on the quality of effluent being discharged by businesses known to have reported restricted waste generation or handling on site. The results of this monitoring indicated that discharges from authorizations in 2017 were generally in compliance with Sewer Use Bylaw restricted waste limits.

3.1.6.3 Code of Practice Monitoring

A sector-focused approach to CoP monitoring was implemented in January 2012. The approach involves focusing on fewer sectors per year, but inspecting and sampling the entire sector, where possible, rather than a portion of it. This focused monitoring is coordinated with inspections in order to address any compliance issues, which may influence monitoring results.

The new monitoring approach generates a comprehensive overview of the composition of the wastewater within each sector and provides information on the effectiveness of specified treatment works reducing contaminant loads. The data generated also assists businesses in meeting the restricted waste criteria defined in the CRD Sewer Use Bylaw (Bylaw No. 2922).

Businesses operating under CoP are not required to sample their own wastewater and report results to the RSCP. Compliance with a CoP is usually achieved by installing the required properly-sized treatment works, carrying out regular maintenance and record keeping.

In 2017, CoP monitoring was carried out on 1 of the 11 regulated sectors; fermentation. Follow-up inspections and monitoring were also conducted at 1 dry cleaning facility that had exceedances in 2016, as recommended in the *Regional Source Control Program 2016 Annual Report*.

- **Fermentation**

  In 2017, a review of the fermentation CoP was initiated and 21 sites were inspected. Of these sites, samples were taken from 6 facilities. All 6 facilities were microbreweries, chosen based on their production volumes and the lack of historical data.

  Composite samples were collected from each facility over the course of 1 normal production day. The goal was to collect a composite sample that was representative of what goes to sanitary sewer from a microbrewery on an average day.

  Samples were analyzed for biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), pH and temperature. Chemical analytical results were evaluated against Schedule "B" Restricted Waste Criteria established in the CRD Sewer Use Bylaw (Bylaw No. 2922), and allowable concentrations granted to breweries that are under permit, which are 1,800 mg/L and 2,500 mg/L for BOD and COD, respectively, hence referred to as the 'limits'.

  All facilities were in compliance for maintaining their treatment works under the CoP; however, only 1 of the 6 sites had analytical COD results below the bylaw limit and zero facilities had analytical BOD results below the bylaw limit. Four of the facilities were able to meet the bylaw limit for TSS and 2 facilities were able to meet the bylaw limits for the pH range of 5.5-12, all other sites had pH results below 5.5.

  While the flows were much higher for permitted facilities, wastewater strength was significantly lower than for microbreweries. It was acknowledged that for some permitted facilities, years of monthly data was available while only 1 or 2 sets of sample results were available for each microbrewery. It was recommended that all microbrewery facilities should be regulated under authorizations to collect adequate data for determining when wastewater strength and volume triggers for permits are reached. The review of the fermentation sector is discussed in greater detail in Section 3.3.

3.1.6.4 Key Manhole Monitoring

Key manhole monitoring is carried out to monitor for contaminants originating from sources within wide sanitary sewer collection areas. This includes monitoring at 2 residential sites and 2 DND sites within the Macaulay Point and Clover Point collection areas. It also includes 1 residential site and 1 Victoria International Airport site within the SPWWTP collection area.

- **Residential Sites**

  Residential (or domestic) key manhole monitoring has been carried out by RSCP staff since 1996. This sampling has provided information on background levels of typical contaminants found in residential wastewater and the data has been used to predict contaminant loads from domestic sources for planning purposes.

  The 2017 residential sampling program included sampling events at Dean Park (North Saanich), Harling Point pump station (Oak Bay) and Lang Cove pump station (Esquimalt) in January, April, July and October. All events included sampling and analysis for a wide range of parameters, including priority contaminants. There were 2 exceedances of Sewer Use Bylaw restricted waste limits at the Harling Point pump station. In April, there was a TSS result of 636 mg/L, and in October there was a sulfide result of 1.03 mg/L.

- **DND Sites**

  In 2017, key manhole sampling was carried out at the Esquimalt pump station, serving the DND Dockyard area in April, July and October, and at the DND Colwood pump station in March and October. In 2017, there were 4 exceedances of the Sewer Use Bylaw restricted waste limits. At DND Dockyard, TSS was in exceedance of the limits in April and July with results of 820 mg/L and 444 mg/L, respectively. Chloride was also in exceedance of the limits at DND Dockyard in July with a result of

2,400 mg/L. DND Colwood had 1 exceedance of total polycyclic aromatic hydrocarbon (PAH) with a result of 0.11 mg/L in April.

- **SPWWTP Collection Area Sites**

  Monitoring at the Airport #5 site was continued and samples were collected in March and October. All parameters were within Sewer Use Bylaw restricted waste limits.

3.1.6.5 SPWWTP Influent and Dewatered Sludge Monitoring

Monthly grab samples (for metals analysis) and 4 composites (for metals and priority pollutant analysis) of SPWWTP influent were collected annually by RSCP staff in past years. Monthly grab sampling was discontinued in June 2007, following a consultant's review of the plant's influent/effluent sampling program. The monthly grab samples were replaced by quarterly triplicate composite sampling (on 3 consecutive days) beginning in April 2008. This triplicate composite sampling is conducted by CRD Marine Monitoring Programs staff in January, April, July and October, on behalf of the RSCP.

Golder Associates Ltd., (2013), recommended that SPWWTP monitoring could be reduced to biannual triplicate 24-hour composite sampling with single 24-hour composites collected in the remaining 2 quarters. As a result, there were 2 triplicate influent sampling events carried out by Marine Monitoring Programs staff at SPWWTP in 2017, those scheduled in January and July. Single 24-hour composite samples were collected in April and October.

Twelve composite dewatered sludge samples were collected by CRD SPWWTP Operations staff for analysis in 2017. Daily samples were combined into weekly composites, which were submitted for moisture, metals and weak acid dissociable (WAD) cyanide analysis on a monthly basis, with a field duplicate submitted in February and September.

3.1.6.6 GWWTP Influent and Mixed Liquor Monitoring

As in past years, a single (grab or composite) sample of influent was collected at the Ganges Waste Water Treatment Plant (GWWTP). The 24-hour composite sample collected in July 2017 was submitted for priority pollutant analysis.

In 2017, 12 mixed liquor (treatment plant wastewater mixed with activated sludge) samples were collected by GWWTP Operations staff for analysis. Grab samples were collected on a monthly basis (with a field replicate taken in February and September). Samples were submitted for moisture and metals analysis.

The data are used to identify contaminants of concern, provide ongoing information on contaminant variability, loads and trends at the treatment plants, and provide input to planning initiatives.

3.2 Enforcement

The district has adopted a stepwise approach to enforcement of the Sewer Use Bylaw, as outlined in the Regional Source Control Program Enforcement Policy. This enforcement policy classifies offences, outlines enforcement steps and includes use of cooperative measures, such as increased communication, education and monitoring, to resolve issues of non-compliance. The policy was originally approved by the CRD Board in February 1997, and was last amended in November 2006.

The CRD Ticket Information Authorization (TIA) Bylaw contains fines (tickets) that have been set for specific offences under the Sewer Use Bylaw and its associated CoP. These fines were last amended in January 2018.

Enforcement activities are directed at ensuring or restoring discharger compliance with the terms and conditions of the Sewer Use Bylaw, waste discharge permits, authorizations and CoP. Enforcement action is applied in an escalating manner that is reasonable, fair, consistent and impartial. Warnings, tickets, orders and fines are issued, as necessary, in cases of continuing non-compliance.

3.2.1 Operations Regulated By Waste Discharge Permit

Of the 41 active waste discharge permits in place at the end of 2017, 28 sites were in “full compliance” with their permits and the Sewer Use Bylaw. One permit was at “staff assessment”, 1 site was classified as a DUR and 7 sites were considered to be “in progress”, but still in compliance with their permits under the enforcement policy. The enforcement levels and numbers of permits at each level are summarized in Table 8.

Table 8 Summary of Waste Discharge Permit Compliance – 2017

Enforcement Level	Number of Permits
Full Compliance	28
Step 1	2
Step 2	4
Step 3	2
Staff Assessment	1
Discharger Under Review (non-compliant)	1

Above Step 3, a significant escalation of enforcement action occurs, including notification of compliance status by letter, increased inspection or monitoring frequency, staff assessment of treatment works or procedures and scheduling of meetings to discuss remedial actions. Commitments and requirements agreed to at these meetings are confirmed in a follow-up letter to the permittee. Further non-compliance incidents can result in elevation from staff assessment to DUR status. Dischargers at the DUR level or above are considered to be non-compliant with their permits.

Operations having DUR status must prepare and submit a detailed compliance plan for approval by the deputy sewage control manager. A 90-day period is allowed for the preparation of this plan. This period allows a discharger to hire a consultant to help determine appropriate actions to achieve compliance. Progress meetings are held with the discharger after 30 and 60 days to measure progress, fully communicate the intent of any requirements and clarify any outstanding issues. A compliance plan, once approved by the deputy sewage control manager, becomes a compliance program that usually forms part of the discharger's waste discharge permit through an amendment.

If no acceptable compliance plan is received within the 90-day period, an order may be issued under the *Environmental Management Act* to set conditions for discharge, or a lawyer's letter is issued. Failure to comply with an order or a lawyer's letter will result in consideration of legal action.

Four permit sites classified above Step 3 were subject to assessment by RSCP staff in 2017. These sites included:

- A septage disposal facility was escalated to DUR level for sulfide exceedances in 2015 and remained there throughout 2017. The permittee submitted a detailed compliance plan, which was accepted by RSCP staff. Exceedances continued and in October 2017, the facility was informed they would be issued tickets for continued infractions. Treatment was increased in December 2017 and results appeared to improve. The facility remained under DUR through the end of 2017, as RSCP staff continued to monitor the effectiveness of changes to practices and treatment upgrades.
- A municipal public works facility was escalated to ‘Staff Assessment’ level in 2016 for failing to operate their authorized equipment works, sample wastewater in accordance with authorized procedures and keep required records. They remained under ‘Staff Assessment’ until a report was received in January 2017 outlining improved sampling procedures. Subsequent inspections showed improvement in monitoring and maintenance procedures.

- A food processing facility was under 'Staff Assessment' due to repeated biological oxygen demand (BOD) exceedances. Personnel changes, equipment malfunctions and maintenance issues appeared to be the cause of the exceedances. The facility is working on improving their policies and procedures in order to reduce their effluent strength.

- A microbrewery had ongoing issues with failing to report in 2017. Since the permit was issued in April of 2016, there were repeated issues of missing self-monitoring samples and reports. Through the enforcement of this offense, staff became aware that the TIA did not include specific penalties related to sampling and reporting for permits and authorizations. Bylaw No. 2922 was amended in January 2018 to address this (sections 3.6 and 3.7 were added). The TIA Bylaw (Bylaw No. 1990) was also amended to include associated fines of $1,000 for permits and $500 for authorizations.

No charges were laid against waste discharge permit holders under the Sewer Use Bylaw during 2017.

3.2.2 Operations Regulated by Authorization

A small group of the total number of authorizations issued is scheduled for inspection each year based on the types of contaminants regulated, the contaminant levels, discharge volumes and the overall impact of discharges from these operations. Discharges from authorizations are considered to have a relatively minor impact in comparison to discharges from permitted facilities.

At the end of 2017, 87 of 92 inspected businesses were in full compliance with their authorizations, 3 were at a Step 1, 1 was at Step 2, and 1 authorization was under 'Staff Assessment'. There were 82 inspections carried out at sites operating under authorizations in 2017.

An aircraft wash treatment facility was classified under 'Staff Assessment' in April 2017, as a result of maximum daily flow exceedances. Communication was increased and a compliance plan was received in April 2017. It is expected construction will be completed in 2018 to correct the issue.

The overall compliance level ("full compliance" or "in progress") for the total 92 authorizations active at the end of 2017 was 90%.

3.2.3 Operations Regulated by Codes of Practice

The stepwise approach to achieve compliance is applied to all CoP sectors in a similar way to dischargers operating under permits or authorizations, as outlined in the enforcement policy. Dischargers are classified as being in "full compliance" if they have been inspected and no unsatisfactory issues are identified. Dischargers having committed offences, up to and including Step 3 are classified as being "in progress" and those at the DUR level and above are classified as being in "non-compliance" with the code. A summary of the CoP enforcement results for inspections carried out from the implementation date of each code to 2017 is presented in Table 9.

Table 9 Code of Practice Enforcement Summary – From Implementation Date to End of 2017

Code of Practice	% Full Compliance[1]	% In Progress[2]	% Non-Compliance[3] (DUR)
Automotive Repair	95%	3%	0
Carpet Cleaning	97%	3%	0
Dental	93%	6%	0
Dry Cleaning	71%	29%	0
Fermentation	100%	0%	0
Food Services	94%	4%	0.4%
Laboratory	64%	23%	0
Photographic Imaging	99%	0%	0
Printing	95%	5%	0
Vehicle Wash	71%	13%	0

Notes:

1 Percentage of active operations, regulated within the sector and in compliance with all requirements of the code at the last inspection – including sites with required treatment works and those using off site waste management.

2 Percentage of active operations, regulated within the sector classified at Step 1, 2 or 3 of the enforcement policy at the last inspection date.

3 Percentage of active operations, regulated within the sector classified as DUR at the last inspection date.

4 Some of the totals do not add up to 100%, when some regulated businesses within a sector have not yet been assessed.

Most CoP enforcement actions to date have been associated with implementation of the food services code, which regulates one of the largest business sectors in the district. This sector has been very cooperative during application of the escalating approach to enforcement, and approximately 4% of food services operations inspected were considered to be “in progress”, with 0.3% being classified as DUR. The main non-compliance issues continue to be failure to maintain GI and failure to install properly sized GI.

There were 5 tickets issued under the CRD TIA Bylaw to food services operations in 2017, all were paid.

The dry cleaning sector continued to have 29% of the facilities “in progress”, which equates to 2 of the 7 regulated facilities. A decision was made in 2016 to increase inspections in this sector to biennially to ensure proper PERC management and/or disposal. In 2017, RSCP commissioned a student project to investigate best practices for PERC treatment. The study is discussed further in Section 3.3.

The automotive (mechanical) sector had 3% of the facilities “in progress” in 2017, which equates to 7 of the 202 regulated facilities. In 2015, a ‘sector-by-sector’ approach expanded the definition of automotive to include all types of mechanical repair. Approximately 2% of the sector include facilities identified as possible dischargers under the code, but are still awaiting confirmation. These were identified through the 2015 sweep or more recently through other means, such as the municipal business license sharing process.

The vehicle wash sector had 13% of the facilities “in progress” in 2017, which equates to 5 of the 38 regulated facilities.

The fermentation sector had 100% compliance in 2017. In light of the growth of this sector, a complete review was initiated in 2017 to ensure regulations are consistently and fairly applied. The review is discussed in greater detail below.

In 2017, 96% of facilities regulated under RSCP CoP, permits and authorizations achieved overall compliance.

3.3 Contaminants Management

Contaminants management builds on the program's successful regulatory approach, but involves a shift in focus towards avoidance, elimination or substitution of polluting products, processes or materials in order to make reductions in specific priority contaminants that have proven difficult to control or treat. Contaminants management projects initiated or completed in 2017 are outlined below.

3.3.1 Contaminant Characterization of Microbreweries in the Fermentation Sector

The number of alcohol distillery businesses in BC is rising in part due to significant transformation in provincial liquor laws in 2013, enabling businesses to operate under a craft designation. The growth rate of new craft distillery operations in BC between 2012 and 2015 was 182% (or 60% annually).

RSCP regulated breweries have recently been observed integrating distillery equipment into their existing production operations. In addition, the region is seeing a growing presence of stand-alone craft distillery enterprises. The distillation sector was reviewed in 2016, and a review of the remainder of the sector was conducted in 2017, as part of a project to evaluate regulation based on contaminant loadings and more consistent requirements across sub-sectors.

Annual production data and effluent samples were collected, where possible, to better understand how wastewater strength varies between different facilities within the fermentation sector. Understanding the contribution of each fermentation facility and sub-sector is crucial to identify where pollution control targets are not being met, or where programs, prescriptions and regulatory effort should be improved and focused to help achieve RSCP objectives.

The fermentation industry has been well documented to produce large wastewater volumes with relatively high concentrations of COD, BOD, TSS and low pH.

In recent years, the Pacific Northwest has seen a similar rapid growth in the number of breweries, distilleries and other fermentation operations. In addition to the loadings review, a brief comparison of regulatory approaches used by other jurisdictions in the Pacific Northwest was included in the report.

In the CRD, there are 26 fermentation facilities, 5 of which are regulated under permit, 13 u-brews that use pre-fabricated kits and concentrates, and 8 microbreweries under the Code of Practice for Fermentation Operations.

A review of historical monitoring data of the permitted breweries showed BOD and COD results ranging from 500-1,250 mg/L and 800-2,000 mg/L, respectively. TSS ranged between approximately 25-100 mg/L. Annual wastewater flows were 7,000-15,000 m^3.

Sampling data from 2015 and 2017 for 6 of the 8 microbreweries was summarized, and results showed BOD and COD results ranging from approximately 2,500-20,000 mg/L and 4,000-36,000 mg/L, respectively. TSS ranged between approximately 100-1,700 mg/L. Annual wastewater flows were 300-2,250 m^3.

Sampling at u-brew facilities was not feasible, but it was estimated that annual flows ranged between 1-8 m^3. Loadings would be negligible for this sub-sector. There were no vintners, cideries or wineries discharging to sanitary sewer at the time of the review.

While the flows were much higher for permitted facilities, wastewater strength was significantly lower than for microbreweries. It was acknowledged that for some permitted facilities, years of monthly data was available while only 1 or 2 samples were collected for each microbrewery. It was recommended that all microbrewery facilities should be regulated under an authorization to collect adequate data for determining when wastewater strength and volume triggers for permits are reached.

3.3.2 BC Medications Return Program Campaign

At a 2016 Saanich Peninsula Wastewater Commission meeting, RSCP staff were asked what more could be done through source control to increase protection of wastewater dewatered sludge and biosolids produced at the treatment plant. The RSCP 4-year plan (2016-2019) included enhancement of initiatives and outreach to achieve further reduction of emerging contaminants throughout the region. In December 2016, an outline of a regional plan was developed and an information report was sent to the Environmental Sustainability Committee in January 2017 and subsequently to the Core Area Liquid Waste Management Committee and CRD Board in March.

RSCP staff, in cooperation with Island Health and the Health Product Stewardship Association, held a campaign and media event to launch the program at a local pharmacy in April 2017. The media event was covered by print, radio and television. The campaign included print and social media ads, social marketing tools, videos and outreach booths at pharmacies throughout the region.

3.3.3 Investigation into the Operational Effectiveness of a Commonly Used Dry Cleaning Wastewater Treatment Unit

Monitoring results from the 2016 dry cleaning sector sweep showed that 80% of the discharging facilities exceeded the CoP tetrachloroethylene discharge limit of 100 µg/L. RSCP commissioned a study by RRU Environmental Science students to research the effectiveness of treatment works used in the dry cleaning sector within the CRD. The research showed a key element in improving the performance of a typical tetrachloroethylene (PERC)-contaminated wastewater treatment unit, and will serve to inform businesses in better waste management practices.

Two operations within the CRD were observed to understand their practices and disposal methods and a literature review was conducted to gather background information. Three benchtop experiments were designed to determine factors that might influence the operational effectiveness of the wastewater treatment unit.

A Pure Water 22 unit produced by Union Systems, vapour and liquid phase activated carbon, and dry cleaning wastewater were obtained from a local dry cleaner. All samples were sent to AGAT Laboratories and analyzed for PERC concentration. The first experiment tested carbon effectiveness, and the hypothesis that manufacturer recommended liquid phase activated carbon is more efficient at removing PERC from wastewater than vapour phase activated carbon. The second experiment was a “settling test”, which was designed to determine whether PERC concentrations in the wastewater would decrease if allowed to settle. The third experiment was designed to determine what volume the unit could process before breakthrough was reached.

The carbon efficiency test showed a significant difference between the 2 types of activated carbon on the absorbance of PERC (p-value = 0.000104). The initial concentration of the PERC effluent was 155,000 µg/L, the treated concentrations of liquid and vapour phase carbons were 46 µg/L and 37,700 µg/L, respectively. This test showed that the manufacturer’s recommendation to use vapour phase rather than liquid phase carbon is valid.

The settling experiment showed a moderate (8%) difference in PERC concentration from the agitated initial sample (120,000 µg/L) to the sample that was settled for 27 hours (110,000 µg/L). Allowing the wastewater to settle prior to loading may extend the life of the liquid phase carbon used. It was noted that the single dry cleaning operator who did not exceeded the limit allowed wastewater to settle for 1-2 weeks before treatment.

The breakthrough experiment resulted in 643.5 L of wastewater being treated in the unit, which indicated that “breakthrough” had not yet been reached. An interesting note is that 2 data points are above the limit and occurred without sustained breakthrough, likely due to the students still becoming familiar with the operation of the unit or indicating that the carbon filter was beginning to lose effectiveness.

The report recommended a detailed standard operating procedure, which included purging, timing and detailed instructions for carbon changes, cleaning procedures, and further monitoring of the dry cleaning sector by RSCP staff.

3.4 Contaminant Reductions

3.4.1 Marine Outfall Contaminant Reductions

One of the main objectives of the RSCP is protection of the marine receiving environment. A specific goal associated with this objective, included in both the Core Area LWMP and Saanich Peninsula LWMP, is “to maintain or reduce effluent contaminant loadings to the receiving environment”.

3.4.1.1 Core Area Outfall Effluent

CRD Marine Monitoring Programs staff regularly monitor effluent quality at the Macaulay and Clover points outfalls for a wide range of substances. The most recent effluent trend analysis was undertaken in 2017. This report provided a statistical assessment of wastewater trends at Clover and Macaulay points outfalls over the period 1990-2015. The findings of this report for Clover and Macaulay points over the 25-year period of record included the following:

A total of 91 routine analysis parameters were assessed as “frequently detected” for effluent trend analyses. Significant trends in detection frequency over time were observed for approximately 20% of the frequently detected parameters. Among the significant trends, increases in detection frequency were generally observed for metals and conventional parameters, and decreases were generally observed for organic parameters. Increased detection frequency over time appears to be related to improved analytical methods (reduced detection limits for several parameters) rather than to systematic increases in concentrations. However, some elevated detection limits were observed in recent years for organic parameters (e.g., di-n-butyl phthalate).

Approximately 70% of the frequently detected routine analysis parameters and 27% of the frequently detected high-resolution analysis parameters had significantly different concentrations between the 2 outfalls. For the majority of these parameters, concentrations measured in the Macaulay Point outfall were greater than those measured in the Clover Point outfall. However, the higher flows of wastewater at Clover Point, relative to Macaulay Point, outweighed the concentration differences and resulted in higher constituent loadings (discharged mass per unit time) at Clover Point.

Statistically significant temporal trends in concentrations were identified for approximately 90% of the frequently detected standard analysis parameters and 39% of the frequently detected high-resolution analysis parameters in the wastewater streams of the Macaulay and Clover points outfalls. The total concentrations of cadmium, chromium, copper, lead, mercury, nickel and zinc all exhibited significant negative trends over the time period assessed. Priority substances generally exhibited significant negative trends (or no significant trend), with the exception of 2 PAH (acenaphthene and fluoranthene) that exhibited annual percent changes ranging from +2.6% to +3.1%.

Statistically significant trends in loadings over time were observed in approximately 85% of the frequently detected standard analysis parameters. Statistically significant trends in loadings over time were observed in 50% of the frequently detected high-resolution analysis parameters. Temporal trends in loadings were similar to those in concentrations among contaminant groups, reflecting a tendency toward reductions over time.

Overall, the trend results for priority substances evaluated in previous Golder studies (Golder, 2006, 2009, 2013b) were confirmed in the current assessment. Few discrepancies were observed between the current assessment and the previous 2 Golder trend assessments (Golder 2009a, 2013); the changes observed in the most recent evaluation were toward additional evidence of stable or decreasing concentrations and loadings of substances in the wastewater stream.

Of the high-resolution parameters, statistically significant decreases in concentrations over time were observed for nonylphenols (-24% to -36%), polybrominated diphenyl ethers (PBDE, -5.3% to -10.1%), and several organochlorine pesticides (annual percent change ranged from -2.9% for alpha chlordane to -18.5% for lindane). Of the organochlorine pesticides, only beta-endosulfan increased with time (+5.3%). Polychlorinated biphenyl (PCB) did not exhibit statistically significant trends in concentrations over time.

These results will be discussed with the Marine Monitoring Program to assess opportunities to reduce input of these contaminants to the sewage system.

Further information about core area effluent quality in 2017 can be found in the *Macaulay and Clover Points Wastewater and Marine Environment Program 2017 Annual Report*.

3.4.1.2 Saanich Peninsula Wastewater Treatment Plant Influent and Effluent

Influent and effluent data has been collected at the SPWWTP since the plant commenced operation in 2000. The first summary of trends in these data was reported in Hatfield Consultants Ltd, 2005. Golder Associates Ltd., 2009a included a statistical assessment of wastewater influent and effluent trends at the SPWWTP over the period 2000-2008. Golder Associates Ltd., 2017 provided an update of trends to 2015. The findings of this report over the 14-year period of record at the SPWWTP included the following:

Trends in influent and effluent composition were similar for most of the frequently detected parameters. Significant temporal trends were identified for approximately 60% of the frequently detected parameters in the wastewater composite samples. Trends were generally negative (decreases) for priority substances and for most of the metals. WAD cyanide, manganese and total PAH increased in either influent or effluent or in effluent only. Similarly, some metals (barium, calcium, dissolved copper, dissolved iron and potassium), as well as diethyl phthalate, increased in either both wastewater streams or in effluent only. The number of significant trends in the current assessment was similar to the previous trend assessment (approximately 66%; Golder, 2013). Results will be discussed with the Marine Monitoring Program to assess opportunities to reduce input of these contaminants that are increasing to the Saanich Peninsula treatment plant system.

Further information about SPWWTP influent and effluent quality in 2017 can be found in the *Saanich Peninsula Treatment Plant Wastewater and Marine Environment Program 2017 Annual Report*.

3.4.2 Sludge and Mixed Liquor Contaminant Reductions

Another important objective of the RSCP is the protection of sewage treatment plant sludge and mixed liquor quality.

Lime and heat-treated biosolids produced at the SPWWTP were monitored for a range of metals and other substances on a regular basis since the plant was commissioned in 2000. This monitoring ended in April 2011 following CRD Board direction to cease land application of biosolids. Monitoring of dewatered sludge produced at the SPWWTP commenced in March 2013 and continued in 2017. Monitoring of the mixed liquor produced at the smaller GWWTP began in 1994 and continued in 2017.

3.4.2.1 Saanich Peninsula Wastewater Treatment Plant Sludge

Following CRD Board direction to cease land application of biosolids, SPWWTP produced only dewatered sludge after April 7, 2011. This sludge was not sampled or analyzed prior to disposal at Hartland landfill as a controlled waste throughout the period April 2011 to February 2013.

A SPWWTP dewatered sludge monitoring plan was developed and implemented in March 2013. The dewatered sludge is not a biosolids product as defined by the Organic Matter Recycling Regulation. The sludge is sampled and is assessed using the Class A biosolids quality criteria for comparison purposes to evaluate overall metal concentrations and end-product quality. This monitoring is not intended to characterize the material as a biosolids product.

The results for metals and WAD cyanide in SPWWTP dewatered sludge are presented in Figure 1. Mercury levels have been consistently well below the maximum acceptable concentration for Class A Biosolids (MAC) in the last 5 years of production.

WAD cyanide, first monitored in 2013 to confirm increasing trends in SPWWTP influent, shows a slight rise to a high point in June 2014 and again in December 2015 and January 2016. Silver results were elevated in two samples in 2017. No cause could be determined and a check of influent and effluent samples taken at different times during the year by the Marine Monitoring Program show no indications of elevated silver in the liquid stream. There is, however, no criterion for these 2 parameters in biosolids to use as a benchmark for evaluating the impact of these observations.

Cadmium and molybdenum levels in SPWWTP dewatered sludge generally continued at levels similar to biosolids in the last few years of production. Results were all below the respective biosolids criteria. The levels of the electroplating metals chromium and nickel appear to be closely correlated with one another, possibly suggesting a common source on the Peninsula, where there are 2 electroplating operations under permit. In addition, the August 2014 result for both metals shows a return to levels last seen in biosolids in the period before 2007.

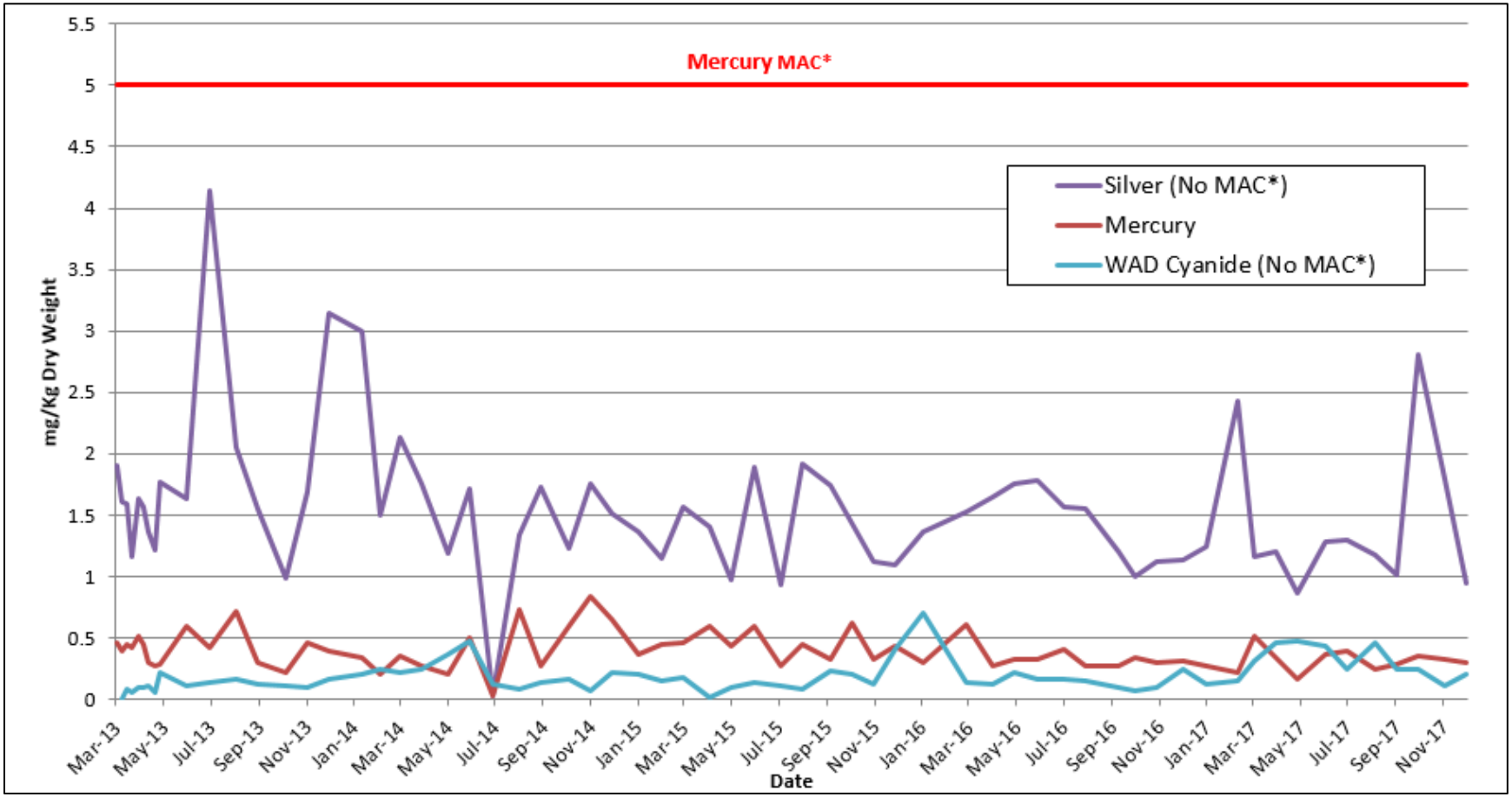
3.4.2.2 Ganges Wastewater Treatment Plant Mixed Liquor

The GWWTP process produces a mixed liquor product, not a biosolids product as defined by the Organic Matter Recycling Regulation. The mixed liquor is sampled and is assessed using the Class A biosolids quality criteria for comparison purposes to evaluate overall metal concentrations and end-product quality. This monitoring is not intended to characterize the material as a biosolids product. The GWWTP mixed liquor has met Class A quality criteria for all parameters except mercury (and occasionally molybdenum, once for cadmium) since monitoring began in 1994.

Mercury and silver levels in Ganges mixed liquor show an overall trend is toward lower levels for both metals (see Figure 3). Implementation of the dental and photo imaging CoP is thought to be the main reason for the reductions in mercury and silver concentrations at the GWWTP. Continued enforcement of the CoP, and a shift to digital imaging, is likely contributing to the continued lower levels of these metals.

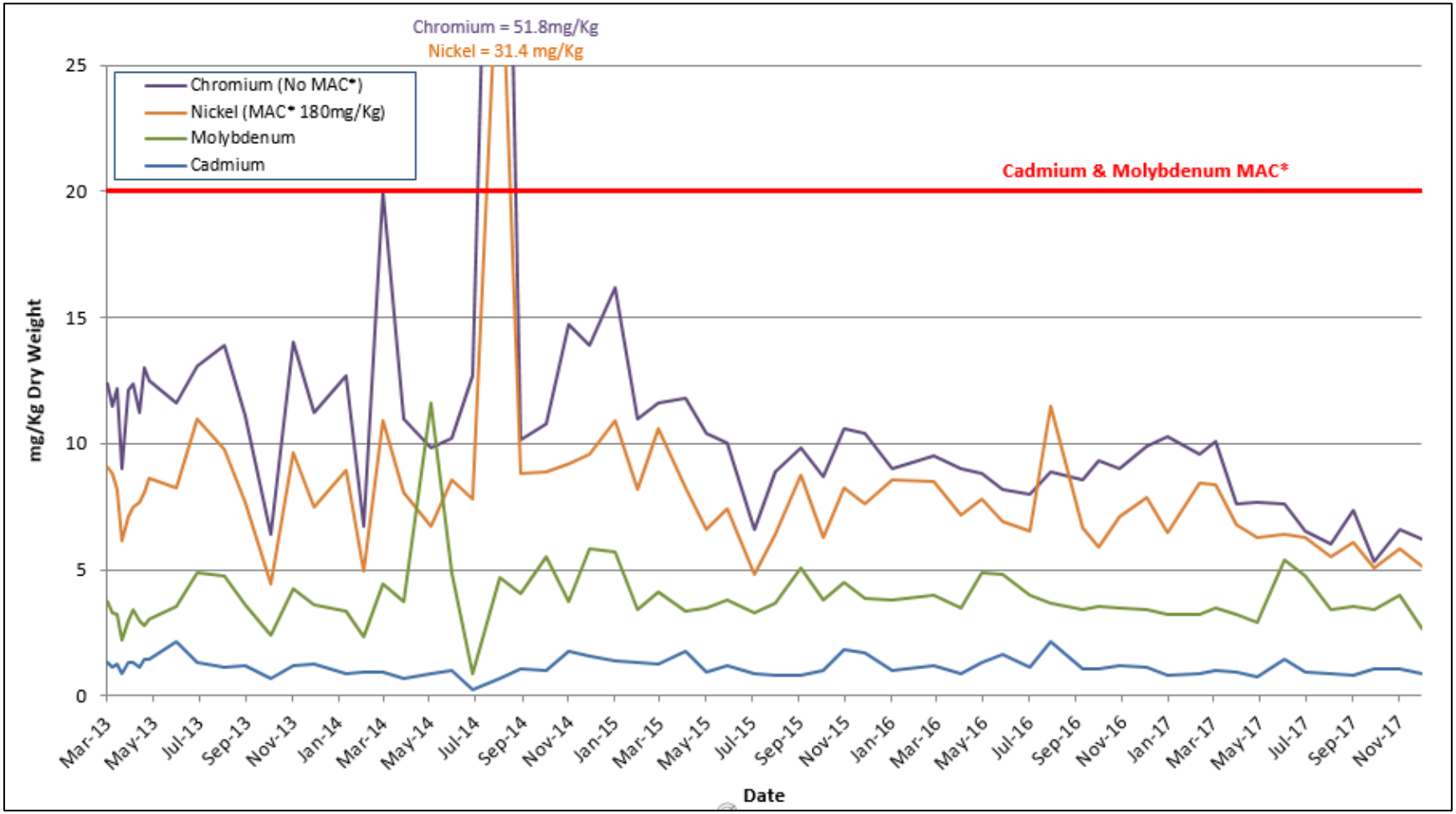
Figure 4 illustrates the decrease in historic levels of cadmium and molybdenum in GWWTP mixed liquor over time. Prior to 2008, molybdenum levels were high and variable, sometimes exceeding the Class A criterion. This may have been due to the use of molybdate corrosion inhibitors in heating and cooling systems within the collection area. More recent levels suggest that there may have been a change to molybdate-free products in at least some situations.

Figure 1 Mercury, Silver and Cyanide in SPWWTP Dewatered Sludge (2013-2017)



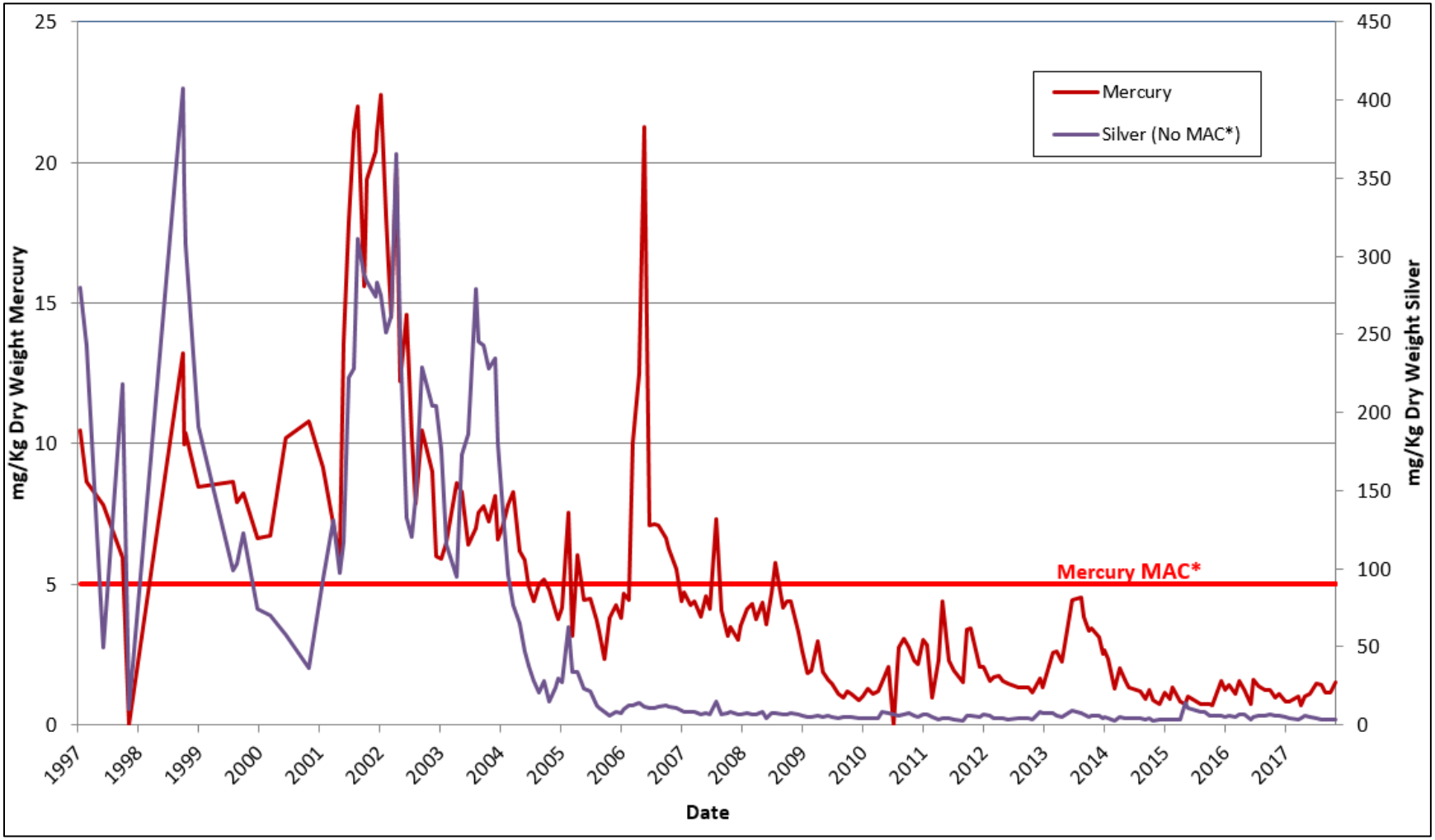
*MAC = Maximum Acceptable Concentration for Class A Biosolids

Figure 2 Chromium, Nickel, Cadmium and Molybdenum in SPWWTP Dewatered Sludge (2013-2017)



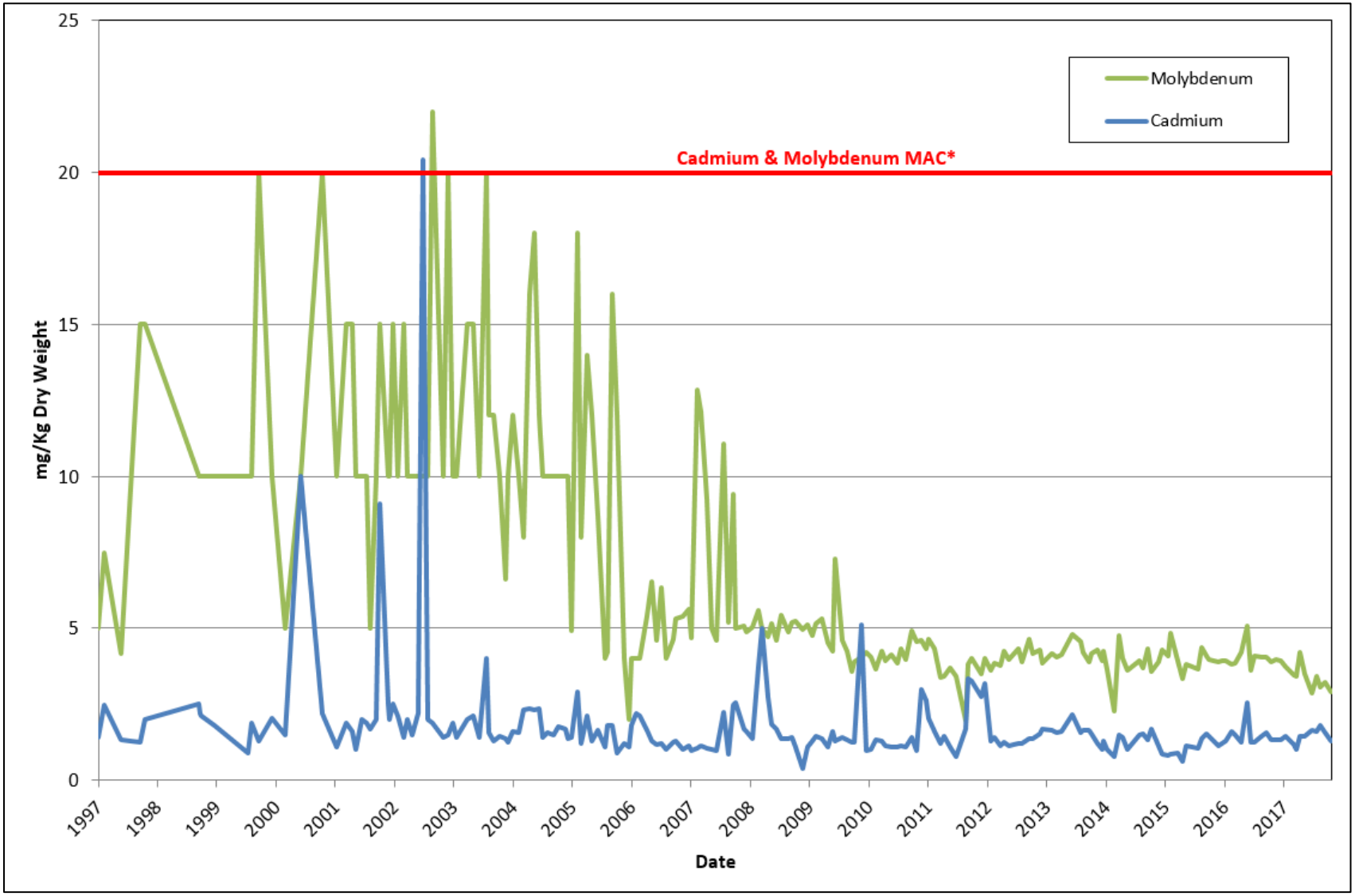
*MAC = Maximum Acceptable Concentration for Class A Biosolids

Figure 3 Mercury and Silver in GWWTP Mixed Liquor (1999-2017)



*MAC = Maximum Acceptable Concentration for Class A Biosolids

Figure 4 Cadmium and Molybdenum in GWWTP Mixed Liquor (1999-2017)



*MAC = Maximum Acceptable Concentration for Class A Biosolids

Table 10 Summary of Reported Sewer System Incidents (2017)

Contaminant	Nature of Incident	Potential Impact	Incident Follow-up
Road construction project	A local resident reported a sewer overflow incident – February 2017	Pollution to marine receiving environment, public health and safety	RSCP staff coordinated with Saanich municipal staff to attend the scene. A transportation construction project's stormwater treatment system was overwhelmed with heavy rainfall and they began pumping excess to sewer, which caused manhole surcharges. The contractor was responsible for cleanup and was issued enforcement letters from both Saanich and CRD.
Fats, Oils and Grease	District of Saanich staff reported FOG buildup in a sewer lateral downstream of 1 Saanich restaurant – May 2017	Grease blockages can lead to overflows in municipal sewer pipes and mains –maintenance and health concerns	RSCP staff followed up with inspections of the restaurant locations and found fixtures not connected to the grease interceptor. Owners were advised of results and follow-up inspections confirmed remedial actions were taken.
Trent Pump Station	CRD Operations staff reported a strong hydrocarbon odour at the Trent Street pump station – July 2017	Pollution to marine receiving environment, public health and safety	RSCP staff carried out an investigation, including sampling and chromatogram analysis of several key manholes in the upstream catchment area. The material in the wet well was identified as weathered diesel, but was not identified in the 5 upstream samples. No source was found.
Hartland Leachate	CRD Operations staff reported discoloured discharge flowing through the Macaulay pump station – August 2017	High total dissolved solids exceeded the Federal Transitional Authorization Limit for CRD	RSCP staff coordinated with CRD Operations and CRD GeoEnvironmental staff to share information and discover the source of the material. During routine operations, organic material entered the pumps between the lagoons at Harland Landfill. Leachate samples met permit limits, but pump station total dissolved solids levels were high. In future, additional staff will monitor pumping to ensure excessive organic material does not enter the sewer.
Fats, Oils and Grease (Shelbourne and Cedar Hill X)	District of Saanich staff reported high levels of FOG in sanitary sewer mains – August 2017	Grease blockages can lead to overflows in municipal sewer pipes and mains – maintenance and health concerns	RSCP staff carried out 37 inspections of food service facilities in the area and found 6 facilities with minor infractions, 1 with compliance actions already in progress, and 2 in non-compliance. Most have since been brought into compliance, but some follow-ups continue.
Suspended Solids (Cecelia Creek)	City of Victoria staff reported suspended solids in storm sewers discharging to Cecelia Creek – August 2017	Pollution to marine receiving environment	RSCP staff collaborated with municipal staff to identify the source, a cross connection from a permitted wet-cutting facility. Municipal staff corrected the infrastructure issue and RSCP staff continued to work with the permitted facility in 2018 to reduce wastewater strength into sanitary sewer, ensuring Bylaw limits are met.

3.5 Significant Incident Reporting

CRD Operations and municipal engineering department staff communicate periodically with RSCP staff regarding sanitary sewer wastewater quality problems, suspicious discharges or significant incidents leading to contamination of the district's collection and treatment systems. A *Significant Incident Report Form* was initially developed in 2000 to record operational problems within all trunk sewers and treatment plants operated by the CRD. The report form and response procedure was reviewed in 2013 following an incident involving a spill of Bunker "C" fuel oil into the CRD's Lang Cove pump station, and a new significant incident response procedure was developed by RSCP staff for implementation in 2014. In 2016, staff continued to develop detailed sewer catchment area maps, and most recently for the Craigflower catchment.

Table 10 provides a summary of incidents reported in 2017 that impacted, or had the potential to impact, the environment, sewerage works, sewage treatment facilities or public health and safety. Notes on incident follow-up were summarized from CRD significant incident reports, municipal grease reports, complaint forms, memos, e-mails, conversation records and other notes on file. There were no incidents reported which affected the operation of CRD sewage treatment plants in 2017.

3.6 Outreach and Partnerships Initiatives

RSCP staff continued to develop and maintain program-specific outreach and education messaging throughout 2017. Where appropriate, source control messaging was also integrated with other initiatives, campaigns and community outreach events held throughout the year, across the region.

Key source control initiatives and campaigns for 2017 are summarized below under separate sections for residential and business outreach, education and the RSCP website.

3.6.1 Residential Outreach

In 2017, RSCP staff continued to partner with the Health Products Stewardship Association and Island Health to promote the proper disposal of waste medications through the BC Medication Return Program (BCMRP). A promotional campaign was launched in the spring of 2017.

The capital region, through the campaign and past initiatives, increased the medication return rate per capita in 2017 (0.0301 kg/capita) from 2016 (0.0275 kg/capita) and continues to have one of the highest rate of proper disposal among regional districts in the Province. Approximately 11.5 tonnes of medications were collected in the region 2017 (*Health Products Stewardship Association Annual Report to the Director, 2017 Calendar Year*).

Based on feedback from pharmacists, BC Pharmacy Association and Health Production Stewardship Association, recycling medication packaging (e.g., plastic pill bottles) remains a challenge to pharmacists who wish to support proper medication disposal. Consumer are bringing back containers that are mainly empty, which take up volume in the BCMRP disposal bins. Those pharmacists/pharmacies that took the extra step to recycle the container are unfortunately charged for recycling of the containers, as they are perceived as commercial waste. In response, RSCP staff designed and produced reusable disposal bags to promote consolidating medications into 1 package. The bags are 1 of the engagement and behaviour change tools distributed at outreach events throughout the region.

Based on concern that 92% of the public surveyed in 2015 believe that source control practices will not be relevant with wastewater treatment, and survey results that "*Clean Green*" was the most recognized Source Control campaign, new outreach tools and prompts were created for *Clean Green 2.0*. The campaign is scheduled to be launched in 2018.

3.6.2 Business Outreach

Inspectors continued to be the front line staff delivering RSCP outreach messaging to local businesses. Outreach included distribution of RSCP sector-based posters and guidebooks. In addition, inspectors worked with business owners to highlight the benefits associated with protection against cross connections (protection of public health), water conservation (potential cost savings), solid waste diversion best management practices and other CRD initiatives.

RSCP staff, in cooperation with other CRD program staff, redeveloped, created and launched new business and sector-specific webpages for the CRD website in 2017.

3.6.3 Partnerships Initiatives

Since its inception, the RSCP has worked with many agencies to expand program reach and effectiveness, improve services and resolve problems of mutual concern. These agencies have included MOE, federal agencies, such as the DND and Public Works and Government Services Canada, regional districts, municipalities, Island Health and local academic institutions.

In 2017, there were continued collaborative efforts between RSCP staff, other CRD environmental programs and external partners to provide augmented inspection services and superior customer service, and to promote high environmental performance within businesses.

Some examples of both internal and external collaborative partnerships initiatives undertaken in 2017 are outlined below.

3.6.4 2017 Collaborations

In 2017, RSCP staff undertook the following collaborative activities:

- Worked with regulators in London, Ontario, sharing information on flushable wipes. The work being done in London involved developing technical specifications on flushable products, working to establish a “non-dispersables” standard. A non-dispersables standard is being considered for the next Sewer Use Bylaw amendment.
- RSCP commissioned a study by RRU Environmental Science students to research the effectiveness of treatment works used in the dry cleaning sector within the CRD.
- Leveraged RSCP’s standing as 1 of the oldest and most comprehensive source control programs in Canada to share information and promote the development of source control programs throughout BC and Alberta at the first Source Control Symposium held during the BC Water and Waste Association (BCWWA) Conference.
- Continued to work with Island Health staff and other CRD program staff, including CCC and Onsite, to share information, maintaining the strong partnership between RSCP and Island Health inspectors.
- Continued the Business Licensing Municipal Working Group to share new businesses license information for RSCP CoP inspection and permitting purposes. Seven municipalities established information sharing procedures, and negotiations continue with 3 remaining municipalities.
- CRD Marine Monitoring Program staff continued to collaborate with RSCP staff through offering odour monitoring in the Lang Cove catchment area to ascertain sulfide sources with a number of permits.
- Collaborated with MOE for assistance in interpretation and application of BC Hazardous Waste Regulations pertaining to biomedical waste in hospital permits and other facilities regulated under the Bylaw. The results were shared with Metro Vancouver staff and led to discussion about working together to develop a consistent regulatory approach.
- Collaborated with CRD Operations staff and a local septage processing facility to accept a temporary high-strength waste discharge, due to an emergency product recall at a dairy processing facility.

3.6.4.1 Source Control Symposium Collaboration

RSCP staff developed and hosted, in partnership with Metro Vancouver, an all-day symposium on source control as part of the BCWWA's 45th Annual Conference, held in Victoria in May 2017.

Invitations were sent to jurisdictions throughout BC and Alberta, as well as the Pacific Northwest. The symposium included 2 panel sessions where attendees had the opportunity to discuss their favourite source control topic. Additionally, there were presentations from RSCP and Metro Vancouver staff covering common source control issues, such as program foundations and regulatory basics, FOG management, fermentation and dry cleaning sector bylaw approaches, "flushable wipes" issues and outreach approaches, and the BC Medication Return Program.

The true measure of success was the establishment of an ongoing network for sharing resources, ideas, updates and supports. Working with BCWWA's "Community of Practice" model, all the various source control programs that attended the symposium signed up to be a part of the community and have continued to work closely and collaborate on a diverse number of topics, which directly enhances RSCP's service delivery.

3.6.4.2 Island Health Collaboration

RSCP staff continued to work with Island Health Authority inspectors, sharing information on difficult food service establishments, planning co-inspections, where necessary, and dealing with food carts.

Island Health administrative staff continued their information sharing efforts in 2016, forwarding "Application for Food Facility" forms to RSCP staff. The forms provide contact and operating details for new food service businesses, enabling RSCP staff to work with new applicants more proactively, and dramatically improving RSCP data quality. The forms are forwarded to CRD Cross Connection Control staff so that, wherever possible, cross connection inspections can be conducted quickly for new businesses, and in some cases jointly with RSCP inspections, saving the businesses money and time for inspection visits.

3.6.4.3 Collaboration with Academic Institutions

The RSCP also developed various partnerships with educational institutions in 2017.

An RSCP inspector presented a workshop to Camosun College Environmental Technology students, covering overviews of regional government, regional wastewater management and source control practices.

RSCP commissioned a study by RRU Environmental Science undergrads to research the effectiveness of dry cleaning treatment works used within the CRD.

3.6.4.4 Municipal Collaboration

Since 1999, municipal staff have been encouraged to issue Waste Discharge Assessment forms to persons applying for new building licenses or new sewer connections for businesses that have the potential to discharge non-domestic waste to sewer. Completed forms are forwarded by the municipality to the CRD for evaluation. In addition, businesses or plumbers contracted to perform upgrades at CoP operations directly contact RSCP staff regarding CoP requirements. Letters copied to municipal plumbing or licensing contacts are sent directly to CoP operations outlining specific requirements and providing information.

In 2017, RSCP staff worked with municipal staff to resolve various oil and grease blockages in sewers. Municipal staff continued to provide plumbing and building information, flow data and other information to RSCP staff to assist in the preparation of permits, authorizations and CoP treatment works installations.

Additionally, RSCP staff continued to attend Vancouver Island Plumbing Code Committee meetings. This is an opportunity to improve personal relationships with municipal plumbing inspectors, provide regulatory updates and problem solve with issues that affect both municipal and regional inspectors.

3.7 Performance Measures

Three program performance measures were developed over the period 2004-2006. These measures have been incorporated in RSCP program budgets since 2007 and were included in the scope of the 5-year review undertaken in 2009. The performance measures are as follows:

- Percentage of regulated businesses with proper waste treatment installed. This measure is associated with the RSCP objective of consistent application of the program for all users of CRD sewage facilities.
- Percentage of priority contaminants showing no increase in loads to the core area environment. This measure is associated with the RSCP objective of protecting the marine environment adjacent to the CRD's sewage outfalls.
- Percentage of biosolids and sludge samples that meet Class A standards for metals. This measure is associated with the RSCP objective of protecting the quality of sewage sludge and biosolids.

"Overall Compliance", was established in 2014 to replace "Percentage of regulated businesses with proper waste treatment installed". The method of calculating each performance measure is described in Appendix 2.

Table 11 Results of RSCP Performance Measures (2005-2017)

Performance Measure	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Proper waste treatment[1]	80	85	87	93	95	96	97	90	97				
Overall Compliance[2]										95	97	98	96
Priority contaminants[3]	92	--	--	78	--	--	94	--	--	--	--	92	--
Biosolids and sludge[4]	92	67	88	93	100	100	100	100	100	100	100	100	100

Notes:
1. Percentage of regulated businesses with proper waste treatment installed.
2. Overall Compliance replaced "Proper waste treatment" as of 2014.
3. Percentage of priority contaminants showing no increase in loads to the core area environment (preliminary result from draft report). Study performed every 3-5 years.
4. Percentage of biosolids and sludge samples that meet Class A standards for metals.

"Proper waste treatment" was modified in 2014 to "Overall Compliance" as a better indicator of effective contaminants diversion. An enforcement status of "Compliant" or "Step 1" indicates proper treatment works or that an acceptable performance-based treatment arrangement has been made, though not necessarily compliant with what is prescribed in the CoP. Further, a "Compliant" or "Step 1" enforcement status assumes that the treatment works are being properly maintained. All treatment systems are rendered ineffective if they are not maintained, thus as a compliance indicator this is much more accurate in representing how well waste is being managed.

"Priority Contaminants" is based on the "yearly trend" in loads at both Macaulay and Clover points outfalls for 36 priority contaminants, as documented in the most recent trend assessment report (Golder Associates Ltd, 2017). Long-term analysis of effluent trends for the core area outfalls is only undertaken every 3-5 years. The most recent analysis, including data from 1990-2015, was received in 2017.

"Biosolids and Sludge" has shown some variability in the early years, largely due to the mixed liquor metals results from the GWWTP exceeding Class A criteria for biosolids. However, in 2017, for the ninth consecutive year, the GWWTP mixed liquor results met the Class A criteria for all metals, including mercury. SPWWTP dewatered sludge monitoring commenced in March 2013. All of these results also met the Class A criteria for metals. The combined results from the 2 plants provided an overall 100% rating for this performance measure in 2017.

4.0 CONCLUSION

The RSCP continued to work towards its goals to protect sewage collection and treatment facilities, public health and safety, and the marine receiving environment by reducing the amount of contaminants that industries, businesses, institutions and households discharge into the district's sanitary sewer systems. The program regulated approximately 2,000 businesses through industrial wastewater discharge permits, authorizations and sector-specific codes of practice.

A total of 1,067 CoP inspections were conducted over the year. Semi-annual inspections of the 41 active permits, and annual inspections of the 92 active industrial, commercial and institutional authorizations, were completed. Six new short-term permits and 11 new authorizations for a variety of business types and terms were issued. Six significant incidents reported in regional and municipal sewers were investigated in 2017 and 5 tickets were issued to non-compliant food services operations. The overall compliance rate, including facilities operating under CoP, authorization and permit was 96% in 2017.

Ganges Wastewater Treatment Plant mixed liquor results met the Class A biosolids criteria for all metals, including mercury, for the 9th consecutive year. Saanich Peninsula Wastewater Treatment Plant dewatered sludge results also met the Class A criteria for metals.

Monitoring targets set for 2017 were achieved. In addition, 6 facilities in the fermentation sector were sampled to support a sector review. The review assisted staff in characterization of fermentation wastewater, particularly for microbreweries with an eye towards contaminant loadings and consistent requirements across sub-sectors. To further improve the program's regulatory components, a consultant was retained to review the CRD Sewer Use Bylaw and suggest improvements. Staff will revise the Sewer Use Bylaw in late 2019.

The RSCP also reduces inputs of contaminants into the sewer system with numerous non-regulatory tools, which leads to the reduction of contaminants to the environment. Significant activities throughout the year included:

- refreshing the existing Medications Return Program and partnering with the Vancouver Island Health Authority and the Health Products Stewardship Association to launch a new campaign to increase public awareness and participation in the BC Medication Return Program. Approximately 11.5 tonnes of medications were collected in the region, one of the highest rates of return in BC.
- commissioning a study by Royal Roads University Environmental Science students to research the effectiveness of dry cleaning treatment works used within the CRD.
- developing new engagement and behaviour change tools for the Clean Green 2.0 campaign, which focuses on environmentally-safe alternatives to household cleaners.
- collaborating with other CRD program and municipal staff to investigate sewer and storm discharges from the "wet-cutting" sector.
- developing and co-hosting a Source Control symposium at the 45th annual British Columbia Water and Wastewater Association Conference & Trade Show in Victoria, BC.

5.0 REFERENCES

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APPENDIX 1

RSCP Priority Contaminant List (2017)

TOTAL METALS
arsenic (As)
cadmium (Cd)
chromium (Cr)
cobalt (Co)
copper (Cu)
lead (Pb)
manganese (Mn)
mercury (Hg)
molybdenum (Mo)
nickel (Ni)
selenium (Se)
silver (Ag)
zinc (Zn)
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)
Total PAH
Low molecular weight PAH
naphthalene
acenaphthylene
acenaphthene
fluorene
phenanthrene
anthracene
fluoranthene
High molecular weight PAH
pyrene
benzo(a)anthracene
chrysene
benzo(b)fluoranthene
benzo(k)fluoranthene
benzo(a)pyrene
dibenzo(a,h)anthracene
indeno(1,2,3-cd)pyrene
benzo(g,h,i)perylene
Phthalates
bis(2 ethylhexl)phthalate
di-n-butyl phthalate
MISCELLANEOUS
1,4-dichlorobenzene
Cyanide - weak acid dissociable (WAD)
Cyanide - strong acid dissociable (SAD)
phenol
total oil and grease

APPENDIX 2

Calculation Methods for RSCP Performance Measures

The following methods are used to calculate the 4 RSCP performance measures referred to in Section 3.7.

RSCP Performance Measure #1:

"Percentage of regulated businesses with proper waste treatment installed"

As of 2014, this performance measure has now been replaced with "Overall Compliance". "Number of regulated business with proper waste treatment installed" was, in earlier program years, a significant marker of program influence. As new CoP were being introduced to the region, it was important to measure how many (and how quickly) businesses were adopting proper wastewater treatment systems. It is the belief of RSCP staff that a shift to "overall compliance" is now a better indicator of effective contaminants diversion, due to:

- **Consistent high compliance with proper treatment works installed:** Inspection history shows that, as a baseline, almost all regulated facilities are operating with proper waste treatment.
- **Performance-based compliance site-specific practices:** Alternative arrangements in practices or technologies, which might deviate from what is prescribed in a code, may be effectively treating the waste. For example, there are several automotive facilities with (technically) under-sized oil/water separators, who are supplementing their systems with oil coalescing plates, analyzing the wastewater effluent and being monitored through an authorization to ensure that the systems are not bypassing hydrocarbons or in excess of other restricted waste limits.
- **Treatment works maintenance:** The top enforcement issue amongst regulated facilities is proper maintenance of treatment works. All treatment work systems are rendered ineffective if they are not maintained; thus as a compliance indicator this is much more accurate representation of proper contaminants diversion. A facility not maintaining a system will receive a major infraction (Step 2) compliance status.
- **Working with facilities with inadequate or no treatment works:** On the rare occasion where a facility is found to have no treatment works on site, staff work swiftly with the business towards adopting an effective system. When there is resistance to working proactively with staff, enforcement actions escalate quickly, typically resulting in positive action from the facility. When inspected treatment works are viewed as ineffective[1], the inspector will work with the business to improve treatment performance through either an upgraded system that meets CRD requirements; authorizing modifications to the existing system to meet or beat base performance requirements; or assisting the business in modifying their practices to eliminate the need for on-site treatment works[2].

RSCP Performance Measure #2

"Percentage of priority contaminants showing no increase in loads to the core area environment"

This measure is associated with the RSCP objective of protecting the marine environment adjacent to the CRD's sewage outfalls.

CRD Marine Monitoring Program has collected samples of wastewater from the Macaulay and Clover points outfalls since 1988. Wastewater samples have been analyzed for over 200 parameters, including priority substances and conventional parameters. Statistical analyses have been conducted periodically in the past to evaluate long-term trends in concentrations and loads of these substances in wastewater. The most recent trend assessment (Golder Associates Ltd., 2017), utilizing data from the period 1990-2015, updates the previous assessment (Golder Associates Ltd., 2013).

[1] (e.g., under capacity, in poor repair, or not undergone base standard certification)
[2] (e.g., an automotive shop disconnecting their floor drains and using off-site treatment services exclusively)

In 2008, the RSCP prepared a list of core area priority contaminants based on information provided by Marine Monitoring Program and other sources. The following table shows the current list of 39 RSCP priority contaminants (Appendix 1 of this report). Most of these contaminants have been targeted for reduction by RSCP, either through regulation or outreach, or a combination of initiatives.

Performance measure #2 is based on the "yearly trend" in loads at both Macaulay and Clover points outfalls for the above 39 priority contaminants, as documented in the most recent trend analysis report. All RSCP priority contaminants showing either a decrease or "no significant trend" in loads at either Macaulay or Clover points outfalls are identified and reported as a percentage of the 39 listed priority contaminants. Note that trends for "total" metals, not "dissolved", are used in the calculation. For polycyclic aromatic hydrocarbon (PAH), trends for individual PAH, low molecular weight PAH, high molecular weight PAH and total PAH are used in the calculation.

Performance Measure Calculation

The following table shows how performance measure #2 was calculated for 2005, 2008, 2011 and 2017, based on information provided in Golder Associates Ltd. Note: only the contaminants for which a significant increasing trend was reported are shown – all other contaminants showed either a "significant decrease", no "significant trend" (ns) or "could not be calculated" (nc).

RSCP Priority Contaminant	Yearly Trend Core Area Loads			
	(1990-2005)	(1990-2008)	(1990-2011)	(1990-2016)
TOTAL METALS				
arsenic (As)		Increase		
cadmium (Cd)				
cobalt (Co)			Increase (MAC)	
chromium (Cr)				
copper (Cu)				
lead (Pb)				
molybdenum (Mo)	Increase (CLO)	Increase (MAC)		
manganese (Mn)				
mercury (Hg)				
nickel (Ni)				
selenium (Se)		Increase		
silver (Ag)				
zinc (Zn)				
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)				
Low molecular weight PAH				
naphthalene				
acenaphthylene				
acenaphthene		Increase		Increase (MAC)
fluorene				Increase (MAC)
phenanthrene				
anthracene				
fluoranthene		Increase		
High molecular weight PAH	Increase	Increase		
pyrene				
benzo(a)anthracene				
chrysene				
benzo(b)fluoranthene				
benzo(k)fluoranthene				
benzo(a)pyrene				
dibenzo(a,h)anthracene				
indeno(1,2,3-cd)pyrene				
benzo(g,h,i)perylene				
Total PAH		Increase (MAC)		
Phthalates				
bis(2 ethylhexl)phthalate	Increase	Increase (MAC)		
di-n-butyl phthalate				
Miscellaneous				
1,4-dichlorobenzene				
phenol				
total oil and grease				
Cyanide - WAD			Increase (CLO)	Increase (CLO + MAC)
Cyanide - SAD				
Total # Increase	3	8	2	3
Total # Decrease or "ns"	33	28	34	33
% of 36 Priority Contaminants	92%	78%	94%	92%

RSCP Performance Measure #3

"Percentage of biosolids and sludge samples that meet Class A standards for metals"

Performance measure #3 is linked to the RSCP objective of protecting the quality of sewage sludge and biosolids.

Composite samples of biosolids produced at the SPWWTP were analyzed on a regular basis during periods of production from May 2000-April 2011. Samples were analyzed for metals, moisture, pH, nutrients and microorganisms. Analytical results for metals were assessed using Class A Biosolids Standards as specified in Canadian Food Inspection Agency Trade memorandum T-4-93 Table II (see below).

Following CRD Board direction to cease land application of biosolids, SPWWTP has produced only dewatered sludge since April 2011. The dewatered sludge was landfilled as controlled waste throughout 2012, without routine sampling and analysis. Consequently, there was no 2012 SPWWTP dewatered sludge data available for input to this performance measure. SPWWTP dewatered sludge monitoring commenced in March 2013.

Class A Biosolids Standards, Maximum Acceptable Metal Concentrations*

Metal	Concentration (mg/Kg dry weight)
Arsenic	75
Cadmium	20
Cobalt	150
Mercury	5
Molybdenum	20
Nickel	180
Lead	500
Selenium	14
Zinc	1,850

*From: Canadian Food Inspection Agency Trade memorandum T-4-93 Table II

The GWWTP produces a mixed liquor product, and the SPWWTP produces dewatered sludge. Neither of these are biosolids products by definition. Grab samples of GWWTP mixed liquor are analyzed for metals and moisture on a monthly basis. Composite samples of SPWWTP dewatered sludge are submitted for metals cyanide and moisture analysis initially on a weekly, and finally on a monthly, basis. The results are assessed using the Class A Biosolids standards referred to above.

The performance measure is calculated using the ratio of the annual number of samples of both dewatered sludge and mixed liquor that were compliant with Class A standards and the total annual number of samples collected and analyzed – expressed as a percentage.

Performance Measure Calculation – 2017

The following table illustrates how performance measure #3 is calculated for 2017.

Treatment Plant	# Samples (2017)[1]	# Compliant (2017)[2]
Ganges WWTP (Mixed Liquor)	12	12
Saanich Peninsula WWTP (Dewatered Sludge)	12	12
Totals	**24**	**24**
Percentage Compliant		**100%**

Notes:

1 the number of dates on which discrete samples were submitted for analysis.

2 the number of samples with results that were fully compliant with Class A Biosolids standards for 9 metals. Results for any field duplicates taken on the same date are averaged. If the standards are exceeded for 1 or more of the 9 metals, a "failure" is recorded for the entire sample.

The overall percentage of biosolids and sludge samples that met Class A standards for metals in 2016 was 100%.

RSCP Performance Measure #4

"Overall compliance"

This new performance measure, replacing "Number of facilities with proper waste treatment" would include facilities regulated through permits, authorizations or CoP receiving either a "compliance" or "Step 1" inspection status. A "Step 1" compliance status is indicative of a "first infraction" e.g., a late permit report, or failure to keep records, as required. A single infraction does not have a significant impact on the program. Any facility without proper treatment works or not maintaining treatment works would be given a "Step 2" (first major infraction" or higher level of enforcement depending on the situation).

Performance Measure Calculation – 2017

The first step in estimating overall compliance is establishing the individual CoP sector size. All of the facilities within each CoP data set are assessed and screened on the following criteria:

- Repeat inspections removed
- "No Regulated Waste" Discharge Types removed
- "Not Connected to Regional Sewers" Discharge Types removed
- "Storm Drain Discharge" Discharge Types removed
- Facilities with no inspection dates removed
- "Unknown Discharge Type" Discharge Types removed
- "Closed Facilities" removed
- "Unknown Discharger Types" Discharge Types removed
- "Operating Under Another Regulatory type" Discharge Types removed
- "Operation Under Construction" Discharge Types removed
- Facilities operating under an authorization removed
- "Groundwater Discharger" Discharge Types removed

It should be noted that the screened facilities are not assumed to permanently exist in that state, and are re-visited for updates through "newly sewered facility" GIS mapping updates and/or site contact to determine if practices have changed. Sector sizes for permitted and authorized facilities are simply based on number of active permits/authorizations at that time.

Summary of Code of Practice/Permit/Authorization Sector Sizes in 2017

Code of Practice	Est. Sector Size (2017)
Automotive Repair	202
Carpet Cleaning	34
Dental	124
Dry Cleaning	7
Fermentation	21
Food Services	1225
Laboratory	22
Photographic Imaging	67
Printing	21
Recreation Facility	na*
Vehicle Wash	38
Total CoP Operations	**1,761**
Total Active Permits	41
Total Active Authorizations	92
Total Regulated Facilities	**1,894**

Notes:
*Recreation facilities previously regulated under the CoP have all been transferred over to individual authorizations.

With the established CoP sector sizes and number of permitted/authorized facilities, number of "overall compliant" facilities within each data set are established using the last compliance status of 2017. Facilities with "Compliant" or "Step 1" status are considered "Overall compliant" i.e., minor infractions but assumed treatment works and associated maintenance. Overall compliance since full implementation of CoP are presented in the following table.

Progress on Overall Compliance for 2017 since Adapting New Success Measures

CODES	Sector SIZE	# INSP 2017	% INSP	Total COMP	COMP %	IN PROG	IN PROG %	STEP 1	# OVERALL COMPLIANT (Compliant or Step 1)	% OVERALL COMPLIANT	DUR	DUR %
Automotive	202	67	33.17%	192	95.05%	7	3.47%	6	198	98.02%	0	0.00%
Carpet	34	3	8.82%	33	97.06%	1	2.94%	1	34	100.00%	0	0.00%
Dental	124	1	0.81%	115	92.74%	7	5.65%	7	122	98.39%	0	0.00%
Dry Cleaning	7	1	14.29%	5	71.43%	2	28.57%	1	6	85.71%	0	0.00%
Fermentation	21	21	100.00%	21	100.00%	0	0.00%	0	21	100.00%	0	0.00%
Food	1,225	937	76.49%	1,152	94.04%	46	3.76%	22	1,174	95.84%	4	0.33%
Labs	22	4	18.18%	14	63.64%	5	22.73%	5	19	86.36%	0	0.00%
Photo	67	5	7.46%	66	98.51%	0	0.00%	0	66	98.51%	0	0.00%
Printing	21	2	9.52%	20	95.24%	1	4.76%	0	20	95.24%	0	0.00%
Recreation*	-	-	-	-	-	-	-	-	-	-	-	-
Vehicle Wash	38	26	68.42%	27	71.05%	5	13.16%	4	31	81.58%	0	0.00%
Total	**1,761**	**1,067**	**60.59%**	**1,645**	**93.41%**	**74**	**4.20%**	**46**	**1,691**	**96.02%**	**4**	**0.33%**
Authorizations	92	76	82.61%	87	94.57%	4	4.35%	3	90	97.83%	0	0.00%
Permits	41	75	182.93%	28	68.29%	8	19.51%	4	32	78.05%	1	2.44%
ALL TOTALS	**1,894**	**1,218**	**64.31%**	**1,760**	**92.93%**	**86**	**4.54%**	**53**	**1,813**	**95.72%**	**5**	**0.26%**

Notes:
*Recreation facilities previously regulated under the CoP have all been transferred over to individual authorizations.

APPENDIX 3

CRD Regulated Industrial Categories (Currently Operating under RSCP Permits or Authorizations)

BUSINESS TYPE	TYPICAL CONTAMINANTS OF CONCERN	TYPICAL PRE-TREATMENT INSTALLED
Breweries	solids, organics, pH	solids diversion, filtration, pH adjustment
Chemical Manufacturing	pH, toxic metals, solvents	process control, waste neutralization, off-site waste management
Food Processing	fats, oil and grease, solids, organics	solids separation, grease interceptor, neutralization, dissolved air floatation
Groundwater Remediation	mineral oil and grease, toxic metals, toxic organics, solids, sulphides	settling, filtration, sulphide reduction, adsorption
Hazardous Waste Treatment	mineral oil and grease, toxic organics, sulphides, solids, solvents	filtration, oil/water separation, chemical oxidation, aeration, precipitation, flocculation, adsorption, sulphide reduction
Hospitals	fats, oil and grease, solids, organics, solvents, pH	solids separation, grease interceptor, off-site waste management, absorption
Industrial Laundries	fats (and mineral) oil and grease, solids, organics	grease interceptor, filtration, oil skimmers
Metal Platers	toxic metals, cyanide, solvents, pH	process control, metals adsorption, off-site waste management
Organic Waste Treatment	fats, oil and grease, metals, solids, pH, sulphides	dewatering, grease interceptor, bio-reactors, sulphide reduction, dissolved air floatation
Recreation Facilities	pH, chloride, high volume	pH and chloride adjustment, attenuation
Ship Repair	mineral oil and grease, solvents, toxic metals, toxic organics, solids	settling, flocculation, filtration, electrocoagulation
Street Waste Treatment	fuel, toxic metals, mineral oil and grease, organics, solids	filtration, settling, oil/water separation
Transportation	mineral oil and grease, fuel, solids, de-icing fluid	neutralization, oil/water separation, dissolved air floatation
Wet-Cutting	suspended solids	solids separation, settling

Esquimalt Lagoon Stewardship Initiative

2017 Annual Report

Vision

To protect, enhance and restore the health of Esquimalt Lagoon for future generations of people, plants and animals.

Goals

- Promote and support lagoon stewardship and education
- Prevent further loss or destruction of habitat and wildlife
- Reduce contaminant inputs to the lagoon
- Promote environmentally protective recreation use in the lagoon area
- Promote environmentally protective land use

Introduction

The Esquimalt Lagoon Stewardship Initiative (ELSI), supported by the Capital Regional District (CRD), is a coalition of community and environmental groups, institutions, governments and First Nations working together to protect, enhance and restore Esquimalt Lagoon and Coburg Peninsula.

After forming in 2001, ELSI developed a Stewardship Plan for Esquimalt Lagoon which provides the framework for a coordinated approach to environmental management of the area. The consensus-based steering committee is responsible for guiding the implementation of this plan. The initiative creates opportunities for collaboration on environmental projects and outreach activities, and provides a forum for exchange and sharing of information. A part-time ELSI coordinator, funded through the CRD, initiates and manages projects, seeks funding and coordinates the initiative.

In 2017 ELSI provided input to Colwood on their Official Community Plan review and continued the fish monitoring and water quality programs in the creeks entering Esquimalt Lagoon. Volunteers attended many community events with the ELSI display and watershed model and joined committee members on other regional initiatives at a volunteer appreciation barbeque held at the Gorge Waterway Nature House. ELSI also held a beach cleanup in partnership with the Greater Victoria Green Team.

Pictured above: The narrow strip of coastal dune on Coburg Peninsula is under pressure from sea level rise, increased storm surge incidents and trampling by human visitors.

Proudly supported by the CRD

Highlights

Water Quality

CRD staff collect water quality data annually from Colwood, Bee and Selleck creeks and a selection of stormwater flows that discharge into the lagoon.

In 2017 staff assessed six stormwater discharges in Esquimalt Lagoon for public health concern. None of the discharges were assigned a high public health concern rating. However, elevated E.coli levels (>200 CFU/100 mL) were occasionally found in Colwood Creek, Bee Creek and discharge 933 at the toe of the lagoon. Elevated bacterial counts were found in discharge 933 previously and bacteria of human origin was detected. It is likely that the source of bacterial contamination in this discharge is due to malfunctioning septic systems. Staff will continue to conduct source investigations.

In addition to regular sampling, CRD staff conducted extensive monitoring in the Colwood Creek watershed. Four locations were sampled weekly for five consecutive weeks in the summer (August—September) and fall flush (October—November). Concentrations of bacteria, nutrients and metals were measured on each visit. Benthic (bottom-dwelling) invertebrates were sampled using the Canadian Aquatic Biomonitoring Network (CABIN) method at 2 locations in early September.

CRD also has a hydrometric station in Colwood Creek collecting continuous water depth data which is transmitted to FlowWorks, a web-based data management site that analyzes and reports monitoring data. Results from this monitoring work will be available in 2018.

ELSI volunteers conducted weekly water quality sampling in Bee Creek over 30 day periods during the summer of 2016 and winter 2017. Sampling was carried out at two locations above and below construction activities. Phosphorus, temperature and turbidity were at times above BC guidelines for protection of aquatic life.

However, comparison of the upstream and downstream sites indicates that it is unlikely that the concurrent construction activities were having an impact on water quality. These results warrant more study to determine if the observed water quality is impacting aquatic life. CRD staff will continue to monitor this creek.

During the annual ELSI beach cleanup in September, volunteers discovered a fire burning in one of the beach logs and alerted the Colwood Fire Department.

ELSI members toured a site on Colwood Creek where a boarding school is being built. The creek runs through the centre of the property and members are concerned about impacts to riparian areas during and after construction.

Land and Water Use

The City of Colwood staff continued updating their Official Community Plan throughout 2017 and ELSI provided comments and feedback to staff and council.

ELSI strongly supported of the incorporation of Green Shores principles for sustainable shoreline development into the OCP. Members also advocated for converting Ocean Boulevard along Coburg Peninsula to a one-way route for vehicular traffic with the other lane for pedestrians and non-motorized transportation.

ELSI continued to advocate for reducing foot traffic through the dunes, removal of picnic tables from the dune onto gravel areas and improved signage about the bird sanctuary and the fragile dune ecosystems at the lagoon.

Stewardship and Outreach Events

ELSI teamed up with the Greater Victoria Green Team to hold the annual spring broom pull on Coburg Peninsula and a beach clean-up in the fall.

Volunteers attended several community events throughout the summer including: International Migratory Bird Day at Fort Rodd Hill, Mother's Day Paint-In at Royal Roads University, Canada Day at Fort Rodd Hill and the Eats & Beats at the Beach event in July. The interactive Esquimalt Lagoon watershed model was brought to all of these events.

ELSI participated in the Urban Sanctuary Project with other regional partners. In July, the capital region was officially declared the Greater Victoria NatureHood in recognition of the outstanding opportunities here for people to connect with nature in an urban environment such as at the Esquimalt Lagoon Migratory Bird Sanctuary.

Fish Monitoring

2017 marked the worst year on record for fish monitoring, with very low numbers of fish observed.

In Colwood Creek this was likely due to high summer water temperatures and record low water levels. An upstream water license on Colwood Creek severely restricted the amount of water released to the lower reaches during the critical June—October period.

Much of the lower spawning region was reduced to a dry gravel bed in late summer and trapping was suspended for fear of increasing stress on the surviving fish. On the positive side, no bullfrogs were observed, perhaps due to unusually low water levels in summer. In winter, coho, cutthroat trout, sculpin, pumpkinseed fish and crayfish were observed in Colwood Creek.

In Selleck Creek no fish were trapped, possibly due to several factors: a man-made pond on Ocean Grove property that was stagnant in summer with large mats of algae; high water temperatures, low oxygen levels and evidence of bullfrogs which are known to prey on small fish. Conditions were better in Bee Creek where cutthroat trout populations remained stable. No coho were observed.

Bee Creek Restoration

Residents are now living at Pacific Landing and many are interested in helping to enhance the Bee Creek riparian area. The property developers provided support for the removal of invasive plants, mainly Daphne, English holly and English ivy. Volunteers replanted with native plants such as Oregon grape in riparian areas, dune grasses in the Migratory Bird Sanctuary area and a pollinator meadow. ELSI continues to be an important community resource for the Bee Creek volunteers.

Esquimalt Lagoon Stewardship Initiative

c/o Capital Regional District
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www.elsi.ca

ELSI Partners

Commitee Members

- Canadian Wildlife Service
- Capital Regional District
- City of Colwood
- City of Langford
- Colwood Community Association
- Parks Canada
- Royal Roads University
- Victoria Natural History Society
- Local residents

Advisory Members

- Esquimalt Nation
- Songhees Nation
- BC Ministry of Environment
- Department of National Defence
- Environment Canada
- Fisheries and Oceans Canada

Focus for 2018

In 2018, ELSI will focus on:

- Reviewing and providing comments on development proposals in the lagoon area
- Working with Colwood and the Canadian Wildlife Service to incorporate interpretive signage at the lagoon
- Working with our partners to improve water quality in the lagoon and investigating nutrient sources entering the lagoon and its tributary creeks, and establishing water quality objectives for Esquimalt Lagoon
- Promoting activities that engage the community in stewardship of the Esquimalt Lagoon watershed

Pictured above: Volunteers attended the Eats & Beats event on Coburg Peninsula, with the ELSI display and watershed model. Hundreds came to enjoy the beach, the music, the food and learn about the lagoon, its watersheds and the Migratory Bird Sanctuary.

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APPENDIX E

Gorge Waterway Initiative
2017 Annual Report

Lkwungen Traditional Dancers welcomed visitors to the annual World Oceans Day festivities at the Gorge Waterway Nature House.

Vision

A healthy environment for all life in the Gorge Waterway, Portage Inlet, their watersheds and communities for the well-being of present and future generations.

Goals

- Provide a forum for the exchange and sharing of information regarding the Gorge Waterway, Portage Inlet and their watersheds
- Promote education and awareness programs on appropriate land and water use
- Establish and encourage activities that show care and concern for the natural environment

Introduction

The Gorge Waterway Initiative (GWI), supported by the Capital Regional District (CRD), is a collaborative, community-driven group of organizations working to protect, enhance and restore the natural and cultural features of the Gorge Waterway, Portage Inlet and the surrounding watersheds. GWI provides a coordinated approach to environmental stewardship of the Gorge and Portage Inlet and their watersheds. GWI is led by a consensus-based steering committee responsible for guiding the implementation of the Gorge Waterway Stewardship Strategy. A part-time coordinator initiates and manages projects, seeks funding and provides administrative support.

In 2017, GWI members provided input to the Town of View Royal about a redevelopment proposal at Christie Point, the Ministry of Transportation and Infrastructure regarding a berm proposal for the Highway 1 Admirals-McKenzie Interchange Project and the City of Victoria regarding the Vic West Neighbourhood Plan. Members attended many outreach events with the GWI display, reaching over 1,400 people with conservation and stewardship messaging. GWI participated in the Urban Sanctuaries Project with other regional partners working to promote awareness of the three migratory bird sanctuaries in the region.

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Highlights

Water Quality

In 2017, CRD staff conducted the following sampling activities in the Gorge Waterway and Portage Inlet to assess the impacts of stormwater on the environment and public health:

- sampled 55 of the 145 stormwater flows that discharge into the Gorge Waterway and Portage Inlet for bacterial levels in summer and winter;
- collected sediment from 11 stormwater discharges;
- assisted Esquimalt staff in locating an upstream source of contamination in Gorge Creek;
- conducted investigations in two other stormwater catchments to find the source of stormwater contamination; and
- assessed the health of the Colquitz Creek watershed through intensive monitoring and collection of benthic invertebrate data.

CRD staff monitors the mouth of Colquitz Creek twice a year for bacterial levels and collects continuous hydrometric data.

In 2017, staff sampled seven additional locations in the watershed weekly for five consecutive weeks in the summer (August/September) and fall flush (October/November). Concentrations of bacteria, nutrients and metals were measured on each visit. Benthic (bottom-dwelling) invertebrate community samples were collected using the Canadian Aquatic Biomonitoring Network (CABIN) method at two locations in early September. Results from all sampling will be analyzed, shared with municipalities and made publicly available in 2018.

Land & Water Use

View Royal requested a referral from GWI for the revised development plan for Christie Point on Portage Inlet. Following a presentation to GWI by the project proponents, GWI provided detailed comments to View Royal about this proposal, expressing support for the Green Shores™ approach being proposed by the developer, but recommending that View Royal turn down the proposal. This recommendation was based on the high density, disturbance to birds and wildlife that construction would impose, and the massing and height (6 storeys) being proposed for a development in the middle of a bird sanctuary. Although the development proposal received council approval, the project was put on hold later in 2017.

The GWI continued to consult with Ministry of Transportation and Infrastructure about the McKenzie Interchange Project adjacent to Cuthbert Holmes Park. When sediment spills from this project entered Colquitz Creek, GWI and community members' concerns prompted MoTI to require increased environmental oversight on this project.

The consultant hired to do this gave a presentation to GWI members at a special meeting to discuss remediation and additional protection measures at the construction site. GWI also provided comments on the berm proposal presented by MoTI at an open house. Suggestions included increasing native plantings and committing to control invasive species at the site post-construction. GWI also expressed concern that the overall height and breadth of the berm was unacceptable in such close proximity to the salmon-bearing Colquitz River.

Members have ongoing concerns around this construction site and remain vigilant for any further damage to the creek and riparian areas.

The 2017 Gorge Swim Fest was cancelled at the last minute due to contamination entering the Gorge Waterway from Gorge Creek. The Township of Esquimalt spent several weeks investigating and finally locating the source of the contamination – a sewer-stormwater cross-connection higher up in the watershed. Esquimalt staff gave a presentation to the GWI explaining how they solved the problem and the lessons learned. Esquimalt staff continue to deal with ongoing cross-connection challenges in the Gorge catchment area. The upside of having to cancel the Swim Fest was the awareness raised among the general public of the problem of contamination in urban creeks, and what we can all do to help prevent this in future.

Craigflower Manor Historic Site on Portage Inlet is now managed by the Victoria Highland Games Association, currently fundraising to build a Scottish Community Centre on the site. VHGA members presented their vision for this new facility to GWI and led a site tour. GWI members offered assistance to design improvements for the foreshore that would incorporate Green Shores principles to improve and enhance wildlife habitat, and still maintain water views from the property.

The City of Victoria staff consulted with GWI during development of the neighbourhood plan for the Vic West neighbourhood. GWI continued to support the City of Victoria in its efforts to regulate vessel anchoring in the Gorge Waterway.

Urban Sanctuaries Project

GWI members continued to promote public awareness of the Victoria Harbour Migratory Bird Sanctuary (MBS).

The Canadian Wildlife Service provided signs that were put up in the five municipalities bordering the MBS to let people know the extent of this significant urban sanctuary.

GWI worked with regional partners to promote the Urban Sanctuaries Project (www.sanctuaryproject.ca) including a well-attended Speakers Series event at the Robert Bateman Centre that focused on birds of Vancouver Island.

In July, the capital region was officially dedicated as a NatureHood by the Lieutenant-Governor in recognition of the outstanding opportunities for connecting people with nature in our unique urban setting.

GWI members, in partnership with other members of the Urban Sanctuary group, installed reef balls in the Gorge Waterway to provide substrate for settlement of native Olympia oyster larvae.

Elk and Beaver Lakes

CRD staff conducted regular water quality sampling in EBL in 2017 to supplement historical data from the Ministry of Environment. In addition, staff monitored for the visible presence of blue-green algae. When present, water samples were taken to determine if any species present were toxin-producers. In Beaver Lake a blue-green algal bloom began in July and persisted through December, and beaches were closed throughout that period.

CRD contracted Hemmera Envirochem to conduct a fish survey in EBL. Out of a total of 640 fish captured, no native fish species were observed. Most of these fish were introduced many years ago, and rainbow trout are re-stocked annually. Survey results showed that yellow perch were the most abundant (61%) followed by largemouth bass (13%), bullhead (10%), carp (7%), smallmouth bass (5%), rainbow trout (3%) and pumpkinseed (1%). These results along with gut analyses suggest that the abundant yellow perch are also a likely major food source for other piscivorous fish.

Community Outreach

The GWI display was brought to many community outreach events in 2017, including, Earth Day at the Royal BC Museum, Vic West Fest, two Oceans Day events, Canada Day on the Gorge and International Migratory Bird Day. Approximately 1,400 people were reached through these events.

In addition, the GWI display and InfoSheets were on display at the Gorge Waterway Nature House throughout the year.

Reef balls were placed in the Gorge Waterway, part of an initiative to increase populations of the Olympia oyster Ostrea lurida, a federally designated Species of Special Concern.

GWI Partners

Community Members

- Burnside Gorge Community Association
- Esquimalt Residents Association
- Friends of Cuthbert Holmes Park
- Friends of Swan Creek Watershed
- Friends of Victoria Harbour Migratory Bird Sanctuary
- Gorge Swim Fest Society
- Gorge Tillicum Community Association
- Gorge Waterway Action Society
- Habitat Acquisition Trust
- Portage Inlet Protection Society
- Portage Inlet Sanctuary Colquitz Estuary Society
- SeaChange Marine Conservation Society
- South Island Aquatic Stewardship Society
- South Island Sea Kayaking Association
- Victoria Canoe and Kayak Club
- Victoria Golden Rods and Reels Fishing and Social Club
- Victoria West Community Association
- World Fisheries Trust

Local Government Members

- Capital Regional District
- City of Victoria
- District of Saanich
- Township of Esquimalt
- Town of View Royal

Gorge Waterway Initiative

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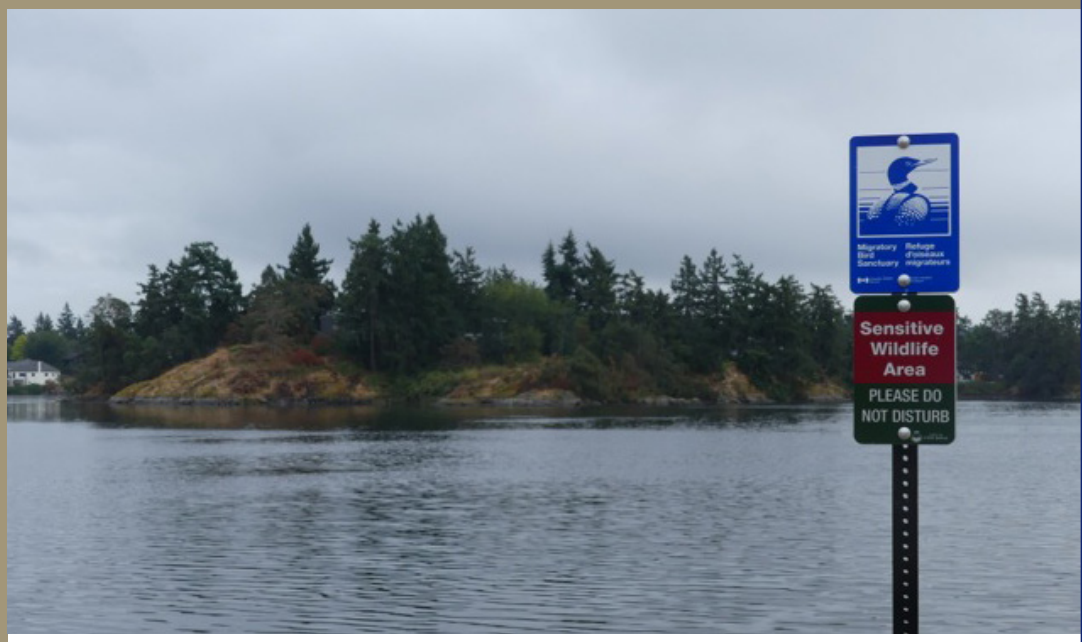

Migratory bird sanctuary signs have now been installed in all five of the municipalities that border the Victoria Harbour MBS. (Credit: Jacques Sirois)

Focus for 2018

In 2018, GWI will focus on:

- Continuing to provide input to review processes for developments along the waterway
- Mapping and developing an inventory of shoreline, intertidal and subtidal habitats focusing on tidal marsh, eelgrass, kelp and Olympia oysters and identifying key areas for restoration, as funding allows
- Planning and initiating bird surveys throughout the waterway
- Promoting the Green Shores program to shoreline residents and encouraging municipalities to incorporate Green Shores principles into planning initiatives
- Promoting activities that engage the community in stewardship of the Gorge Waterway and Portage Inlet

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Making a difference...together

Core Area Stormwater Quality

2017 Annual Report

Parks & Environmental Services | Environmental Protection

Including the jurisdictions of:

City of Colwood
Township of Esquimalt
City of Langford
District of Oak Bay
District of Saanich
City of Victoria
Town of View Royal
Esquimalt First Nation
Songhees First Nation
Department of National Defence

Prepared by
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October 2018

CORE AREA STORMWATER QUALITY PROGRAM
2017 ANNUAL REPORT

1.0 INTRODUCTION

The Capital Regional District (CRD) plans, promotes and coordinates stormwater quality initiatives. In the core area, this work is guided by the Core Area Liquid Waste Management Plan (LWMP) and done in consultation with the municipalities, First Nations, and community groups with the goal of protecting human health and the environment. The program works to identify and reduce contamination in stormwater, creeks and the ocean through monitoring, assessment, collaboration and education.

Program staff monitor stormwater, creeks and the ocean to identify contamination and impacts from stormwater due to various land use practices through bacterial and chemical sampling. The program assesses stormwater discharges and creeks in the core area and assigns priority ratings for mitigative action to be undertaken by the appropriate jurisdiction(s). Where contamination is found, CRD staff conduct investigations and work with municipal staff to find and eliminate the source.

This report summarizes the results of work completed by the program in 2017. Water and sediment quality data, including details about how the discharges were rated for public health and environmental concern and sampling locations, are available in the *Core Area Stormwater Quality Program 2017 Supplemental Data* on the CRD website (https://www.crd.bc.ca).

2.0 RESULTS AND DISCUSSION

2.1 Stormwater Discharge Evaluations

The program evaluates water and/or sediment quality in approximately 550 core area stormwater discharges from the coastline between the Colwood-Metchosin border in the west and the Saanich-Central Saanich border in the east, including Esquimalt Lagoon, Esquimalt and Victoria harbours, the Gorge, Portage Inlet and the City of Langford coastline along Saanich Inlet.

2.1.1 Public Health – *E. coli*

Each year, CRD staff collect water samples from a selection of stormwater discharges for measurement of bacteria levels. The extent of bacterial contamination, and the potential for members of the public to contact the discharge flow, is used to rate each discharge for public health concern. This allows jurisdictions to undertake remedial measures where they will have the most benefit. Appendix G contains detailed information about the CRD public health concern rating system.

In 2017, the CRD assessed 167 stormwater discharges for *E.coli* concentrations in the winter and the summer. Ninety-six of the discharges (58%) had 1 or more *E.coli* counts greater than 200 colony forming units (CFU)/100 mL), a level of contamination that indicates sources of sewage or animal waste with potential to cause adverse effects for public health from primary recreational activities (e.g., swimming, diving). However, many of these discharges have low flows or are located where there is little risk of contact. Considering the potential for public contact, CRD staff assigned the following public health concern ratings:

- 66 low ratings,
- 70 moderate ratings, and
- <u>31 high ratings</u> (Table B, Figures A and B).

Bacterial stormwater data and the public health concern ratings for each discharge can be found in appendices B and C, respectively.

There were 31 high-rated discharges in 2016 as well; however, many of these were different discharges, due to repair of some sources, identification of new sources and fluctuations in bacterial levels. The changes in discharge ratings from 2016 to 2017 are as follows:

- 8 of the previously high-rated discharges were assigned a lower rating,
- 1 previously high-rated discharge was not rated, as it was not accessible, and
- 9 previously low- or moderate-rated discharges were assigned a high rating (5 of these are newly-identified highs).

Improvements in stormwater quality have resulted in a decline in the number of high-rated discharges in recent years (Table A) despite the ongoing addition of new sources of contamination that come up as infrastructure ages and new developments or renovations create the potential for stormwater-sewage cross-connections.

In 2007, the number of high-rated discharges increased to 41, prompting municipal and CRD Integrated Watershed Management Program (IWMP) staff to concentrate efforts on decreasing bacterial concentrations in these discharges. In 2017, 17 of the 41 discharges were still high-rated, a 59% reduction in this subset since 2007.

2.1.2 Environment – Chemical Contaminants

CRD staff also rate stormwater discharges for environmental concern based on the level of metals and organic contaminants measured in sediment collected within the stormwater collection system (i.e., pipes, manholes, ditches and creeks) relative to marine sediment quality guidelines for protection of aquatic life. Discharges are sampled annually until the rating and contaminant(s) are confirmed. Once confirmed, a high rating results in an investigation to locate the sources of contamination. Appendix G contains detailed information about the CRD chemical contaminant rating system.

In 2017, the CRD collected 31 sediment samples (23 at the discharge and 8 upstream). Stormwater discharge sediment data and ratings can be found in Appendix E. Contaminant ratings for the 23 stormwater flows sampled at the point of discharge are as follows:

- 9 were assigned a low environmental concern rating,
- 8 were assigned a moderate rating, and
- 6 were assigned a high rating.(Table C, figures A and B)

Staff make recommendations for corrective action to find and eliminate sources of chemical contamination when the rating remains high for 2 years and the parameter(s) of concern are determined. Two discharges rated high in 2017 are not on the action list, as the contaminants have not been confirmed. In 2017, CRD recommends 18 discharges for corrective action in the core area (Table C and figures A and B).

The number of discharges recommended for action was reduced from 20 in 2016 to 18 in 2017. The CRD removed 3 discharges from the action list and added 1. Discharge (873A) was removed due to lower contaminant levels, while discharges 613A and 767 were removed as previous samples were marine-influenced, therefore, observed contamination may not have been originating from the land. Staff will continue to sample these discharges upstream of marine influence. Elevated mercury levels were confirmed in discharge 614 and it was recommended for action. City of Victoria staff removed contaminated sediment from an upstream catch basin in 2018 and CRD will continue to monitor the discharge.

Many discharges recommended for action have been a concern for more than 5 years. Sources of contaminants in stormwater sediment can be complex to find and eliminate, as sediment is not always present when sampling and contaminant levels fluctuate. In addition, non-point sources (e.g., from roadways, parking lots) and transient point sources (e.g., spills) exist. In some cases, sediment can remain for a long time, therefore, samples can reflect past practices that are no longer occurring.

Source control education has increased awareness of products used on commercial and private sites and contaminant levels leaving their properties. As well, the use and maintenance of stormwater rehabilitation units continues to increase. The CRD and municipalities will continue to work together to identify and eliminate potential sources of contamination for these discharges.

Table A. Number of Discharges with a High Public Health Concern Rating from 1993 to 2017

Area	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2011	2012	2013	2014	2015	2016	2017
Colwood	0	2	2	1	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	0	0
View Royal	1	0	0	0	0	0	0	0	0	1	0	1	2	1	1	1	0	0	0	0	0
Esquimalt	12	10	9	9	9	6	6	5	5	5	5	7	7	8	7	7	8	7	5	6	6
Esquimalt private[1]	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	1	0	2
DND	0	0	1	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Saanich	6	2	1	2	1	0	2	2	1	0	4	1	1	2	2	3	4	5	5	6	4
Saanich private[1]	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	0	0	0	0
Victoria	22	17	12	10	9	11	13	9	8	13	14	14	15	15	20	17	13	12	14	11	11
Victoria private[1]	*	*	*	*	*	*	*	*	*	*	*	2	3	5	3	1	1	2	2	2	2
Oak Bay	8	7	3	4	3	4	5	6	8	6	5	9	9	10	9	9	7	9	8	6	6
Langford	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**49**	**38**	**28**	**28**	**23**	**22**	**27**	**22**	**23**	**26**	**28**	**34**	**37**	**41**	**43**	**38**	**33**	**36**	**35**	**31**	**31**

Notes:

[1] Discharges that are not part of the municipal infrastructure are not under municipal jurisdiction and are separated out from the municipal totals.

* Private discharges included in the municipal totals.

Table B. Discharges Rated High for Public Health Concern in 2017

Jurisdiction	CRD Discharge Number
City of Colwood	---
Township of Esquimalt	726, 727, 744B, 780, 805, 806
Township of Esquimalt – private[1]	736A, 749A
City of Langford	---
District of Oak Bay	245, 310A, 318, 319, 320, 322
District of Saanich	503, 505, 559, 653
City of Victoria	214, 216, 222, 229, 230, 611, 613, 619, 622, 758A, 777A
City of Victoria – private[1]	645A, 649
Town of View Royal	---
Esquimalt First Nation	---
Songhees First Nation	---
DND	---

Notes:

[1] Discharges that are not part of the municipal infrastructure are not under municipal jurisdiction

Figure A - Core Area 2017
Stormwater Discharges Requiring Action for Public Health and Environmental Concerns (Metchosin to Esquimalt Border)

CRD
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Kilometres
0 0.5 1
Projection: UTM ZONE 10N NAD 83

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

Discharges Requiring Action
- High Public Health Rating
- High Environmental Rating and/or Recommended for Action

- Municipal Boundaries
- DND Boundaries
- Streams and Rivers
- Roads
- Stormwater Monitoring Area

CRD - Facilities Management & Engineering Services - Jul 18, 2018 - Technologist: srulliancich - Map Document: SWQCoreDischargeColwoodConcern2017.mxd

Figure B - Core Area 2017

Stormwater Discharges Requiring Action for Public Health and Environmental Concerns
(Esquimalt to Central Saanich Border)

CRD - Facilities Management & Engineering Services - Jul 18, 2018 - Technologist: srujiancich - Map Document: SWQCoreDischargeVictoriaConcern2017.mxd

CRD
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Kilometres
0 1 2
Projection: UTM ZONE 10N NAD 83

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Discharges Requiring Action

- ■ High Public Health Rating
- ▲ High Environmental Rating and/or Recommended for Action

- Municipal Boundaries
- DND Boundaries
- Streams and Rivers
- Roads
- Stormwater Monitoring Area

Table C. Discharges Recommended for Action Due to Elevated Chemical Contaminant Levels

Jurisdiction	Discharges Recommended for Corrective Action	Total
City of Colwood	-	0
Township of Esquimalt	737, 742, 749, 806	4
Township of Esquimalt – private[1]	-	0
City of Langford	6006	1
District of Oak Bay	250, 307, 310	3
District of Saanich	-	0
District of Saanich – private[1]	-	-
City of Victoria	216, 603, 614, 620, 627, 629, 634, 636	8
City of Victoria – private[1]	-	0
Town of View Royal	866, 874	2
DND	-	0
Total		**18**

Notes:

[1] Discharges that drain from private property do not fall under municipal jurisdiction.

[2] Other discharges were assigned high ratings in 2017 (306, 505) but further testing must be done to confirm the results.

3.0 SOURCE INVESTIGATIONS

The program conducted source investigations in the catchment areas of 17 stormwater discharges for bacterial contaminant sampling and 4 discharges for chemical contaminant sampling.

3.1 Bacterial Investigations

In 2017, staff conducted source investigations in 17 stormwater discharge catchment areas. Esquimalt and CRD staff identified a cross-connection in the Gorge Creek catchment and it was repaired shortly afterwards. CRD staff narrowed down a source of bacteria in Plumper Bay and is working with Songhees First Nation and the First Nations Health Authority to determine the source and facilitate repairs. CRD staff have narrowed down 3 additional sources, but the results need to be confirmed. Investigations are ongoing in 13 discharges, due to presence of multiple sources, lower fecal coliform counts or lack of flows to sample in 2017. The status of bacterial investigations completed by CRD staff in 2017 is summarized in Table D.

Table D. 2017 Summary of Stormwater Fecal Coliform Source Investigations by IWMP staff

Discharge	Municipality	BST Results	Sampling Events	Status
222	Victoria	Human, ruminants, dog, general	1	Ongoing
229	Victoria	Human, ruminant, general	1	Ongoing
244	Oak Bay	Human, ruminant, general, potential dog	1	Ongoing
307	Oak Bay	Human, ruminant, dog, general	1	Ongoing
316	Oak Bay	Not tested	1	Ongoing
505	Saanich	Human, ruminant animal, general (2015)	1	Ongoing, counts low upstream in 2017; Saanich **repaired** a cross-connection in 2015.
559	Saanich	Human, dog, general	1	Ongoing; Douglas Creek
629	Victoria	Ruminants and general	1	Ongoing, CRD narrowed down 1 source but needs confirmation.
634	Victoria	Ruminants, dog, gull, general, potential human	1	Ongoing
636	Victoria	Human, ruminants, dog, gull general	1	Ongoing, CRD is narrowing down 2 sources flowing into a manhole at Hillside Avenue and Bridge Street, but needs confirmation.
690D-11		Not tested	1	Ongoing
742	Esquimalt	Human and general	1	Ongoing
744	Esquimalt	Human, ruminants, general	1	Source found with Esquimalt staff and **repaired**; other sources exist.
736A	Esquimalt	Human and ruminant animal	4	Ongoing, another source exists; CRD dye-tested all properties in the strata; source unknown. CRD identified a cross-connection and it was **repaired** in 2016.
Plumper Bay 865C 865D 865AB	Esquimalt First Nation and Songhees First Nation	865C: gull and general 865D: bacteria too low at time of testing 865AB: human and general 2 marine samples; counts too low in 1 and dog, gull and general in another	4	Source **narrowed**, others sources may exist. CRD will continue monitoring once source is repaired.

Notes:
BST = Bacterial Source Tracking; genetic analysis to determine the source of stormwater bacteria
General bacteria are those for which a specific marker is not available; for example, there is no marker for ducks

3.2 Chemical Contaminant Investigations

In 2017, IWMP staff conducted chemical contaminant source investigations in sediment from 4 discharge catchment areas. Results from 2 of these discharges confirmed the location of sources of previously found contamination and results have been shared with municipal staff. In 2017, Oak Bay removed contaminated sediment from 2 manholes with sources of contamination and staff will continue to monitor this discharge. Overall, CRD staff have narrowed down sources in 10 of the 18 catchments on the action list and continue to work with municipal staff on eliminating or lessening these sources.

4.0 MARINE SURFACE WATER MONITORING

In 2018, CRD staff will conduct water sampling in Esquimalt Lagoon, Esquimalt and Victoria harbours, and the Gorge and Portage Inlet for bacteria, metals and dissolved oxygen levels to see if water quality has changed over time (the last sampling event was in 2011 and 2012) and to compare these values with the BC Ministry of Environment and Climate Change Strategy (MOE) draft site-specific water quality objectives for these waters.

5.0 MAJOR WATERCOURSE MONITORING

CRD staff continued to monitor Bee, Bowker, Cecelia, Colquitz, Colwood, Craigflower, Douglas, Hospital, Noble, Selleck and Tod creeks, and Mill Stream in 2017 to provide information about watershed health.

Each year, staff collect water quality data twice at the discharge of each creek, providing a snapshot of creek health in the wet and dry seasons but conduct more comprehensive watershed health assessments in 2-3 core area watercourses with the goal to assess each watercourse in this manner every 5 years.

In 2017, Colquitz, Colwood and Tod creeks were assessed more extensively, including measuring water quality 5 times in 30 days in summer and fall at various locations in the watershed and undertaking a health assessment of the benthic invertebrate animals living in the creeks. Additional water quality parameters, including metals, were measured as well. Sampling 5 times in 30 days allows for comparison to British Columbia water quality guidelines.

5.1 Water Quality Data

Colquitz Creek water quality data indicated that aluminum, copper, iron, zinc, phosphorus, and suspended solids were at concentrations that could result in adverse effects on aquatic life. Bacteria were also elevated indicating sewage presence in the creek. Water quality was particularly poor when samples were taken while it was raining.

Water quality in Colwood Creek was good at the mouth of the creek, but poorer upstream in 2017. With the exception of phosphorus and *E.coli*, no water quality parameters exceeded water quality guidelines for protection of aquatic life at the mouth. A number of water quality parameters were outside guidelines just downstream of Sooke Road, at Hagel Road and just downstream of Glen Lake, including metals (copper, chromium, iron and zinc), dissolved oxygen, turbidity and suspended solids, phosphorus, pH and *E.coli*. Exceedances of guidelines coincided with heavy rainfall. In addition, poor site water management on a construction site just downstream of Glen Lake impacted water quality for approximately 3 weeks in the fall.

Extensive sampling in Tod Creek indicated that the mouth of the creek was healthy (with very few exceedances of water quality guidelines), but upstream sites, particularly near Farmington Road, were unlikely to be able to support aquatic life. Dissolved oxygen levels were below guidelines for protection of aquatic life (averages were 1.4 and 3.5 mg/L in summer and fall). Staff also measured elevated phosphorus, turbidity, iron and zinc.

CRD data indicate that the water quality parameters of most concern in core area creeks are bacteria, phosphorus, turbidity and metals. Some sites also experience low dissolved oxygen and elevated temperature in the summers. This is consistent with what is seen throughout the region wherever there is

increased human presence. The draft Vancouver Island phosphorus objective was exceeded in all CRD creeks due to human and animal presence in these watersheds.

Overall, creek water quality was similar to last year: poor in Bowker and Cecelia creeks; moderate in Bee, Colquitz, Colwood, Douglas, Hospital, Noble and Selleck creeks; and good in Craigflower Creek, Mill Stream and Goldstream River. Before 2017, CRD only monitored the mouth of Tod Creek as part of the Saanich Peninsula sampling program and found water quality to be generally good. Extensive sampling in 2017 confirmed that the creek mouth is still healthy, but identified poor water quality upstream.

Water quality is important in these creeks, but hydrological changes and physical alteration are also a concern. Therefore, benthic invertebrate community data and hydrological data are also collected.

5.2 Benthic Invertebrate Community Data

Benthic invertebrates live in or on the bottom of streams and are good indicators of stream health. Their community composition reflects the overall condition of the aquatic environment and depends on water and sediment quality, as well as hydrology.

CRD data indicate that the benthic invertebrate communities in Colwood Creek and Mill Stream (at the discharge) are healthy based on their similarity to invertebrate communities in minimally-impacted Vancouver Island creeks. Benthic invertebrate community data from downstream locations in Bee, Bowker, Cecelia and Colquitz creeks, and at Treanor Road in Mill Stream, indicate that these communities are not healthy and it is recommended that upstream activities impacting the watershed be identified and managed.

The Hilsenhoff Biotic Index indicates the amount of organic and nutrient pollution in a stream based on species distribution and their tolerance to such pollution. Mill Steam was deemed “Very Good” with slight organic pollution probable. Colwood, Colquitz (downstream of Elk Lake), Craigflower, Douglas, Mill Stream (at Treanor Road) and Tod creeks were deemed “Good” with some organic pollution likely; Colquitz, Bee and Cecelia creeks were deemed “Fair” with fairly substantial pollution likely; and Bowker was deemed “Fairly Poor” with substantial pollution likely. A slight degradation of the Hilsenhoff Biotic Index in Colwood Creek in 2012 (4.38) compared to 2017 (4.80), suggests that pollution may be increasing in the creek and further study is warranted.

6.0 SPECIAL PROJECTS AND OTHER ACTIVITIES

CRD staff are involved with a number of special projects and activities to improve stormwater quality in the region and promote healthy, livable watersheds and their receiving environments. Some initiatives that were carried out to reduce stormwater pollution and related activities included:

- Implementing an integrated watershed management approach to work in partnership with municipalities and the community to protect watersheds as regional assets rather than working at the individual local government scale.
- Coordinating a Community Integrated Watershed Management Group to allow CRD staff and other watershed stewards to communicate with each other about watershed activities, ideas and research.
- Promoting stormwater source control through development of model bylaws, codes of practice, best management practices, educational outreach and technical assistance.
- Assisting the MOE in the development of water quality objectives in core area harbours and streams.
- Overseeing initiatives to improve and protect the environmental quality of core area watersheds and harbours, in cooperation with community and municipal groups through the Esquimalt Lagoon Stewardship Initiative, Gorge Waterway Initiative and Bowker Creek Initiative.
- Participating in community outreach events and hosting educational workshops.

7.0 2018 PROGRAM

The program will continue to work with municipal partners, First Nations and community groups to achieve LWMP goals to identify stormwater discharges of public health and environmental concern and investigate the sources of contamination. Staff will continue to collaborate with Island Health on public beach safety through sampling, communication and assistance in developing public notice messaging.

8.0 CONCLUSIONS

In 2017, CRD staff assessed water and sediment quality in stormwater discharges and creeks to identify and reduce contamination, assess watershed health and develop priority ratings to allow the appropriate jurisdictions to deal with contamination of most concern to public health and the environment. In 2017, the majority of stormwater discharges were assigned low or moderate ratings for public health and environmental concerns.

CRD and municipal staff efforts have resulted in a decrease in the number of high-rated discharges over time. In 2017, 31 stormwater discharges are high-rated for public health concern, a decrease from 43 in 2011. However, as improvements to stormwater quality have been made, new contaminant sources come up as infrastructure ages and development and renovations create the potential for stormwater-sewage cross connections. Eight of the 2016 high-rated discharges received a lower rating in 2017, yet, 5 new high-rated discharges were discovered.

Six stormwater discharges received high environmental concern ratings in 2017. Four of these and 14 others have been previously rated high for environmental concern and are recommended for corrective action. CRD staff have narrowed down sources in 10 of the 18 stormwater catchments, however, sources can be complex to find and eliminate. Many of these discharges have been of high concern for more than 5 years.

CRD staff assess watershed health in 12 creeks (through water quality and flow measurements and benthic invertebrate community assessment). In 2017, Tod, Colwood and Colquitz creeks were intensively sampled. CRD data indicate bacteria, phosphorus, turbidity and metals are the parameters of most concern in CRD creeks. Overall, creek water quality was similar to last year: poor in Bowker and Cecelia creeks; moderate in Bee, Colquitz, Colwood, Douglas, Hospital, Noble and Selleck creeks; and good in Craigflower Creek, Mill Stream and Goldstream River.

In 2018, staff will continue to work together with CRD municipalities, First Nations and others to identify and reduce bacteria and contaminant levels in stormwater discharges, creeks and the marine receiving environment.

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Trucked Liquid Waste Program

2017 Annual Report

Parks & Environmental Services | Environmental Protection

Prepared by:
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October 2018

TRUCKED LIQUID WASTE PROGRAM
2017 ANNUAL REPORT

BACKGROUND

Under Section 19 of the Core Area Liquid Waste Management Plan, the Capital Regional District (CRD) implements a program to coordinate the collection and disposal of trucked liquid waste (TLW). TLWs are non-domestic liquid wastes that are prohibited from discharge to sanitary sewer or stormwater systems and must be transported by truck to a disposal facility. Examples of TLWs include catch basin, grease interceptor and oil/water separator wastes.

The CRD's Trucked Liquid Waste Program (the Program) addresses the Core Area Liquid Waste Management Plan requirements related to management of TLW. The objective of the Program is to ensure that TLW is handled and disposed of in an appropriate and responsible manner, to protect the environment and public health. The Program's goals are to:

- promote pollution prevention;
- promote informed decisions by the industrial, commercial and institutional sector on liquid waste disposal;
- encourage the development of appropriate and cost-effective facilities; and
- encourage and increase compliance with regulations.

These goals are achieved through industry partnerships, outreach and education of TLW generators and haulers. The Program educates service providers regarding disposal options, waste pre-treatment, and maintenance requirements through outreach materials and via presentations at annual stakeholder meetings. The 2017 Program initiatives are summarized below and include outreach and education, industry relations and waste quantity monitoring.

OUTREACH AND EDUCATION

In 2017 and 2018, outreach initiatives targeted TLW haulers and waste generators to advertise appropriate management and disposal options through advertising, web content and events.

Advertisements: Fall Series

The annual fall advertising program focusses on catch basin maintenance and clean outs and typically runs in early October prior to the rainy season. Communications and media plans were updated to effectively target the intended audience (businesses and business associations). The following media were used to promote catch basin cleaning:

- Paper and electronic news publications (see Figure 1)
- Magazines
- Radio
- Facebook and Twitter

Website metrics indicate the ad campaign was successful at directing traffic to relevant pages on catch basin cleaning throughout the duration of the campaign. Over 10,000 people were reached on popular social media platforms. In addition, some constructive feedback was received on social media and will aid in modification of future outreach messaging to improve clarity.

TLW staff are currently coordinating with other programs to develop a new campaign that reminds commercial manufacturers that liquid wastes require proper management. The new campaign is expected to launch in early 2019.

Figure 1 Fall Catch Basin Ad, 2017

Website

The CRD's TLW website includes a service provider directory, information on proper management and disposal of wastes, catch basin facts, technical reports and tools for waste management. The service provider directory is a useful tool to connect generators with service providers to ensure responsible waste management. The directory and TLW pages are reviewed regularly and updated, as needed.

The majority of website traffic was related to catch basin maintenance and servicing, which is the focus of the TLW fall ad campaign series. Analysis of page views reveals that the majority of web traffic occurs throughout the duration of the ad campaign. This web content is a unique regional resource for individuals and businesses looking for information on catch basins.

Outreach Events

Program staff collaborate with other CRD programs and share outreach material and events. The TLW catch basin pamphlet is part of the watershed-wise pamphlet series, which is delivered through many CRD outreach programs. New campaign material is currently in the planning stages to support commercial liquid waste management throughout the region.

INDUSTRY RELATIONS

CRD staff routinely liaise with the TLW industry to inform outreach objectives and areas for research. Industry liaison includes periodic consultation with the TLW stakeholders' group and annual tours and/or meetings with service providers or waste generators. In addition to the annual stakeholder meeting, Program staff prepared workshops and outreach materials in anticipation of the future Saanich Peninsula Stormwater Bylaw launch.

In March 2018, the TLW stakeholders met with the service providers at an annual event for industry representatives and service providers. This annual event provides an opportunity for comment on outreach programs, industry needs or emerging issues regarding TLW. The Program presentation summarized the Program purpose and goals, as well as upcoming 2018 and 2019 plans. Additionally, industry feedback regarding TLW programs, outreach and disposal survey was sought in the form of a survey at the meeting.

The survey indicated that catch basin management is routine service work for many companies with the exception of emergency blockage related work. Maintenance work is often aligned with our fall outreach program and the ad campaign messaging is considered relevant. In anticipation of future record keeping requirements, staff asked service providers if they take part in record keeping for their clients. The providers indicated that they have not seen any requests for additional record completion to date. Service providers voiced concerns over disposal costs and lack of competition for TLW disposal in the CRD. While the CRD has no regulatory jurisdiction over TLW management and disposal outside of Hartland landfill, staff will continue to work with stakeholders to promote a fair and transparent service across the region.

WASTE QUANTITIES

TLW disposal quantities are routinely assessed for trends and cycles. The data contributes to regional planning efforts and supports outreach activities. A large portion of TLWs are disposed of at private and out-of-region facilities and those volumes are not available for assessment. Regardless, in 2017, total quantities received at both Hartland Landfill and SPL Wastewater Recovery Center have increased over the last 4 years. Between 2013 to 2017, catch basin waste quantities disposed of at local facilities more than tripled.

CONCLUSION

The Program continues to successfully improve TLW management practices within the region. Program performance measures demonstrate that the Program effectively reaches waste generators and service providers. Outreach and education activities continue to promote proper maintenance practices for catch basins and a new outreach program is in development for 2019. Staff continue to work with waste generators, haulers and other stakeholders to achieve program goals and to meet requirements under the Core Area and Saanich Peninsula Liquid Waste Management Program.

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EFE 18-43

REPORT TO CORE AREA LIQUID WASTE MANAGEMENT PLAN COMMITTEE
MEETING OF WEDNESDAY, OCTOBER 10, 2018

SUBJECT **Core Area Inflow & Infiltration Program – Annual Report 2017**

ISSUE

To present a summary of activities and accomplishments of the Core Area Inflow & Infiltration (I&I) Program in 2017, including infrastructure work carried out by the participating municipalities and efforts related to private property I&I.

BACKGROUND

The Core Area Liquid Waste Management Plan (CALWMP) sets out goals and commitments for the municipalities, First Nations and Capital Regional District (CRD) to manage I&I through the Core Area I&I Management Plan. The purpose of this Core Area I&I Annual Report is to document progress towards meeting these commitments for the period of 2017 to mid-2018.

In general, municipalities with aging sewer infrastructure are addressing areas with elevated I&I through sewer catchment analysis, investigations, rehabilitation and targeted sewer renewal. The municipalities with newer sewer infrastructure are focusing on I&I prevention. Overviews of municipal I&I actions, along with specific actions from 2017 to mid-2018, are as follows:

Colwood diligently inspects its new underground infrastructure to manage and prevent I&I. Colwood continues its program of manhole and cleanout visual inspection and sewer flow monitoring and analysis from its pump stations.

Esquimalt completed an extensive infrastructure investigation between 2004 and 2016, including: camera inspection and smoke testing, relining of approximately half of its sewers, targeted repairs to manholes, and separation of its combined manholes. This work increased the performance of the sewer system and reduced I&I. In 2017 and 2018, Esquimalt has interpreted results of its smoke testing program to find cross connections, is developing a pilot project to install inspection chambers on public and private sewer laterals, and is preparing a sewer model.

Langford has a rapidly expanding new sewer system. Langford diligently inspects new connections and is incentivized to monitor and repair the sewer system to preserve sewer capacity for future growth. In 2017 and 2018, Langford camera inspected 8 kilometres of sewer and inspected 136 manholes, resulting in the rehabilitation of 75 sewer inspection chambers and two significant sections of sewer line.

Oak Bay has been working since 2010 to satisfy the CALWMP commitments to develop a solution for separating its combined sewer system serving the Humber and Rutland catchment areas in the Uplands. In 2017, Oak Bay finalized a plan to separate the sewers in the Uplands and received conditional approval of its Uplands Combined Sewer Separation Plan under Amendment No. 12 to the CALWMP. The conditional approval is subject to additional plan submissions, due by December 31, 2019. In addition to the Uplands separation work, Oak Bay is currently in year 3 of a 5-year program to camera inspect all its sewers. In 2017 and 2018, Oak Bay rehabilitated 1.4 kilometres of sanitary sewer, replaced 3 manholes, and separated 21 cross-connections.

Saanich continues its program of sewer maintenance and repair, including camera inspections, smoke testing and flow monitoring. Annually, Saanich replaces or relines approximately 3 kilometres of sanitary sewer and relines or replaces approximately 80 sewer laterals to the property line.

Victoria continues to manage its sewer repair and replacement work in its sewer master plan. This plan was greatly influenced and affected by the site of the core area treatment plant. During the site selection, Victoria camera inspected and smoke tested its entire sewer system. In 2017 and 2018, Victoria completed its sewer master plan, rehabilitated or repaired 3.8 kilometres of sewer main and replaced 11 sewer manholes. Victoria also camera inspected 17 kilometres of sewer main.

View Royal continues its program related to sewer maintenance and repairs, camera inspections, sewer flushing and flow monitoring. In 2017, View Royal completed a drainage master plan and is currently working on its sewer master plan. View Royal also repaired two sections of sewer and four manholes.

Esquimalt Nation continues its program related to sewer maintenance, including active flow monitoring of their pump station.

Songhees Nation continues its program related to sewer maintenance and repairs. Initiated in late 2015, Songhees completed an I&I study to investigate I&I sources, along with detailed design, to remediate. In 2017, the Songhees Nation initiated the implementation of sewer improvements to address the study findings.

Through the Core Area I&I Program, the CRD continues to work with its municipal and First Nations partners on I&I related management and reduction efforts. This includes efforts related to regional flow monitoring, standardizing I&I approaches, preparing management plans and annual reports, private property I&I initiatives, and education programs. This also involves coordination with municipalities and related national organizations that are dealing with similar issues. Key actions completed in 2017 and early 2018 include:

- Updated the private property I&I educational approach and related materials. The approach is focused on encouraging the inspection and maintenance of private sewer laterals to prevent basement flooding. The work included substantial regional and national stakeholder engagement. The private property I&I education program is scheduled to be formalized and delivered to the public in 2019-2020.
- Carried out a project to confirm flow data accuracy from municipal pump stations.
- Conducted a pilot study designed to identify “semi-combined” sewers using GIS, historical plumbing codes and interviews with municipal staff.
- Developed a draft I&I benchmarking template for use nationally. The CRD is leading this effort, with help from the National Water & Wastewater Benchmarking Initiative.

The work described above will continue to support the regional effort to control and reduce municipal I&I flow rates; however, continued and focused work is still needed to meet the LWMP commitment of reducing wet weather flows below four times average dry weather flow at Clover

Point and McLoughlin Point wastewater treatment plant by 2030. The municipalities with older sewers, and inherently higher I&I, will need to allocate additional resources and accelerate their I&I reduction efforts to meet their respective I&I reduction targets.

ALTERNATIVES

Alternative 1

That the Core Area Liquid Waste Management Committee recommend to the CRD Board:

That the Core Area Inflow & Infiltration Program – Annual Report 2017 be approved.

Alternative 2

That the Core Area Liquid Waste Management Committee direct staff to submit a revised report.

FINANCIAL IMPLICATIONS

The I&I Program engages with core area municipalities and First Nations to identify and reduce the amount of rain and ground water that enters the sanitary sewer system. The 2017 budget for this work was $397,509. Municipal infrastructure repair initiatives are wholly funded by the respective municipality. Monitoring, reporting, strategy and leadership are facilitated by the I&I Program.

ENVIRONMENTAL IMPLICATIONS

The work documented in the report supports CALWMP commitments including and related to reducing overflows, which will have a positive impact on local creeks, beaches and ecosystems.

SOCIAL IMPLICATIONS

Reduced I&I and overflows will reduce the number of beach closures and the impact on the natural environment. As residents and businesses become more aware of I&I through ongoing public education and outreach programs, there will be a greater understanding of how everyone can contribute to I&I reduction.

CONCLUSION

The Core Area Inflow & Infiltration Program – Annual Report 2017 summarizes the activities and accomplishments of participating Municipalities and First Nations for 2017 to mid-2018.

RECOMMENDATION

That the Core Area Liquid Waste Management Committee recommend to the Capital Regional District Board:

That the Core Area Inflow & Infiltration Program – Annual Report 2017 be approved

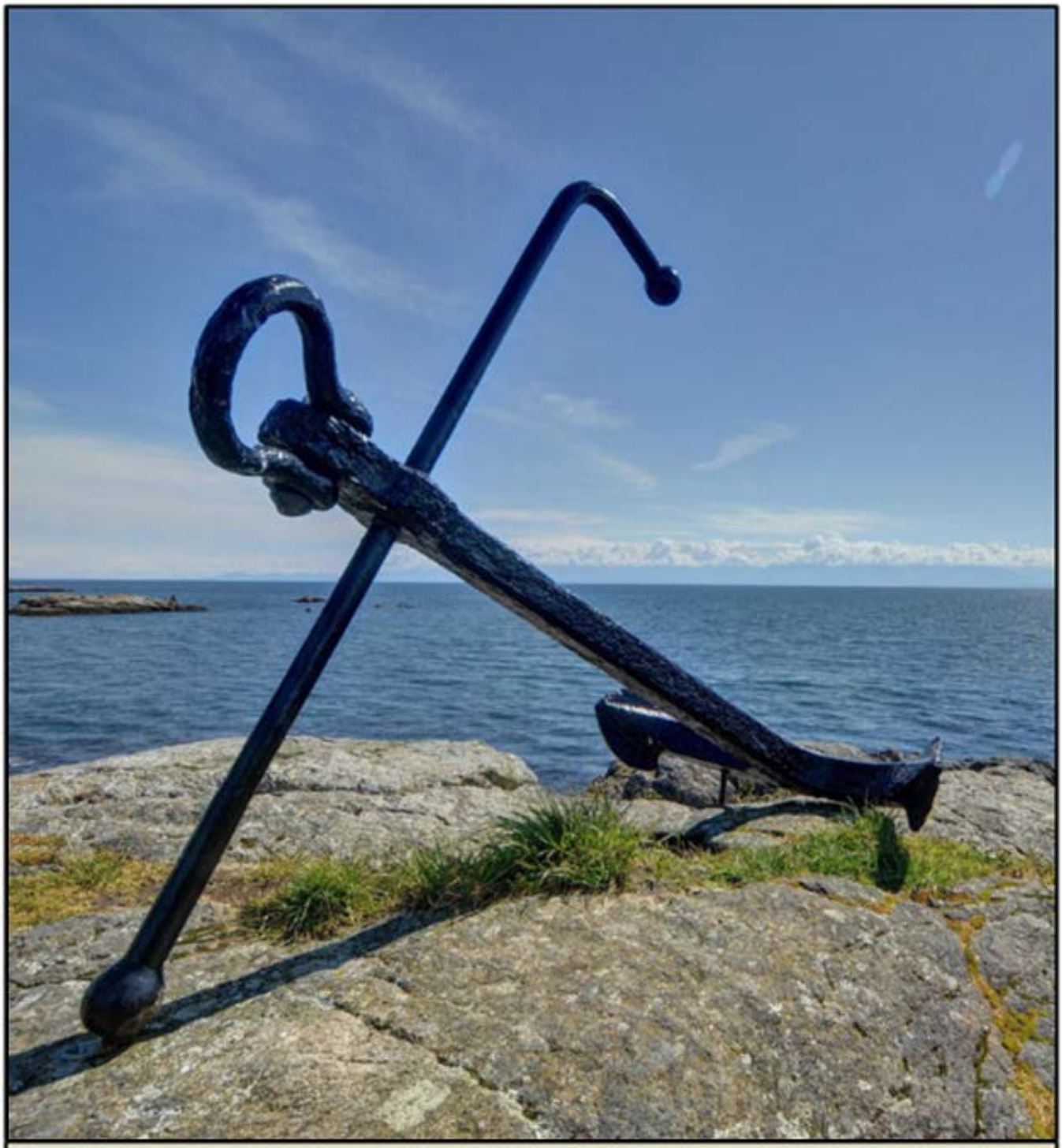
Submitted by:	Stephen May, P.Eng., Senior Manager, Facilities Management & Engineering Services
Concurrence:	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

SM:mr

Attachment: Appendix A – Core Area Inflow & Infiltration Program - Annual Report 2017

Core Area Inflow & Infiltration Program

Annual Report 2017



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October 2018

Table of Contents

List of Appendices

CORE AREA INFLOW AND INFILTRATION PROGRAM
ANNUAL REPORT FOR 2017 TO MID 2018

EXECUTIVE SUMMARY

Inflow and Infiltration (I&I) related activities carried out in the core area of the Capital Regional District (CRD) from 2017 to mid-2018 include work related to management of public and private property I&I, sanitary sewer overflows and education. Highlights of the public property I&I work completed in 2017 include:

Colwood
- New sewer infrastructure installation
- Visual inspection of manholes and cleanouts
- Flow monitoring at pump stations

Esquimalt
- Initiated efforts to: develop a sewer model; interpret smoke testing results; and to set up a pilot project related to the installation of inspection chambers
- Installed or replaced 16 sewer laterals, 13 stormwater laterals and a manhole

Langford
- Rehabilitated 75 sewer inspection chambers and 2 significant sections of sewer
- Camera inspected 8 km of sanitary sewer and inspected 136 manholes

Oak Bay
- Completed design of a grant funded Uplands combined sewer separation project in the Humber catchment area. Received conditional approval of the Uplands Combined Sewer Separation plan under Amendment No. 12 to the Core Area Liquid Waste Management Plan (CALWMP)
- Rehabilitated 1.4 km of sanitary sewer, replaced 3 manholes, and separated 21 cross-connections

Saanich
- Replaced or relined approximately 3 km of sanitary sewer
- Continued with programs related to maintenance & repairs, sewer camera inspections, smoke testing to eliminate unused connections and flow data collection and monitoring

Victoria
- Completed a citywide sanitary sewer master plan
- Rehabilitated or repaired 3.8 km of sewer main and replaced 11 sewer manholes
- Camera inspected 17 km of sewer main

View Royal
- Completed a drainage master plan in 2017. Commenced development of a sewer master plan in 2018.
- Continued with its program to camera inspect and flush the sewer system
- Repaired two sections of sewer and 4 manholes

Esquimalt Nation
- Continues its program related to sewer maintenance, including active flow monitoring of their pump station

Songhees Nation
- Continues its program related to sewer maintenance and repairs. Initiated in late 2015, Songhees completed an I&I study to investigate I&I sources, along with detailed design, to remediate. In 2017, the Songhees Nation initiated the implementation of sewer improvements to address the study findings.

CRD

- Completed the I&I Management Plan Update (2017)
- In the process of updating the private property I&I educational approach and related materials
- Carrying out a project to document flow data accuracy from municipal pump stations
- Conducted a pilot study designed to identify “semi-combined” sewers using GIS
- Developed a draft I&I benchmarking template for use nationally

1. BACKGROUND

1.1 Overview

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

Each year, the CRD's Core Area Liquid Waste Management Committee, which is comprised of core area representatives, submits a status report on the CALWMP to the Province. In order to prepare this report, the Committee requires annual reports from the CRD departments that are involved in the implementation of the LWMP. This report provides the update for the Core Area I&I Program and includes data from 2017 to mid-2018. The report is divided into the following sections:

- Background (Section 1)
- Key Initiatives (Section 2)
- Overflows (Section 3)
- Public Property I&I (Section 4)
- Private Property I&I (Section 5)
- Education (Section 6)
- Future Initiatives (Section 7)
- Summary (Section 8)

1.2 Study Area

The core area of the CRD is a partnership of 7 local governments and 2 First Nation areas. These include: Colwood, Esquimalt, Langford, Oak Bay, Saanich, Victoria, View Royal, the Esquimalt Nation and the Songhees Nation. The core area has a total land area of about 215 square km and a population of approximately 320,000 people.

In the core area, municipal sewer flows are discharged into CRD trunk sewers, which convey the flows to either the Clover Point or Macaulay Point pump stations, where the flows are screened and pumped out deep sea outfalls. A map of the core area sewers is located in Figure 1.1. A summary of sewer infrastructure in the core area is located in Table 1.1.

Figure 1.1: Map of the CRD Core Area

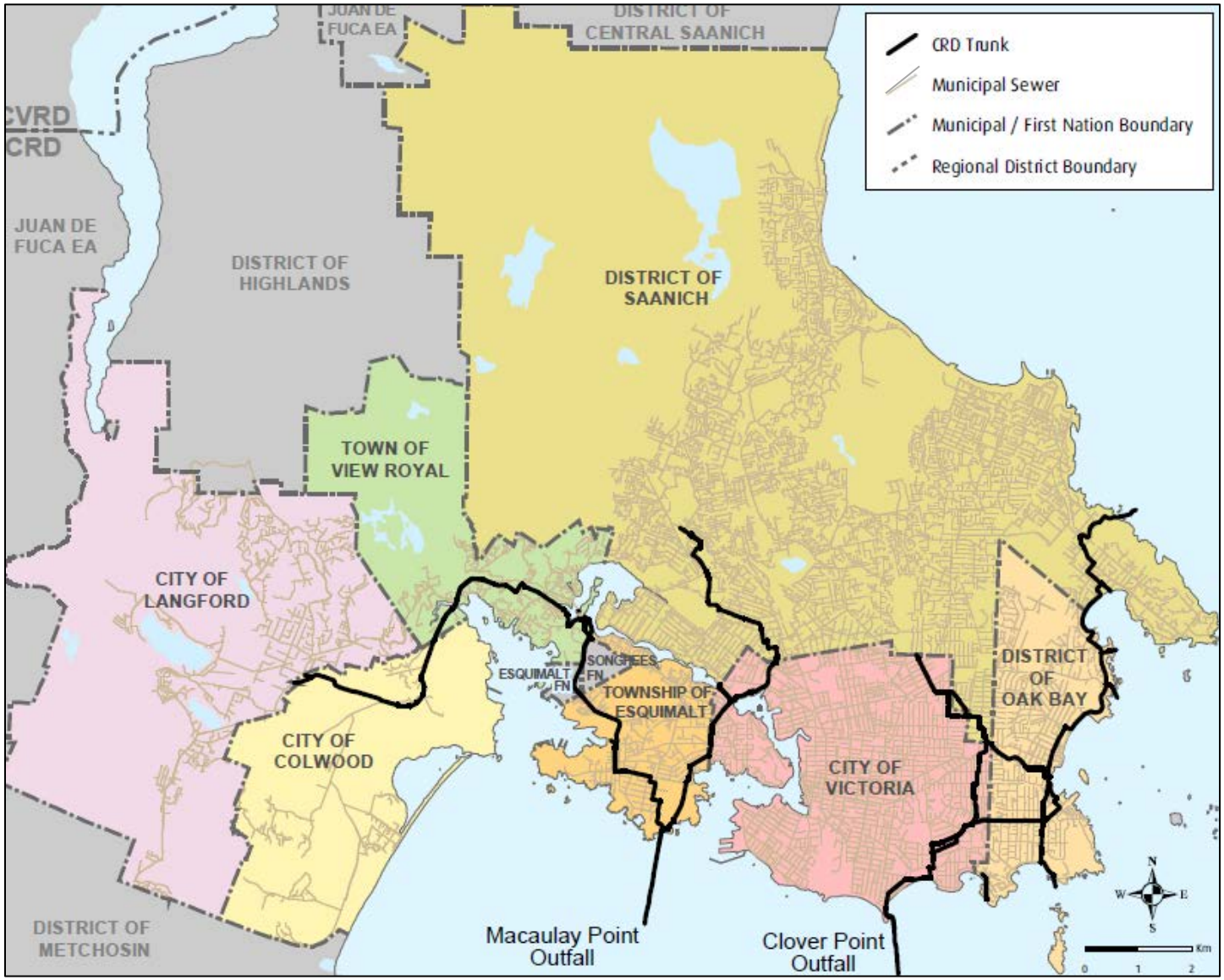


Table 1.1: Sewer Infrastructure in the Core Area

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

Jurisdiction		Gravity Sewers (km)	Force Mains (km)	Manholes	Pump Stations	Laterals**	Average Pipe Age *** (years)	% Developed Properties Connected to Sewer
Colwood	Municipal	35	7.3	510	9	1643	14	25%
	Private	5.2	3.7	120	12		15	
	Gov't of Canada	6.7	2.7	125	6		26	
Esquimalt	Municipal	54.8	3.9	820	12	4215	53	100%
	Private	0.2	0.0	4	0		81	
	Gov't of Canada	15.6	4.5	368	23		45	
Langford	Municipal	103.3	19.9	1512	14	6854	11	69%
	Private	9.0	0.9	144	8		10	
Oak Bay	Municipal	97.8	2.1	1280	7	6079	72	100%
	Private	2.3	0.0	32	2		56	
Saanich	Municipal	547.1	18.8	6173	43	29060	42	93%
	Private	11.7	1.4	181	0		13	
Victoria	Municipal	232.1	3.5	2754	11	17023	106	100%
View Royal	Municipal	43.0	6.5	765	23	3016	28	98%
	Private	1.4	0.2	21	1		13	
First Nations	Esquimalt	1.2	0.3	16	1	42	25	100%
	Songhees	N/A	N/A	N/A	N/A	233	N/A	100%
CRD Owned *		57.2	9.9	296	16	0	31	NA
Total		1222	85.8	15101	188	68165	51	91%

*** Some Estimated*
**** Includes both Gravity and Force Mains*

1.3 Core Area I&I Program

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

The I&I program provides educational services to the public and technical support to municipalities to help promote the reduction of the amount of rainwater and groundwater entering the sanitary sewer system to achieve the CALWMP commitment of reducing wet weather flows below four times average dry weather flow at Clover Point and McLoughlin Point wastewater treatment plant by 2030. The 2017 program budget was $397,509.The goals of the program are to:

- Assist members with regulatory compliance
- Coordination and analysis of regional flow monitoring and analysis

- Promote the inspection and repair of private property laterals through education
- Assist with prioritization of I&I reduction work required to reduce sewage overflows
- Support sewer asset management programs
- Support efforts to maintain sewer capacity needed for future growth, densification and climate change

The I&I program carries out a variety of routine tasks, including:

- Preparing annual I&I reports, I&I Management Plans and Overflow Management Plan updates
- Developing and analyzing flow meter data for I&I analyses
- Assisting municipalities with tasks related to I&I reduction
- Developing and executing private property I&I initiatives
- National leadership in I&I initiatives, such as private property initiatives and benchmarking

1.4 Past Reports

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

Table 1.2: Key Program Reports by Year

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

2. KEY INITIATIVES

2.1 I&I Management Plan Update

The CRD finalized the 5-year update of the I&I Management Plan. The plan was presented to the Core Area Liquid Waste Management Committee on September 13, 2017 and subsequently submitted to the Province.

2.2 Private Property Stakeholder Engagement Report

This report was commissioned to better understand the various private property I&I stakeholders and support education outreach. The report identified the key stakeholder groups, how they are organized, their interaction with private property Owners and how they relate to private property. A copy of the report is located in the I&I Annual Report for 2016.

2.3 Updating the Private Property Education Approach

Efforts continued on a new educational approach for addressing private property I&I. The new approach promotes the inspection and maintenance of sewer laterals to avoid pipe failure and basement flooding and promote preventative maintenance. This approach is more relevant and engaging to private property owners and stakeholders while meeting the desired outcomes of I&I related education. An overview of the key educational materials and outreach program is noted below. The materials are on track to be finalized in 2019.

Program Materials:

1. Generally Accepted Principles (GAP) Document & Brochure
   - The GAP is designed to answer questions that the public may have on the issue in a clearly communicated fashion. It was developed in partnership with over 20 key stakeholder groups (local, provincial and national). Through consensus, the focus was extended to all private property underground pipes, including foundation drains and stormwater laterals.
   - The key outcomes of the GAP are to align various stakeholder groups, facilitate stakeholder education to the public and to establish relationships with stakeholders.

2. Public Display
   - Designed to be deployed on its own at outreach events

3. I&I Program Booklet
   - Designed to rapidly get readers up to speed on regional I&I issues and the Core Area I&I Program

4. Website Updates

5. Outreach Program
   - Key regional events will be selected to interface with the public, including annual home show events, municipal events and key stakeholder events.

2.4 Identifying Semi-Combined Sewers Using GIS

A methodology was developed to identify private properties that have direct stormwater connections to the sanitary sewer. On a municipal level, these connections often go undetected due to plumbing configuration. Historically, these semi-combined cross connections were permitted or occurred for reasons, such as:

- The Building Code of the day; or
- Municipal exemption when:
  - Homes were built on a street without existing municipal stormwater infrastructure

- A home's basement plumbing was below the level of the municipal stormwater infrastructure

Regional analyses of flow data show that there are specific areas in the core area that are likely to have semi-combined sewers. During short, intense summer thundershowers, flow rates in these catchments increased dramatically (> 4x normal hourly flows), indicating the presence of semi-combined sewers.

The GIS based methodology for finding semi-combined sewers was developed and tested on 2 "pilot" catchments in Victoria. The approach included:

- a review of historical plumbing codes
- interviews with City of Victoria engineering and plumbing inspector staff
- creating a flowchart to document the logic for finding semi-combined properties; and
- using GIS to carry out the analyses.

The report documenting the approach is located in Appendix D.

2.5 Assessing the Accuracy of Municipal Pump Station Flow Data

The I&I Program collects and analyzes sewer flow data for municipal pump stations using electronic data from wetwell levels, pump starts/stops, wetwell dimensions and flow monitor devices. The resulting data is used for I&I analyses and clearly shows how sewer flows are impacted by I&I. The accuracy of the data varies widely between pump stations due to site-specific factors. Establishing the accuracy is critical for municipalities, as this data identifies deficiencies and guides rehabilitation. The purpose of this project was to:

- Assess the flow data from each pump station for accuracy using existing tools on FlowWorks.com
- Engage municipal technical staff with the results to conduct technical review of the data
- Conduct engineering review of respective flow characteristics
- Make recommendations for improvements / next steps, as appropriate

In 2018, the assessment is being carried out on municipal pump stations from Esquimalt, Oak Bay, Victoria and View Royal. The program will extend in 2019 for Colwood, Langford and Saanich.

2.6 Developing National I&I Benchmarking Metrics

The National Water & Wastewater Benchmarking Initiative's (NWWBI) I&I Task Force was formed in 2007 by AECOM and is a valuable forum for discussing the many technical aspects of I&I management.

As a key member of the taskforce, the CRD is showing leadership by leading the development of national I&I benchmarking metrics. The CRD has taken the following key actions:

- In late 2016, the CRD commissioned a report on national I&I rate benchmarking metrics. Although a large number of rate metrics were identified, none were found suitable for national use. The final report is located in the 2016 I&I Annual Report.

- In 2017, the CRD developed a methodology on a suitable I&I benchmarking rate metric and presented this to the NWWBI I&I Task Force. Subsequently, the CRD developed an I&I benchmarking rate metric table that included multiple additional metrics (i.e., GIS mapping, CCTV). Again, this was presented to the NWWBI I&I Task Force working group. The summary report is located in the 2016 I&I Annual Report.

- In April 2018, the CRD again presented the approach to senior operators and managers at the NWWBI's annual conference in Calgary (see Section 2.7). This audience is considered a key end user for the benchmarking rate metrics. The approach was updated based on the comments and recommendations received.

2.7 Additional Source of I&I Model Bylaw Language

In May of 2017, the Institute of Catastrophic Loss Reduction published a report entitled "Assessing Local Mandatory Measures to Reduce Flood Risk and Inflow & Infiltration in Existing Homes". The report includes a sample model bylaw for addressing I&I. The link for the report can be found at:

http://www.publications.zizzostrategy.com/category/flooding/

The report aligns with work already carried out by the CRD, including our sample model bylaw, which can be found at the following link:

https://www.crd.bc.ca/education/stormwater-wastewater-septic/at-home/preventing-sewer-backups

2.8 Notable Presentations

ASTTBC Home Inspectors Annual Conference

On November 17, 2017, the CRD presented at the ASTTBC Home Inspectors Annual Conference. The presentation introduced the CRD private property educational approach related to the inspection and repair of laterals and perimeter drains.

National Water & Wastewater Benchmarking Initiative (NWWBI) I&I Task Force

The CRD presented its benchmarking approach and updates to the I&I Task Force on September 14 and November 22, 2017.

National Water & Wastewater Benchmarking Initiative Workshop

The NWWBI Workshop took place in Calgary on April 24, 2018. It included over 100 municipal water and wastewater managers and specialists from across the country. The CRD presented in 2 separate 45-minute blocks at the workshop

The first presentation, entitled "Progress in Inflow & Infiltration Benchmarking", focused on a CRD-led effort to develop national I&I benchmarking metrics for Canada. The second presentation, entitled "Private Property I&I Program (lessons learned)", shared our current approach to private property I&I reduction and education.

City of Burnaby Presentation to the Core Area I&I Subcommittee

On June 28, 2018, the CRD arranged for Burnaby to provide a presentation to the subcommittee highlighting a recent pilot project targeted at private property I&I. The pilot project identified and addressed private property cross-connections found through smoke testing. The approach involved:

- Categorizing smoke test results based on I&I potential
- Focusing only on those with the highest I&I potential
- Sending enforcement letters and I&I information to those properties to fix the issues under the threat of fines
- Monitoring compliance by confirming which homes take out building permits to correct the identified issues
- Mailing progressively stronger follow-up letters and fines when appropriate

Burnaby achieved results from 13 of 14 properties engaged and is planning on expanding the project methodology to other problem catchment areas. The I&I Subcommittee will receive copies of the project documentation and correspondence for review.

3. OVERFLOWS

3.1 Overview

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

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

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

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

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

3.2 Beach Closures

In 2014, the CRD began testing water quality at selected public beaches. The testing was in response to a late summer intense storm event that resulted in an overflow into Cadboro Bay. Water quality testing after the overflow showed elevated bacteria levels in the ocean maintained for longer periods of time than would be expected for a typical sewer overflow event. Further investigation work was carried out through the winter and the results indicated that stormwater was a major source of the contamination. Prior to this time, water quality testing was not done in response to overflow events because most overflow events occur in the middle of winter when public use of beaches is low.

Following coordination with Island Health staff, the CRD undertook a four-month investigation in the winter of 2015/2016 and collected samples every 2 weeks for enterococci analysis at beaches with the potential for high winter public use. This sampling program showed that bacterial contamination levels exceeding recreational guidelines were found at most sites after rainfall events even when overflows did not occur. In the winter of 2016/2017, the CRD investigated and worked with municipalities and Island Health to further assess the shoreline areas of high public use and develop public education and notification strategies.

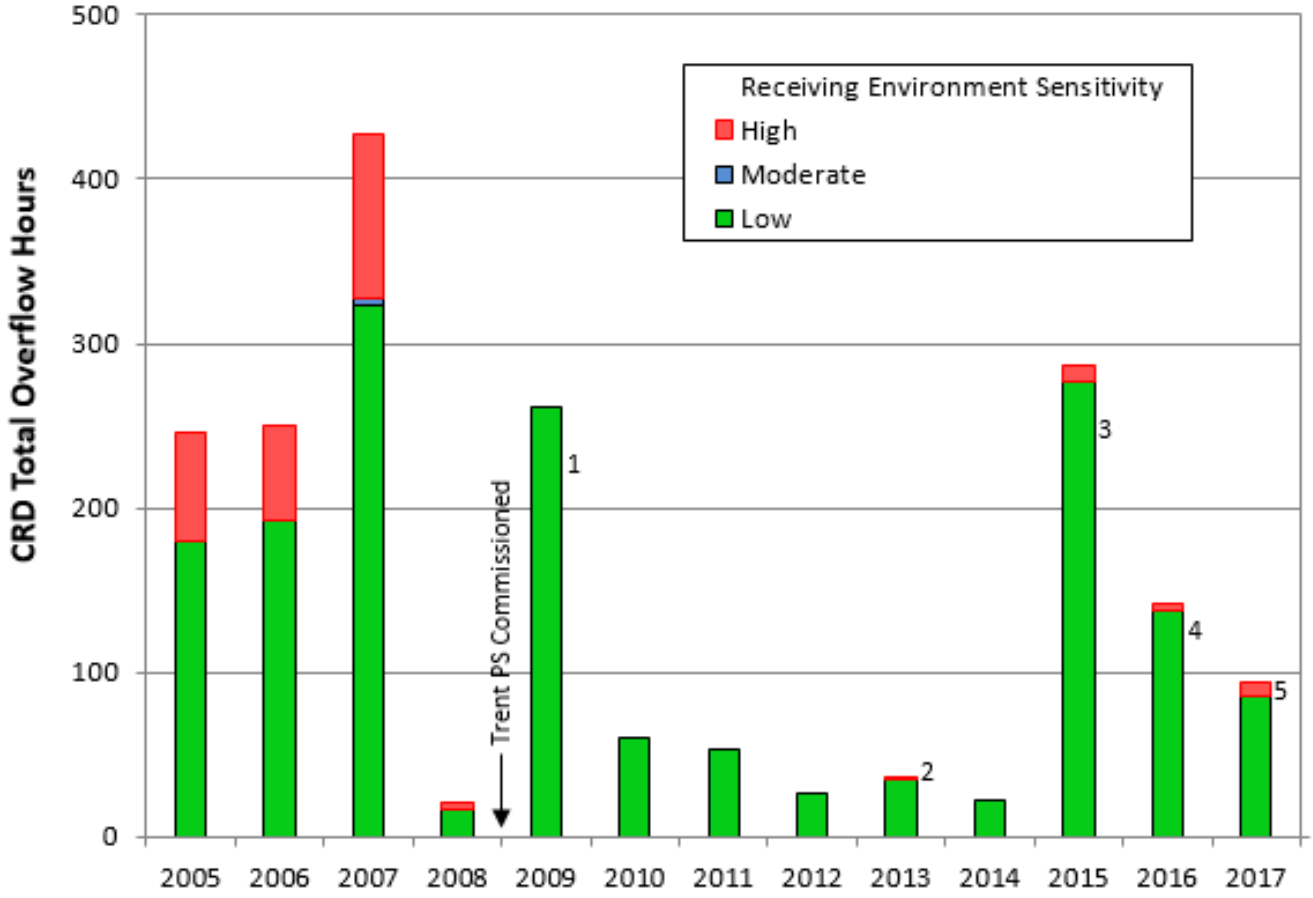
Based on the work carried out, the CRD and Island Health have developed a new notification and sampling protocol for overflow events. The public is notified of overflow related beach closures with signs on the beaches and notifications on Island Health's website, the CRD website and through CRD social media. CRD staff sample the beaches following an overflow to determine when the signs can be removed. When stormwater is a source of elevated bacteria, staff continue to work with the appropriate jurisdiction to identify and eliminate the source of contamination.

3.3 Reported Overflows

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

Figure 3.1 summarizes the overflows by year between 2005 and mid-2018. Note that discharges to high sensitivity receiving environments have decreased substantially over that time. Figure 3.2 to 3.6 summarize the specific overflow events by year for 2014 to mid-2018. Note that most overflow hours occur during very large storm events when conditions are saturated.

Figure 3.1: Graphical Comparison of Rainfall vs. Overflows



Notes

1) 54% of the overflow hours in 2009 came from a single storm event that included snow melt.
2) In 2013, the overflow to a high sensitivity receiving environment occurred at Bowker. It occurred during an intense short duration September storm event when the Trent PS was down for maintenance.
3) In 2015:
   - The overflow to a high sensitivity receiving environment occurred at Broom Road, as a result of a storm event with a 20-year return period.
   - There were more large storms than usual. In total, 6 storm events had return periods greater than 1 year.
4) In 2016, the overflow to a high sensitivity receiving environment occurred at Broom Road, as a result of a storm event with a 10-year return period.
5) The overflow to a high sensitivity receiving environment occurred at Broom Road, as a result of a storm event with a 3.5-year return period.

Figure 3.2: CRD Overflows from January to June 2018

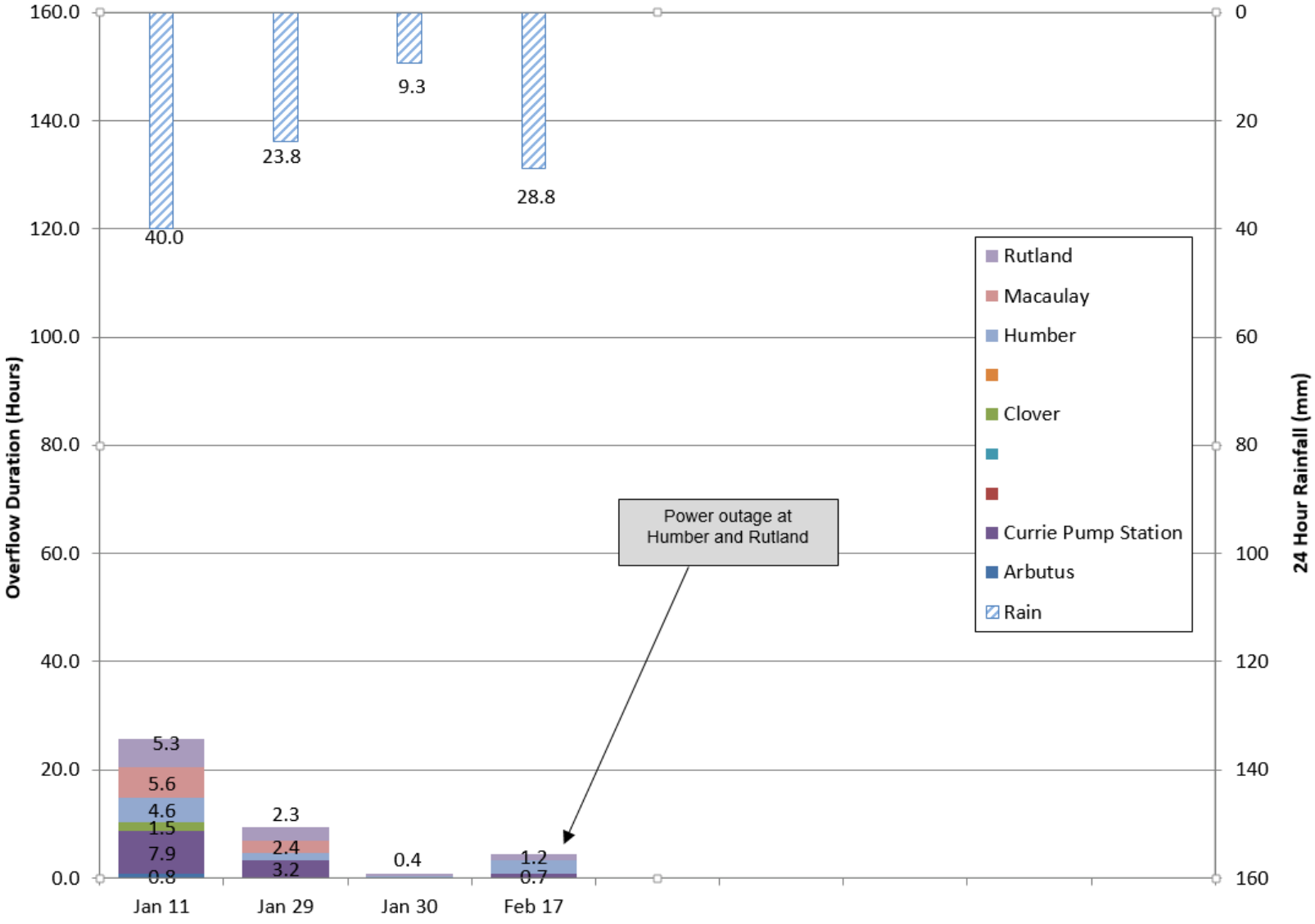


Figure 3.3: CRD Overflows in 2017

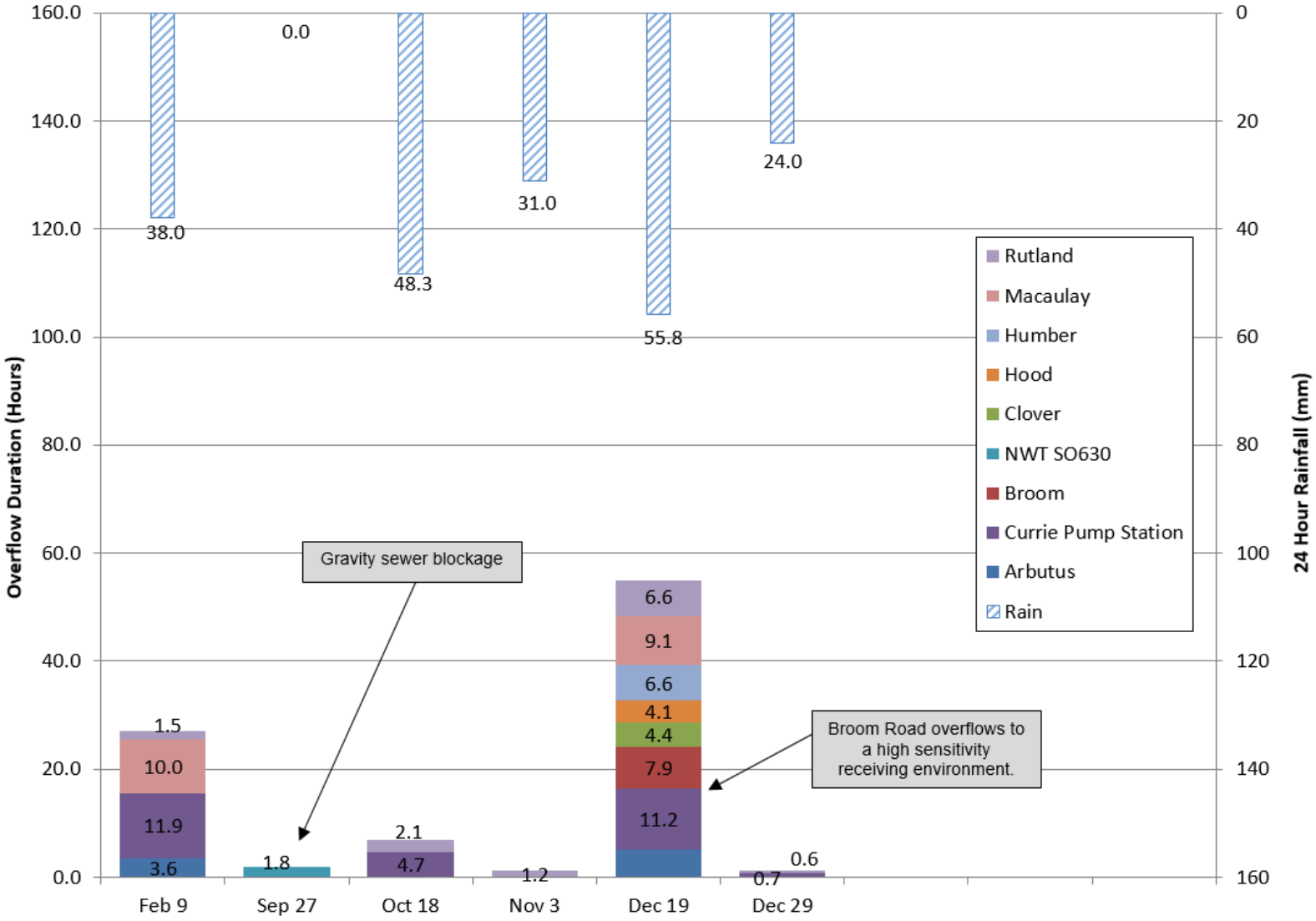

Overflow Duration (Hours)
24 Hour Rainfall (mm)
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0
20
40
60
80
100
120
140
160
38.0
0.0
48.3
31.0
55.8
24.0
Rutland
Macaulay
Humber
Hood
Clover
NWT SO630
Broom
Currie Pump Station
Arbutus
Rain
Gravity sewer blockage
Broom Road overflows to a high sensitivity receiving environment.
1.5
10.0
11.9
3.6
1.8
2.1
4.7
1.2
6.6
9.1
6.6
4.1
4.4
7.9
11.2
0.6
0.7
Feb 9
Sep 27
Oct 18
Nov 3
Dec 19
Dec 29

Figure 3.4: CRD Overflows in 2016

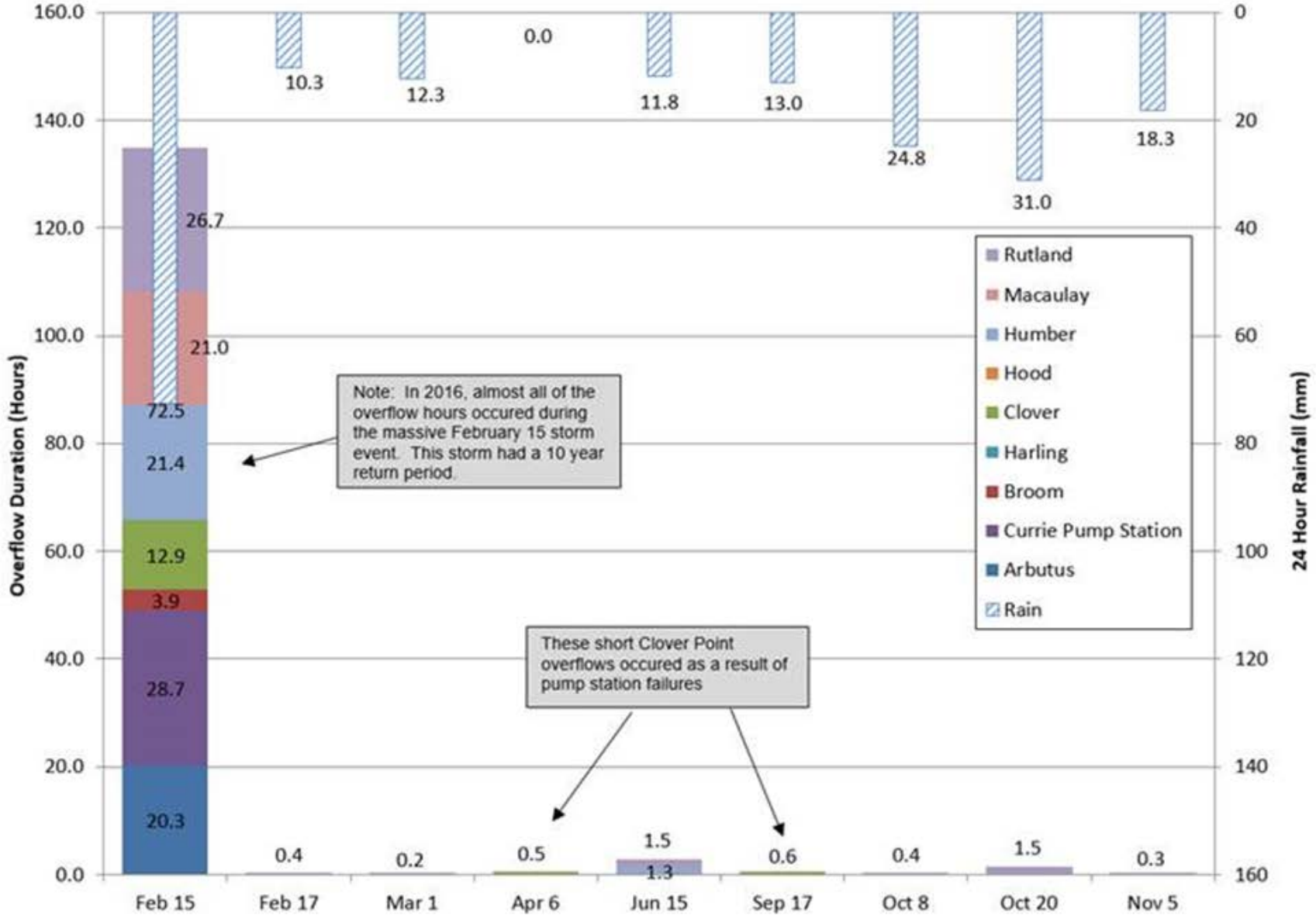


Figure 3.5: CRD Overflows in 2015

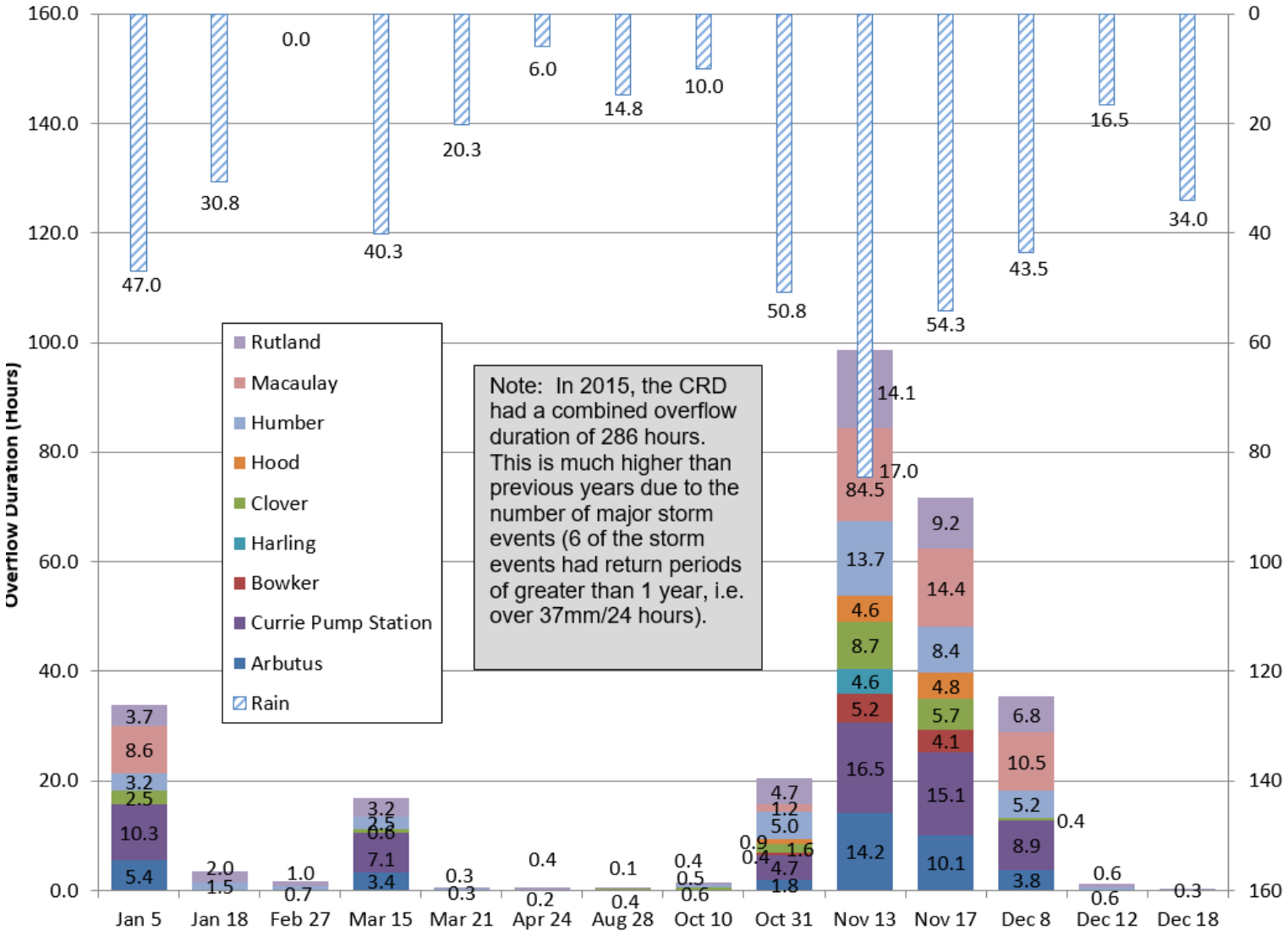
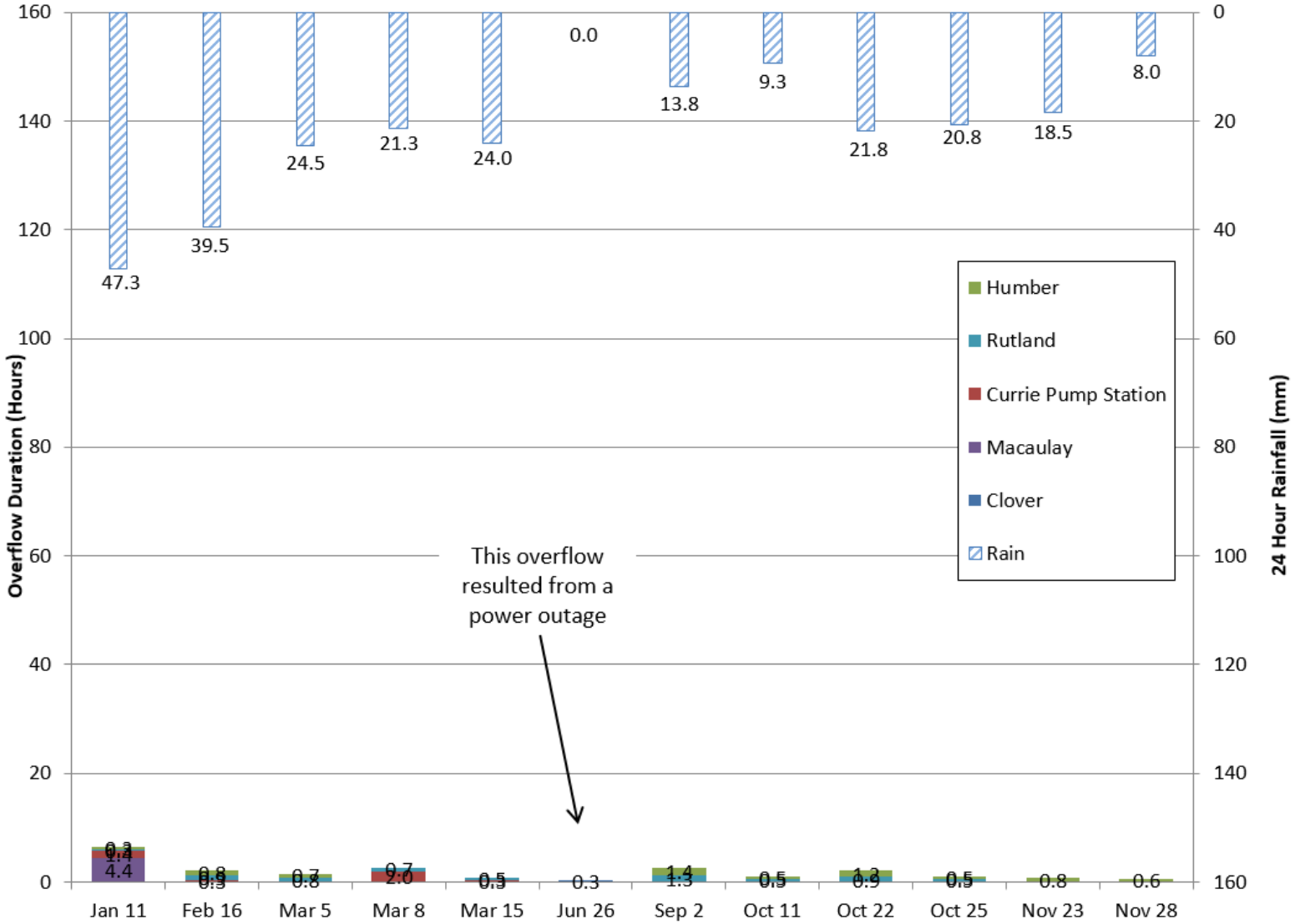


Figure 3.6: CRD Overflows in 2014



4. PUBLIC PROPERTY I&I

Municipal Actions

A number of I&I related activities were carried out in the core area of the Capital Regional District (CRD) in 2017 and early 2018. This included work related to management of public and private property I&I, sanitary sewer overflows and education as highlighted below.

Colwood

- New sewer infrastructure installation
- In 2017, added 35 manholes, 2,279 meters of sewer mains, 1 lift station and 117 sewer services
- Visual inspection of manholes and cleanouts
- Collected sewer flow data from municipal pump stations

Esquimalt

Infrastructure

- Installed or replaced the public property portion of 16 sewer laterals and 13 stormwater laterals
- Replaced one sewer manhole
- Development of a preliminary sewer model

I&I Program

- Interpretation of smoke testing results to take place in the first and second periods of 2018
- Pilot project for inspection chambers to be initiated in the first period of 2018
- Will prepare a draft bylaw for Inflow and Infiltration Control for discussion in 2018, which will include a cost sharing program for cross connections and service line condition. The strategy for cost sharing was presented to the municipal council in the third quarter of 2017. Staff to develop feedback into a working strategy in 2018.

Overflows

- During 2 storm events, 3 pump stations suffered minor overflows. The Province was notified and transfer trucks were utilized to reduce overflow volumes.
- At the end of July, Gorge Creek experienced a contamination incident. Esquimalt minimized the impact by pumping contamination out of the creek. It investigated the source of the contamination and collaborated with the Ministry of Environment, Island Health and CRD. As a follow-up, Esquimalt carried out preventative maintenance on its collection system, rectified a cross connection and presented information to Gorge Waterway Initiative.

Langford

2017

- Inspected 71 sewer manholes for I&I
- Rehabilitated 46 sewer inspection chambers
- Camera inspected 4.5 km of sanitary sewer
  - CCTV video uncovered two areas where the lines had significant root intrusion, which were subsequently repaired

2018

- Inspected 65 sewer manholes and assessed necessary repairs
- Rehabilitated 29 sewer inspection chambers
- Camera inspected 3.5 km of sanitary sewer

Oak Bay

- Carrying out a 5-year program to camera inspect its sewer system. 2017 was year 2 of this program and included camera inspection, flushing and cleaning of 16.8 km of sewer mains. 2018 is year 3 of the program and will include an additional 13.8 km of this work.
- In year 2 of a 10-year program to camera inspect storm sewers
- Rehabilitated 1.4 km of vitrified clay sewers using trenchless technology
- Replaced 3 municipal sewer manholes
- Completed 124 storm dye tests
- Discovered 28 cross connections, of which 21 were separated
- Continued renewal of private property laterals:
  - In 2017, 41 new houses were built with associated new laterals. In addition, there were 8 new storm laterals, 10 new sewer laterals, 5 old combined sewers were separated, and 110 inspection chambers were added.
  - In 2018, 14 new houses were built with associated new laterals. In addition, there was 1 new storm lateral, 6 new sewer laterals, 7 old combined systems were separated and 48 inspection chambers were added.
- In 2017, KWL assessed and prioritized sewer and storm mains for replacement / rehabilitation
- Received grant for the Humber catchment storm main design, which is part of the Uplands combined sewer separation project. Also, worked with a consultant to prepare request for proposals on the Humber Design. Very close to 100% design completion.
- Contractors replaced some sewers, laterals and manholes in for 3 properties / subdivisions. They also smoke tested 490m of sewer main as part of an I&I investigation.

Saanich

- Ongoing capital program to replace or reline approximately 3 km of sanitary sewer annually, including manhole replacement and service replacement or relining to the property line
- Continued with programs related to maintenance & repairs, sewer camera inspections smoke testing to eliminate unused connections and flow data collection / monitoring

Victoria

<u>2017</u>

- 11 sanitary sewer manholes replaced
- 233 meters of sanitary sewer mains replaced
- 1,594 meters of sanitary sewer main relined
- 77 new storm drain laterals installed in the City's ROW
- 64 new sanitary sewer laterals installed in the City's ROW
- 334 sanitary sewer laterals inspected with CCTV
- 12,372 meters of sanitary sewer mains inspected with CCTV
- 215 catch basins dye tested, which detected leakage by smoke tests completed in 2006, 2008 and 2010
- 10 catch basins cross-connected to the sanitary sewer system
- 89 properties dye tested at the private properties' rainwater leaders to confirm storm drain connection
- 5 private property laterals cross-connected to the sanitary sewer system

<u>2018</u>

- Completed a citywide sanitary sewer master plan
- 3 new rain gauges installed and in operations
- 11 open channel flow meters relocated and re-installed with newer accurate monitors
- 153 meters of storm drain mains installed to correct the cross-connected laterals from private properties

- 2,034 meters of sanitary sewer mains relined
- 63 new storm drain laterals installed in the City's ROW
- 67 new sanitary sewer laterals installed in City right of way
- 4,600 meters of sanitary sewer mains inspected with CCTV
- 120 meters of sanitary sewer mains, 145 lineal meters of storm drain mains and 4 sanitary manholes, 2 storm drain manholes installed to eliminate the combined manholes

View Royal

- Completed a drainage master plan in 2017; working on a sewer master plan in 2018
- Continuing with its program to camera inspect and flush the sewer system
- Repaired 2 sections of sewer
- Replaced 1 manhole and raised three sewer manholes

Esquimalt Nation

- Continues its program related to sewer maintenance, including active flow monitoring of their pump station

Songhees Nation

- Continues its program related to sewer maintenance and repairs. Initiated in late 2015, Songhees completed an I&I study to investigate I&I sources, along with detailed design, to remediate. In 2017, the Songhees Nation initiated the implementation of sewer improvements to address the study findings

CRD

- Finalized the 5-year update of the I&I Management Plan, which was presented to the Core Area Liquid Waste Management Committee on September 13, 2017 and subsequently submitted to the Province
- Carrying out a project to document flow data accuracy from municipal pump stations
- Continued developing an education approach focused on industry stakeholders. In 2017, this involved creating a mockup educational booklet, which was reviewed and refined by the stakeholders. In 2018, this involves finalizing the booklet content, production and formal buy-in from the stakeholders. The booklet is designed to:
  - Align the various stakeholder groups on the issue;
  - Be useful to stakeholders when educating the public; and
  - Establish a solid foundation for all future I&I initiatives that require stakeholder buy-in.
- Developed a new educational brochure (draft) aimed at the general public
- Conducted a pilot study designed to identify "semi-combined" sewers based on a review of historical plumbing codes and GIS data
- Developed a draft I&I benchmarking template for potential use nationally. Representatives from the National Water and Wastewater Benchmarking Initiative's I&I Task Force reviewed the approach a total of 3 times in 2017 and early 2018. Efforts are currently underway to finalize the approach.

4.1 I&I Rates for the Core Area

Regional I&I flow rates are generally analyzed every 3 years for the core area because there are not enough significant storm events to justify I&I analyses on an annual basis. In general, there are between 0 and 3 significant storm events per year. The most recent I&I analysis results report included storm event data up to March 2016, which was documented as part of the I&I Management Plan Update (2017). The next I&I analyses will be included in the I&I Annual Report for 2019.

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

- A map of the entire core area displaying the most recent 5-year peak I&I rates for individual catchments is located in Figure 4.1.

- The individual I&I rates within each municipality have been converted into an overall weighted average for each municipality and compared with previous years' estimated I&I rates (see Table 4.1). This table is useful in providing a performance measure benchmark for each municipality to track overall I&I trends, but it must be interpreted with caution because it summarizes a vast amount of data into single municipal averages. For instance, one very high I&I sub-area could skew the overall municipal average, or one year of erratic weather and/or flow data could lead to misleading results. Therefore, it is prudent to allow sufficient time to measure the full effect of any I&I reduction work in addition to gathering, compiling and analyzing weather patterns and I&I rates to track overall trends.

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

Figure 4.1: I&I Rates Map for the Core Area (update rate map to 4xADWF)

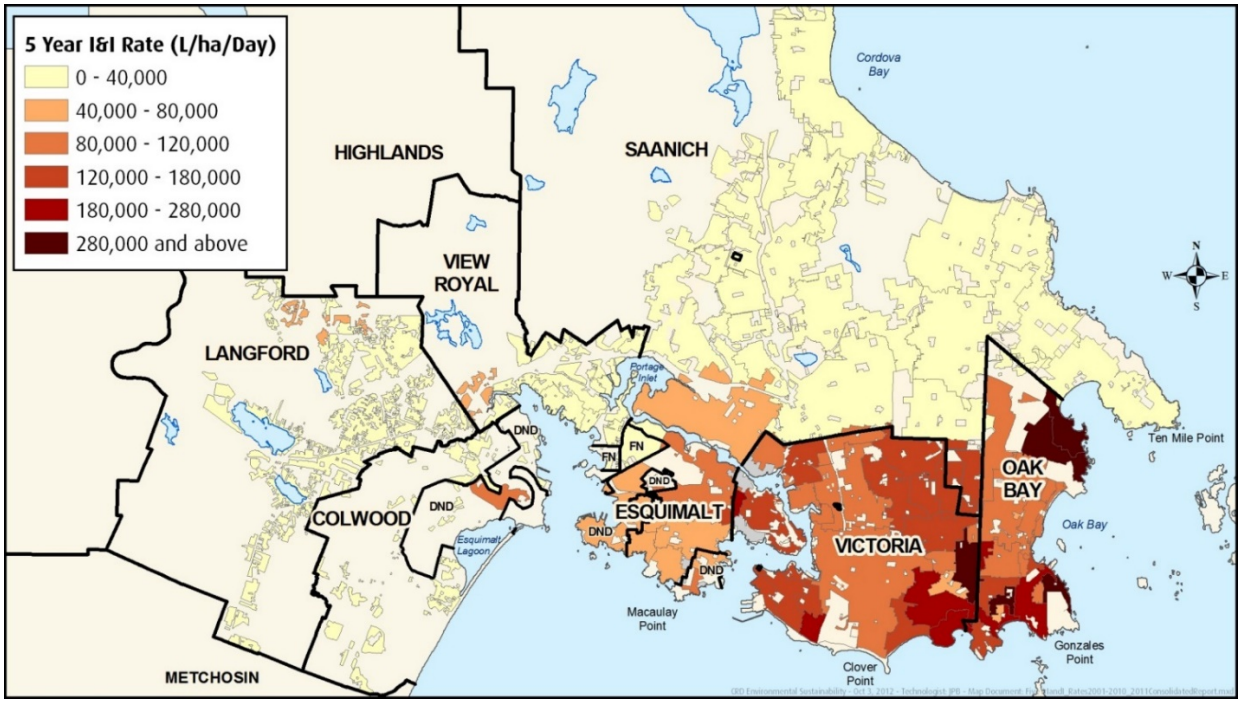


Table 4.1: Summary of Core Area Municipal Peak 5-Year I&I Rates

Municipality	Ave. Age of Sewers	Estimated 5-Year Peak I&I Rate (L/ha/day)					
		2005/06	2006/08	2008/10	2010/12	2012/14	2014-2016
Colwood	16	18-22,000	18-22,000	18-22,000	18-22,000	16,000	13,000
Esquimalt	89	95-110,000	100-115,000	85-90,000	85-90,000	81,000	89,000
Langford	13	17-22,000	17-22,000	17-22,000	17-22,000	16,000	15,100
Oak Bay *	81	110-120,000	110-120,000	110-120,000	110-120,000	110-120,000	94,000
Saanich	40	18-22,000	18-22,000	18-22,000	18-22,000	18-22,000	20,000
Victoria	96	150-160,000	145-150,000	145-150,000	145-150,000	144,000	133,000
View Royal	28	18-22,000	20-25,000	20-25,000	20-25,000	23,000	22,000
First Nations	39	50-55,000	55-60,000	55-60,000	55-60,000	82,000	82,000
DND	43	---	---	---	---	---	64,000

**Excludes the combined sewer in the Uplands which have I&I rates over 400,000 l/ha/day*

Notes related to Table 4.1:

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

5. PRIVATE PROPERTY I&I

Each municipality sets standards for new lateral installations and requires that laterals be tested prior to connection to the municipal sewer main. Victoria has carried out small pilot projects that included the repair or replacement of private sewer laterals. Oak Bay and Esquimalt require that laterals be inspected and fixed, if required, when applications are made for major building permits.

The CRD has been tasked with developing a regional approach for addressing private property I&I in the core area. Table 5.1 summarizes the work carried out to date.

Table 5.1: Private Property I&I Actions to Date

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

2017 to mid-2018	The following is a list of private property I&I work carried out in 2017 and the first half of 2018. Details of this work are located in Section 2.
	
	• Completed a background report to better understand I&I related stakeholders
	
	• Updated the education approach to be more relevant to home owners and stakeholders with a focus on preventing basement flooding. Updated documents will include:
	
	- Generally Accepted Principles Document, which:
	  • Aligns the various stakeholder groups on the issue.
	  • Helps stakeholders educate the public
	  • Establishes a solid foundation for stakeholder engagement, which will be useful for all future municipal private property I&I initiatives
	- New I&I Brochure
	- Stand Alone Display
	- I&I Program Booklet
	- Website Updates
	
	• Report showing how to identify semi-combined sewers using GIS
	
	• Additional private property I&I models bylaws from across Canada
	
	• Enforcement Approach for Addressing Cross Connections, as presented by the City of Burnaby to the Core Area I&I Subcommittee

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

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

6. EDUCATION

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

- Provide education showing where I&I comes from and the problems it creates so that when funding is required and/or rehabilitation work is proposed in local neighborhoods, the public will have a better understanding of why the work is required.

- Encourage home owners to camera inspect and maintain their underground sewer lateral, which will result in lower private property I&I.

Table 6.1: CRD I&I Education Efforts to Date

Action	Description / Timeline
2017 and 2018	The CRD is in the process of updating its educational materials to make it more relevant to home owners and related stakeholders, as summarized in Section 2.2. The new materials are expected to be finalized by 2019.
2011 to 2018	I&I was added to CRD outreach events where the materials were displayed along with education materials from other CRD programs. In general, I&I was "featured" at 4 key events (i.e. home shows) per year and the materials are available, upon request, at an additional 10 events. From talking to CRD outreach staff, attending outreach events, and talking to stakeholder groups, it is clear that I&I knowledge is low with the general public. Most people have little interest in the topic and say that they will deal with issues if they come up.
2010	The CRD, in collaboration with the core area municipalities, created an I&I brochure, two sets of videos to help explain I&I, and an I&I website. This information is valuable when staff are providing notification to neighborhoods of upcoming video inspection, smoke testing, sewer rehabilitation or other work related to I&I management. The brochure and videos can be found on the CRD website at the following link: *http://www.crd.bc.ca/wastewater/ii/index.htm*

7. FUTURE INITIATIVES

Table 5.2: Anticipated Next Steps for Supporting I&I Reduction

Action	Description / Timeline
Updated Education Approach / Materials *(2019)*	• Finish updating the education materials (Generally Accepted Principles document, brochure, display, I&I program booklet, and website updates.) • Confirm partnerships options for distributing the GAP document (i.e., partnerships with the Institute of Catastrophic Loss Reduction)
Stakeholder Education Plans / Rollout *(2019)*	• Develop and execute stakeholder engagement plans to roll out the GAP document to stakeholder association members. This may include developing education webinars, presentations, booths for conferences, etc. The goal will be to work with the various stakeholder groups (i.e., home inspectors, realtors) to determine how to best inform their members.
Assessing the Accuracy Pump Station Flow Data *(2018/2019)*	• Finalize the assessments for Esquimalt, Oak Bay, Victoria and View Royal (late 2018) • Carry out assessments for Colwood, Langford and Saanich (2019)
Finalize Benchmarking Approach *(2018/2019)*	• Continue leading the effort to develop I&I benchmarks for Canada
Identifying Areas of Focus for Meeting the CRD's I&I Commitments by 2030 *(2019/2020)*	• Confirm how much I&I needs to be reduced to avoid overflows at Clover • Review available information to identify areas of focus • Consider workable solutions (costs / expected I&I reductions) and assess the expected results using the core area sewer model • Make recommendations
Collaborations / Leadership *(Ongoing)*	• Continue working in collaboration with Metro Vancouver and the National Water and Wastewater Benchmarking Initiative's I&I Task Force to further private property I&I programs / options in Canada
Assisting with Municipal Programs *(Ongoing)*	Assist the municipalities, upon request, with the following: • Incorporating the powers of the sample private property I&I model bylaw into their municipal bylaws, as appropriate • Providing options for municipal specific private property I&I programs to help address their unique needs and circumstances • Assisting with municipal specific private property I&I related educational materials (i.e., brochures to support municipal smoke testing or municipal installation of inspection chambers) • Addressing: public property laterals; smoke testing results (smoking guns); methods for collecting basement flooding statistics when home owners inform city
Review Time of Sale Options *(2019/2020)*	• Determine potential options for incorporating sewer lateral education / actions into the real estate time of sale process. Include viability and pros and cons of the options.

8. SUMMARY

The purpose of this report was to provide an update on work related to I&I in the core area in 2017 and the first half of 2018. The work supports commitments located in Section 5 of the LWMP, which addresses the *Management of Infiltration and Inflow and Control of Wastewater Overflows.* The report included:

- Summary of special projects, including: the updating of education materials; using GIS to find semi-combined sewers; quantifying accuracy of flow data from pump stations; and developing I&I benchmarking metrics for use across Canada
- Documentation of overflow events from 2017 and early 2018
- I&I related actions from each of the core area municipalities

Appendix A:
LWMP Commitments Related to I&I

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

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

GOAL

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

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

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

COMMITMENTS

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

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

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

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

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

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

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

Table 5.2
Prioritized Order of Colwood Overflow Reduction Plan

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

Table 5.3
Prioritized Order of Esquimalt Overflow Reduction Plan

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

Table 5.4
Prioritized Order of Langford Overflow Reduction Plan

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

Table 5.5
Prioritized Order of Oak Bay Overflow Reduction Plan

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

Table 5.6
Prioritized Order of Saanich Overflow Reduction Plan

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

Table 5.7
Prioritized Order of Victoria Overflow Reduction Plan

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

Table 5.8
Prioritized Order of View Royal Overflow Reduction Plan

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

APPENDIX C

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

Appendix B:

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

Capital Regional District

Core Area Inflow & Infiltration Management Plan

2017 Update

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CORE AREA INFLOW & INFILTRATION MANAGEMENT PLAN

EXECUTIVE SUMMARY

Purpose

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

Background

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

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

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

Regulatory Context

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

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

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

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

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

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

Overflows

In 2014, the CRD submitted an updated Core Area Overflow Management Plan to the Province. The plan documents the CRD's overflow related commitments and summarizes the significant work carried out related to overflows.

Asset Management

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

Climate Change

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

Public Property Inflow and Infiltration

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

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

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

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

Private Property Inflow and Infiltration

The I&I Management Plan (2012) contained a 5-year plan for implementing a common private property I&I approach for the core area. The plan was to consult with stakeholders and the public from 2012 to 2014, recommend an approach in 2015 and implement that approach in 2016. Significant effort was made to come up with a common approach. By 2014, it was clear that a common approach wasn't appropriate as the core area municipalities have different I&I rates, different issues and require different solutions. Three of the core area municipalities have older sewers and elevated I&I and they would benefit from strong programs to reduce I&I. The other four municipalities have newer sewers and have low I&I. These municipalities would prefer to focus on I&I prevention activities. The I&I Subcommittee agreed that each municipality should implement their own custom approach to suit their needs and should draw on the significant research and support that the CRD has provided.

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

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

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

Municipal Inflow and Infiltration Plans

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

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

Monitoring and Verification

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

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

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

Forecasted Inflow and Infiltration Reduction

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

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

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

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

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

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

Key Future Actions

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

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

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

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

Conclusion

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

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

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

Appendix C:

EXECUTIVE SUMMARY: CORE AREA OVERFLOW MANAGEMENT PLAN UPDATE (2014)

CAPITAL REGIONAL DISTRICT
CORE AREA LIQUID WASTE MANAGEMENT PLAN

SANITARY SEWER OVERFLOW MANAGEMENT PLAN: 2014 UPDATE
EXECUTIVE SUMMARY

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

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

Background

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

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

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

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

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

As of 2014:

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

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

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

Overflows (2008 – 2013)

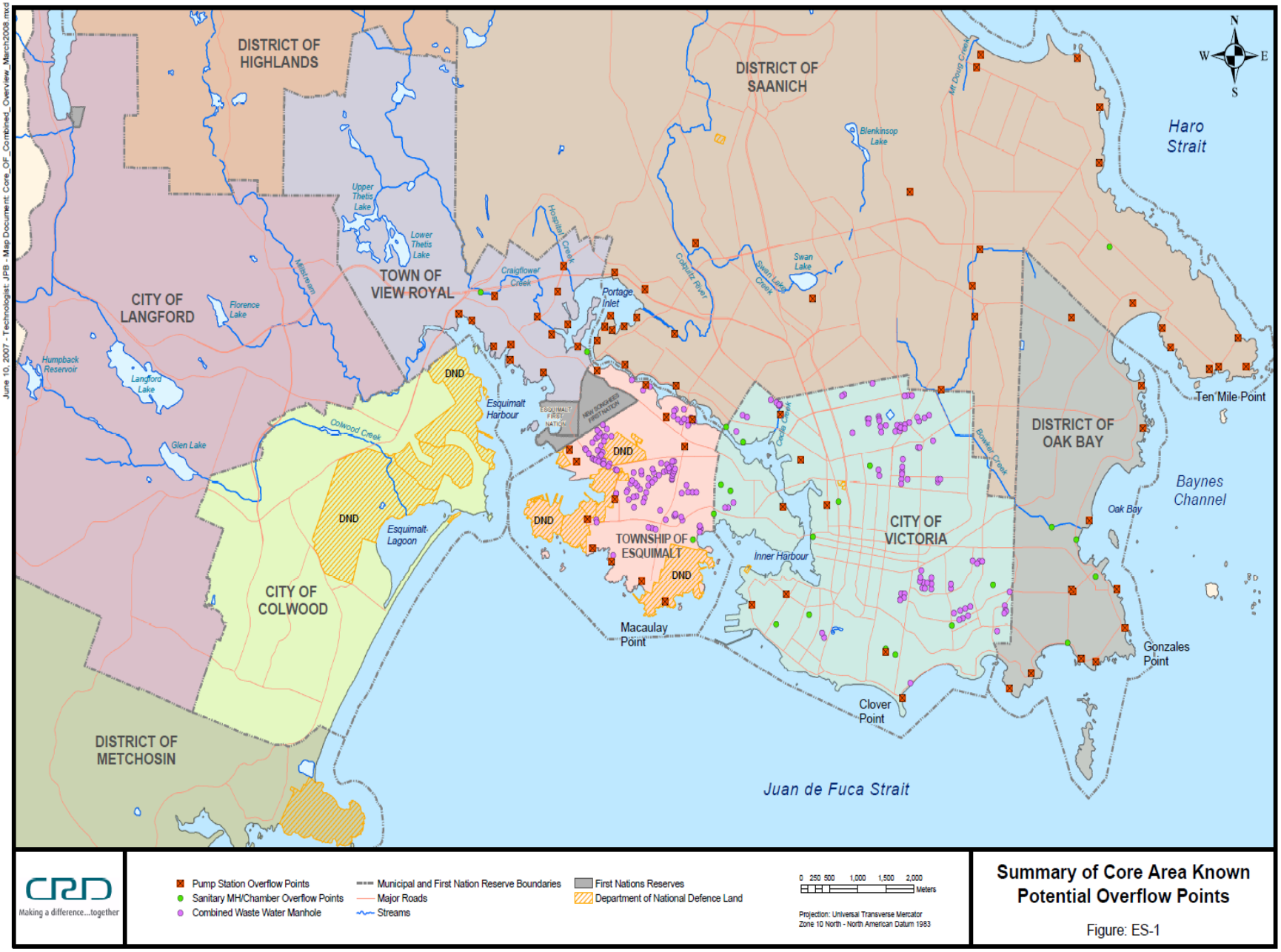
The CRD and core area municipalities have identified all of their known sewer overflow locations, which are summarized in Table ES-1 and Figure ES-1. It must be emphasized that, even though there are a large number of known overflow locations, the majority of them are never used or are infrequently used.

Table ES-1: Number of Known Potential Overflow Points

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

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

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



Summary of Core Area Known Potential Overflow Points

Figure: ES-1

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

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

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

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

Wet Weather Flow Management Progress Update

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

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

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

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

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

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

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

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

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

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

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

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

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

Conclusions

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

to eliminate sanitary and combined sewer overflows. This progress report was written to satisfy that requirement.

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

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

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

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

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

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

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

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

APPENDIX D

Identifying Semi-Combined Sewers Using GIS

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TECHNICAL MEMORANDUM

June 20, 2018

Mr. Jim McAloon
Capital Regional District
625 Fisgard Street
Victoria, BC V8W 1R7

RE: SEMI-COMBINED SEWERS
Methodology for Identification of Cross-Connected Properties
Project Number: 102.004

Introduction

As part of the Capital Regional District's (CRD) Inflow and Infiltration (I&I) Program, the CRD works with municipalities and First Nations to reduce the amount of groundwater and rainwater entering the sanitary sewer system.

In 2014, the CRD confirmed that some catchments had substantial rapid I&I (generally considered inflow). This was determined by analyzing sewer flows in 105 catchments during two significant short duration (less than one hour) rain storms, that were preceded by extended dry periods (see Appendix A). As expected, most catchments had little or no I&I response. However, the flows in some of the older catchments more than doubled as a result of these storms, indicating significant quantities of rainwater entering the sanitary sewer system.

Recent studies[1] indicate that private property foundation drains are a significant contributor of rainwater inflow in many catchments. These semi-combined sewers have traditionally been identified through smoke and dye testing programs, which are labour intensive and costly to complete.

This document outlines a new methodology to identify semi-combined sewers by using a geographic information system (GIS) analysis of infrastructure, historical plumbing and building code information, and property data. This analysis has been developed to identify properties that likely contribute rainwater to the sanitary system, the results of which can be used to focus cross-connection elimination programs.

Semi-Combined Sewers

Semi-combined sewers refer to historically permitted stormwater connections to the "sanitary sewer system". Historically these were permitted by local government in certain situations. Examples of these situations, as outlined in historical building/plumbing codes or local government practices, are as follows:

- Foundation drains were permitted to connect to the sanitary sewer system in some old building codes.
- Surface and roof drains were permitted to connect to the sanitary sewer system if the property was lower than the road.
- Building drains were permitted to connect to the sanitary sewer system if an adjacent storm drain did not exist or if foundation drain gravity flow was not possible.

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[1] Metro Vancouver, *Private Lateral Foundation Drains and Semi-Combined Sewers as an Inflow and Infiltration Source*, June 2016. This study includes references to other studies in Metro Vancouver and elsewhere.

- Foundation drains that discharged to failing infiltration systems (e.g. rock pits) were sometimes permitted to connect to the sanitary sewer system.

Key factors to identify semi-combined sewers are as follows:

- Gravity flow from the foundation drain to the municipal storm drain;
- The age of the building compared to the age of the adjacent storm drain, and;
- The local government regulations at the time the building was constructed.

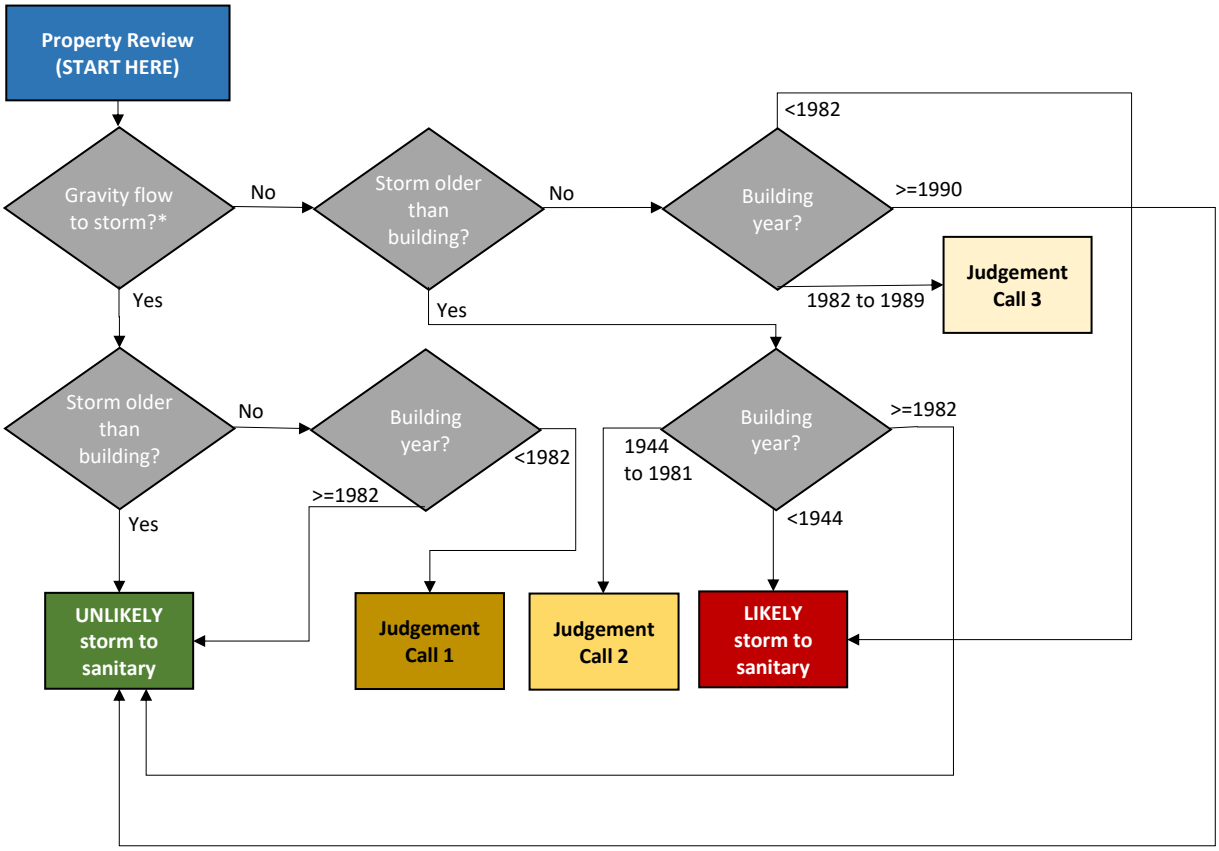
Methodology

The following methodology outlines the proposed process for identifying semi-combined sewers:

1. Review flow records to identify catchments which show a rapid I&I response (significant I&I during short duration rain storms that occurred during dry antecedent conditions). Efforts to identify semi-combined sewers should be focussed on the catchments that show a rapid response.
2. Review of historic municipal plumbing and building codes, in particular conditions that permit connections of foundation drains and surface/roof drains to the sanitary sewer system.
3. Develop a *Semi-Combined I&I Flow Chart* to categorize properties as *likely*, *unlikely* or *judgement call*, to contribute stormwater to the sanitary sewer system. The flow chart developed for the City of Victoria (see Figure 1 below) can be used as a reference.
4. Have engineering departments, building/plumbing departments and/or consultants review the flowchart and in particular the *judgement call* properties and decide, based on understanding of local issues, if these properties should be categorized as *likely* or *unlikely* to be cross-connected. This review could also include runoff calculations to back calculate impervious areas based on the sanitary sewer flow data to be used for comparison with the flow chart results.
5. Make refinements to the *Semi-Combined I&I Flow Chart*.
6. Collect relevant infrastructure and property GIS data (See GIS Data Quality Considerations section below).
7. Run a GIS analysis using the *Semi-Combined I&I Flow Chart* and produce colour coded maps of properties categorized as *likely* or *unlikely* to be cross-connected.

FIGURE 1: Semi-Combined Inflow and Infiltration *Flow Chart - City of Victoria*

A flow chart to categorize properties as LIKELY or UNLIKELY to contribute to stormwater to the sanitary sewer system



Notes:
Buildings without age information are excluded from the analysis.

Gravity Flow to Storm
* The "Gravity flow to storm?" is determined based on the potential lowest elevation of the storm service (storm main obvert plus 2% service lateral slope to the furthest point of the building) compared with the building foundation elevation. The building foundation elevation is determined based on the average ground elevation less the foundation type:
- 1.5 m for basements
- 1.0 m for crawl space / unknown
- 0.5 m for slab

Judgment Calls
Judgement Call 1 - Gravity flow, however the strom drain was constructed after the building and when the codes (before 1982) permitted some surfaces to drain to the sanitary sewer system.
Judgement Call 2 - The storm drain was built before the building, however gravity flow to the storm drain is unlikely and the codes (1944 to 1981) permitted foundation and some surface to drain to the sanitary sewer system.
Judgement Call 3 - Relatively new building (1982 to 1989), however gravity flow to the storm drain is unlikely and the building is older than the adjacent storm drain.

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Pilot Testing

Appendix B documents the methodology for identification of semi-combined sewers in two pilot project sewer catchments in the City of Victoria. It includes the details of the background data review, procedure, analysis and results. In general, this pilot project follows the methodology noted in the section above.

Some of the lessons learned in preparing the project for the City of Victoria are as follows:

- Local historical building and plumbing codes contain the details regarding allowable cross-connection practices (storm to sanitary). These cross-connections are not regulated by the provincial codes.
- Restriction on cross-connections have gradually become more stringent over time.
- Discussions with building/plumbing department staff are critical to the process as they have extensive knowledge, in particular regarding the application of the codes.
- Having complete and accurate GIS data, in particular storm drain age, build age and storm drain elevation information, is necessary for obtaining accurate analysis results. Data sources and strategies to deal with missing data are summarized in Table 1 below.

Table 1: Data Sources and Missing Data Strategies

Data	Source	Missing Data Strategies
Storm drain age (critical data)	Record drawings/GIS for year of installation	Estimate based on material type
Building age (critical data)	Building department/property records, or BC Assessment Authority	Estimate based on overall neighbourhood age
Storm drain main elevation (critical data)	Record drawings/GIS at manholes (interpolate between manholes)	Estimate based on ground elevation and typical depths.
Storm drain service location	Record drawings/GIS at manholes	Assume drain services are located at the low side of the property
Building location/footprint	Building department/property records, or local or regional mapping linework	Estimate based on zoning setbacks
Foundation type (slab, crawl space, basement)	Building department/property records, or BC Assessment Authority	Estimate based on local knowledge
Building ground elevation	Building department/property records	Estimate based on average of footprint ground elevations

Summary

The CRD has identified that a number of catchments (particularly older catchments) have substantial quantities of rainwater entering the sanitary sewer system, indicating these are semi-combined sewers. The methodology described in this memorandum outlines a new way to identify individual semi-combined properties by using a GIS analysis of infrastructure, historical plumbing and building code information, and property data. The results of this analysis and mapping can be used to focus cross-connection elimination programs.

The methodology was developed and pilot tested using two sewer catchments in the City of Victoria, but is also applicable to other municipalities. The methodology includes a number of steps and is reliant on complete and accurate GIS data.

It is our intention that this methodology to identify semi-combined I&I sewer areas will be a useful resource in the reduction of I&I.

Prepared by:

COLQUITZ ENGINEERING LTD.

Jeff Howard, P.Eng.
Water Resources Engineer

JH/jh

Statement of Limitations

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Revision History

Revision #	Date	Status	Revisions	Author
0	April 23, 2018	DRAFT	Submitted for client review and discussion	J. Howard
1	May 25, 2018	DRAFT	Submitted for client review	J. Howard
2	June 20, 2018	FINAL	Revised based on comments received	J. Howard

Appendix A

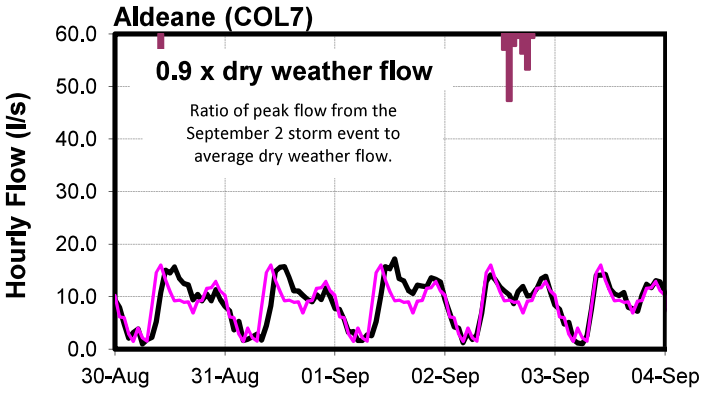
I&I RESPONSE DURING 2014 SHORT-DURATION STORM EVENTS

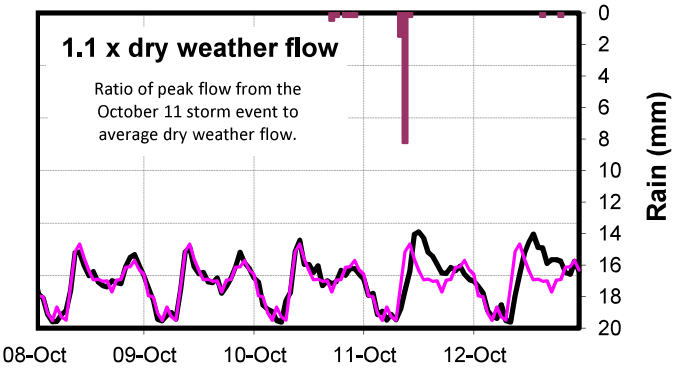
Colwood

Inflow Event: September 2, 2014

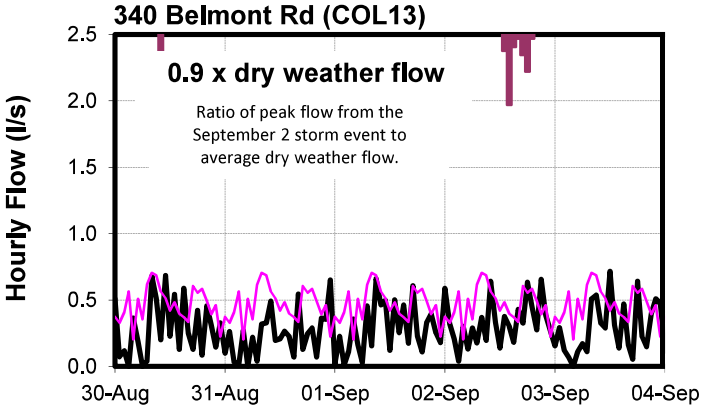
Inflow Event: October 11, 2014

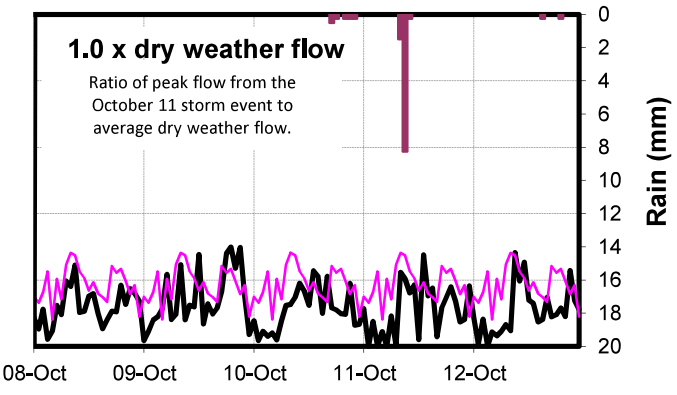
Aldeane (COL7)



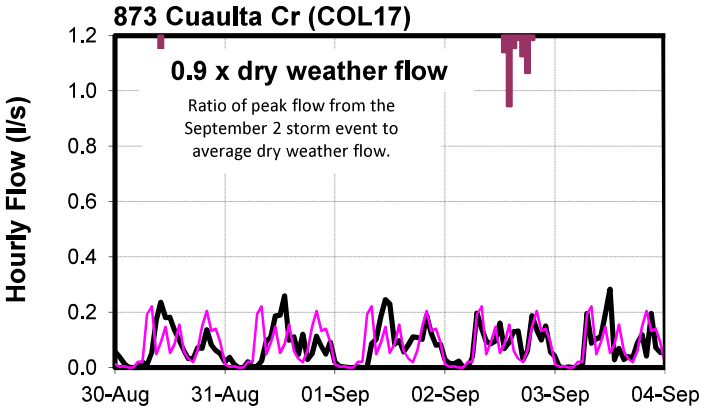


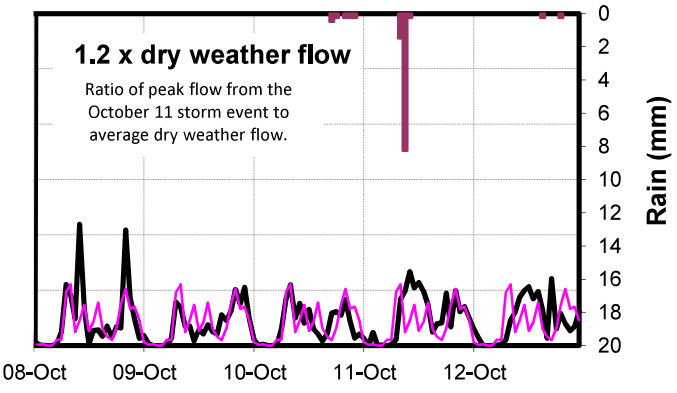
340 Belmont Rd (COL13)



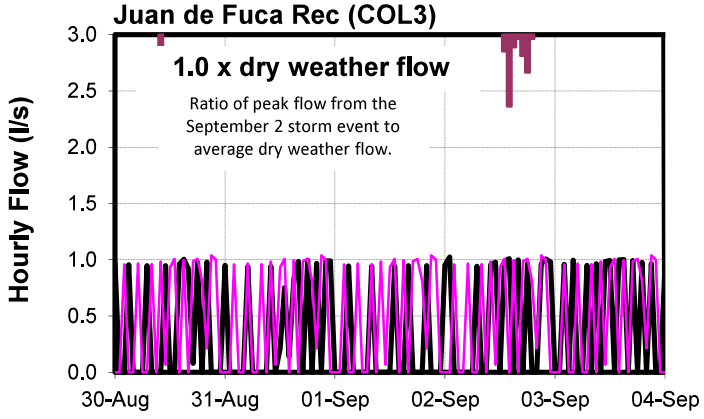


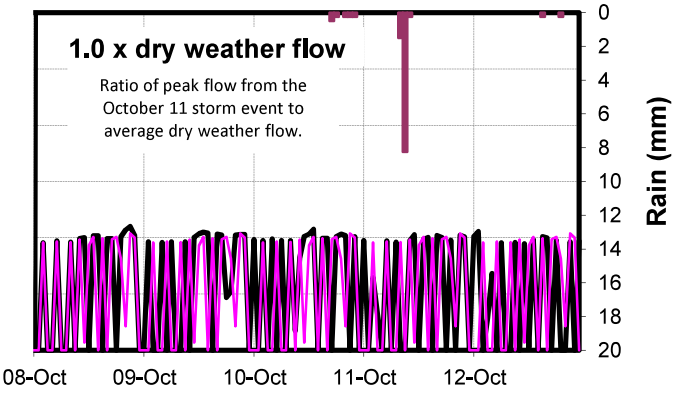
873 Cuaulta Cr (COL17)





Juan de Fuca Rec (COL3)





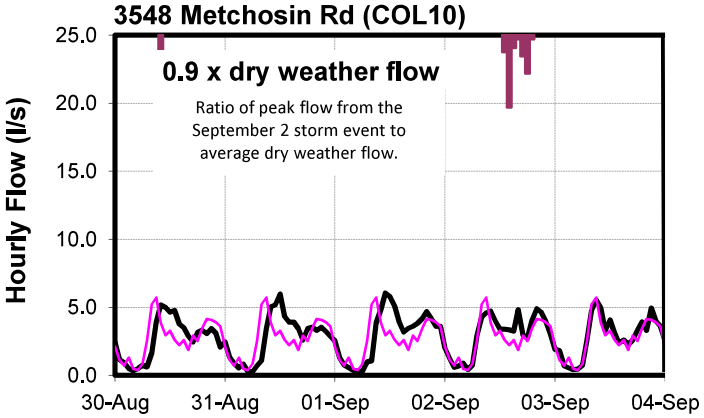
Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

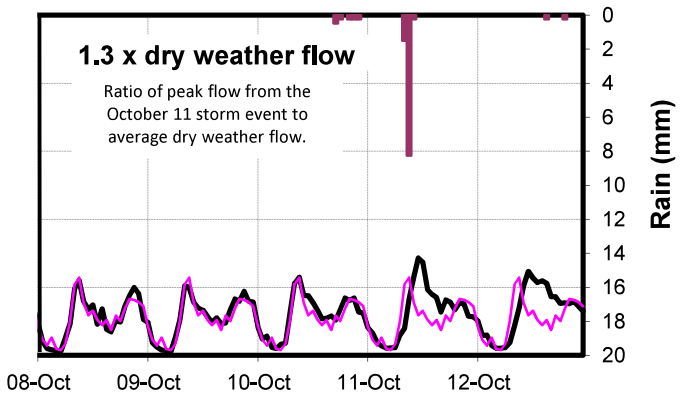
Colwood

Inflow Event: September 2, 2014

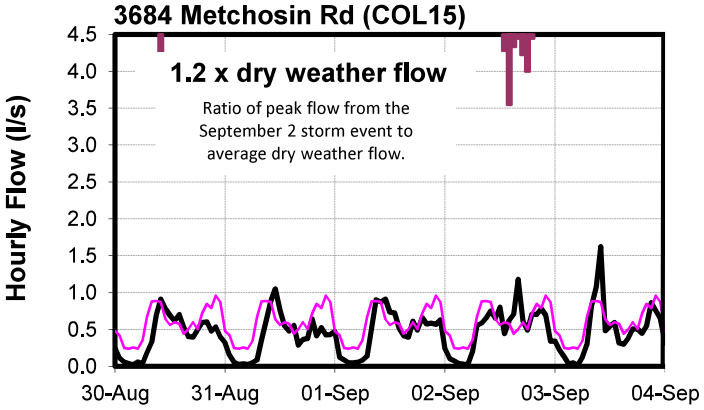
Inflow Event: October 11, 2014

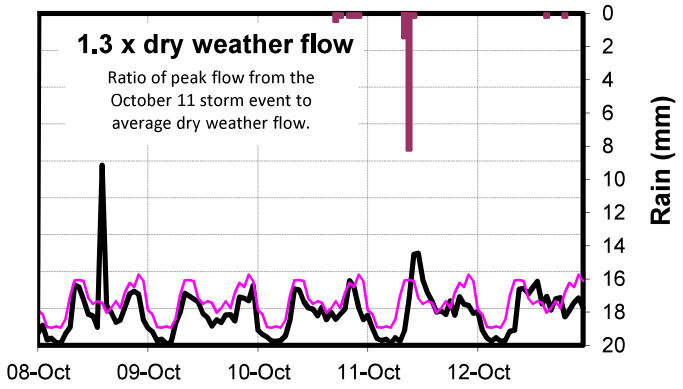
3548 Metchosin Rd (COL10)



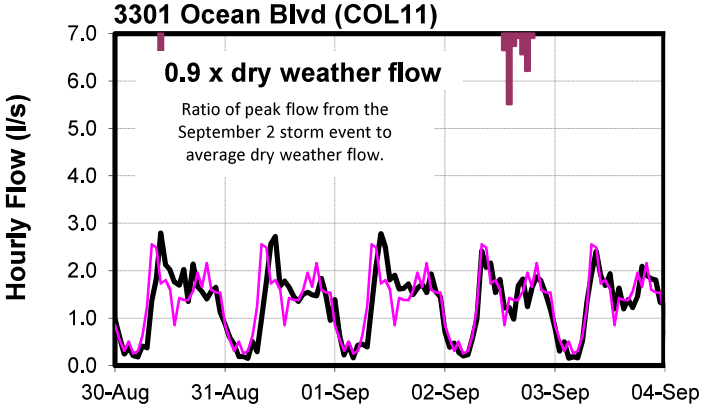


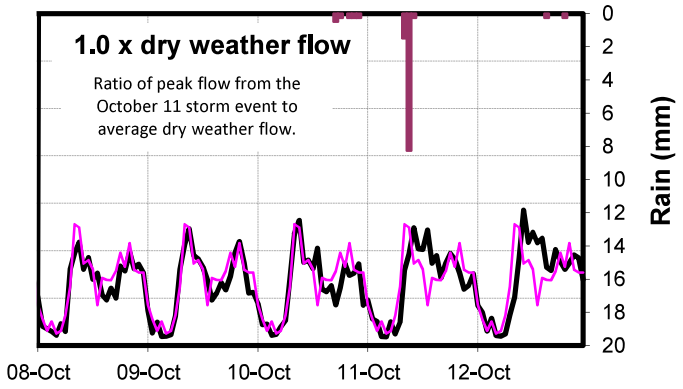
3684 Metchosin Rd (COL15)



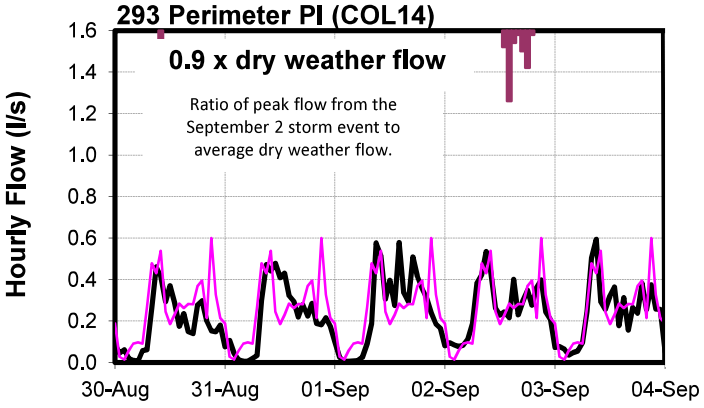


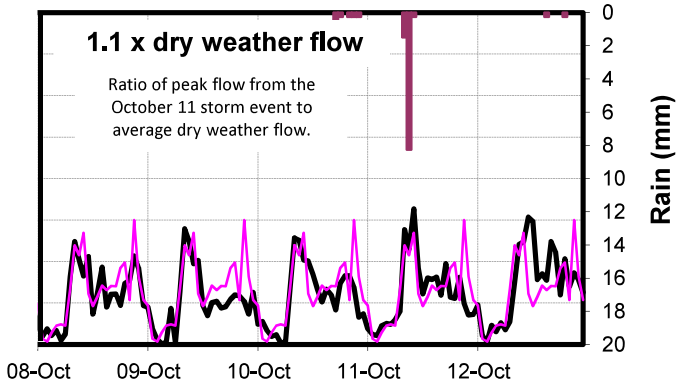
3301 Ocean Blvd (COL11)





293 Perimeter Pl (COL14)



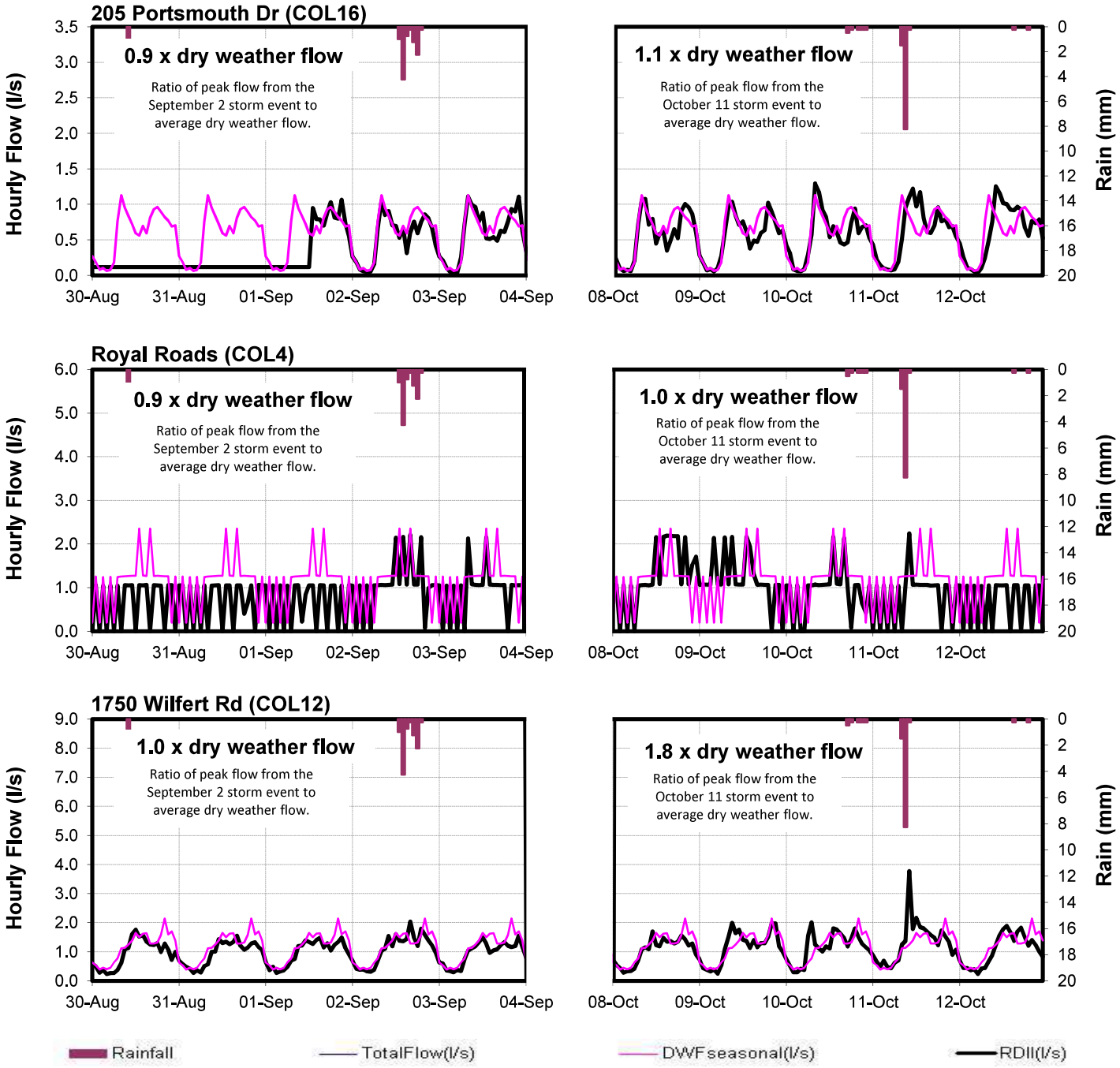


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Colwood

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

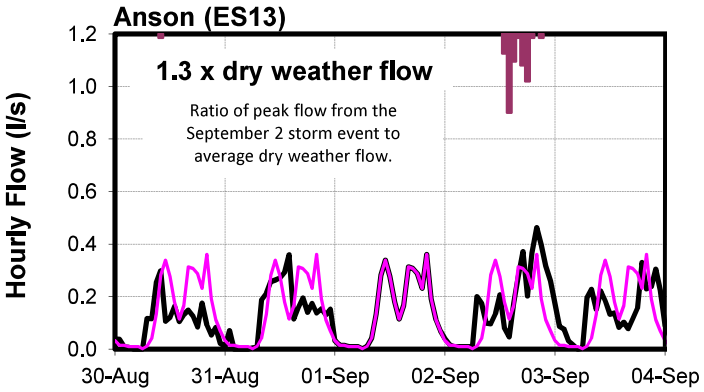


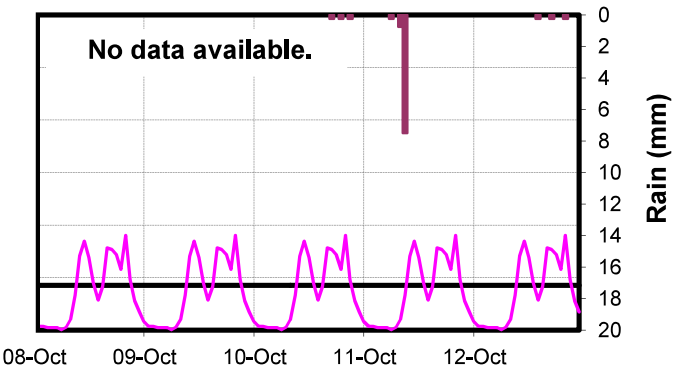
Esquimalt

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

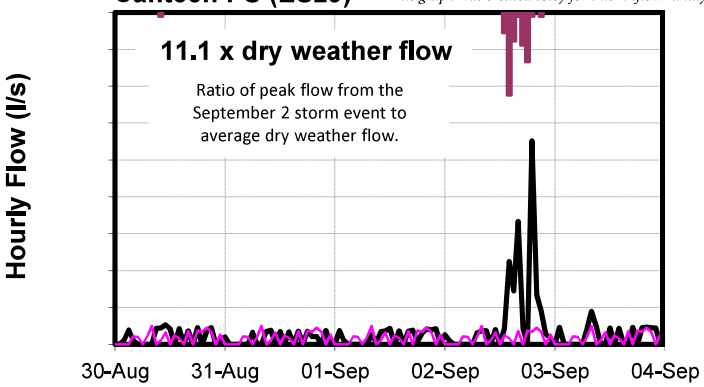
Anson (ES13)

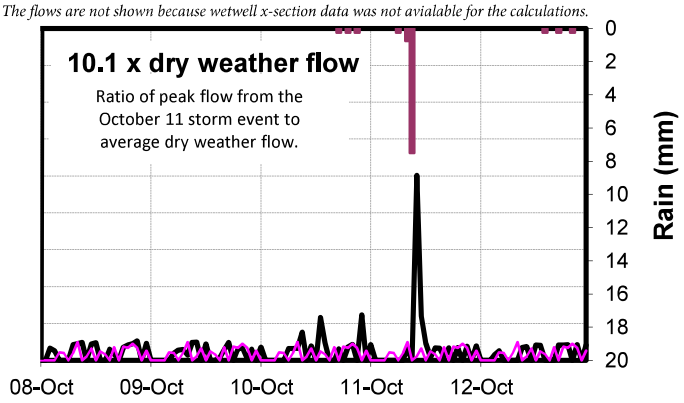




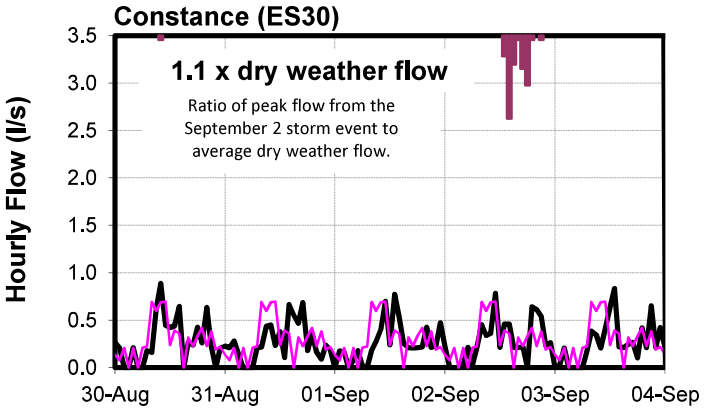
Canteen PS (ES29)

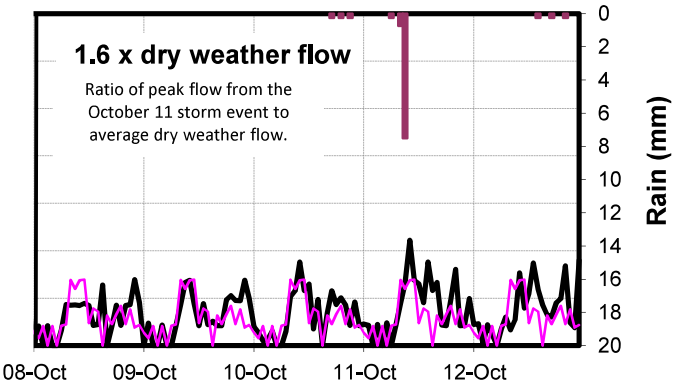
This graph was created soley for this "inflow" analyses. The flows are not shown because wetwell x-section data was not avialable for the calculations.



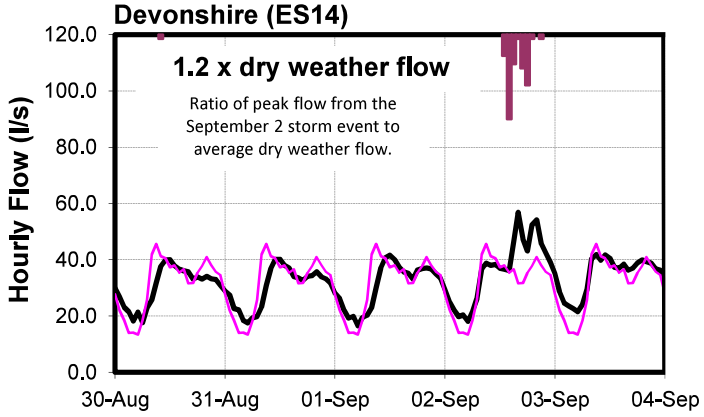


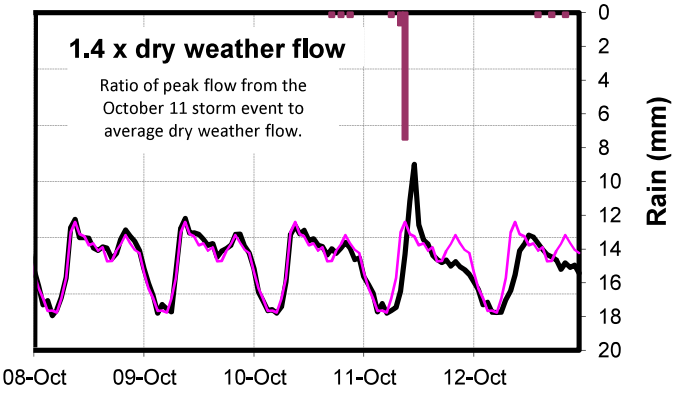
Constance (ES30)





Devonshire (ES14)



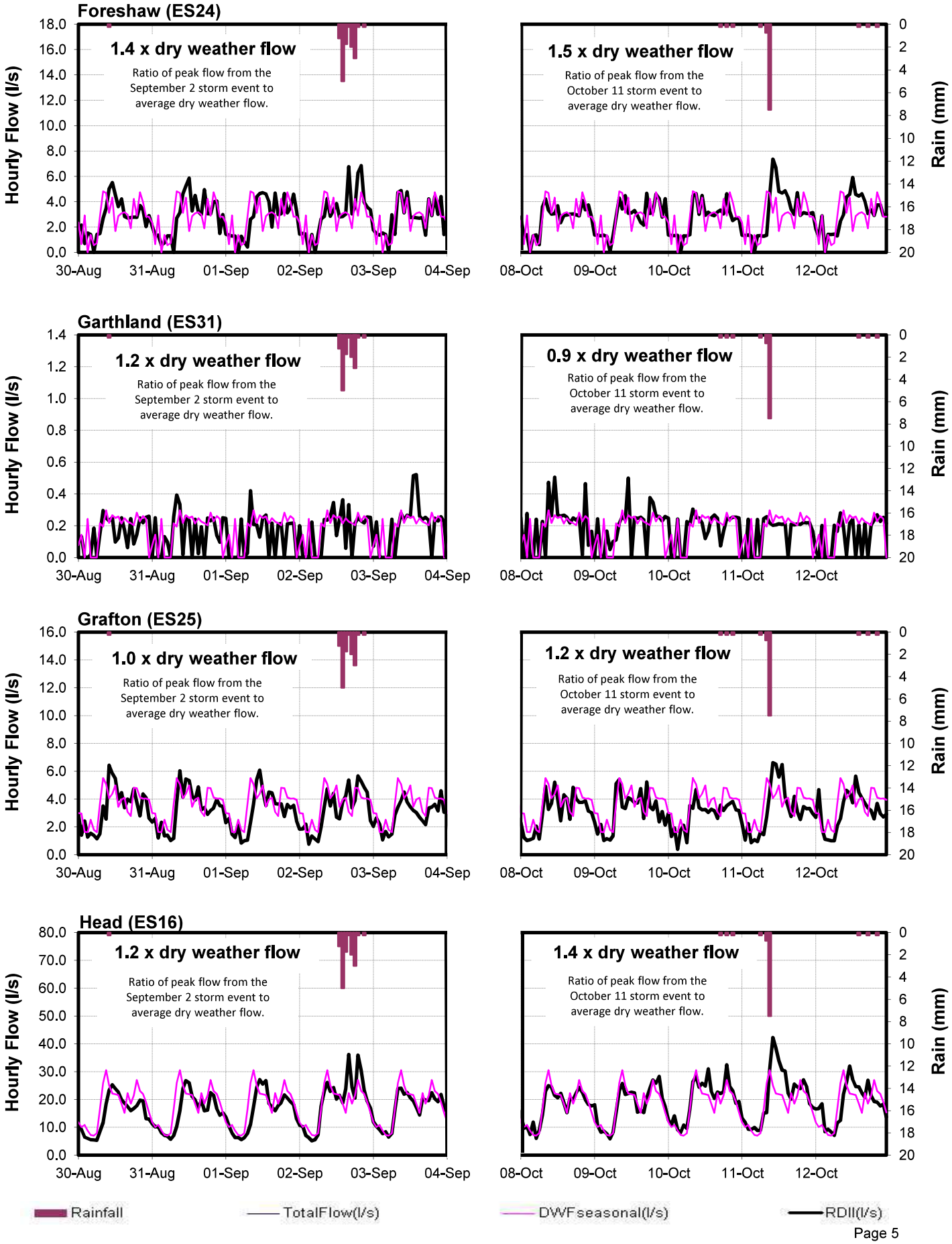


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Esquimalt

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

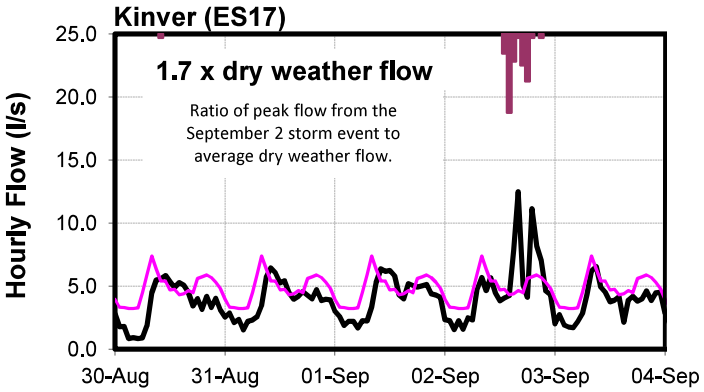


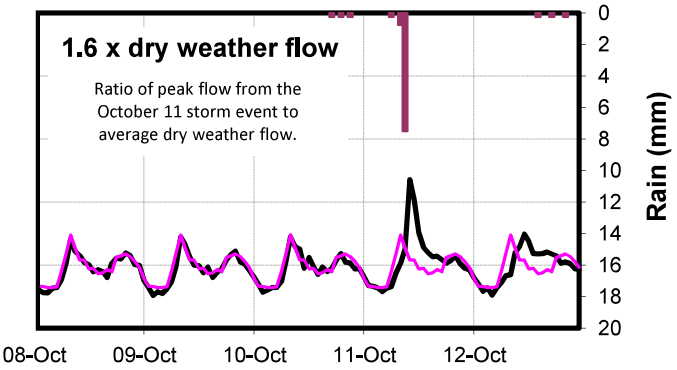
Esquimalt

Inflow Event: September 2, 2014

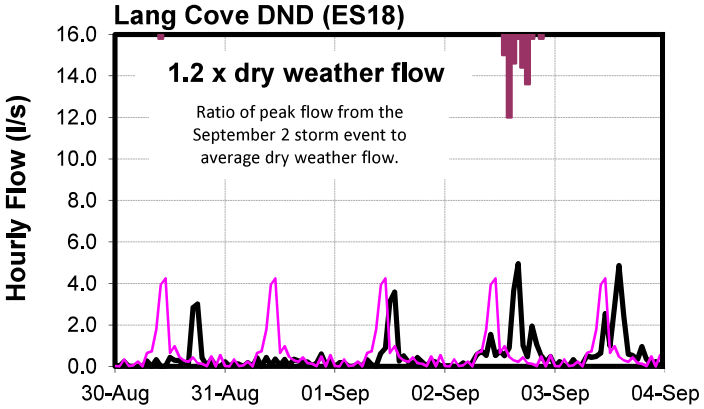
Inflow Event: October 11, 2014

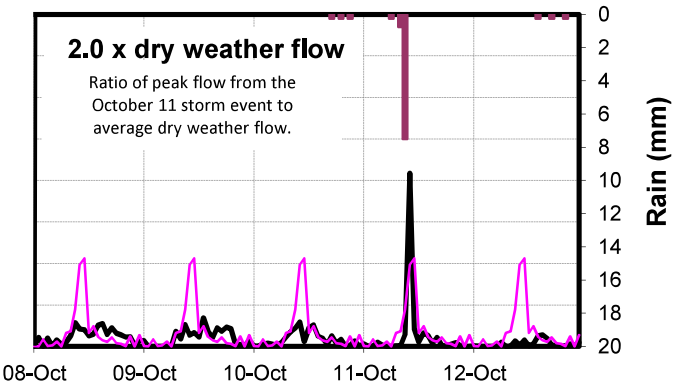
Kinver (ES17)



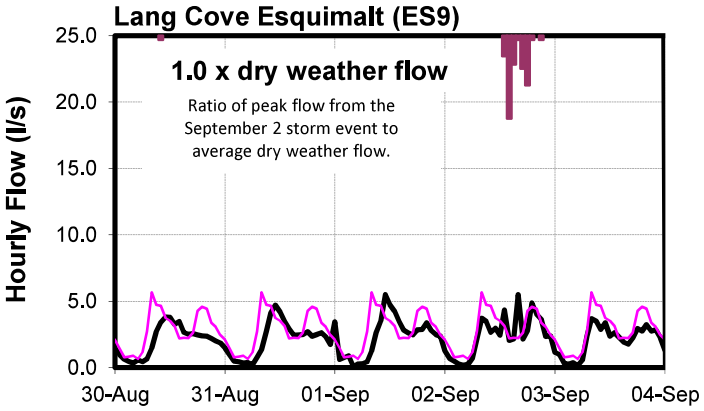


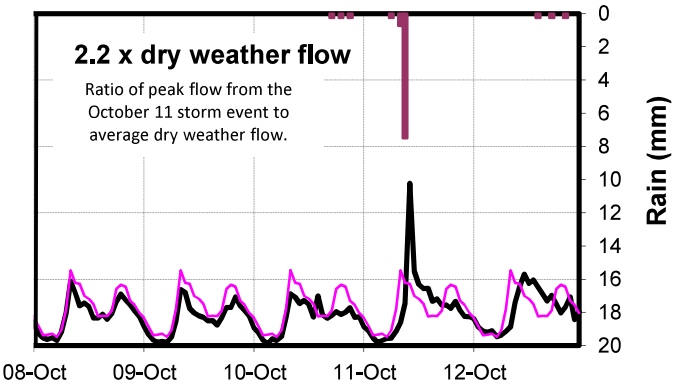
Lang Cove DND (ES18)



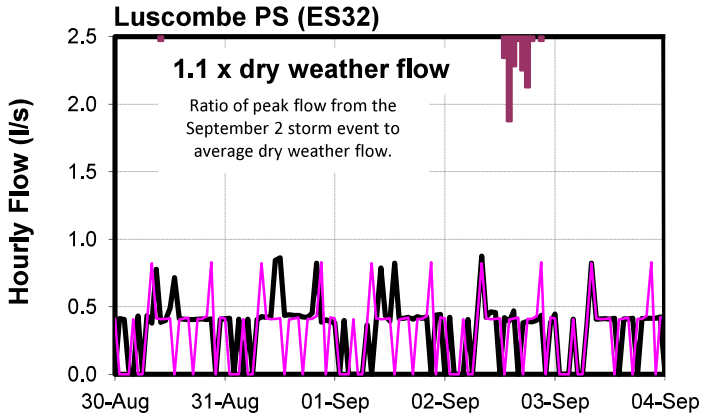


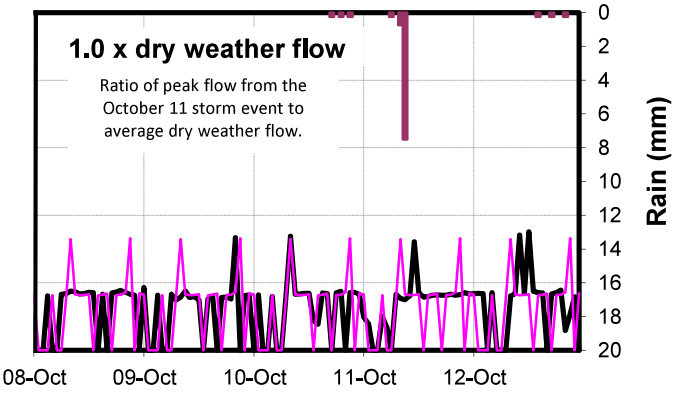
Lang Cove Esquimalt (ES9)





Luscombe PS (ES32)





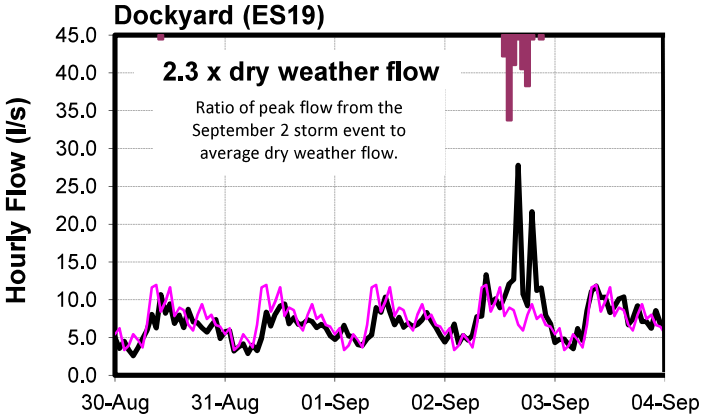
Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

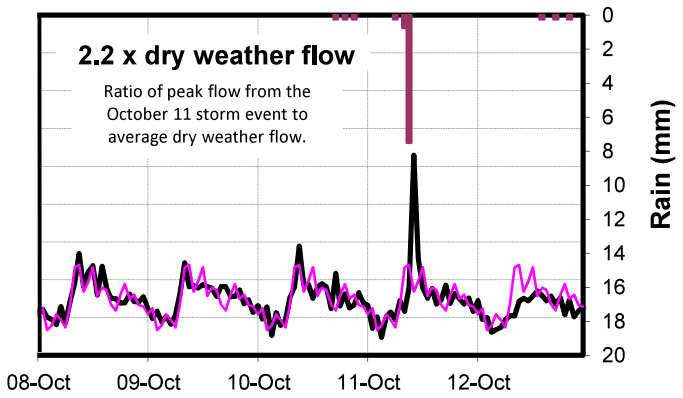
Esquimalt

Inflow Event: September 2, 2014

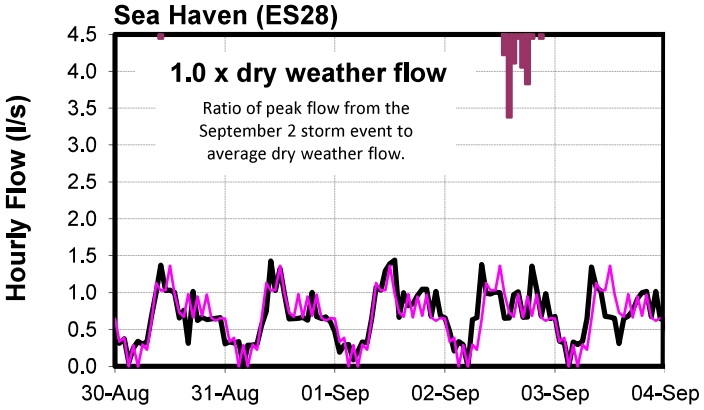
Inflow Event: October 11, 2014

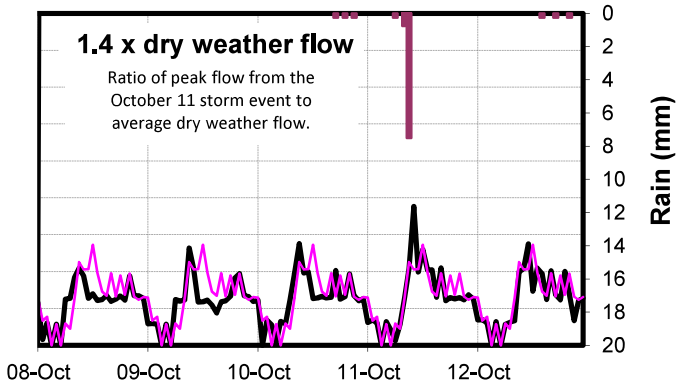
Dockyard (ES19)



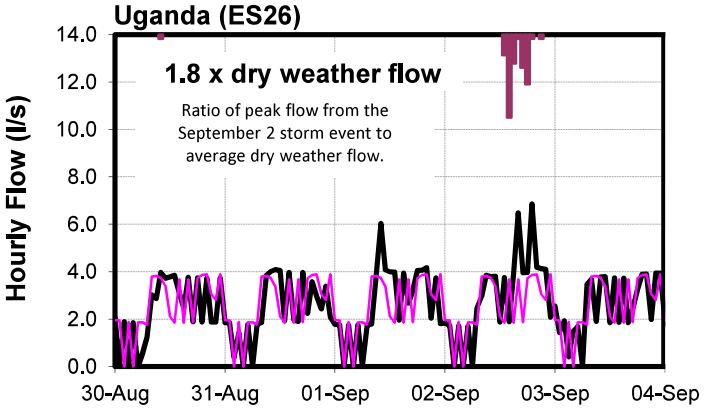


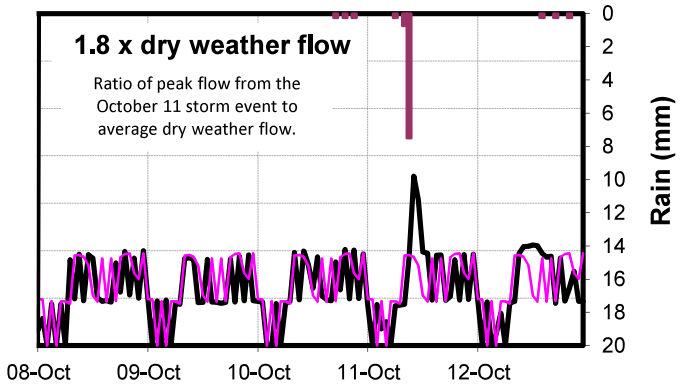
Sea Haven (ES28)



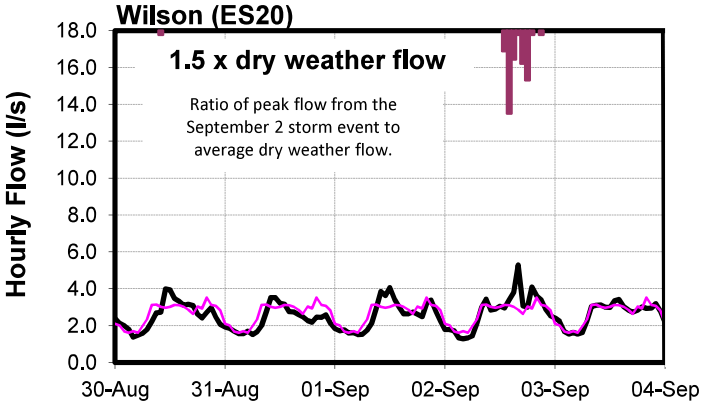


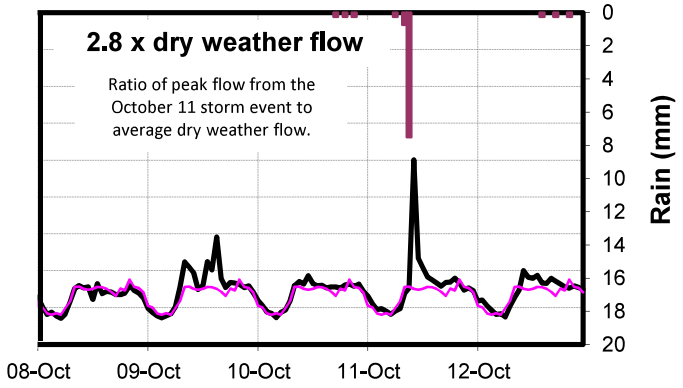
Uganda (ES26)





Wilson (ES20)



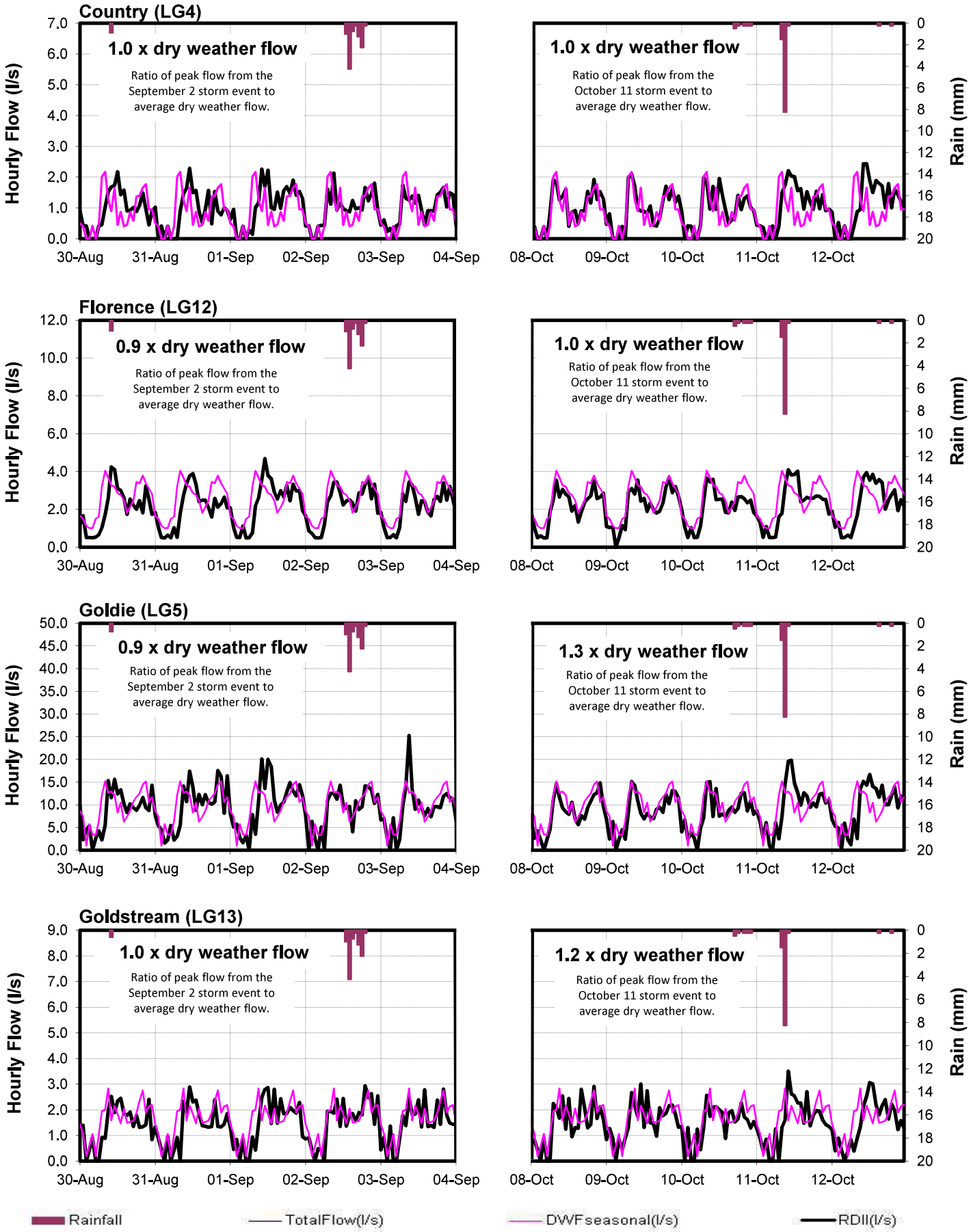


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Langford

Inflow Event: September 2, 2014

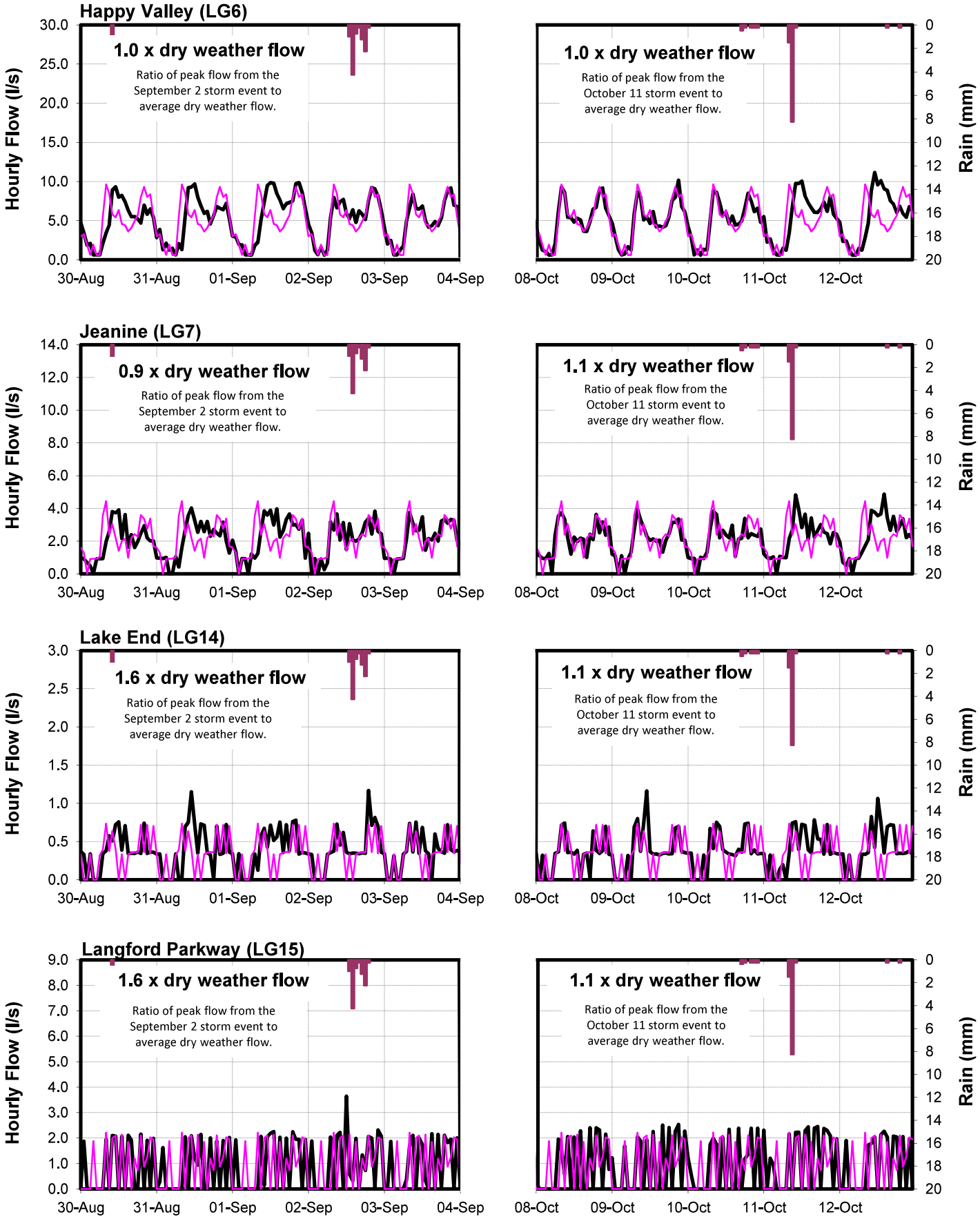
Inflow Event: October 11, 2014



Langford

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

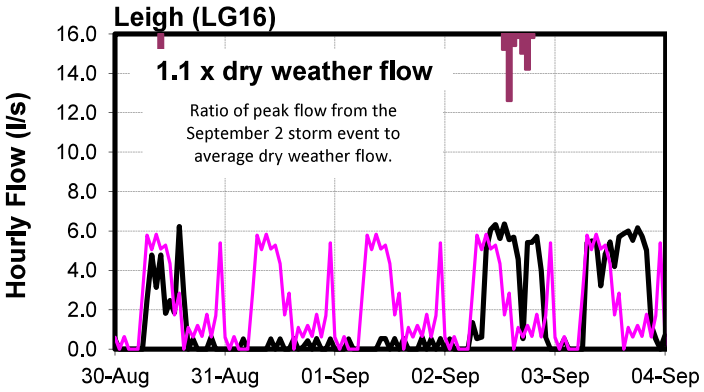


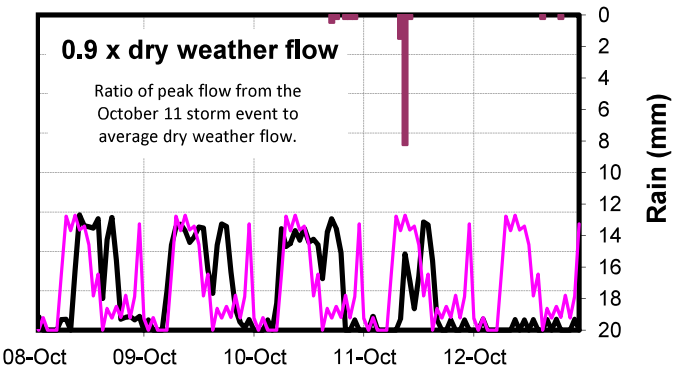
Langford

Inflow Event: September 2, 2014

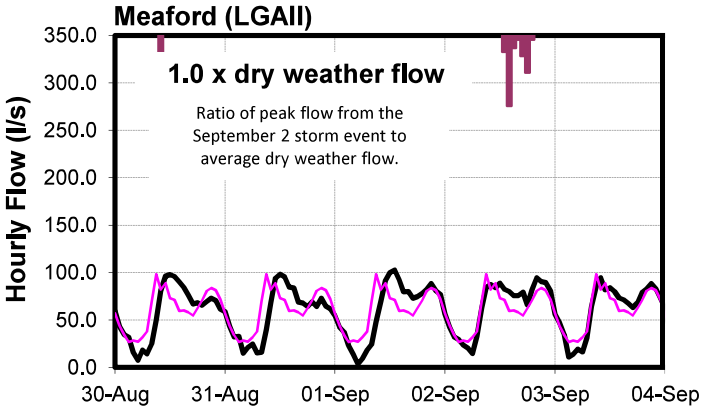
Inflow Event: October 11, 2014

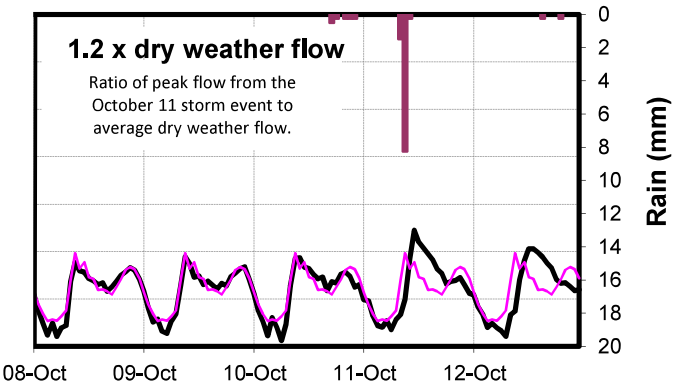
Leigh (LG16)



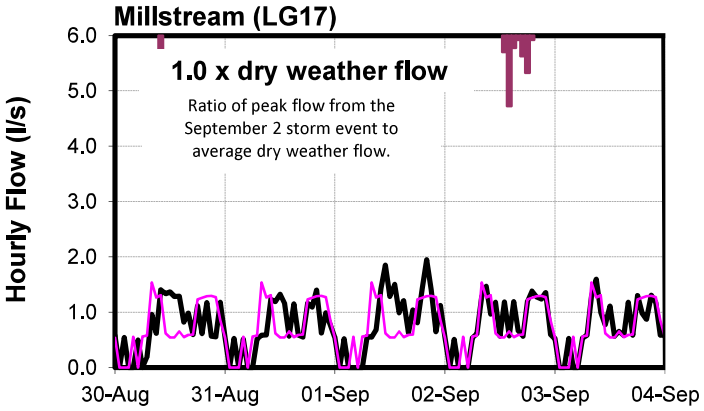


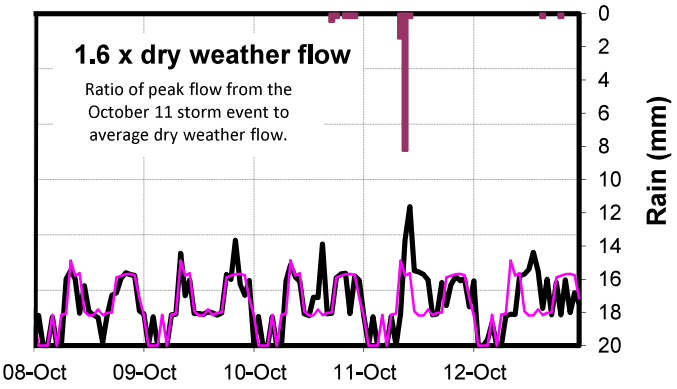
Meaford (LGAII)



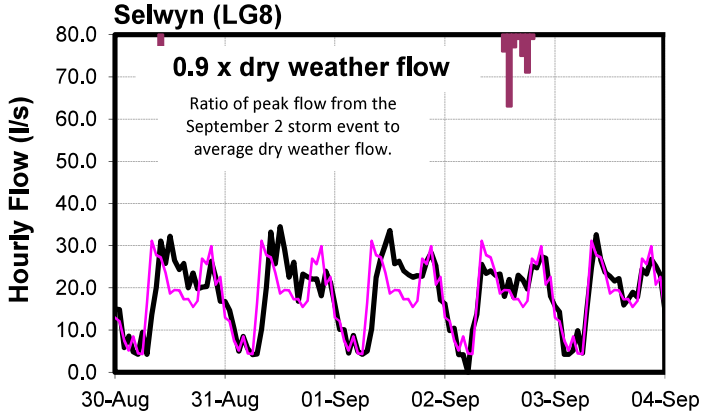


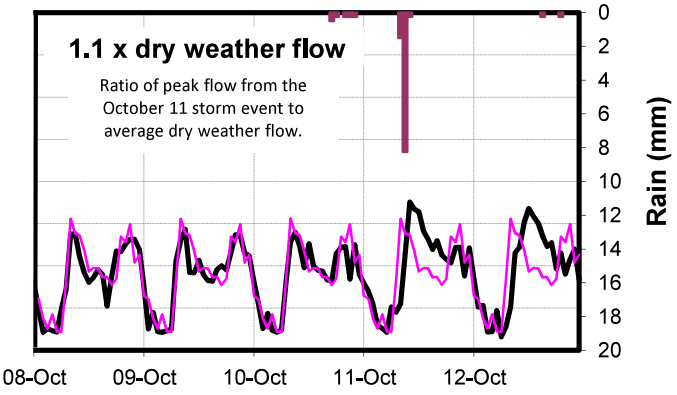
Millstream (LG17)





Selwyn (LG8)



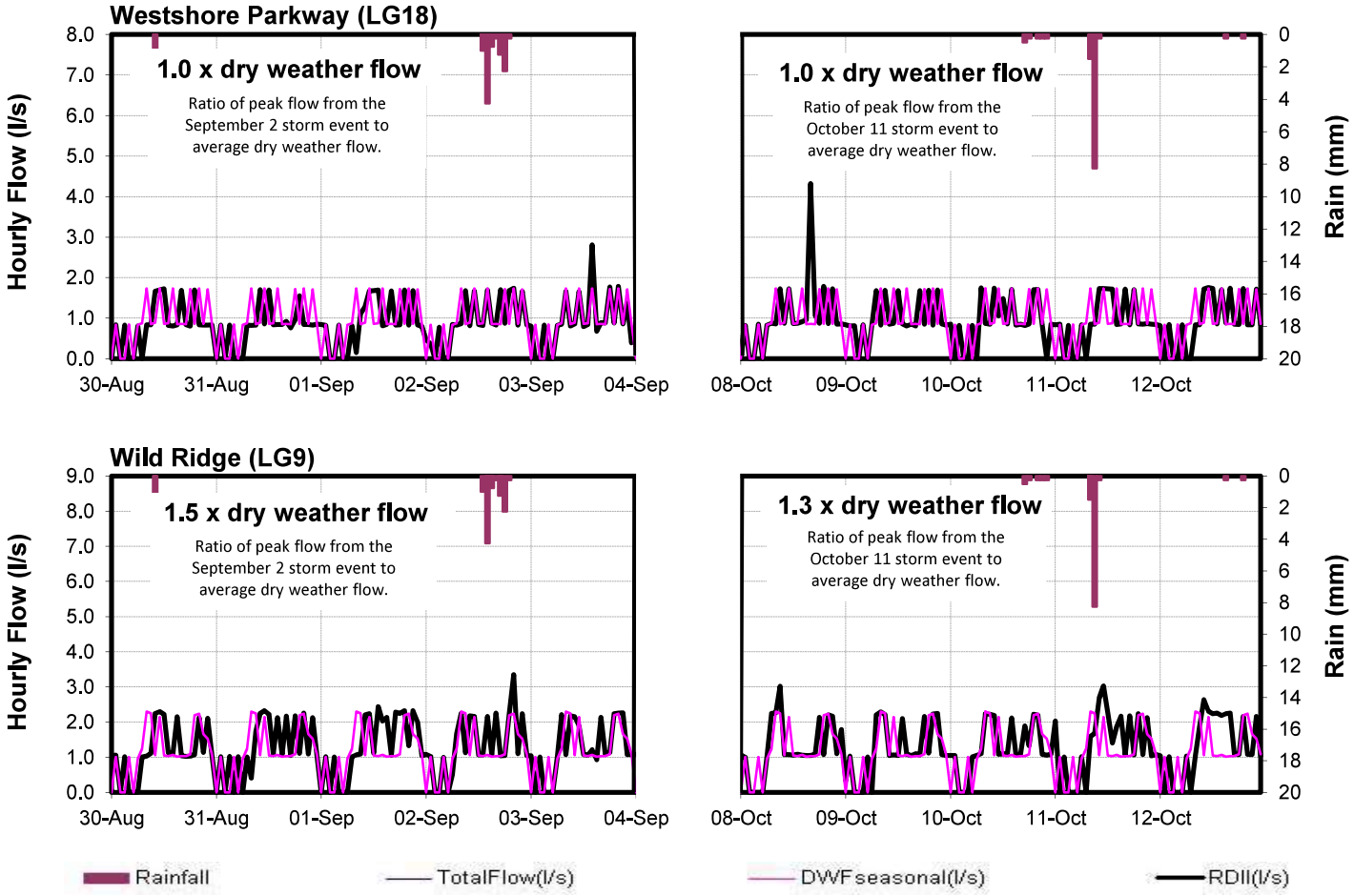


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Langford

Inflow Event: September 2, 2014

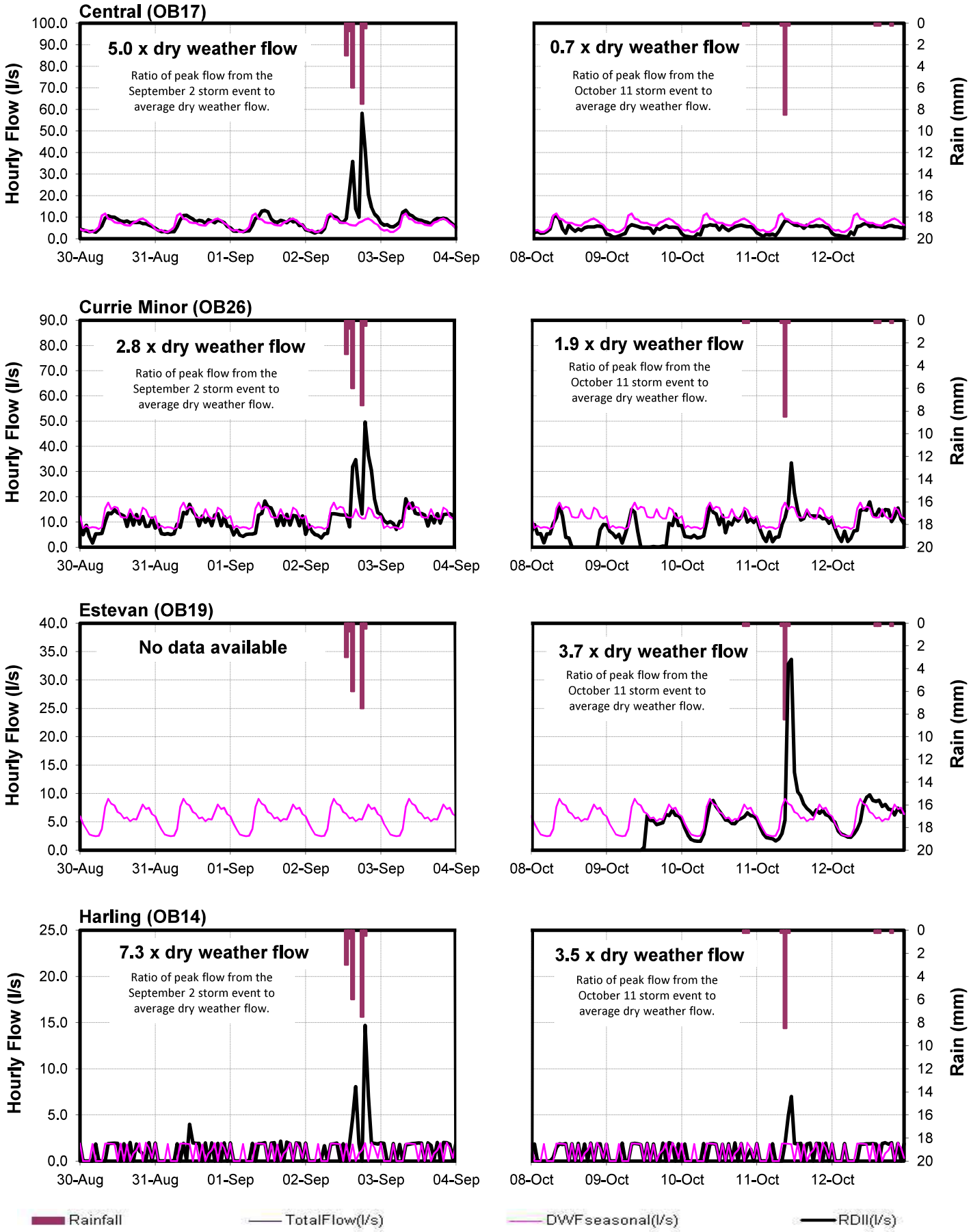
Inflow Event: October 11, 2014



Oak Bay

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

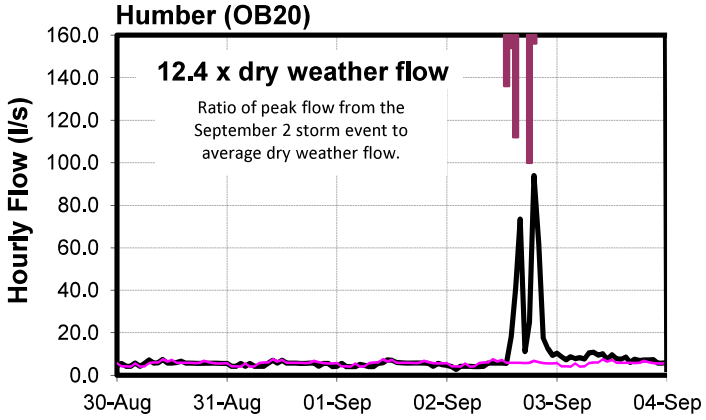


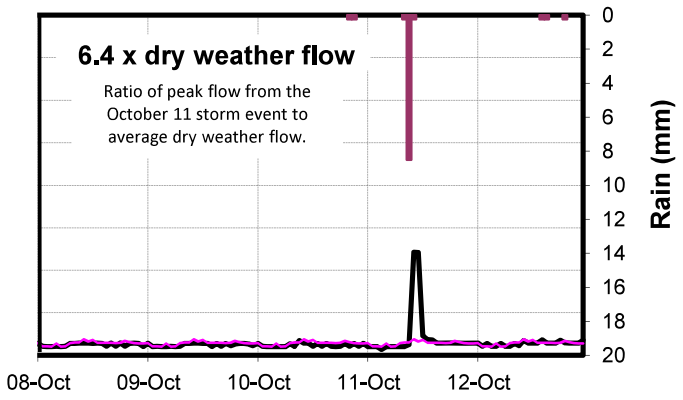
Oak Bay

Inflow Event: September 2, 2014

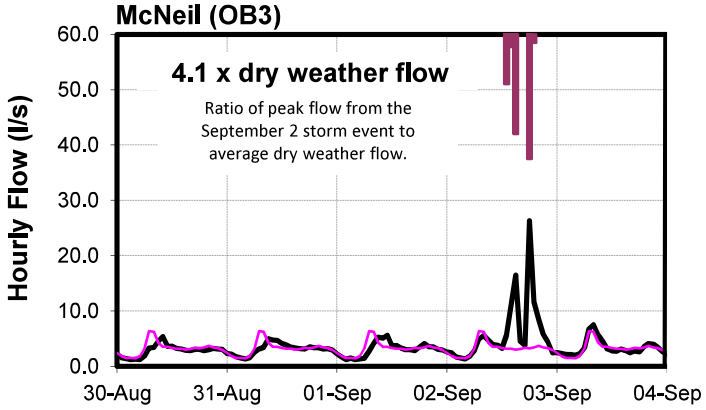
Inflow Event: October 11, 2014

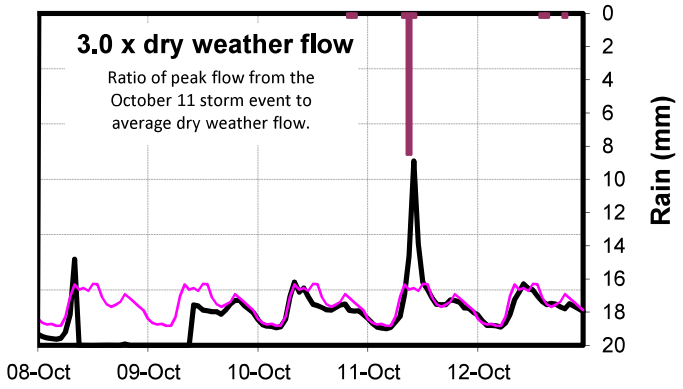
Humber (OB20)



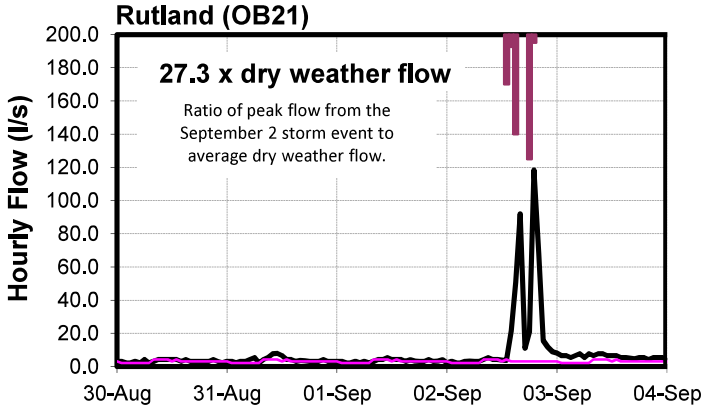


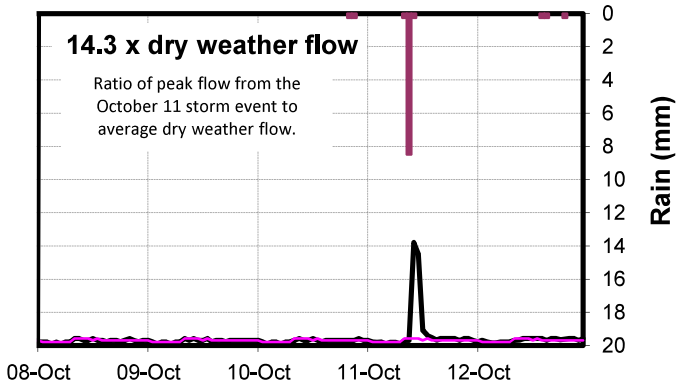
McNeil (OB3)



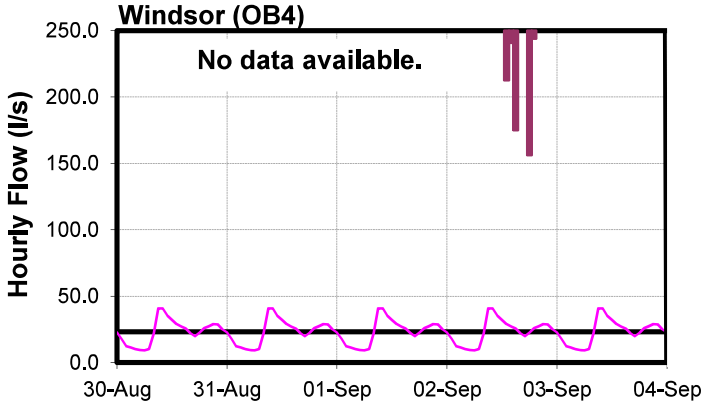


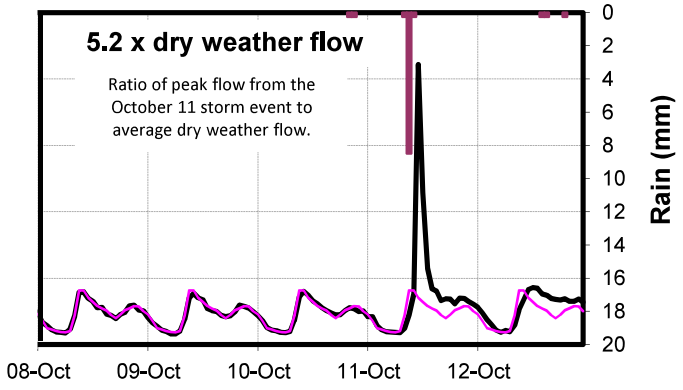
Rutland (OB21)





Windsor (OB4)



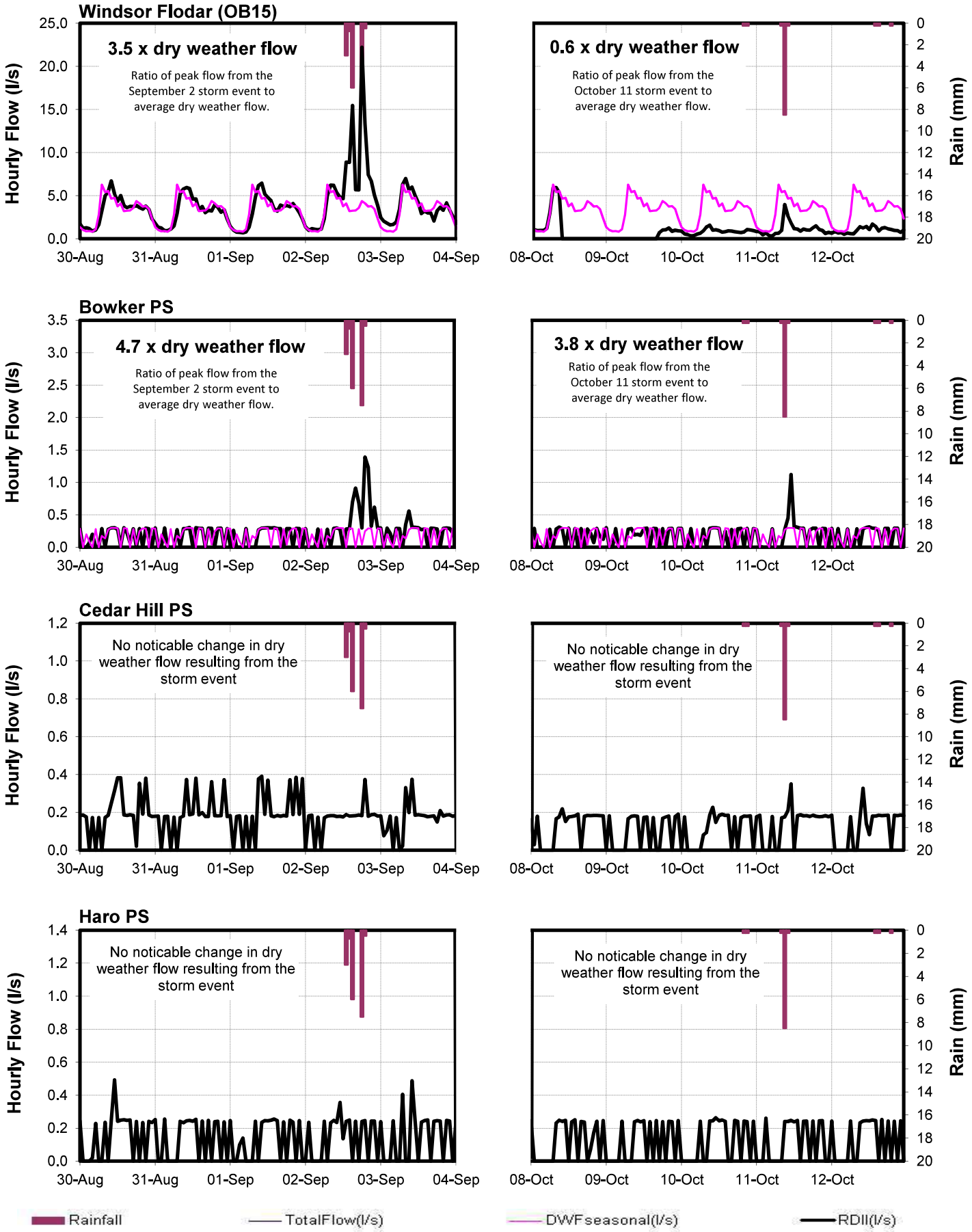


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Oak Bay

Inflow Event: September 2, 2014

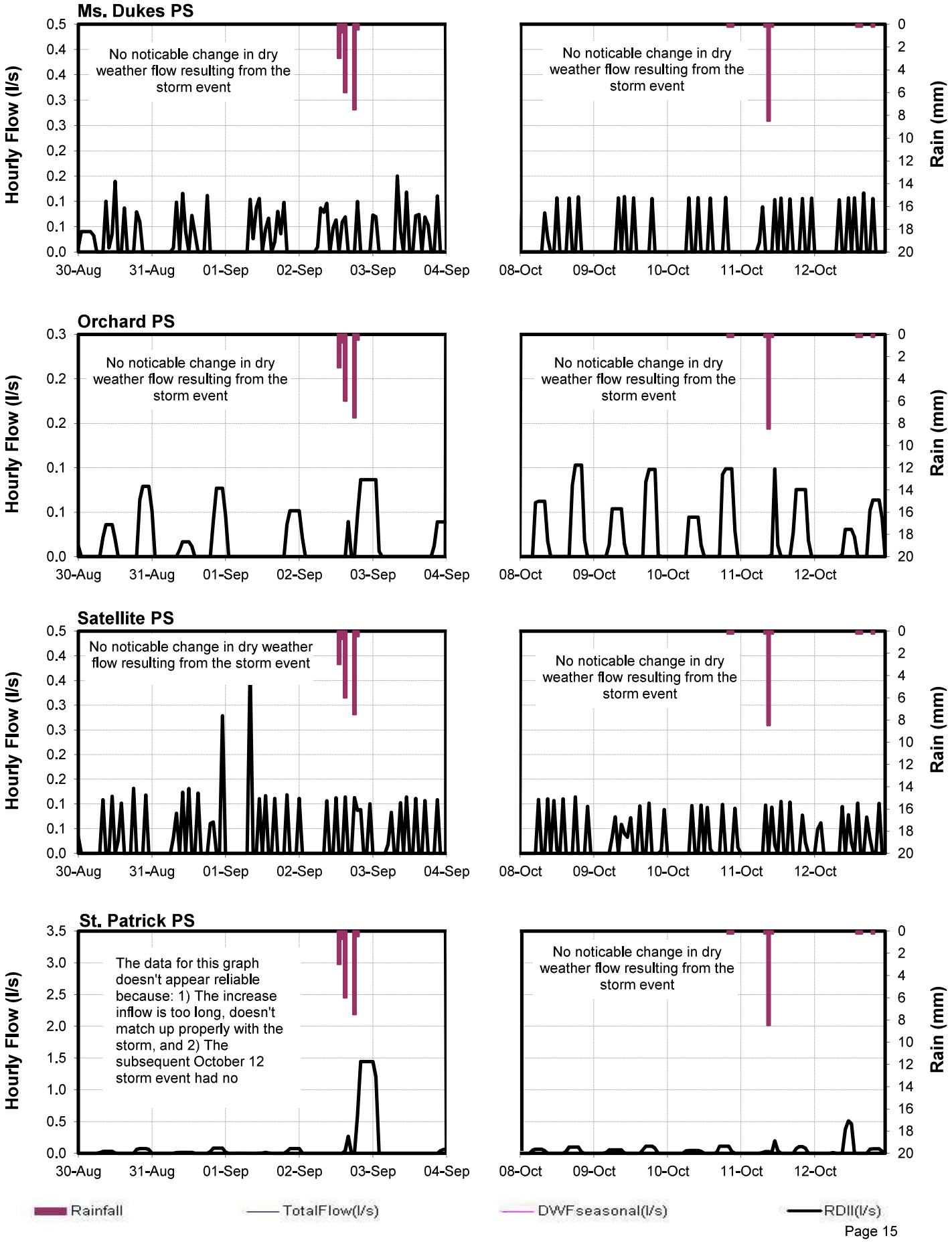
Inflow Event: October 11, 2014



Oak Bay

Inflow Event: September 2, 2014

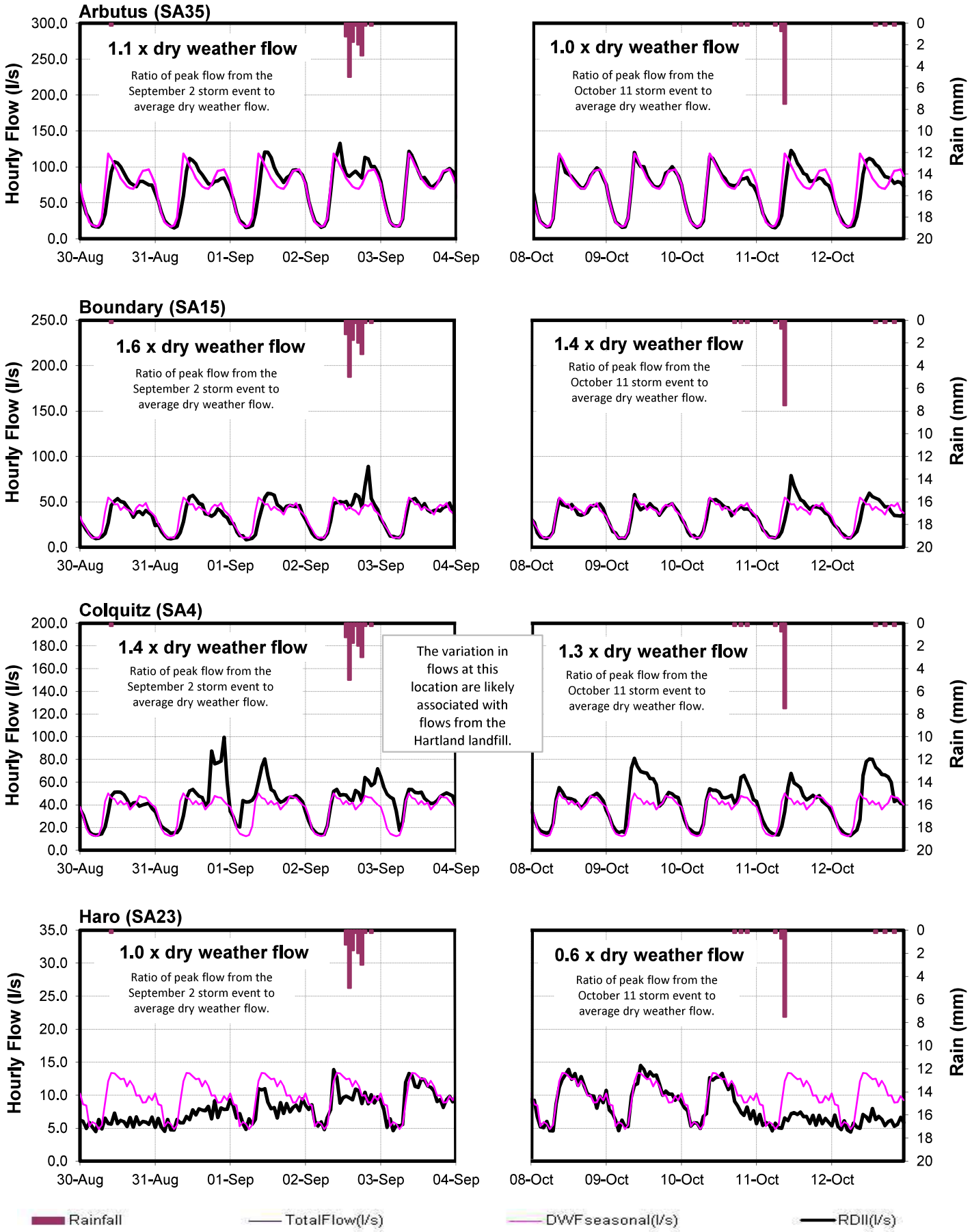
Inflow Event: October 11, 2014



Saanich

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

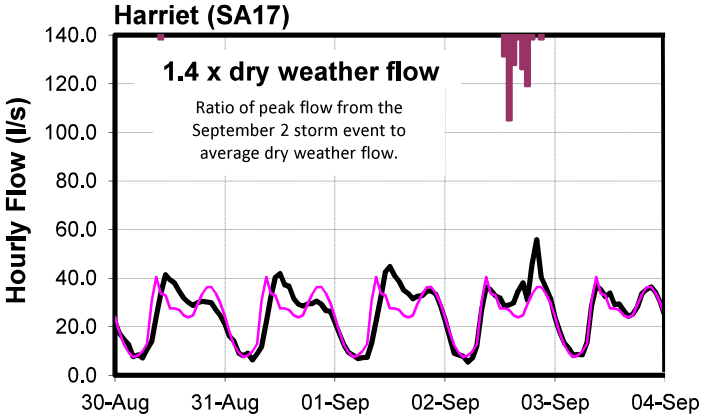


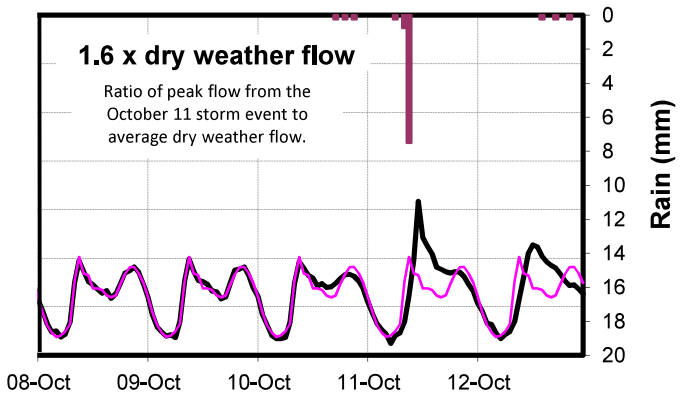
Saanich

Inflow Event: September 2, 2014

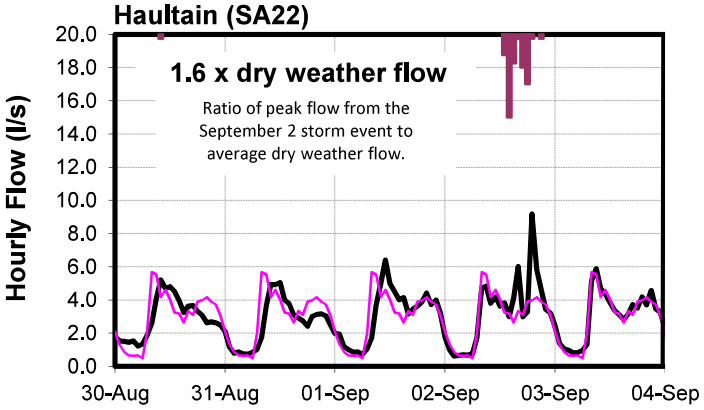
Inflow Event: October 11, 2014

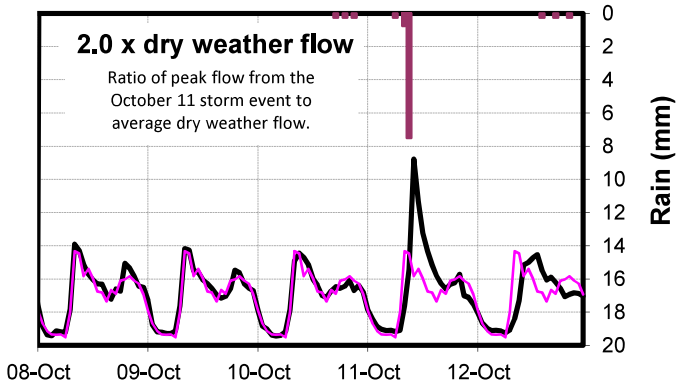
Harriet (SA17)



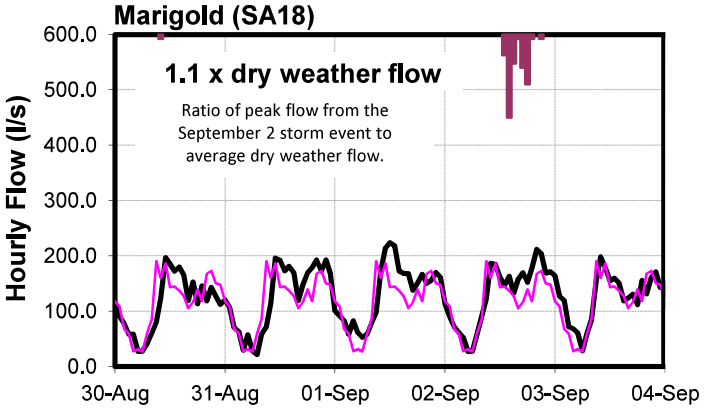


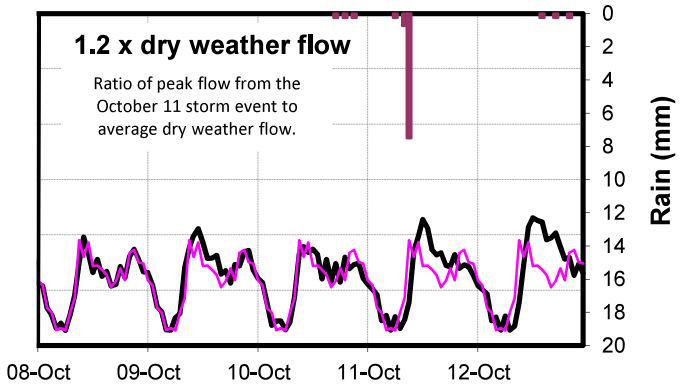
Haultain (SA22)



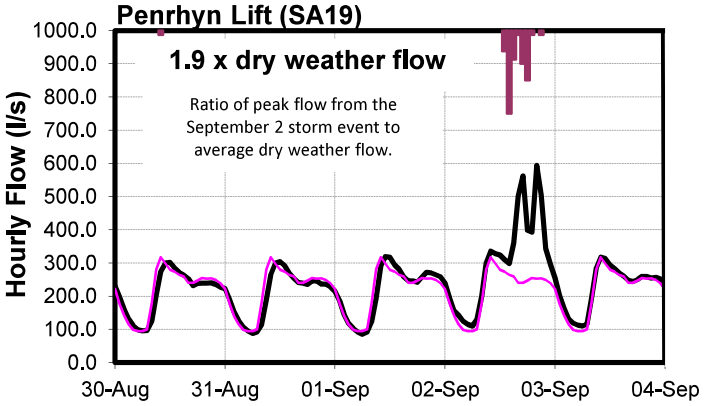


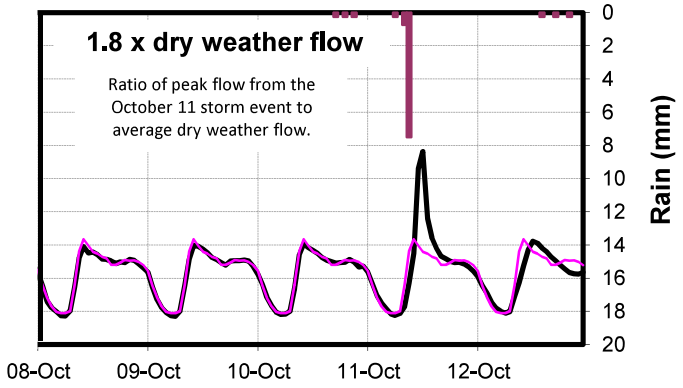
Marigold (SA18)





Penrhyn Lift (SA19)



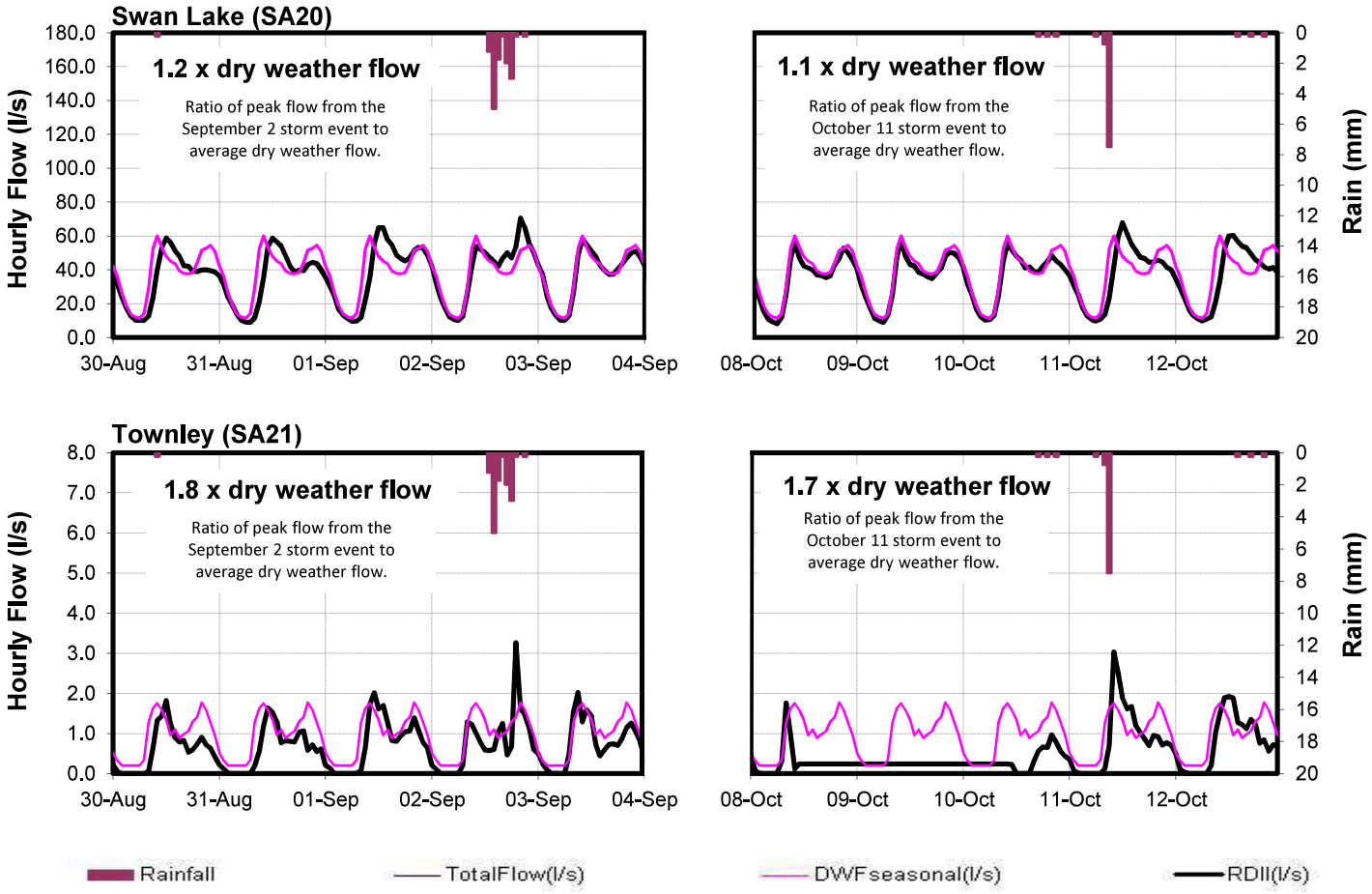


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Saanich

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

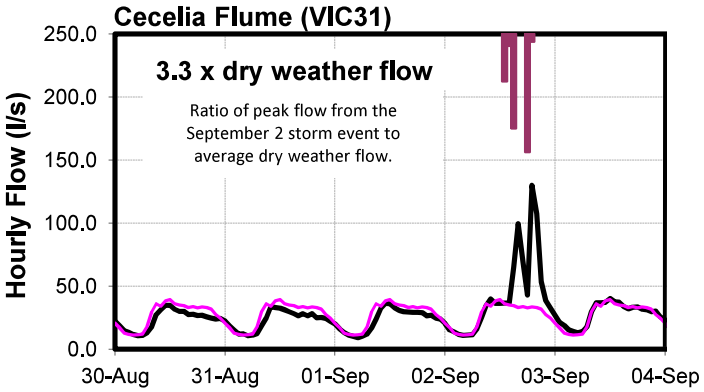


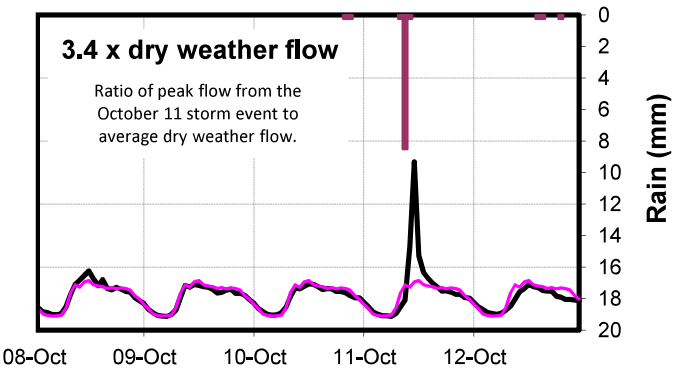
Victoria

Inflow Event: September 2, 2014

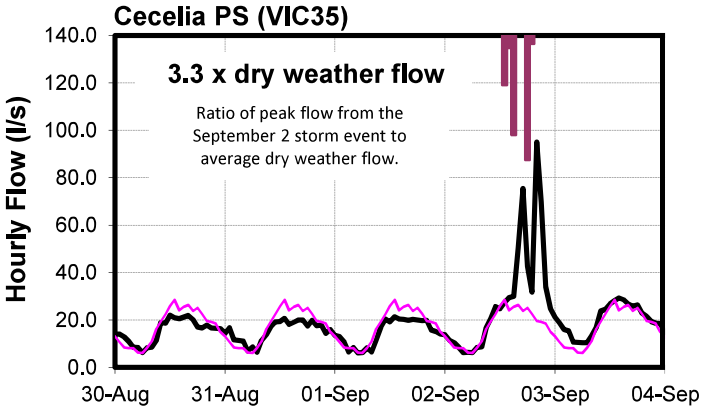
Inflow Event: October 11, 2014

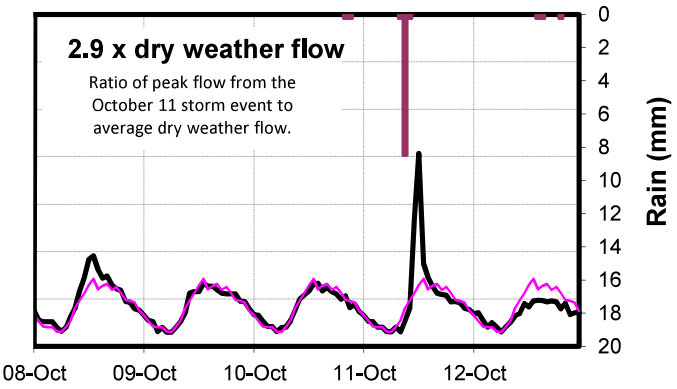
Cecelia Flume (VIC31)



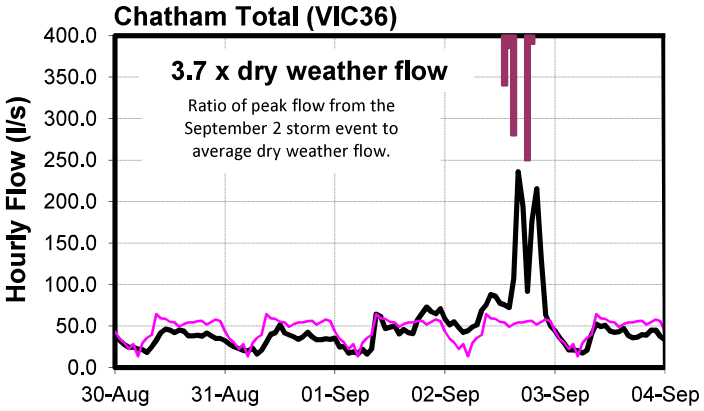


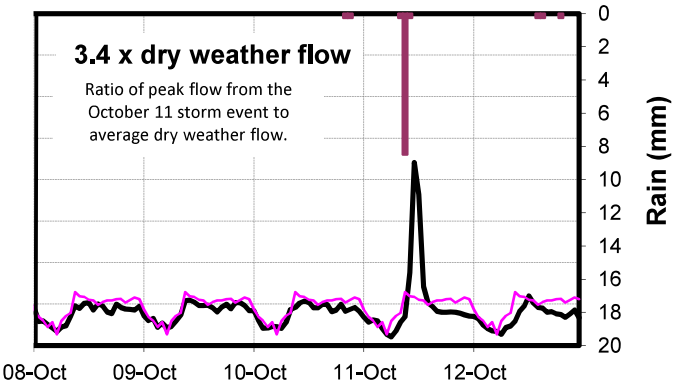
Cecelia PS (VIC35)





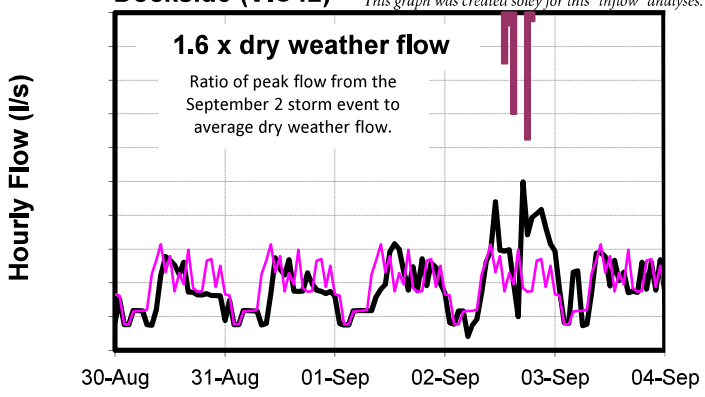
Chatham Total (VIC36)

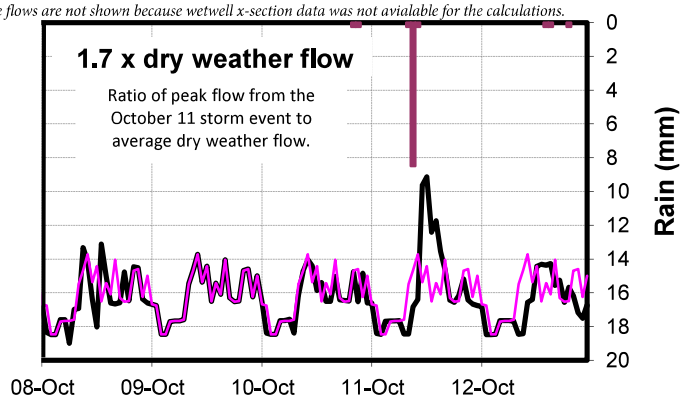




Dockside (VIC42)

This graph was created soley for this "inflow" analyses. The flows are not shown because wetwell x-section data was not avialable for the calculations.



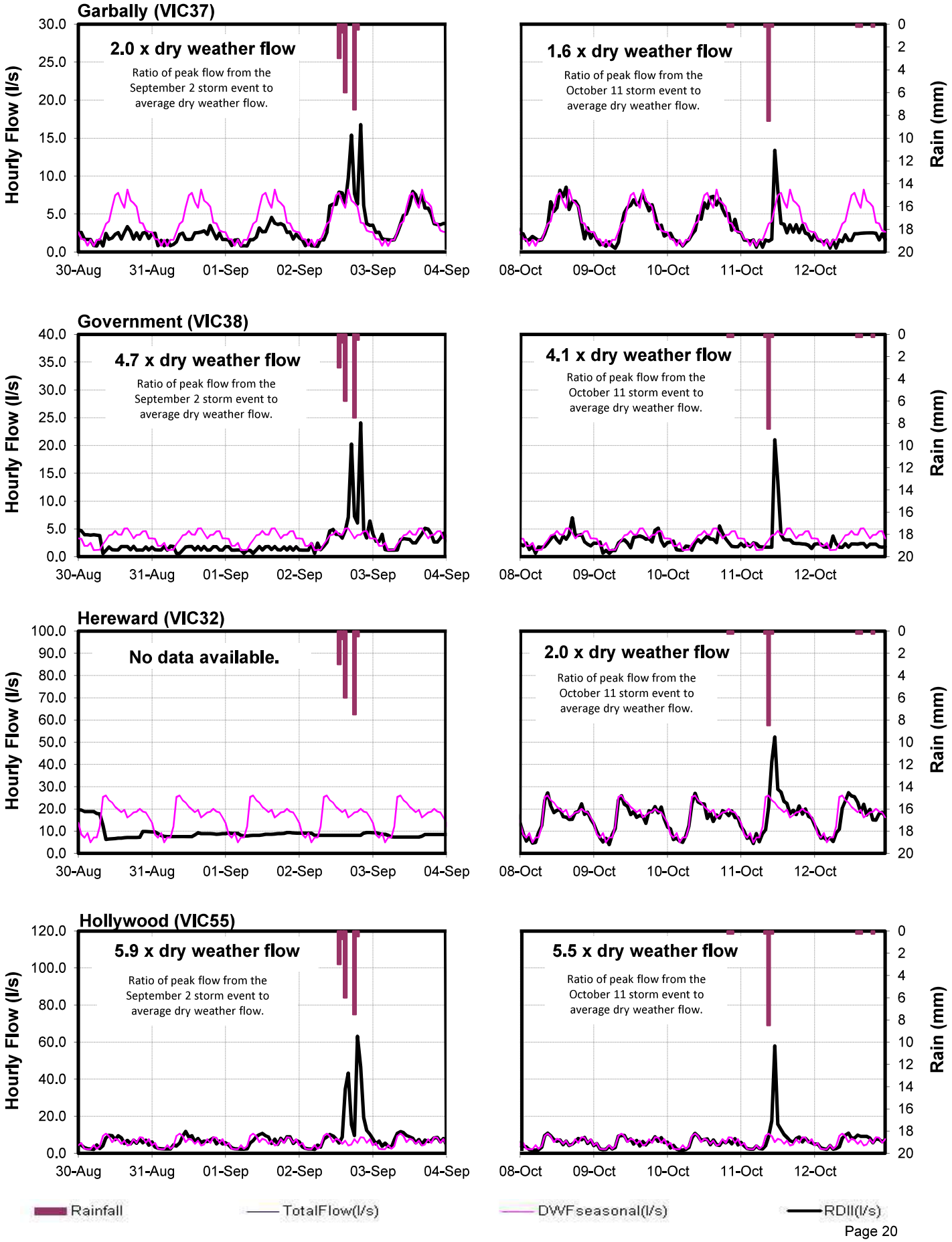


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Victoria

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

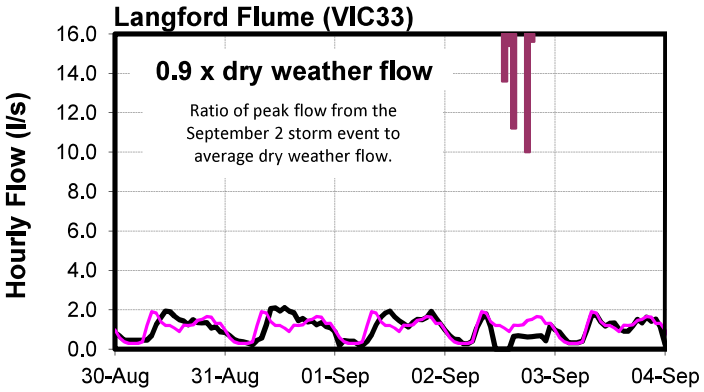


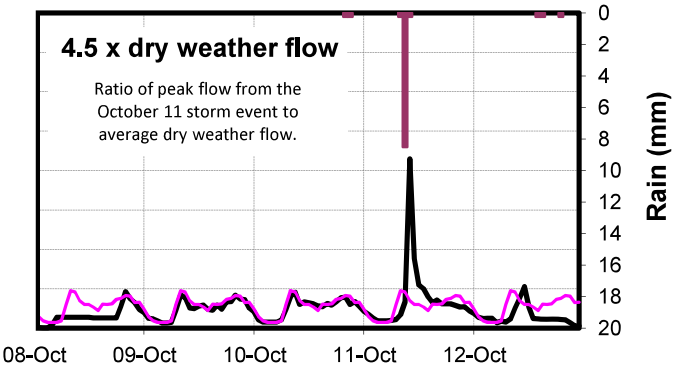
Victoria

Inflow Event: September 2, 2014

Inflow Event: October 11, 2014

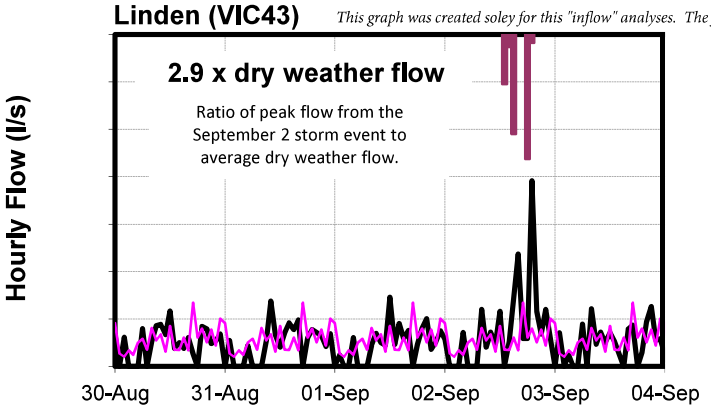
Langford Flume (VIC33)

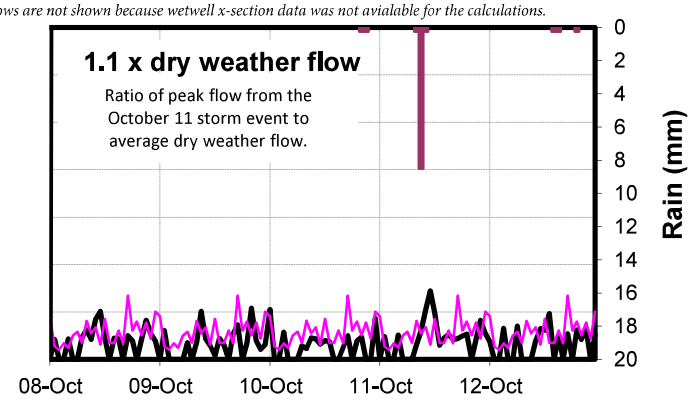




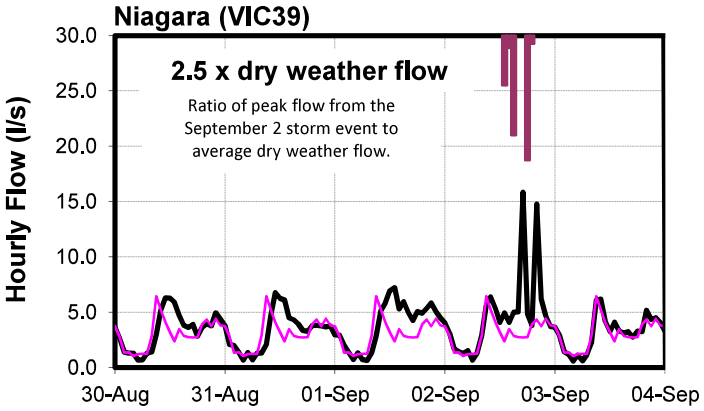
Linden (VIC43)

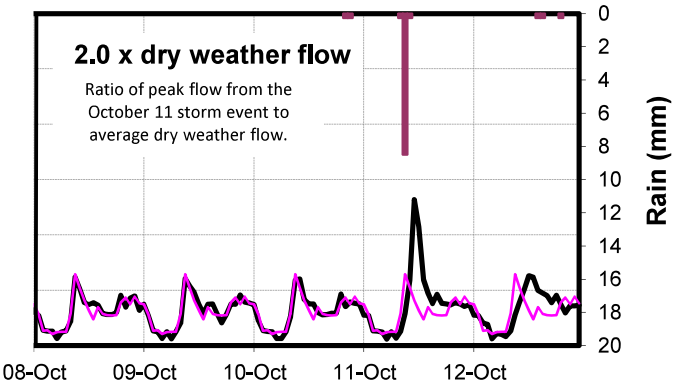
This graph was created soley for this "inflow" analyses. The flows are not shown because wetwell x-section data was not avialable for the calculations.



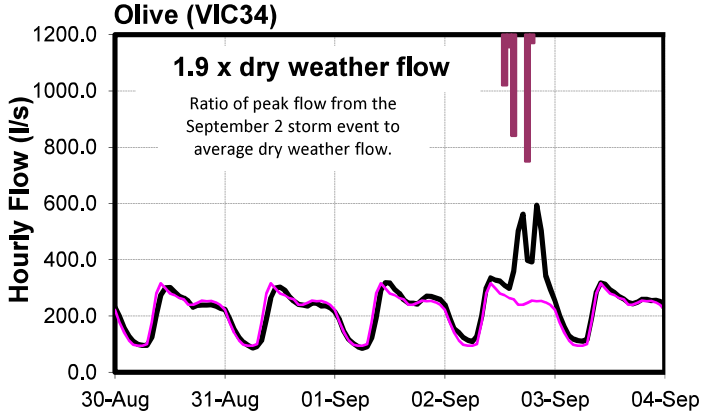


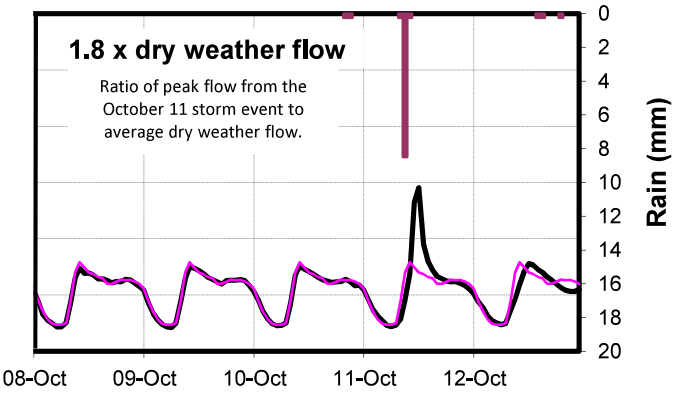
Niagara (VIC39)





Olive (VIC34)



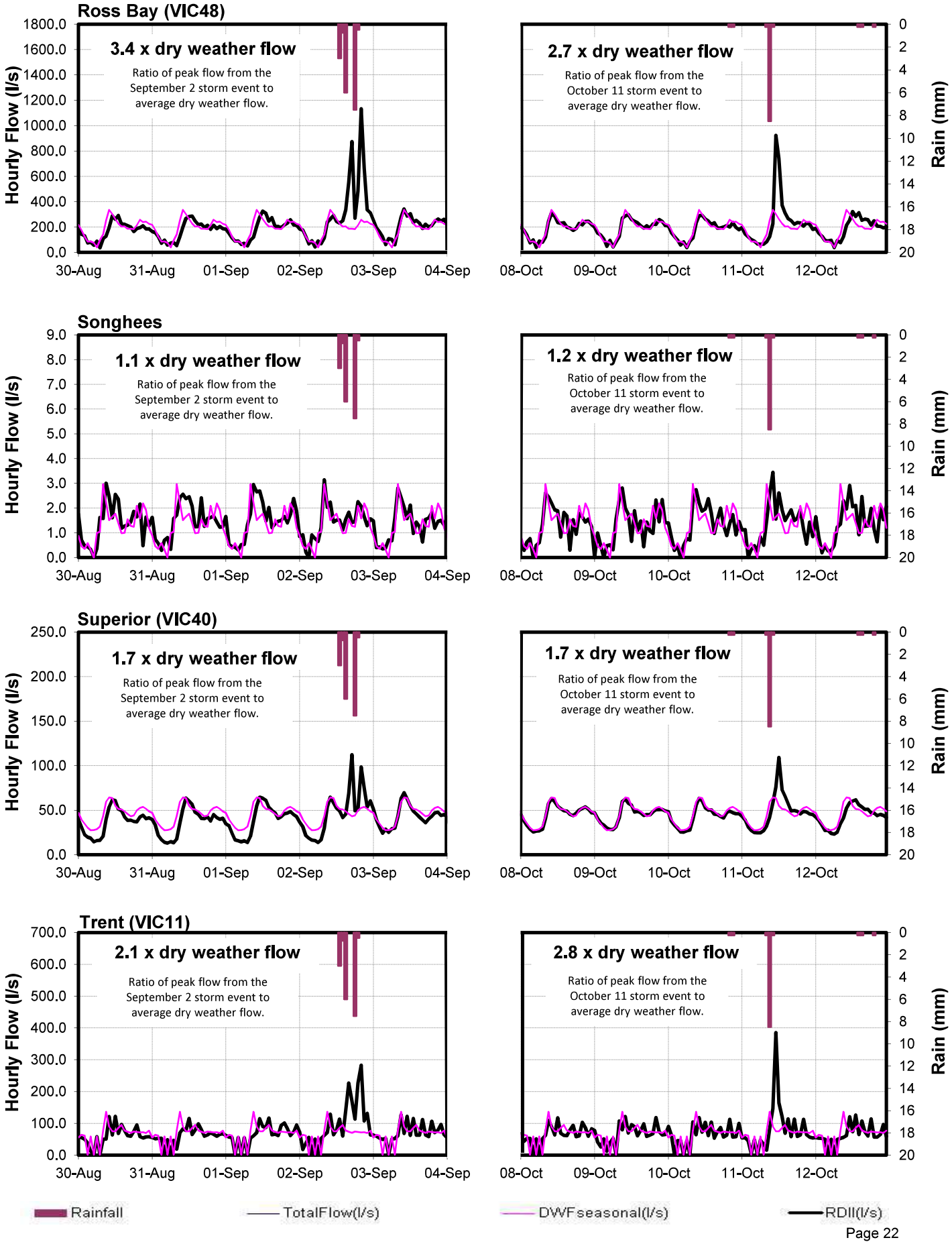


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

Victoria

Inflow Event: September 2, 2014

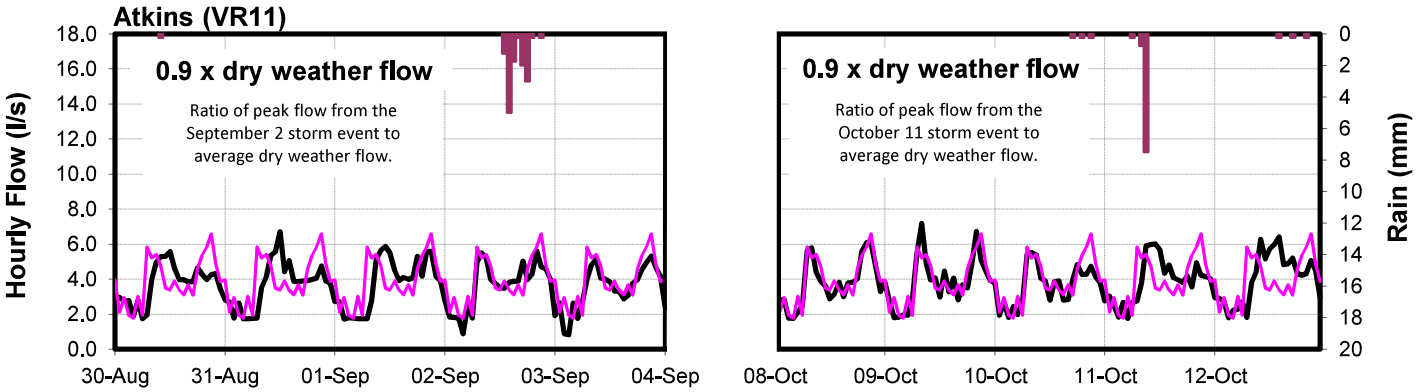
Inflow Event: October 11, 2014



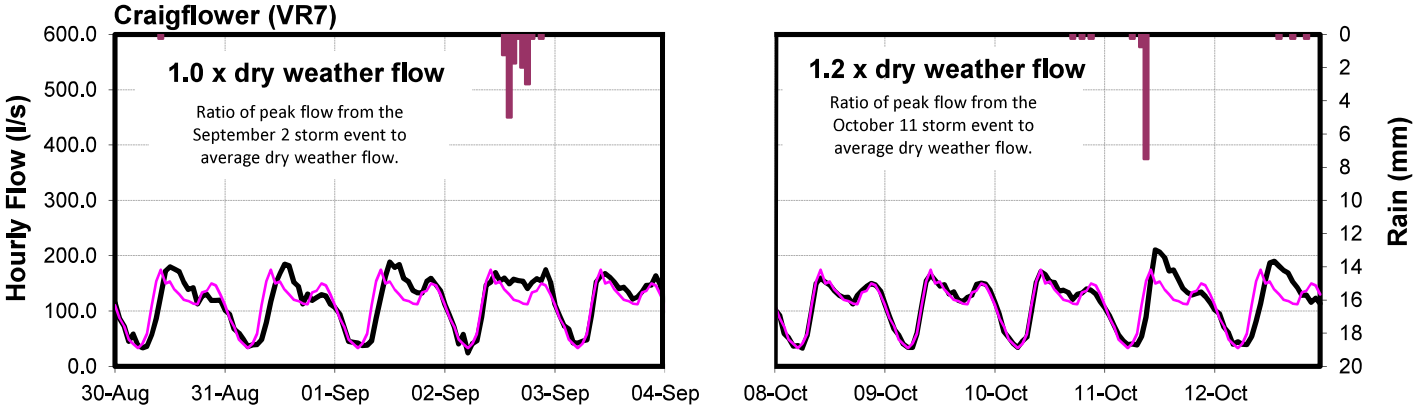
View Royal

Inflow Event: September 2, 2014 | Inflow Event: October 11, 2014

Atkins (VR11)

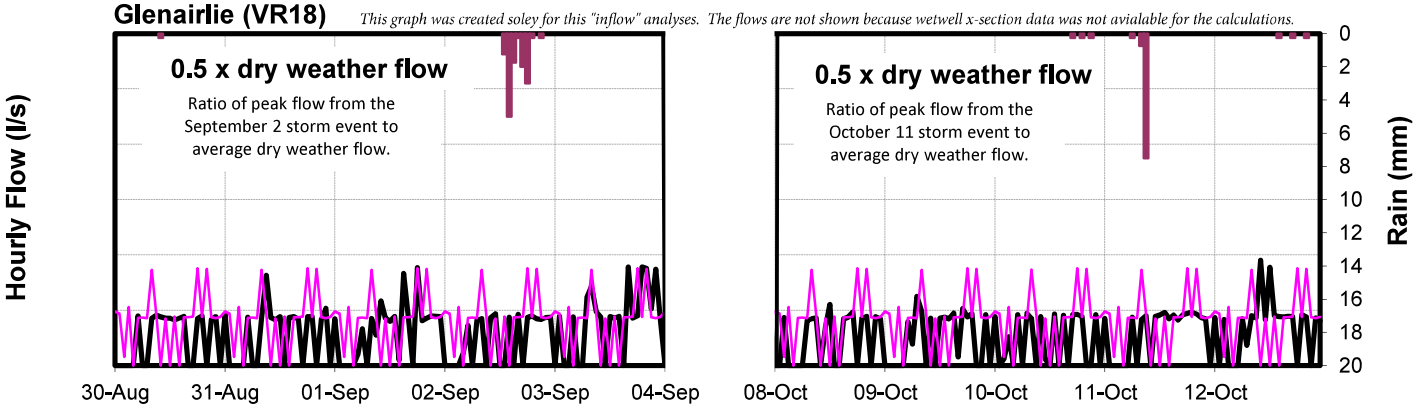


Craigflower (VR7)



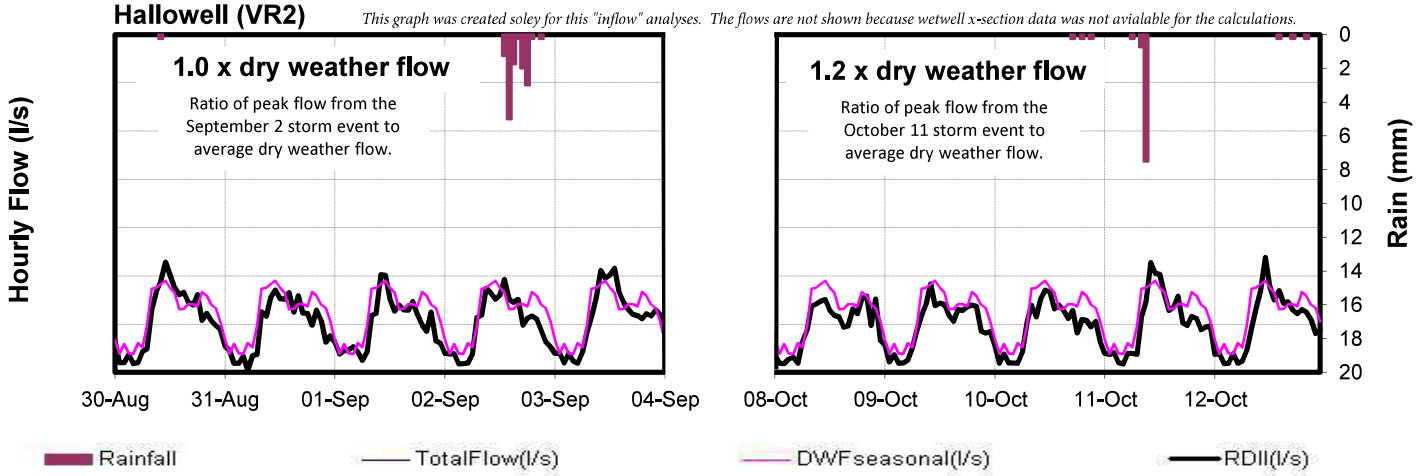
Glenairlie (VR18)

This graph was created soley for this "inflow" analyses. The flows are not shown because wetwell x-section data was not avialable for the calculations.



Hallowell (VR2)

This graph was created soley for this "inflow" analyses. The flows are not shown because wetwell x-section data was not avialable for the calculations.

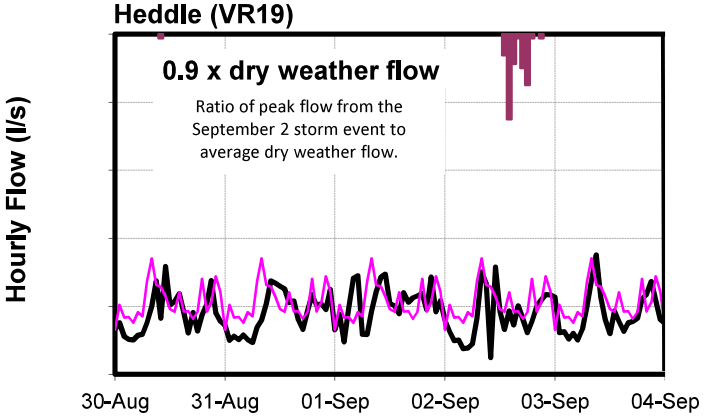


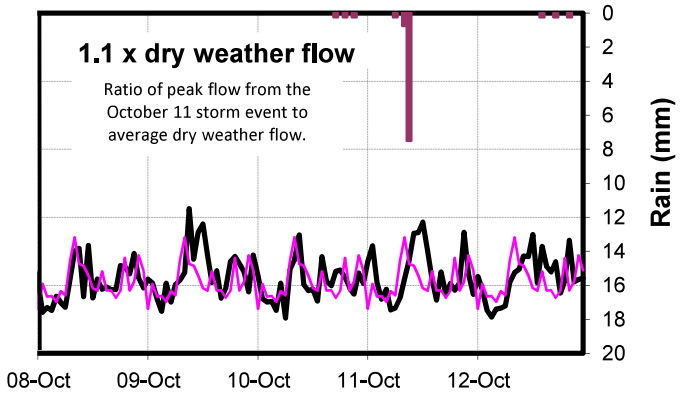
View Royal

Inflow Event: September 2, 2014

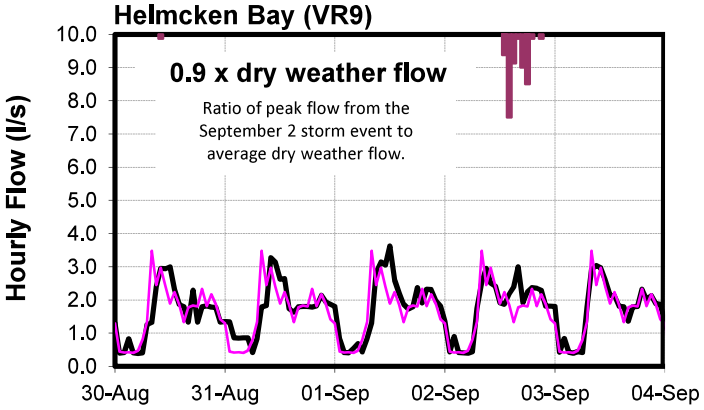
Inflow Event: October 11, 2014

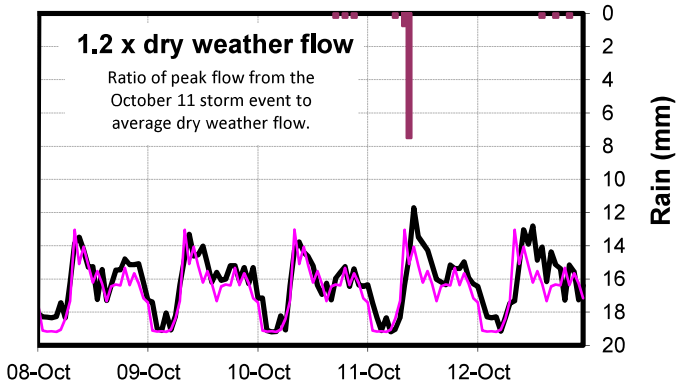
Heddle (VR19)



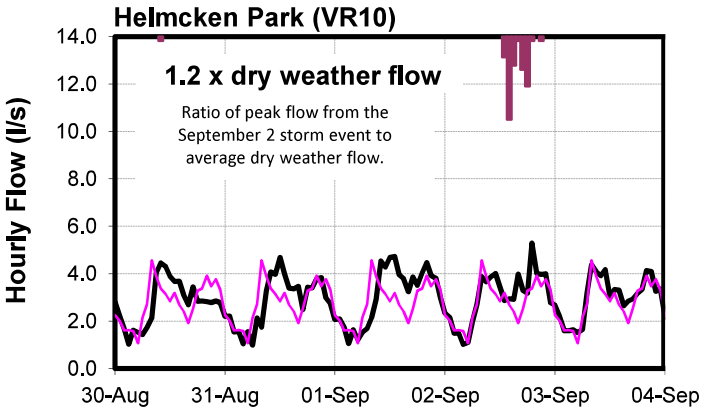


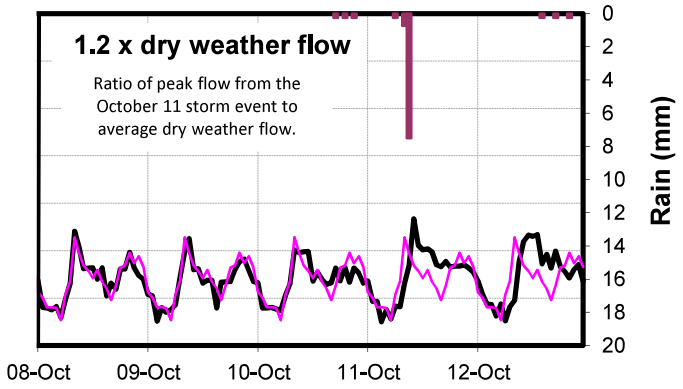
Helmcken Bay (VR9)



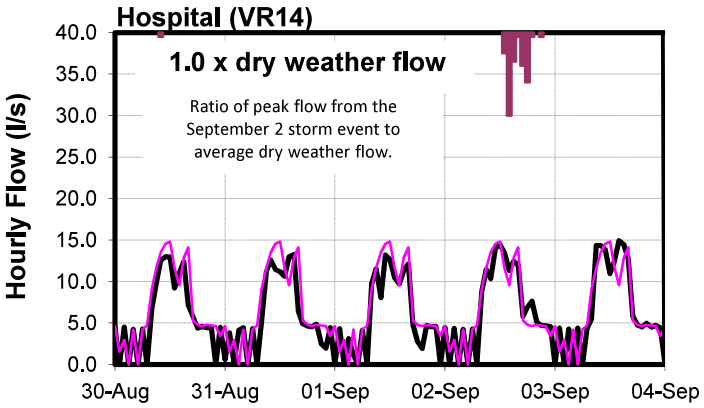


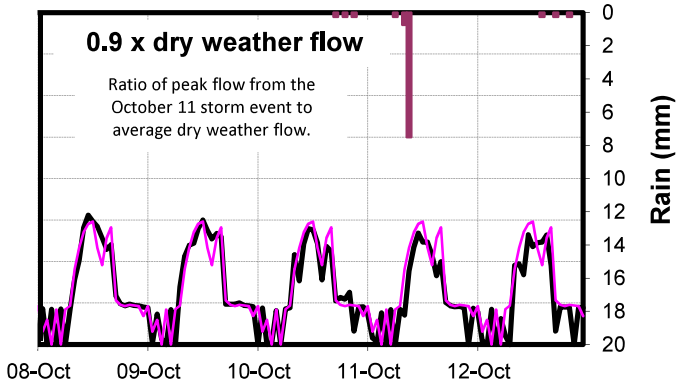
Helmcken Park (VR10)





Hospital (VR14)



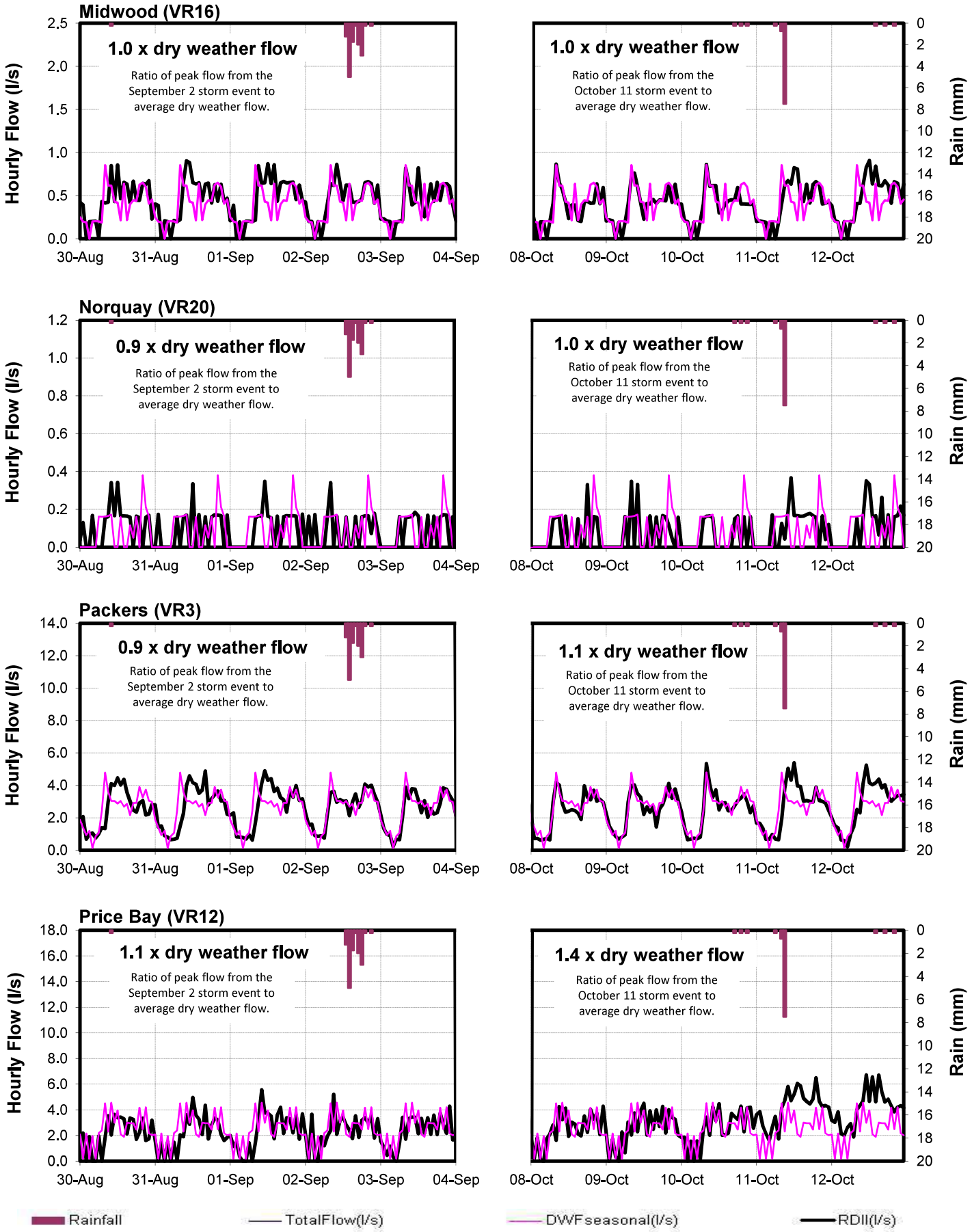


Rainfall — TotalFlow(l/s) — DWFseasonal(l/s) — RDII(l/s)

View Royal

Inflow Event: September 2, 2014

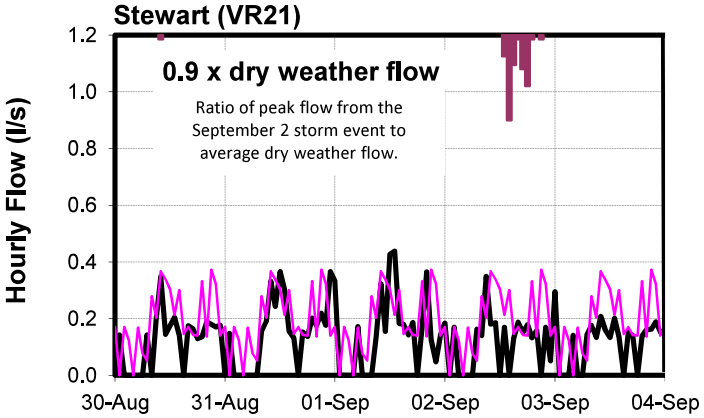
Inflow Event: October 11, 2014

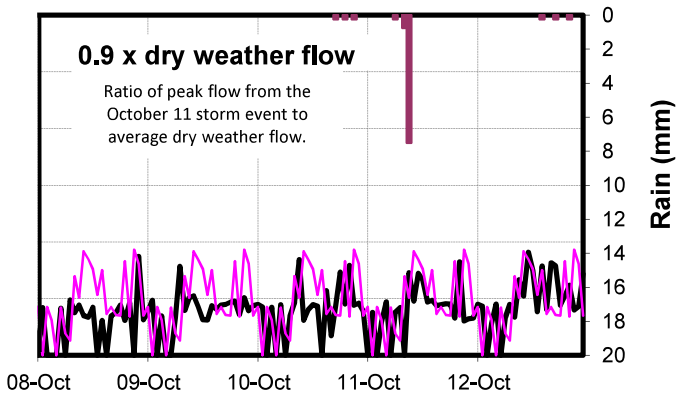


View Royal

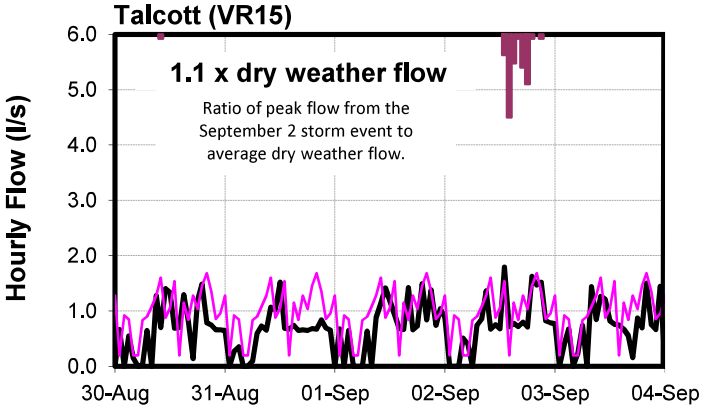
Inflow Event: September 2, 2014 | Inflow Event: October 11, 2014

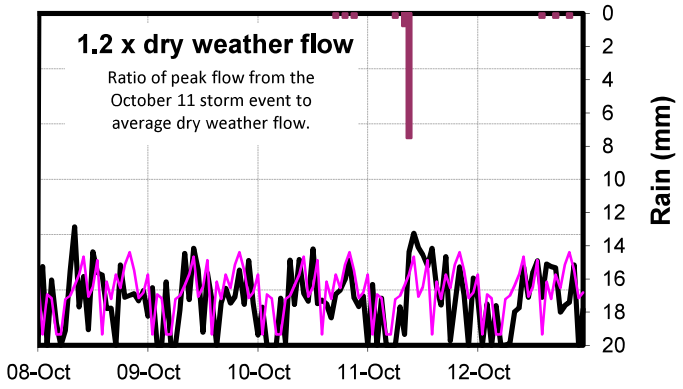
Stewart (VR21)



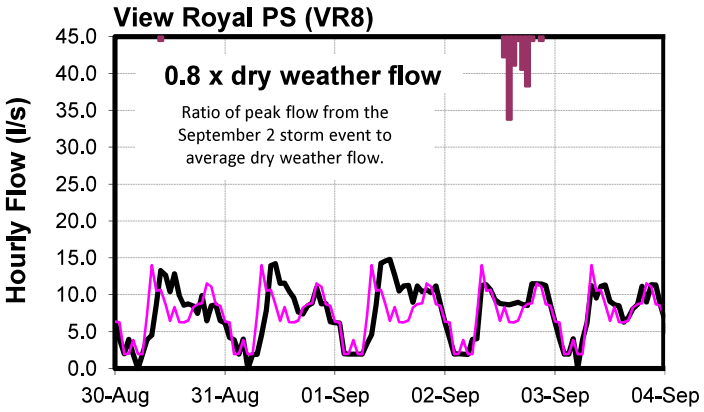


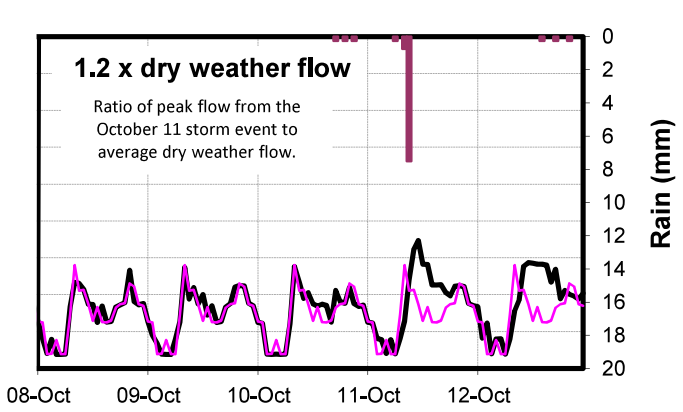
Talcott (VR15)





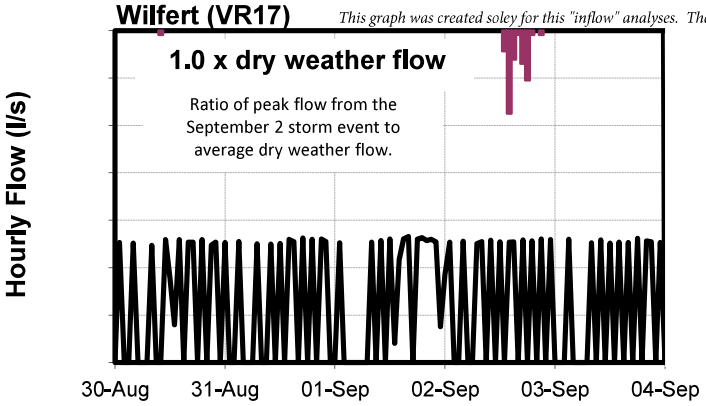
View Royal PS (VR8)

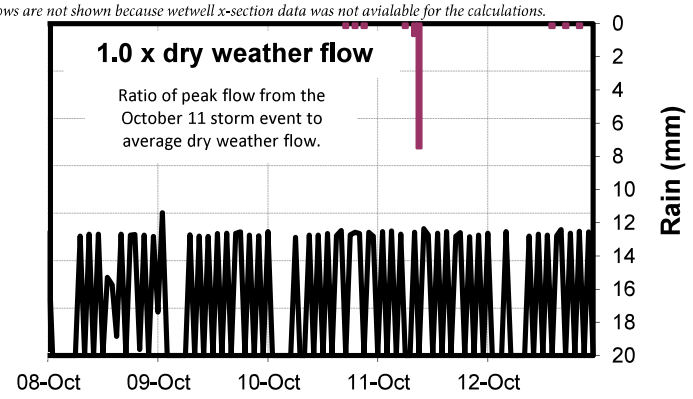




Wilfert (VR17)

This graph was created soley for this "inflow" analyses. The flows are not shown because wetwell x-section data was not avialable for the calculations.

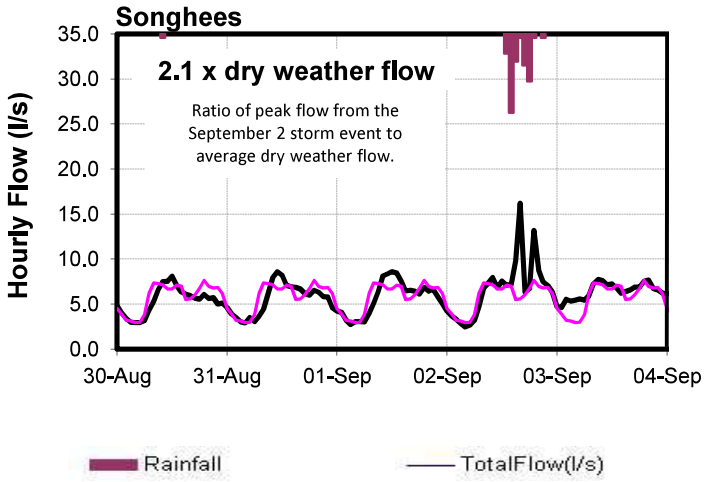




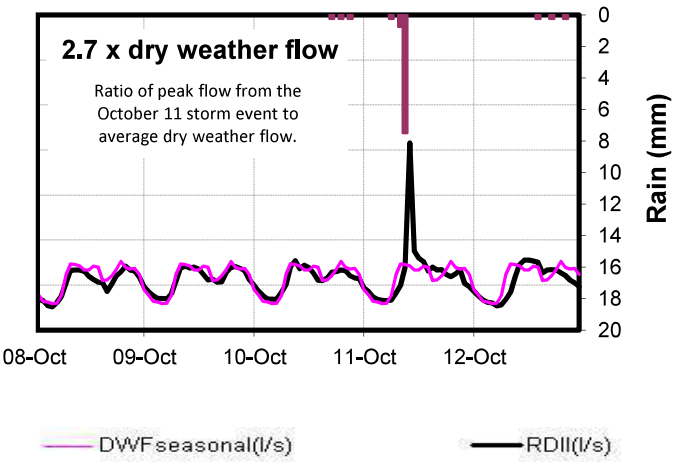
Rainfall | TotalFlow(l/s) | DWFseasonal(l/s) | RDII(l/s)

First Nations

Inflow Event: September 2, 2014



Inflow Event: October 11, 2014



Appendix B

CITY OF VICTORIA SEMI-COMBINED SEWER I&I PILOT PROJECT

Contents

Figures

Tables

1. Introduction

This document outlines the process used in developing a GIS based methodology to identify semi-combined I&I sewers for the City of Victoria. The methodology followed in this project was generally as follows:

- Review historic and current provincial and municipal plumbing and building codes to identify permitted practices regarding the connection of foundation or roof drains connected to the sanitary sewer system.
- Meet with municipal representatives to gain an understanding of their experiences and observations with foundation and roof drain connections.
- Collect or develop the following relevant information to be used in the analysis:
    - Storm drain age
    - Building age
    - Storm drain main elevation
    - Storm drain service location
    - Building location/footprint
    - Foundation type
    - Ground elevation at the building
- Develop the *Semi-Combined I&I Flow Chart* using the above information to categorize properties into *likely, unlikely* or *judgement call*.
- Complete a GIS analysis using the *Semi-Combined I&I Flow Chart* to identify the properties into each of the categories, calculate the total number and area of properties in each category.
- Produce colour coded maps for portions of two catchments.

Future steps for this project may include the following:

- Comparison of analysis with City of Victoria smoke and dye testing results.
- Review *Semi-Combined I&I Flow Chart* and colour coded maps with the City of Victoria and revise the flow charts to eliminate the judgement call categories.
- Complete GIS analysis for complete flow monitoring catchments.
- Prepare drainage calculations for catchments and compare the results of the *Semi-Combined I&I Flow Chart* analysis with the drainage calculations.

2. Provincial Code Review

2.1 Documents

The provincial code relevant to this study is the BC Building Code, specifically Section 7 the Plumbing Code.

The provincial government website provides a document[i] which outlines that the first BC Building Code (including the plumbing code section) was the adoption of the 1970 National Building Code in September of 1973. Prior to this, buildings and plumbing in BC fell under the jurisdiction of the local municipality.

The 1970 National Building Code was not reviewed as it appears a copy is not available locally.

Colquitz Engineering visited the BC Archives and were directed to contact the Legislative Library. The Building/Plumbing Codes for the years 1980, 1985, 1992, 1998, 2006 and 2012 were reviewed at the Legislative Library.

2.2 Relevant Findings

Relevant finds from the Provincial code reviews are outlined below.

The 1980 provincial code leaves the authority for the connection from the on-site storm drain to the municipal storm drain or sanitary up to the local authority as it provides the following statement:

> *1.6.2 - Every storm drainage system shall be connected to a public storm sewer, a public combined sewer or as designated by the authority having jurisdiction.*

The allowance for combined connections from the storm drain to the sanitary sewer system, subject to approval from the local authority continues in the 2012 code (current code) with the following clause:

> *A-2.1.2.1.(2) Combined Building Drains – Combined building drains may have proven acceptable on the basis of past performance in some localities and their acceptance under this Code may be warranted.*

The 2012 also provides allowance for the connection from "subsoil drain" (foundation drain) to the sanitary sewer system in the following clause:

> *2.4.5.3 Connection of Subsoil Drainage to a Sanitary Drainage System – 1) Where a subsoil drainage pipe is connected to a sanitary drainage system, the connection shall be made on the upstream side of a trap with a cleanout or a trapped sump.*

Based on the above information, the BC Building/Plumbing Code has and continues to leave the jurisdiction for the connection from the private storm drains to the municipal system up to the local authority.

3. City of Victoria - Code Review

3.1 Building Bylaws

The City of Victoria's original Building Bylaw 98[ii] was adopted by the City of Victoria in 1883. A review of this bylaw indicated that it did not contain regulations relevant to our project.

Some relevant sections were found in the City's Building Bylaw 2800[iii] that was adopted in 1938. Sections from this bylaw include the following:

> *Definition (11) "Basement" shall mean a habitable space between two floors, the lower floor of which is placed more than one foot, but less than five feet below the grade of the adjoining ground.*
>
> *Definition (17) "Cellar" shall mean the space between two floors, the lower of which is placed more than five feet below the grade of the adjoining ground.*
>
> *Section 410 – Whenever it is proposed to lay sewers, connected with the City of Victoria sewer system, for the removal of roof or ground water or for the drainage of foundations, the owner, or contractor, or the architect who represents the owner shall satisfy himself that such sanitary or storm can be connected to the City of Victoria sanitary or storm sewer system and that the grade of such connection shall be adequate for the proposer removal of such domestic waste or storm water.*
>
> *Section 3617 – Waste pipes from wash stands and floor waste shall be installed in accordance with the requirements of the Plumbing and Sewer By-law.*
>
> *Section 5500 (1) – Except as may be otherwise provided for by By-law or Rules duly promulgated by the City Council, the Plumbing, Sewer or Drainage system of a building or any structure shall be installed in conformity with "PLUMBING AND SEWER BY-LAW 1930, NUMBER 2533" and Amendments thereto.*

Subsequent building bylaws and building bylaw amendments continued to make similar references to the plumbing bylaws.

3.2 Plumbing Bylaws

City of Victoria's original Plumbing Bylaw[iv] was adopted by the City of Victoria in 1930. Relevant sections from this bylaw include the following:

> *Definition (22) - "Sewer" shall, in addition to its ordinary meaning, include any system of piping used to convey the drainage from any building or premises to any main, public, or private sewer.*
>
> *Definition (23) - "Main Sewer" shall mean and include any sewer in or under the control of the City of Victoria which is intended for public use.*
>
> *Definition (24) – "House Sewer" or "House Connection" shall mean and include the sewer used to convey the drainage from the house drain to the main sewer.*
>
> *Definition (25) – "Soil Pipe" shall mean any pipe which conveys the discharge of a water-closet, with or without that from other fixtures, to the house drain.*

Definition (29) – "Surface Drain" shall mean that the part of the horizontal piping and its branches which conveys the surface drainage from areas, courts, yards, or roof leaders and which connects with the surface drain directly or indirectly.

Based on the above information, it appears that in 1930 there was one buried sewer pipe was used for conveyance of both wastewater and stormwater. Furthermore, there was a preference to connect surface and roof drainage to the surface drain as outlined in the following sections:

Section 66 (5) – Where a public surface drain has been provided by the City, connection shall be made to such surface drain.

Section 67 (1) – Where it is impossible to connect to a surface drain special permission must be obtained from the City Engineer to drain into the sewer.

In 1944 a relevant amendment to the plumbing bylaw included separate definitions for the sanitary sewer and the storm sewer as follows:

Definition (22-A) – "Sanitary Sewer" shall mean a sewer which carries sewage other than storm surface and ground water.

Definition (22-B) – "Storm Sewer" shall mean a sewer which carries storm and surface water, street wash, and other waters or drainage but excludes other sewage and which storm sewer is under the control of the City of Victoria and is intended for public use.

The 1944 plumbing code amendment also directed all drainage after this date to connect to a storm drain, if a storm sewer existed within 150 feet.

Section 4-A – Every owner or occupier of any building or structure hereafter shall connect such building or structure with a storm sewer, if any part of the premises, lot or parcel of land upon which such building or structure is situated is within one hundred and fifty (150) feet of a storm sewer, and shall drain the roof and basement water into said connection, and all drains and connections shall conform to the requirements for plumbing generally as set forth in said By-law Number 2533.

In 1954 a new Plumbing Bylaw 4147[v] was introduced. This bylaw also introduced a new requirement regarding basements and cellars, implementing the requirement for a pump.

Section 4:10:14 – Where basements or cellars are below grade to an extent that gravity drainage cannot be obtained, the storm and/or sub-surface water shall be lifted to the storm drain by the use of a pump.

The 1954 bylaw also requires all roof areas greater than 450 ft^2 (42 m^2) to connect to the storm drain.

Section 3:1:2 – Except as hereinafter in this Section provided, the owner or occupier of any building or structure hereafter constructed shall connect the roof drainage of such building or structure with the public storm sewer or public combined sewer, either by gravity flow or by pumping, if the area of the roof or roofs, including canopies, etc., exceeds 450 square feet.

In 1982 the 1954 Plumbing Bylaw was repealed and an updated Plumbing Bylaw 82-44[vi] was adopted. The relevant updates in the 1982 bylaw, which called for the elimination of cross connections from both sanitary to storm and from storm to sanitary, are as follows:

Section 42 (1) – No person shall connect or allow to remain connected any sanitary building sewer with any public storm sewer.

Section 42 (2) – No person shall connect or allow to remain connected any storm building sewer with any public sanitary sewer.

In 1990 the bylaw was amended in Bylaw 90-108 to read that all roofs are to go to the storm drain or a rock pit (a new definition was added) for single family and duplex dwellings.

Section 3 – Any roof of a single family or duplex dwelling shall connect directly to a public stork sewer which serves the property or in the absence of a public storm sewer to a rock pit.

This 1990 bylaw amendment also required driveways to connect to the storm drain, if the driveway was larger than 40 m^2.

Section 6 – Any driveway with more than 40 m^2 of paved or impervious surface for any single family or duplex dwelling shall be drained to an area sump, which shall be piped directly to a public storm sewer, or in the absence of a public storm sewer, to a rock pit.

The current City of Victoria Plumbing Bylaw No. 04-067[vii] adopted in 2015 does not revise the relevant sections from the previous bylaws but continues support the 1990 bylaw with the following sections:

Definitions – "Sewage" means liquid waste other than (a) clear-water waste; and (b) storm water;

Section 18 (1) – A person must not connect, or allow to remain connected, a sanitary building sewer with a Municipal Stormwater System.

3.3 City of Victoria - Summary of Code Review

The following table summarizes the relevant key dates with respect to private property storm drain connections to the sanitary sewer system.

Table 3-1: City of Victoria - Summary of Key Dates from Code Review

Date	Storm Connections to Sanitary	
	Foundation Drains	**Surface/Roof Drains**
Prior to 1943	To sanitary sewer.	Permitted to sewer with permission (properties lower than road surface).
1944 to 1953	To storm drain if drain within 45 m (150 ft) and by gravity.	To storm drain if drain within 45 m (150 ft) and by gravity.
1954 to 1981	To storm drain and with pump if not by gravity.	To storm drain if area is greater than 42 m2 (450 ft2) with pump if not by gravity.
1982 to 1989	Existing buildings to connect to storm drain (not allowed to remain connected to sanitary sewer).	Existing buildings to connect to storm drain (not allowed to remain connected to sanitary sewer).
1990 to existing	Existing buildings to connect rock pit if no storm drain.	Surface and roof to connect rock pit if no storm drain.

4. City of Victoria – Review Meeting

On May 4, 2017 the CRD and Colquitz Engineering met with the City of Victoria to discuss the project and receive the City input as it relates to foundation and roof drain connections to the sanitary sewer system.

Some of the key input received from the City includes the following:

- The City commented that smoke testing has been completed for the entire City, and dye testing has been completed for properties that do not have a storm service lateral.
- It is difficult to resolve the private property storm to sanitary cross connections and the largest number of storm to sanitary cross connections are likely on private property.
- The City attempts to resolve storm to sanitary cross connections at the time a building permit is applied for, but otherwise they are not enforcing removal of these connections. Additionally, for current building permits the builder is not required to bring entire house up to code, only portion of house that is being worked on.
- If the foundation drain is connected to the sanitary sewer then the roof will also be connected to the sanitary sewer system.
- Pumps for the foundation drains were not common in the past.
- Many of the rock pits have resulted in issues and were switched over to the sanitary sewer system.
- Some areas that are expected to have the most semi-combined properties include the following: James Bay; Hollywood Crescent; Moss Street, and; Haultain Street.

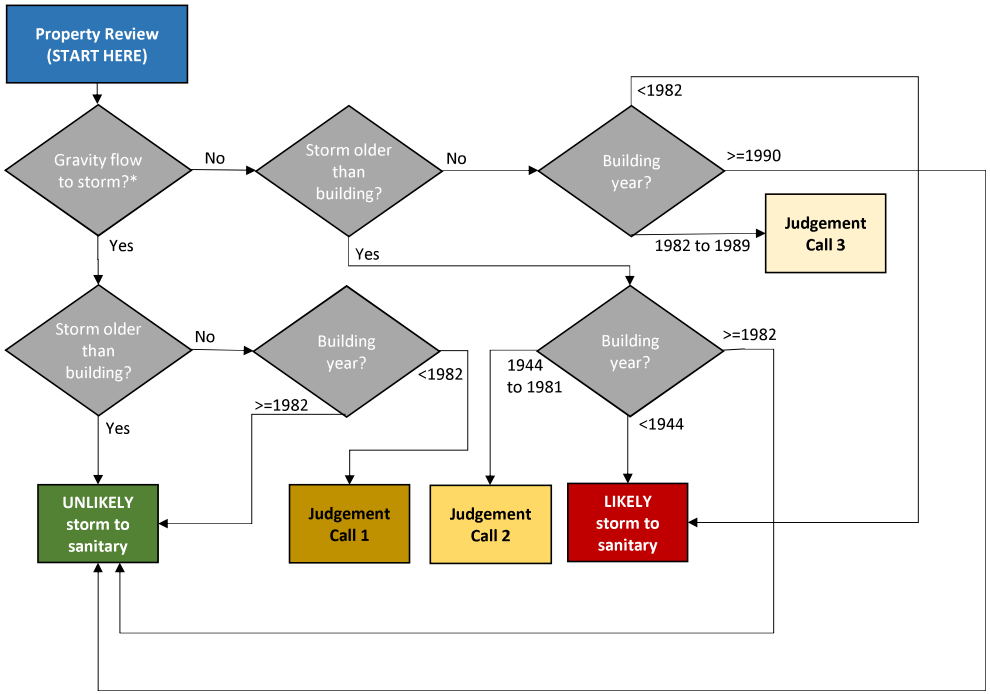
5. City of Victoria – Data Analysis

Based on the historical code review and the input received from the City of Victoria, a *Semi-Combined I&I Flow Chart* was developed to categorize properties into *likely, unlikely* or *judgement call 1, 2 or 3*. The City of Victoria Semi-Combined I&I Flow Chart is illustrated in Figure 5-1 below.

This flow chart and methodology was used to analyze two catchments in the City of Victoria. The results of this analysis are illustrated on Figure 5-2 below.

FIGURE 5-1: Semi-Combined Inflow and Infiltration *Flow Chart - City of Victoria*

A flow chart to categorize properties as LIKELY or UNLIKELY to contribute to stormwater to the sanitary sewer system



Notes:

Buildings without age information are excluded from the analysis.

Gravity Flow to Storm

* The "Gravity flow to storm?" is determined based on the potential lowest elevation of the storm service (storm main obvert plus 2% service lateral slope to the furthest point of the building) compared with the building foundation elevation. The building foundation elevation is determined based on the average ground elevation less the foundation type:

- 1.5 m for basements
- 1.0 m for crawl space / unknown
- 0.5 m for slab

Judgment Calls

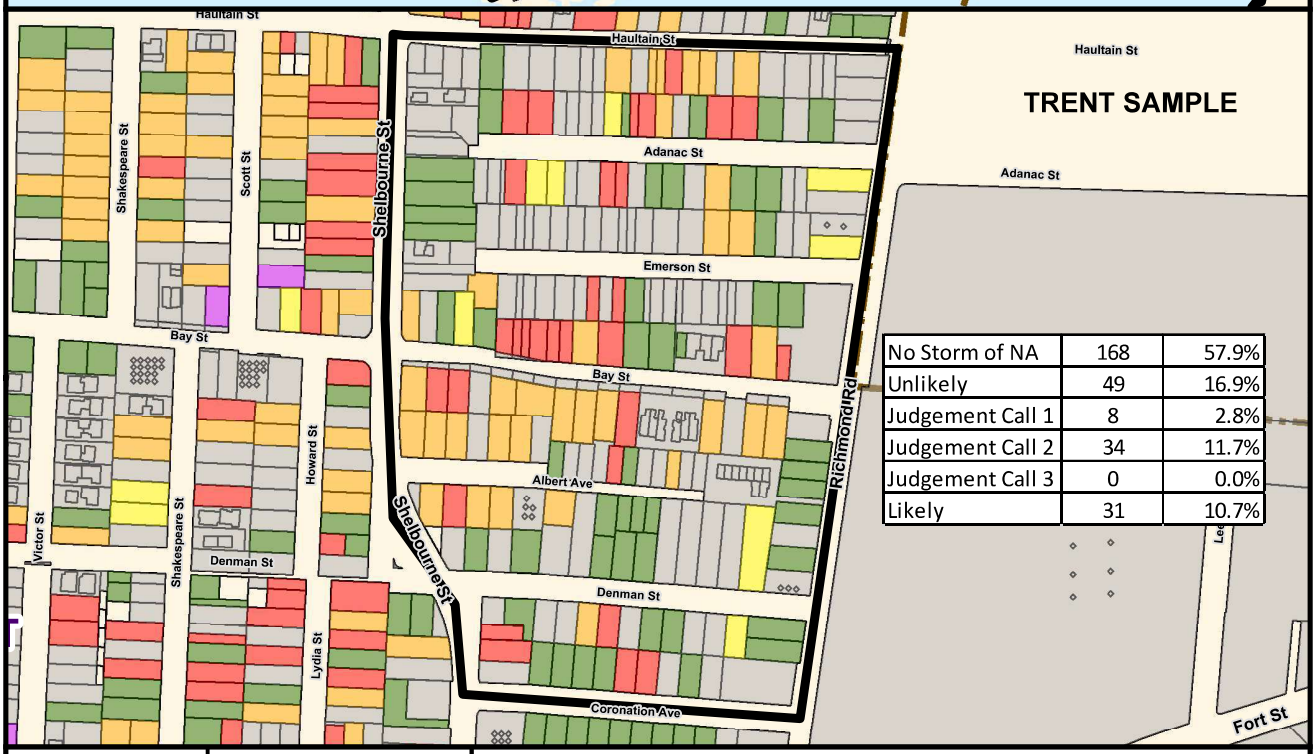
Judgement Call 1 - Gravity flow, however the strom drain was constructed after the building and when the codes (before 1982) permitted some surfaces to drain to the sanitary sewer system.

Judgement Call 2 - The storm drain was built before the building, however gravity flow to the storm drain is unlikely and the codes (1944 to 1981) permitted foundation and some surface to drain to the sanitary sewer system.

Judgement Call 3 - Relatively new building (1982 to 1989), however gravity flow to the storm drain is

VICTORIA I&I SEMI-COMBINED SAMPLES

No Storm of NA	287	54.3%
Unlikely	99	18.7%
Judgement Call 1	11	2.1%
Judgement Call 2	57	10.8%
Judgement Call 3	1	0.2%
Likely	74	14.0%



No Storm of NA	168	57.9%
Unlikely	49	16.9%
Judgement Call 1	8	2.8%
Judgement Call 2	34	11.7%
Judgement Call 3	0	0.0%
Likely	31	10.7%

CRD
Making a difference...together

Metres
0 25 50 100
Projection: UTM ZONE 10N NAD 83

Semi-Combined Category

- No Storm or NA
- Unlikely to Drain to Sanitory
- Judgement Call 1
- Judgement Call 2
- Judgement Call 3
- Likely to Drain to Sanitory

The results of the GIS analysis are summarized in the following table.

Table 5-1: City of Victoria – Decision Flow Chart Analysis Results Summary

Catchment	# of Properties (%)			
	Total Analyzed	Unlikely	Judgement Call	Likely
Hollywood	242 (100%)	99 (41%)	69 (29%)	74 (31%)
Trent	122 (100%)	49 (40%)	42 (34%)	31 (25%)

6. Summary

6.1 Summary

A GIS methodology to identify semi-combined I&I sewers for the City of Victoria has been developed. This methodology was developed by reviewing historic and current provincial and municipal plumbing and building codes, meeting and receiving input from City staff, collecting GIS data, and completing a GIS analysis based on the *City of Victoria – Semi-Combined I&I Flow Chart*.

The GIS analysis was completed for portions of two catchments in the City of Victoria. The results of this analysis indicate that in the Hollywood catchment, 31% of properties analyzed are likely to be cross-connected. For the Trent catchment 25% of properties are likely to be cross-connected. These results should be considered preliminary as future steps to refine the results are recommended. These steps include the following:

- Comparison of analysis with City of Victoria smoke and dye testing results.
- Review Semi-Combined I&I Flow Chart and colour coded maps with the City of Victoria and revise the flow charts to eliminate the judgement call categories.
- Complete GIS analysis for complete flow monitoring catchments.
- Prepare drainage calculations for catchments and compare the results of the Semi-Combined I&I Flow Chart analysis with the drainage calculations.

6.2 Report Submission

We submit this report for your review and comments.

Prepared by:

COLQUITZ ENGINEERING LTD.

Jeff Howard, P.Eng.
Water Resources Engineer

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Revision History

Revision #	Date	Status	Revisions	Author
0	May 25, 2018	FINAL		J. Howard

7. References

[i] History of British Columbia Building Regulations, British Columbia, Office of Housing and Construction Standards, September 29, 2015.
[ii] No. 98, A By-law, To regulate the Erection of Buildings within the Fire Limits of the City of Victoria, and to provide for the storage of Inflammable and Combustible Articles, 1883.
[iii] The Corporation of the City of Victoria British Columbia, Building By-law 1938, No. 2800, A By-law to provide Regulations for the Erection, Maintenance, and safety of Buildings and Structures in the City.
[iv] No. 2533, A By-Law, For regulating the installation and maintenance of Plumbing and Sewers within the City of Victoria, 1930.
[v] No. 4147, A By-Law, For regulating the installation and maintenance of plumbing systems within the City of Victoria, 1954.
[vi] Bylaw No. 82-44, A Bylaw of the City of Victoria to regulate the installation and maintenance of plumbing and drainage and associated equipment, 1982.
[vii] City of Victoria Plumbing Bylaw No. 04-067, consolidated on February 1, 2015 up to Bylaw No. 14-074.