ATTACHMENT 1

metrovancouver

Biennial Report: 2019-2020

Integrated Liquid Waste and Resource Management: A Liquid Waste Management Plan for the Greater Vancouver Sewerage and Drainage District and Member Municipalities Volume 1: Metro Vancouver Report

June 2021

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Abbreviations

AMF	Monitoring and Adaptive Management Framework for Stormwater
BIEAP-FREMP	Burrard Inlet Environmental Action Plan and the Fraser River Environmental Management Plan
BMP	Best management practice
BOD	Biological oxygen demand
CBOD	Carbonaceous biological oxygen demand
CEPA	Canadian Environmental Protection Act
CEPT	Chemically enhanced primary treatment
CCME	Canadian Council of Ministers of Environment
CCTV	Closed circuit television
CSO	Combined sewer overflow
CWS-MMWE	Canada-wide Strategy for the Management of Municipal Wastewater Effluent
DONCE	Discharge out of the normal course events as pertaining to the Fisheries Act
EDO	Effluent discharge objective
EMBC	Emergency Management BC, formerly PEP
EMC	Environmental Monitoring Committee
GHG	Greenhouse gas
GVS&DD	Greater Vancouver Sewerage and Drainage District
GVWD	Greater Vancouver Water District
I&I	Inflow and infiltration
IDZ	Initial dilution zone as defined as boundary for regulatory criteria
ILWRMP	Integrated Liquid Waste and Resource Management: A Liquid Waste Management Plan for the Greater Vancouver Sewerage & Drainage District and Member Jurisdictions
IPREM	Integrated Partnership for Regional Emergency Management in Metro Vancouver
IRR	Integrated resource recovery
ISMP	Integrated stormwater management plan

IUMAC	Integrated Utilities Management Advisory Committee
LEED	Leadership in Energy and Environmental Design
LWMP	Liquid Waste Management Plan
OC	Operational Certificate (as issued under the BC Environmental Management Act)
OCP	Official Community Plan
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PBDE	Polybrominated diphenyl ethers
PEP	Provincial Emergency Program, now Emergency Management BC (EMBC)
RAAC	Regional Administrative Advisory Committee
REAC	Regional Engineering Advisory Committee
REAC-LWSC	Liquid Waste Subcommittee of the Regional Engineering Advisory Committee
RPAC	Regional Planning Advisory Committee
RGS	Regional growth strategy or the Regional Growth Strategy Bylaw
SCADA	Supervisory control and data acquisition
SILG	Stormwater Interagency Liaison Group
SS	Suspended solids
SSO	Sanitary sewer overflow
TSS	Total suspended solids
UEL	University Endowment Lands
WSER	Wastewater Systems Effluent Regulations (under the Fisheries Act)
WWTP	Wastewater treatment plant

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1.0 INTRODUCTION

Background

The current Liquid Waste Management Plan, titled Integrated Liquid Waste and Resource Management: A Liquid Waste Management Plan for the Greater Vancouver Sewerage & Drainage District and Member Municipalities, was adopted by the Metro Vancouver Board and its members in 2010. This Plan was then approved by the Minister of Environment in 2011.

Under this updated Plan, Metro Vancouver and its members provide biennial progress updates on the implementation of the Plan as well as annual updates specific to sanitary sewer overflows and integrated stormwater management plan progress.

This biennial report focusses on implementation progress for the period 2019-2020 and is the fifth biennial report under this Plan. Some actions under this Plan have been completed or are long-term and ongoing. In these instances, the reporting may refer back to a previous biennial report or an interim report for particular details.

Highlights

During 2019 and 2020, Metro Vancouver and its Greater Vancouver Sewerage and Drainage District members continued to implement its actions identified in the ILWRMP. Highlights include the following initiatives.

Resiliency

Metro Vancouver has actively been working to improve the resiliency of its facilities and services, and thereby mitigate risks to the environment, people and its investments. Ongoing planning work, environmental monitoring programs and construction help to identify and mitigate risks. For example, Metro Vancouver continues to assess and respond to increasing risks and impacts from climate change on its liquid waste services. This includes mitigating some risks through planning and design for new facilities, and reducing the carbon footprint in the materials and energy used by Metro Vancouver to build, maintain and operate its liquid waste system.

Environmental Monitoring

Metro Vancouver continues to provide environmental monitoring programs that assess wastewater treatment plant performance, ambient environmental quality, recreational water quality, and the occurrence, duration, volume and quality of combined and sanitary sewer overflows and their receiving environments.

Several Metro Vancouver CSO locations are monitored each year to characterize the CSO discharge. Monitored CSO locations are rotated every year or two so that all 15 Metro Vancouver CSO locations are monitored on a five to eight-year cycle. Metro Vancouver characterizes the discharge quality of select CSOs that discharge to Burrard Inlet and the Fraser River. CSO discharges continue to be tested for fecal coliform bacteria, metals, select organics and toxicity to rainbow trout. The CSO samples collected during this period were non-toxic to rainbow trout.

Inflow and Infiltration Management

To address excessive inflow and infiltration (I&I), Metro Vancouver and its member jurisdictions are exploring strategies to accelerate actions to reduce I&I, including providing financial incentives for member jurisdictions and private-side management.

The reduction of I&I is a key component of reducing the long-term likelihood of wet weather sanitary sewer overflows (SSOs) by keeping excessive amounts of rainwater and groundwater out of sanitary sewer systems. For some areas with high I&I, interim SSO mitigation is addressed by the construction of wet weather SSO storage. In addition to the existing Cloverdale SSO Storage Tank, two new Metro Vancouver SSO storage tanks are being planned – one being planned for North Surrey and the other being built in Maple Ridge. In Maple Ridge, the Golden Ears Pump Station and a 20,000 m3 SSO Storage Tank are anticipated to be completed in 2022. Regional sewers are also being upgraded to ensure that suitable conveyance for wet weather flows are maintained. A report on I&I action was presented to Metro Vancouver's Liquid Waste Committee in January 2021.

Combined Sewer Separation

The Cities of Burnaby, New Westminster and Vancouver, along with the University Endowment Lands continue to separate their combined sewers as part of their long-term commitment that will eliminate combined sewerage overflows from Metro Vancouver's outfalls. In 2019 and 2020, 14,645 meters of combined sewers in the region were separated at a cost of $74.1 million.

While the City of Burnaby has made significant progress towards completing separation of its portion of the combined sewer system in the Vancouver Sewerage Area, the current rate of sewer separation in the City of Vancouver's portion has declined to less than half of both the City's historical separation rate and the 1% average rate required in the ILWRMP. The 1% target from the current ILWRMP was previously requested by MV on behalf of the City of Vancouver and agreed to by the Province as it linked the City's sewer separation program to the asset renewal cycle required to replace its aging combined system. The City of Vancouver has on several occasions reaffirmed, as part of its LWMP approvals, a 1% life cycle replacement policy for sewer mains and its commitment to replace approximately 1% of the system annually to achieve elimination of combined sewer overflows by the year 2050. However, the annual rate of sewer separation in Vancouver for this reporting period was only 0.40%, and the projected separation rates, based on the forecast budget figures provided for this report by the City for

its Main Sewer Separation and Renewal Program, do not indicate that substantial increases towards the 1% requirement are planned in 2021 or 2022.

During this period, Metro Vancouver undertook combined sewer separation planning for the Manitoba Combined Trunk Sewer to reassess options in relationship to improved climate change impact scenarios and to assess the effectiveness of green infrastructure as a supportive mitigation strategy. These plans serve as conceptual designs and will guide subsequent combined sewer separation work for the municipal and regional systems in their specific catchment areas.

Stormwater Management

Metro Vancouver continues to facilitate the Stormwater Interagency Liaison Group (SILG). Through this forum, member jurisdictions continue to share information on the development and implementation of their integrated stormwater management plans as well as contribute to shared initiatives such as the development of the region-wide baseline for on-site stormwater management. In 2019, SILG focus topics included: management of water quality during construction work, green infrastructure maintenance, and Stormwater Monitoring and Adaptive Management Framework (AMF) data sharing and interpretation. The members talked about their experience and shared technical information regarding stormwater tree trench research, groundwater management, bioretention, erosion and sediment control, residential neighborhoods stormwater management, dewatering and sediment accumulation, and purple roofs. Other topics included MECCS update on the Ministry involvement in MV committees, biennial Integrated Stormwater Management Plan (ISMP) Monitoring and AMF reporting to MECCS, update of the ISMP template, development of the terms of reference for Stormwater Source Control Design Guidelines, use of the MV Chemistry Laboratory for AMF testing, development of Watershed Condition Objectives for BC's South Coast Region, the value of ISO 14034 – Environmental Technology Verification (ETV) in the municipal technology procurement process, guidance for manufactured treatment devices and municipal stormwater regulations, Kwantlen Polytechnic University Green Infrastructure Course, National Green Infrastructure Certification Program (NGICP), barriers to effective green infrastructure operations and maintenance, and the use of rubberized material in artificial sports fields and its impact on stormwater infrastructure.

In 2020, SILG focus topics included the review of SILG membership and work plan, discussions related to review and update of the Liquid Waste Management Plan (LWMP), application of Stormwater Monitoring and AMF and planning for the joint EMC-SILG meeting, update of the Stormwater Source Control Design Guidelines, microplastics in urban watersheds and Ocean Wise's Pollution Tracker initiative, and municipal watershed impacts on the receiving environment. The members shared their experience on source controls and discussed development of a Green Infrastructure Community of Practice in Metro Vancouver, Mitchell Island environmental management collaboration, and received a presentation on Metro Vancouver's publicly accessible real-time sewer overflow map. Other discussion topics included remaining tasks to help ensure the ISMP template remains current, further discussion on erosion and sediment control, and the UBC Sustainability Scholar project reports on stormwater source controls.

Wastewater Treatment

In meeting the environmental protection needs of a growing region, substantial investments are being made in wastewater treatment at four facilities; the North Shore WWTP, Iona Island WWTP, Annacis Island WWTP and the Northwest Langley WWTP.

Construction of a new North Shore WWTP to replace the Lions Gate WWTP started in 2017. The budget for this work is $1.058 billion, with $212.3 million in grant funding from the federal government and $193 million in grant funding from the provincial government. Once the new secondary level wastewater treatment plant is operational in 2024, the existing Lions Gate WWTP will be decommissioned.

In 2018, the indicative design process for upgrade and replacement of the Iona Island WWTP began. When completed in early 2022, the process will determine the treatment technology, general form and anticipated cost of the new wastewater treatment plant that will replace the existing primary treatment plant.

The Annacis WWTP Stage 5 upgrades continue to increase treatment capacity, improve plant reliability and enhance facility resiliency. This work represents a ~$835 million investment in expanding the existing plant to meet growing demand and is being completed in two phases: the first phase is currently moving into commissioning and is scheduled to complete in Q3 2021. The main portion of second phase will start in second half of 2021 and is scheduled to complete in 2027.

Similarly, the expansion of the Northwest Langley WWTP will address location growth and absorb some of the growth pressure from Annacis Island WWTP by investing $1.3 billion on a new Northwest Langley WWTP. This new plant will achieve higher levels of wastewater treatment, will have improved long-term resiliency and provided expanded service area through a new trunk sewer crossing the Fraser River from Maple Ridge. The Pump Station and storage tank is under construction and will be operational next fall with the River Crossing tenders closing end of April 2021. As for the outfall, it's in the preliminary stage. The system will be fully operational in spring of 2027.

Research and Collaboration

Metro Vancouver continues to establish new research partnerships with the wastewater treatment technology and process industry, academic institutions including the University of British Columbia and Thomson Rivers University, and organizations. Metro Vancouver continues to explore new opportunities and partnerships to support expanded energy and materials recovery from wastewater, such as sewer and effluent heat, biogas, biocrude, biosolids, reclaimed water, and nutrients.

Throughout 2019 and 2020, Metro Vancouver continued and/or initiated its collaboration with researchers and other partners on the following research initiatives:

- With UBC on the *Strait of Georgia Ambient Monitoring Program*;

- With Ocean Wise on *Investigation of Microplastics in the Metro Vancouver Liquid Waste System* and on the *Pollution Tracker* initiative;
- With University of Victoria, Capital Regional District and Biologica Environmental Services Ltd. on *Establishment of Robust eDNA Assays to Assess Organic Pollution Impacts on Infaunal Macrobenthic Invertebrate Communities in Coastal Waters of British Columbia*;
- With BC Centre for Disease Control (BCCDC) and UBC on *Investigation of Gastrointestinal Viruses* and *Investigation of SARS-CoV-2 Virus in Wastewater*;
- With BCCDC, Vancouver Coastal Health, McMaster University and the City of Vancouver on *False Creek Microbial Source Tracking*;
- With Statistics Canada on *Drugs in Wastewater.*

Metro Vancouver also supported other stakeholders in the Development of Burrard Inlet Water Quality Objectives and on the Protection of the Southern Resident Killer Whale and Their Prey.

Plan Review and Update

The Integrated Liquid Waste and Resource Management Plan has an eight-year review and update cycle. As the plan was approved by the Minister of Environment in 2011, its review and update would have occurred in 2019. In September 2018, the GVS&DD Board requested that the Minister of Environment and Climate Change Strategy extend the review cycle, with a review extension granted in 2019. In 2020, as required through the extension, Metro Vancouver submitted to the Minister its proposed strategy to carry-out the review. At the end of 2020, Metro Vancouver was awaiting feedback from the Ministry on its proposed review strategy.

1.0 METRO VANCOUVER

1.1. Goal 1: Protect Public Health and the Environment

1.1.1. Strategy 1.1 Reduce liquid wastes at their source

Action 1.1.1 –	Review and enhance sewer use bylaws to reduce liquid waste at source, including contaminants identified by the Canadian Environmental Protection Act (2012).

Metro Vancouver continues to regulate the discharge of liquid waste to sewer and wastewater treatment plants through the Sewer Use Bylaw No. 299 and associated bylaws and codes. The Bylaw protects the environment, sewer workers, and sewer infrastructure and is continually being updated to improve the quality of wastewater entering the sewer and wastewater treatment plants from liquid waste dischargers.

Through 2019 and 2020, liquid waste regulation development was underway for a few different sectors:

- In 2020, Metro Vancouver adopted amendments to the Fermentation Operations Bylaw with revised treatment fees that more accurately reflect servicing costs. An accompanying implementation guide was developed and distributed to affected stakeholders.
- A review of the Food Sector Grease Interceptor (FSGI) Bylaw was initiated in 2018 to update current language and technical requirements with respect to Grease Interceptors as well as address industry challenges by improving education and outreach. Originally scheduled for completion in 2020, the FSGI Bylaw Review is currently paused due to the challenges experienced by the food sector during the COVID-19 pandemic. Metro Vancouver continues to monitor developments regarding COVID-19 and is committed to work towards finalizing proposed policy recommendations in 2021.
- Metro Vancouver is improving how the discharge of trucked liquid waste (TLW) at Metro Vancouver wastewater treatment plants and discharges at sani-dumps are regulated. A TLW Bylaw and a Sani-dump Bylaw have been in development to update fees, definitions, and requirements of TLW haulers, TLW generators and sani-dump operators. The two new proposed bylaws will complement requirements in the Sewer Use Bylaw which are still applicable to these discharges. Bylaw adoption and implementation are planned for 2021.

Action 1.1.2 – Develop new regulatory instruments, such as Pollution Prevention Plans to complement existing regulations *(2014).*

New regulatory instruments have been implemented with the adoption of the Hospital Pollution Prevention Plan Bylaw in 2018.

Since the legalization of cannabis in 2018, Metro Vancouver has been monitoring potential impacts of the cannabis sector on the liquid waste system. Currently, effluent from cannabis cultivation and production facilities discharging to sanitary sewer do not currently meet the threshold for Waste Discharge Permits or warrant a sector specific bylaw. Ongoing information gathering on the wastewater quantity and quality from the Cannabis sector will inform future regulatory options.

Action 1.1.3 – Increase resources for permitting and inspection to support and enforce sewer use bylaws *(2010).*

This action was completed in 2010.

Action 1.1.4 – Investigate the implications of the use of domestic food grinders *(2012).*

This action was completed in 2012.

Action 1.1.5 – Develop and implement targeted outreach plans to support liquid waste source control programs *(Ongoing).*

Metro Vancouver used social marketing approaches to educate residents on the proper disposal of wipes and fats, oils and grease. Metro Vancouver also conducted focus groups and region-wide surveys on compounds of environmental concern (microfibres, medications and surfactants) in preparation for a regional campaign in 2021.

In 2019 and 2020, regional campaigns took place for both wipes and fats, oils and grease:

- The 'Unflushables' campaign educated residents about how to correctly dispose of seven problem items for the wastewater system: wipes, paper towels, hair, floss, tampons and applicators, condoms and medications.
- The 'Wipe It, Green Bin It' campaign asked residents to dispose of fats, oils and grease in their green bins and not down their sinks.

The campaigns included advertising, social media, videos, information handouts and in-person engagement at public events (Unflushables campaign) and grocery stores/farmers markets (Wipe It, Green Bin It campaign). A range of metrics were used to assess campaign effectiveness.

Action 1.1.6 – Develop a template to guide the preparation and implementation of inflow and infiltration management plans as part of broader asset management plans and to support sanitary sewer overflow reduction strategies *(2011).*

This action was completed in 2011.

Action 1.1.7 – Work with the real estate industry and their regulators, and the municipalities to develop and implement a process for the inspection and certification of private sewer laterals being in good condition as a required component of real estate transactions within Metro Vancouver *(2011).*

Metro Vancouver and the REAC Liquid Waste Subcommittee continue to explore solutions to excessive I&I entering Metro Vancouver's sewerage system through municipal sewers. Controlling I&I from private laterals is key to reducing the I&I entering from member jurisdictions. Through 2019 and 2020, Metro Vancouver continued to work with its members to develop a workable strategy to control I&I from private sewers laterals. Based on feedback from the REAC Liquid Waste Subcommittee, a strategy of private lateral certification linked to a dual sewer use rate structure appears to be more favorable to members than one linked to property time-of-sale, and will be addressed as part of the broader I&I management strategy being developed with members.

Action 1.1.8 – Develop and implement inflow and infiltration management plans that identify reduction strategies and timelines to ensure wet weather inflow and infiltration are within targeted levels (2012)

No change from the 2017-2018 Biennial Report. This Action's scope is for I&I originating from Metro Vancouver assets. For progress on I&I management originating from municipal systems, please see the respective municipal reporting under their Action 1.1.18.

Action 1.1.9 – Work with municipalities to review historical data and adjust, as necessary, the average inflow and infiltration allowance for regional trunk sewers and wastewater treatment plants, and develop associated target allowances for municipal sewer catchments associated with a 1:5 year return frequency storm event for sanitary sewers to a level that ensures environmental economic sustainability (2013)

The review for this action was completed in 2014. The regional I&I allowance remains unchanged at 11,200 L/ha·d.

Action 1.1.10 – Review progress in reducing inflow and infiltration every four years *(every 4 years).*

Municipal I&I is reported individually by municipality in Volume 2, under Action 1.1.18. Municipal I&I estimates provide a better reflection of local I&I rates due to the smaller catchment scales and the normalization of rainfall return periods.

Recent I&I rates as measured at Metro Vancouver's sewer flow meters and wastewater treatment plants for the Fraser Sewerage Area, the Lulu Island West Sewerage Area and North Shore Sewerage Area are shown on Figure 1 to Figure 4 and represent an estimated average I&I rate for their respective upstream catchments. Combined sewer catchments are excluded from this I&I assessments. Annual variations in I&I rates are due to variations in storm intensity and storm tracking as well as remedial works undertaken by member jurisdictions.

A comprehensive report on managing I&I in the Metro Vancouver area was completed in March 2019 by the REAC Liquid Waste Subcommittee. Inflow and infiltration originating on private property appears to be a significant source of I&I entering the municipal and regional sewers. Although some sort of certification program for private sewer laterals seems necessary to address a major source of I&I, members have not yet committed to develop and implement sewer lateral certification programs and continue to focus on I&I originating in municipal sewers.

North Shore Sewerage, Inflow and Infiltration (July 1, 2018 to June 30, 2019)

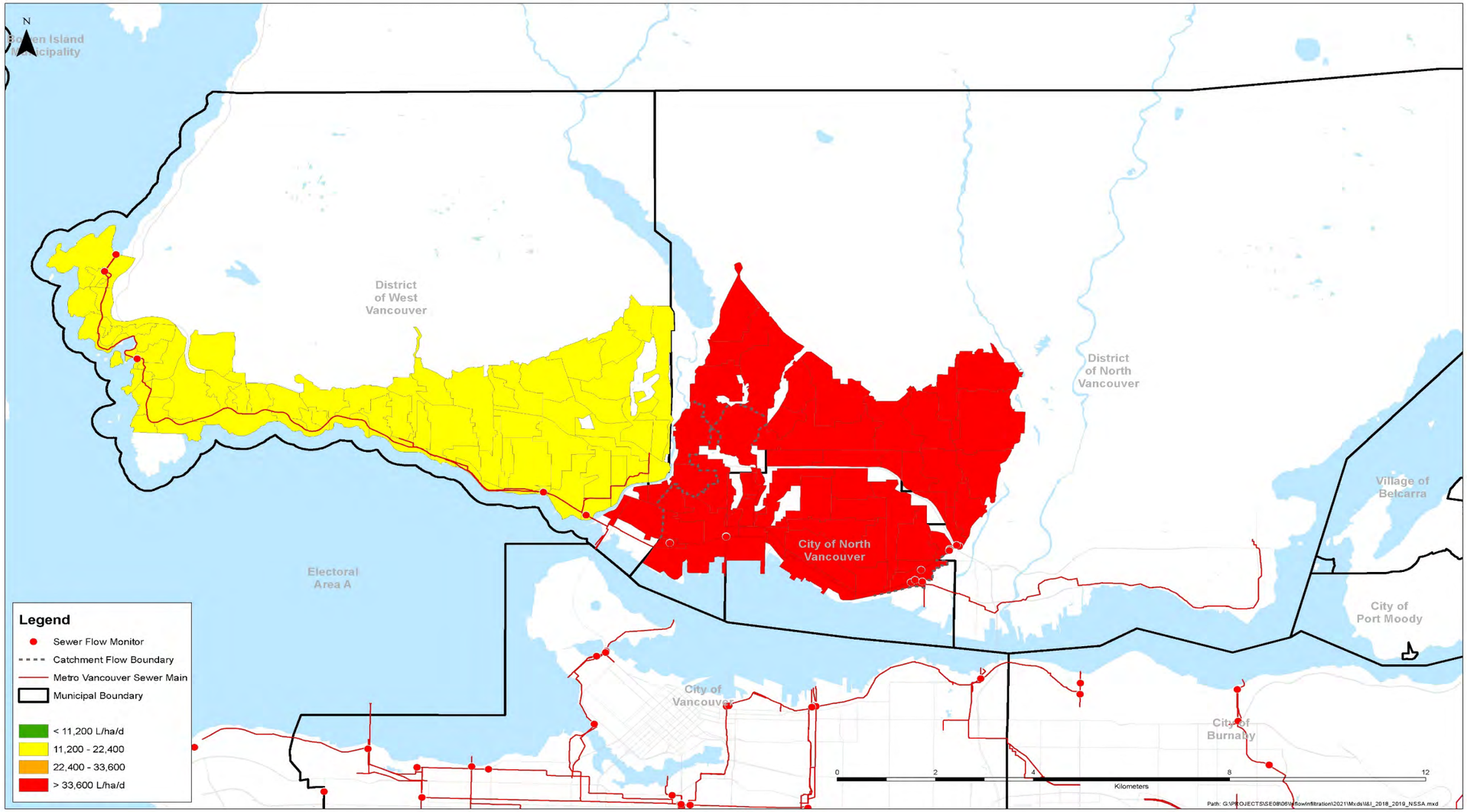


Figure 1 Inflow and Infiltration - North Shore Sewerage Area 2018-2019

North Shore Sewerage, Inflow and Infiltration (July 1, 2019 to June 30, 2020)

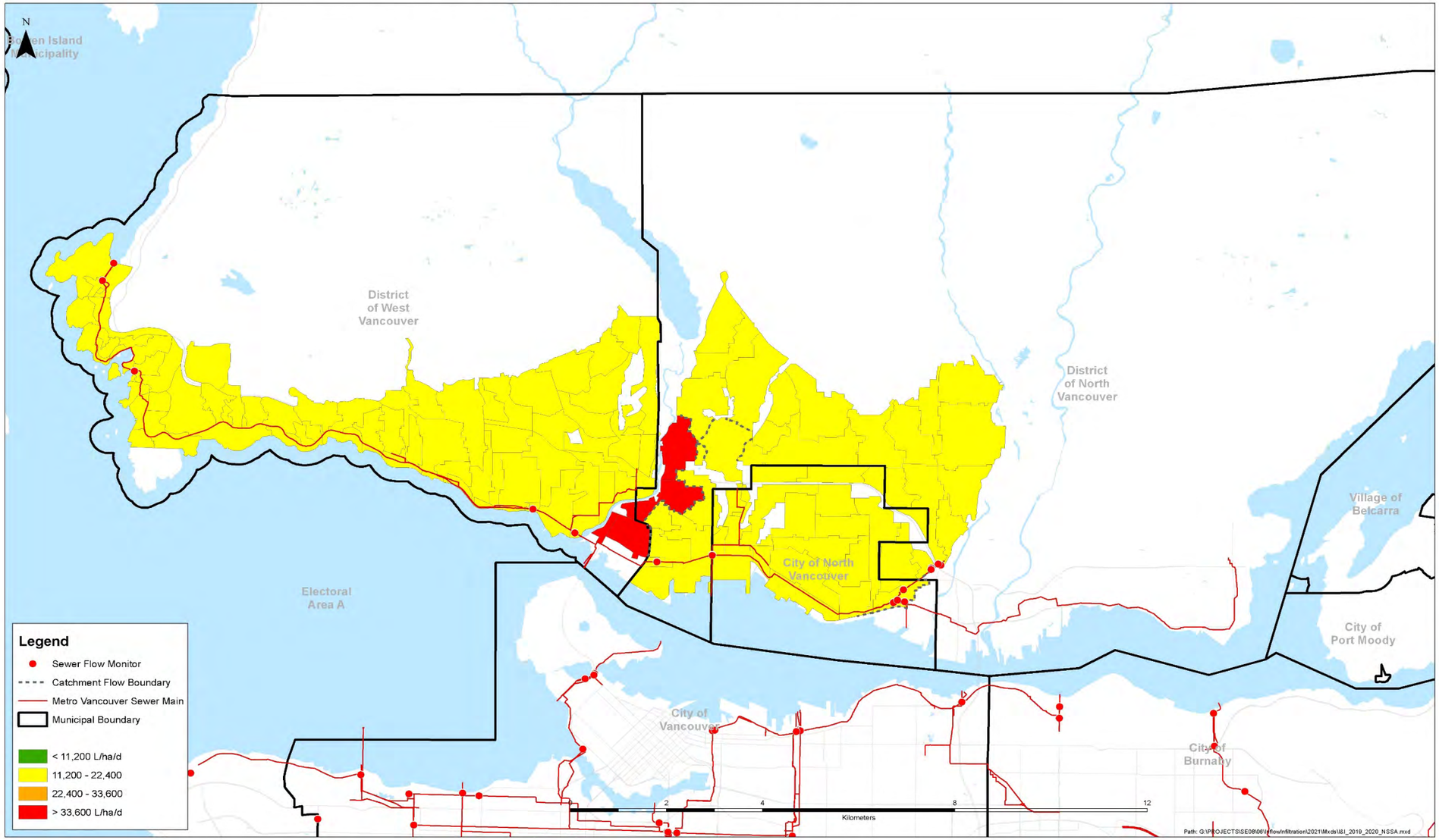


Figure 2 Inflow and Infiltration - North Shore Sewerage Area 2019-2020

Fraser and Lulu Island Sewerage, Inflow and Infiltration (July 1, 2018 to June 30, 2019)

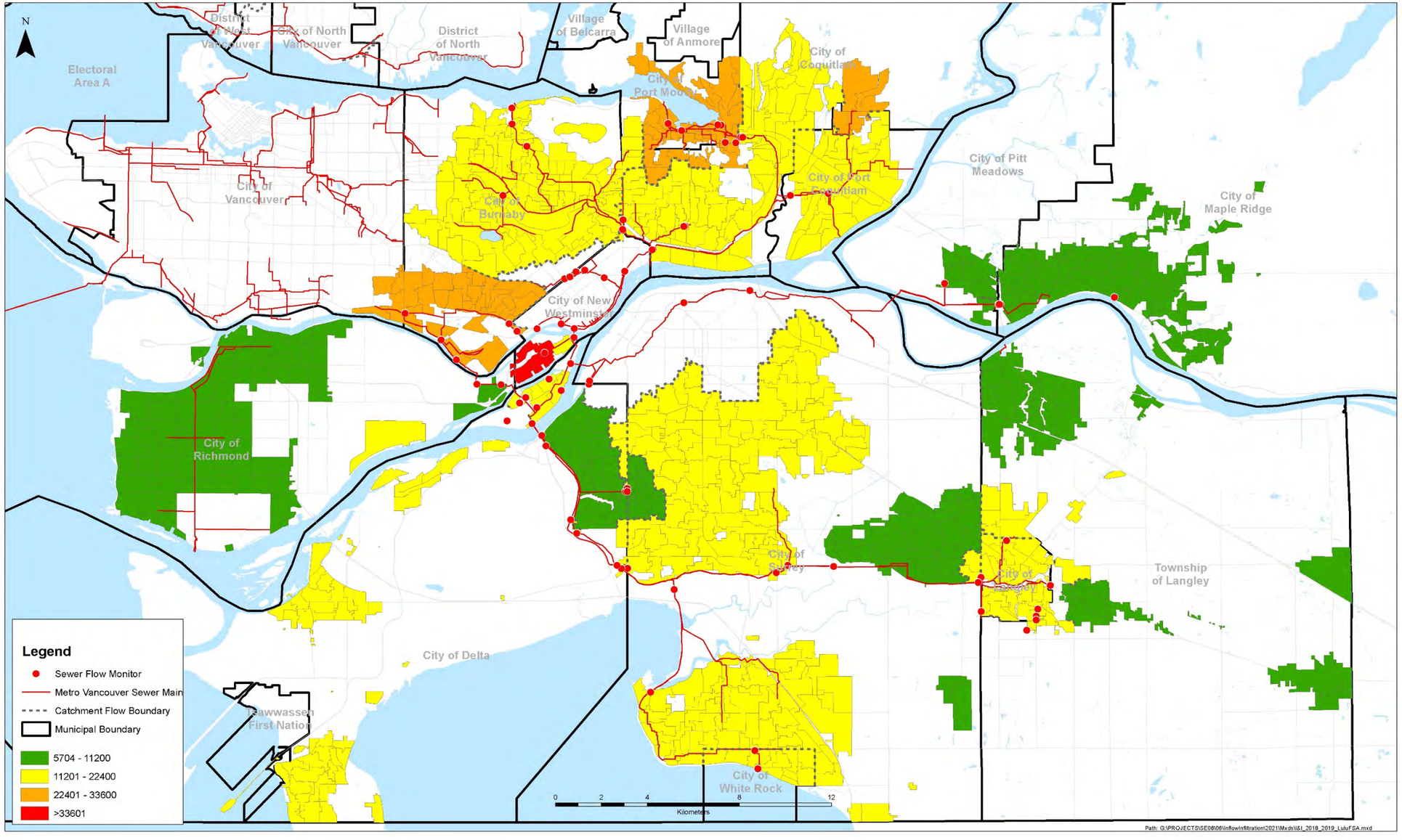


Figure 3 Inflow and Infiltration - Lulu Island West and Fraser Sewerage Areas 2018-2019

Fraser and Lulu Island Sewerage, Inflow and Infiltration (July 1, 2019 to June 30, 2020)

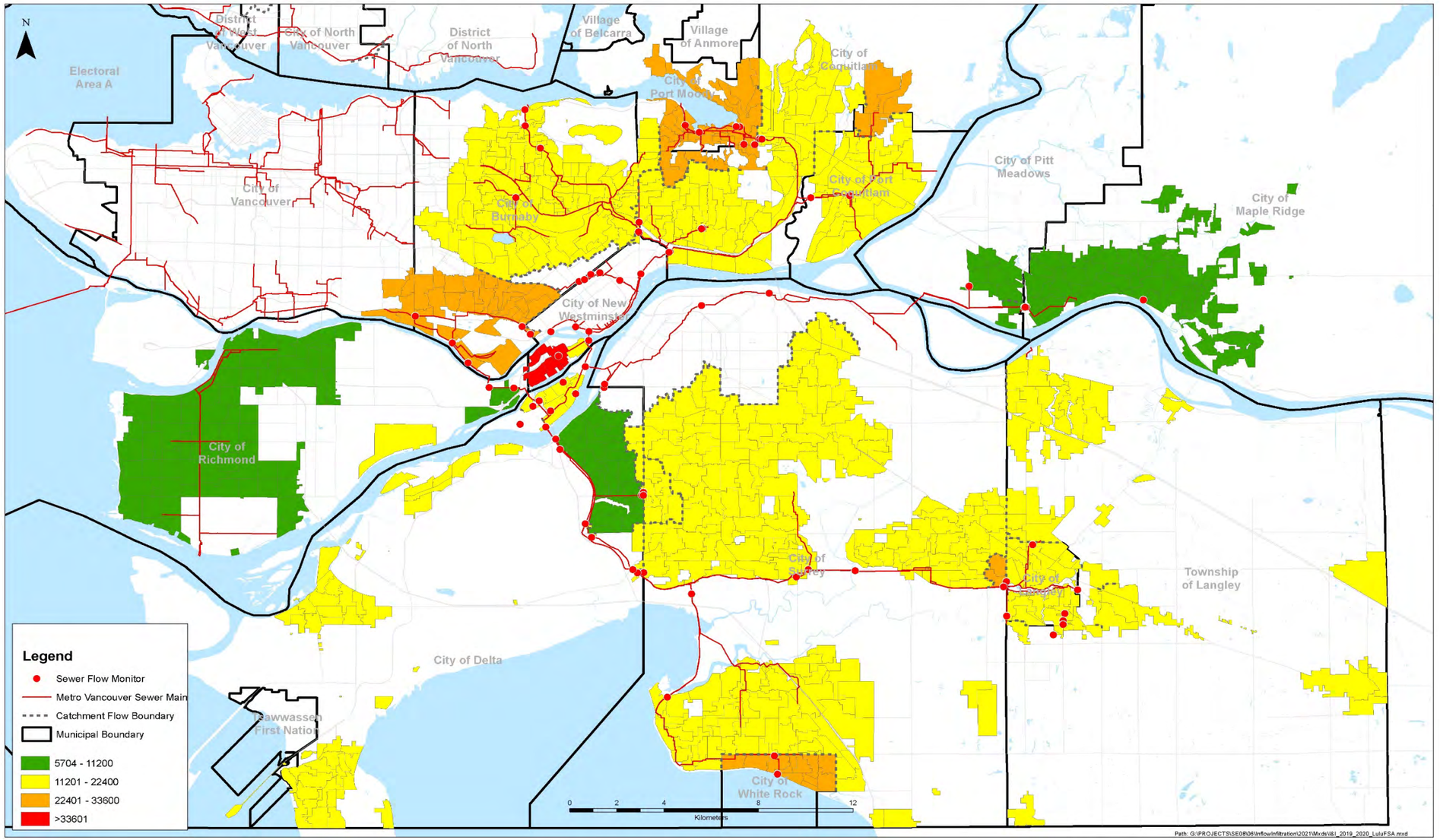


Figure 4 Inflow and Infiltration – Lulu Island West and Fraser Sewerage Areas 2019-2020

Action 1.1.11 – Enhance enforcement of sewer use bylaw prohibition against the unauthorized discharge of rainwater and groundwater to sanitary sewers *(2010).*

This action was completed in 2010.

Action 1.1.12a – Work with municipalities to facilitate research on watershed-based stormwater management approaches.

Regular bi-monthly meetings of the Stormwater Interagency Liaison Group (SILG) continued through 2019 and 2020. Through SILG, Metro Vancouver continues to facilitate the ongoing exchange of information on stormwater issues, and provide support to its member jurisdictions on technical matters related to stormwater management. This supports member jurisdictions in implementing their ILWRMP actions.

In 2019 and 2020, work on a review of the 2005 *Integrated Stormwater Management Plan Template* (ISMP template) was continued by a SILG technical working group comprised of municipal, Metro Vancouver and BC MOECCS members to incorporate policy and practices changes since the implementation of the *Stormwater Monitoring and Adaptive Management Framework* and local experience in managing ISMPs has grown. Completion and publication are planned for 2021.

In 2020, work began on updating the 2012 *Stormwater Source Control Design Guidelines.* Local practices and research were shared extensively in SILG meetings, a UBC Sustainability Scholar was engaged to document local practice and conduct a literature review, and a SILG technical working group was established to manage the document update. The work is on-going.

Action 1.1.12b – Work with municipalities to identify improvements to stormwater bylaws to include on-site rainwater management requirements.

This action was completed in 2017 with the approval by the GVS&DD Board of the *Region-wide Baseline for On-site Stormwater Management* for use as a guideline by GVS&DD members. A model bylaw for on-site rainwater management is included as part of the guideline.

Action 1.1.12c – Work with municipalities to develop model utility design standards and options for neighbourhood design guidelines.

This action was completed in 2012.
www.metrovancouver.org/services/liquidwaste/LiquidWastePublications/StormwaterSourceControlDesignGuidelines2012.pdf.

Action 1.1.12d – Work with municipalities to establish region wide baseline criteria for on-site rainfall management including variations for localized geology, rainfall and watershed conditions.

See action 1.1.12b.
http://www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/Region-wideBaselineOnsiteStormwaterManagement-Feb2017.pdf

Action 1.1.12e – Work with municipalities to establish mechanisms to ensure continued performance of on-site rainwater management systems.

This action was completed in 2017.

Action 1.1.12f – Work with senior government and industry to develop codes of practice, certification, guidelines and standards which support this plan. (2012)

Through 2019, Metro Vancouver participated on the Plastics Advisory Panel of the National Zero Waste Council and contributed to the report "*Regulatory Approaches for Priority Plastic Wastes*". Metro Vancouver made recommendations on provincial and federal policy options, including extended producer responsibility, that would reduce the amount of synthetic wipes, microfibres from textiles, and microplastics from car tires that enter the sewer system.

In 2020, Metro Vancouver provided comments for the Ministry of Environment and Climate Change Strategy (MoECCS) Recycling Regulation Policy Intentions Paper. Metro Vancouver recommended prioritizing the addition of the following products within the Recycling Regulation to protect the sewer system:

- Flammable, explosive, corrosive, or toxic liquid wastes;
- Wastes that may cause sewer worker safety risks such as medical sharps (syringes); and
- Any outstanding pharmaceuticals that are not already regulated in the Recycling Regulation such as veterinary medicine for pets.

These products can be discharged to the sewer system from potentially thousands of access points including from residential locations and, therefore, can be better managed through provincial policies such as the Recycling Regulation.

Metro Vancouver continues to support the Municipal Enforcement Sewer Use Group (MESUG) and the Canadian Water and Wastewater Association (CWWA), in their efforts to address non-flushable items including the development a Canadian Standard for Flushability. Metro Vancouver is currently working with member jurisdictions to better document financial and operational impacts of non-flushable wipes and will be participating on the new CWWA Flushable Committee to better address issues around non-flushable wipes.

Action 1.1.13 – Decrease liquid waste volumes through complementary initiatives in the Metro Vancouver Drinking Water Management Plan to reduce potable water consumption *(Ongoing).*

Actions in the Metro Vancouver's Drinking Water Management Plan continue to support and implement water conservation strategies that lead to reduced sewage flows. Ongoing efforts include a regional water conservation campaign that encourages water-wise behavioural change through education and outreach initiatives such as the We Love Water website, the Water Wagon, Tap Water Campaign, and lawn sprinkling communications.

As of 2018, the *Drinking Water Conservation Plan* (DWCP) limits lawn watering to two days per week from three days per week. Every year, the DWCP seasonal Stage 1 watering restrictions are implemented on a region-wide basis for the summer demand period. To help with this effort, the *Region-wide Guide for Enforcement of Metro Vancouver's Drinking Water Conservation Plan* was implemented in 2018 to support member jurisdictions in monitoring and enforcement. The Guide consists of best practices which can be used as a guideline by local governments.

Through the Water Sustainability Innovation Fund, Metro Vancouver has undertaken an initiative to advance a Non-Potable Water Reuse Project for the Metro Vancouver region. This work supports the uptake of non-potable water systems, reducing the use of potable water for non-potable purposes. This project presents an opportunity for Metro Vancouver to advance non-potable water use through research, education, capacity building and by convening relevant stakeholders into a process to identify and address barriers to broader adoption of these systems. The project will culminate in two key deliverables: A Guidebook that acts as an industry go-to resource to improve education, simplify implementation, and support ongoing operation of these systems in the region; and a Roadmap that identifies parries and opportunities to address those barriers.

1.1.2. Strategy 1.2 Reduce wet weather overflows

Action 1.2.1 – Prohibit the construction of new combined sewer systems other than those functioning as part of a strategy to reduce combined sewer overflows or to manage stormwater quality *(Ongoing).*

Metro Vancouver did not construct any new combined sewer systems during 2019 or 2020, nor did any member jurisdictions.

Action 1.2.2 – Address the Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CWS-MMWE) by working with Burnaby, New Westminster and Vancouver to develop and implement: priorities for sewer separation of catchments tributary to combined sewer outfalls; regional and municipal sequence for trunk and collector sewer separation; strategic use of existing combined sewers to manage rainwater quality runoff; and strategy to separate combined sewer connections from private properties (2014).

Combined sewer separation planning for the Heather-Cambie and Canoe Creek Combined Sewer Catchments was completed in early 2019. These planning areas lie in Vancouver and extend north of the Manitoba catchment to False Creek and cover the Douglas Park, Fairview and Mount Pleasant neighbourhoods. The Manitoba Combined Trunk Sewer was reassessed starting in 2019 to evaluate the implications of updated climate change precipitation scenarios as well as the effectiveness of green infrastructure and its limitations in mitigating rainfall runoff amounts. This area lies in South Vancouver and covers the Oakridge-Langara neighbourhoods and extends south to the Fraser River. The reassessment will be complete in early 2021.

A joint municipal Metro Vancouver steering committee and working group was formed in late 2018 and continued in 2019 and 2020 to meet and work on developing a coordinated strategy for CSO elimination initiatives by City of Burnaby, New Westminster, Vancouver and Metro Vancouver. One on one meetings were held in 2020 between Metro Vancouver and each member jurisdiction to exchange progress on their sewer separation programs.

To support sewer separation planning work, Vancouver Sewerage Area sewer model is being used to assess combined sewer separation strategies and inform the prioritization of work.

Action 1.2.3 –	Replace combined regional trunk sewers with separated sanitary and storm sewers as determined by the plans developed in 1.2.2 (Ongoing).

The Conceptual Design Engineering for the Glenbrook System in New Westminster has been completed. Construction is currently planned to commence in the late 2020's.

Action 1.2.4 –	Work with municipalities to develop and implement municipal –regional sanitary overflow management plans which will: prevent sanitary overflows resulting from heaving rain and snowmelt occurring less than once every five years (for a 24 hour duration event); reduce emergency overflows due to power outages; and identify locations and schedules for appropriate system capacity improvements, wet weather containment, and point treatment and discharge to receiving waters of chronic overflows, including Cloverdale Pump Station, Katzie Pump Station, Lynn Pump Station (2013).

Metro Vancouver continued to support its members in their I&I management planning through work with the REAC LWSC in developing strategies for long-term I&I control. The recommendations from this work was delivered to REAC in early 2019 and are intended to help members' I&I management programs. In addition, video-workshops were held on the correct use of the Envelope Method for estimating I&I, and on national findings regarding I&I in new sewer construction.

Metro Vancouver has commissioned backup power systems on four of the seven pump stations that did not have back up power systems in the Vancouver Sewerage Area. A fifth station is under construction, and the remaining two are in the design and approvals stage.

With respect to the three priority locations for SSO (Sanitary Sewer Overflow) management planning, Cloverdale Pump Station, Katzie Pump Station and Lynn Branch Siphon, progress is summarized as follows:

North Shore Interceptor - Lynn Branch Siphon

Four wet weather SSOs occurred at Lynn Branch Siphon in 2019 while three occurred in 2020. The total estimated volume of SSOs in 2019-2020 is 20,748 m3 compared to 28,400 m3 in 2017-2018. The District of North Vancouver indicated that it continues its work to reduce I&I from private laterals in the upstream Lynn Valley area. An overview of the District's I&I management work is provided in Volume 2: Municipal Reports under Action 1.1.18.

North Surrey Interceptor – Maple Ridge Section & Port Mann Section

Discharges to locations of reduced environmental sensitivity are preferred if SSOs are unavoidable. To minimize environmental risks to Katzie Slough, during wet weather, emergency wet weather overflows occur to the Fraser River from the City of Maple Ridge's system at their 225th Street Pump Station.

Six wet weather SSOs occurred at the 225th Street overflow in 2019 and nine occurred in 2020; the total estimated SSO volume is 167,482 m3 for this period. In 2020, two overflows were the result of storms which exceeded the 1:5-year event control threshold, and these two events resulted in 52,647 m3 of overflow. One SSO occurred at the Katzie Pump Station in 2019, and one in 2020, with an estimated SSO volume of 15,229 m3. In 2020, the overflow at the Katzie Pump Station was associated with a 1:10-year return storm event which is greater than 1:5-year overflow event control threshold. This single storm resulted in 12,865 m3 of overflow at the Katzie Pump Station, or 85% of the biennial overflows at this location. For the previous period 2017-2018, no wet weather SSO occurred at the Katzie Pump Station and 12 wet weather SSOs (144,500 m3) occurred at the 225th Street location.

As part of the interim solution to reoccurring wet weather overflows associated with the North Surrey Interceptor, Metro Vancouver is building the Golden Ears Pump Station and SSO Storage Tank to replace the existing Katzie Pump Station. Construction includes a 20,000 m3 SSO containment tank and is anticipated to be completed by 2022. This will reduce the likelihood of SSOs occurring to Fraser River at the 225th Pump Station and to Katzie Slough.

Metro Vancouver continues to experience reoccurring wet weather SSOs on the Port Mann Section of the North Surrey Interceptor at Maintenance Hole 48. The reoccurrence of wet weather SSOs at this location was five events in 2019 and eight events in 2020, and resulted in a total 212,021 m3 of overflows. One overflow event was associated with rainfall which exceeded the 1:5-year overflow control threshold and contributed 94,749 m3, or 45% of the biennial overflow total for this location. This compares to the previous 2017-2018 period when seventeen events occurred and resulted in 112,400 m3 of overflows. To reduce the reoccurrence of SSOs at this location, Metro Vancouver

completed repairs to sections of the North Surrey Interceptor to reduce I&I and has started design of an SSO storage facility as part of a solution that also includes reductions in tributary municipal I&I.

The Cities of Maple Ridge and Surrey continue with their I&I management work with an overview of this work provided in Volume 2: Municipal Reports under Action 1.1.18.

South Surrey Interceptor – Cloverdale Pump Station

Construction of capacity improvements to the South Surrey Interceptor and operation of the Cloverdale SSO containment tank have prevented SSOs at the Cloverdale Pump Station from occurring since 2013 with the exception of one SSO in 2020. This resulted in a 18,081 m3 overflow and was due to an infrequent 1:10-year return frequency. This event was greater than the event control threshold of 1:5-years which the Cloverdale tank was designed to control. Ongoing efforts by both upstream and downstream member jurisdictions will help ensure that wet weather SSOs remain controlled. I&I management reporting for the City of Delta, the City of Langley, Langley Township, the City of Surrey and the City of White Rock are contained in Volume 2 under Action 1.1.18.

1.1.3. Strategy 1.3 Reduce environmental impacts from liquid waste management to a minimum

Action 1.3.1 –	Develop and implement operational plans for sewerage and wastewater treatment facilities to ensure infrastructure reliability and optimal performance (Ongoing).

Plans for wastewater treatment facilities are ongoing to maintain and to upgrade existing infrastructures; to increase power reliability and to ensure system resilience.

Action 1.3.2 –	Maintain trunk sanitary sewer capacity for dry weather sewerage conveyance levels plus the Metro Vancouver target inflow and infiltration allowance; as necessary upgrade trunk sewer systems to maintain hydraulic grade lines and safe operating levels which have been established based on measured flow (Ongoing).

The work is ongoing. Please refer to the 2017-2018 Biennial report.

Action 1.3.3 – Work with municipalities to develop and implement emergency sanitary sewer overflow plans including contingency plans to minimize impacts of unavoidable sanitary sewer overflows resulting from extreme weather, system failures or unusual events (Ongoing).

No new work was initiated on this action during 2019-2020. Refer to the 2013-2014 Biennial Report.

Action 1.3.4 –	Operate wastewater treatment plants which have secondary level treatment (Annacis Island, Lulu Island, North West Langley wastewater treatment plants) to meet requirements specified in each facility's Operational Certificate as well as the national Wastewater Systems Effluent Regulations including: (a) maximum Carbonaceous Biochemical Oxygen Demand (CBOD5): 25mg/L (monthly average for Annacis Island and Lulu Island and quarterly average for North West Langley); and (b) maximum Total Suspended Solids (TSS): 25mg/L (monthly average for Annacis Island and Lulu Island and quarterly average for North West Langley)

The secondary wastewater treatment plants are treating effluent within their compliance parameters. The following tables summarize Annacis Island, Lulu Island, and Northwest Langley WWTP performance with the Operational Certificate and Wastewater Systems Effluent Regulations (WSER) parameters.

Table 1 WWTP Operational Certificate Exceedances per Year – CBOD

WWTP	2019	2020
Annacis	0	0
Lulu	0	0
NW Langley	0	0

Table 2 WWTP Operational Certificate Exceedances per Year – TSS

WWTP	2019	2020
Annacis	0	0
Lulu	0	0
NW Langley	0	0

Table 3 Total WWTP Operational Certificate Exceedances by Year – All Parameters

WWTP	2019	2020
Annacis	4	4
Lulu	1	0
NW Langley	2	0

Table 4 WWTP Operational Certificate Exceedances per Year – Coliform

WWTP	2019	2020
Annacis	0	0
Lulu	0	0
NW Langley	0	0

Table 5 WWTP WSER Exceedances per Year- CBOD

WWTP	2019	2020
Annacis	4	4
Lulu	1	0
NW Langley	2	0

Table 6 WWTP WSER Exceedances per Year - TSS

WWTP	2019	2020
Annacis	0	0
Lulu	0	0
NW Langley	0	0

Tables 1 - 6 WWTP Operational Exceedances

Action 1.3.5 -	Upgrade or replace Lions Gate (North Shore Sewerage Area) and Iona Island (Vancouver Sewerage Area) wastewater treatment plants to secondary level treatment to meet Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CWS-MMWE) requirements and timelines.

Lions Gate WWTP/North Shore WWTP

Construction of the NSWWTP, the First Narrows Pump Station, and associated conveyance piping is on-going, but is delayed. The Project Agreement for the NSWWTP was amended in October 2019 and an amendment to the Conveyance Project Agreement is in progress. Metro Vancouver is in the process of developing information for communications around schedule and budget changes for the project.

Following completion and operation of the new wastewater treatment plant, the existing Lions Gate WWTP will be decommissioned.

Iona Island WWTP

The Iona Island Wastewater Treatment Plant Project Definition Phase is to develop an indicative design for upgrade and replacement of the Iona Island WWTP continued between 2019 and 2020. The selection of the treatment technology and indicative design, including upgrading to secondary/tertiary treatment and undertaking ecological restoration work to the island, was endorsed by the GVS&DD Board in July 2020. Subsequent work identified longer implementation schedule requirements and higher than expected capital cost estimates that is resulting in further work being done. When completed in early 2022, this phase of the project will include the schedule and anticipated costs to implement the recommended design.

Metro Vancouver started the Project Definition Phase of the new Iona Island Wastewater Treatment Plant on September 20, 2018. A total of 7 integrated design workshops involving Metro Vancouver and a consulting team have been held and the schedule and budget for implementing the recommended indicative design will be presented in May 2021. Various stakeholder groups were engaged throughout the Project Definition Phase between 2019 and 2020, including but not limited to: local government staff and elected officials; residential and business neighbours of the plant; First Nations; environmental groups; regulators and other government agencies; recreational users of Iona Beach Regional Park; and commercial and recreational Fraser River users. A Community Engagement report on Public and First Nation engagement activities and findings will be provided in early 2022. Initiating the upgrades to the Iona Island WWTP is urgently needed to meet the federal requirements to upgrade the level of treatment provided as well as to replace much of the current plant infrastructure.

Action 1.3.6 – Maintain interim maximum daily concentration limits for wastewater effluent of 130mg/L BOD_5 at both Lions Gate and Iona Island plants and 130mg/L TSS at Lions Gate and 100mg/L TSS at Iona Island until such a time as secondary treatment is operational, and operate the plants to meet requirements specified in each facility's Operational Certificate *(Ongoing).*

The primary wastewater treatment plants are treating effluent within their compliance parameters. The following tables summarize Iona Island and Lions Gate WWTP performance with the Operational Certificate parameters.

Operational Certificate Exceedances by Year

Total WWTP Operational Certificate Exceedances per Year – All Parameters

WWTP	2019	2020
Iona	1	0
Lions Gate	0	0

Total WWTP Operational Certificate Exceedances per Year - BOD

WWTP	2019	2020
Iona	1	0
Lions Gate	0	0

Total WWTP Operational Certificate Exceedances per Year – TSS

WWTP	2019	2020
Iona	0	0
Lions Gate	0	0

Total WWTP Operational Certificate Exceedances per Year – Fecal Coliforms

WWTP	2019	2020
Lions Gate	0	0

Action 1.3.7 – Assess environmental monitoring results (see Strategy 3.3) to determine whether any actions are required to meet Ministry of Environment/Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CWS-MMWE) requirements *(Ongoing).*

Metro Vancouver has developed Effluent Discharge Objectives (EDOs) to support major wastewater treatment plant upgrades. These assessments were conducted in accordance with the CCME *Canada-wide Strategy for the Management of Municipal Wastewater Effluent*.

In 2019 and 2020, Metro Vancouver conducted a Key Maintenance Hole Monitoring Program to collect additional data from the Vancouver Sewerage Area. This program targeted conventional substances and those substances identified in the 2018 Iona Island WWTP EDO study as potentially requiring an EDO and for which there was no historical monitoring data available. The 2019 and 2020 data is under review and will be used to verify and update the 2018 Iona Island WWTP EDO study.

Action 1.3.8 – Continue odour control programs at wastewater treatment plants and implement odour control programs for targeted facilities in the regional sewer system and for relevant energy and material recovery processes, see Action 3.3.4 *(Ongoing).*

Installation of new odour control units at Annacis Island Wastewater Treatment Plant and Lulu Island Wastewater Treatment Plant to improve existing odour control systems were completed in 2020. Two new Primary Odour Control scrubbers built as part of the Annacis Island Wastewater Plant upgrade project were in operation since March 18, 2020. A new Biotrickling Filter system for Lulu Island Wastewater Treatment Plant was in operation since March 06, 2020. Inclusion of plant wide odour control systems that will reduce plant-generated odour at North Shore Secondary Plant, Northwest Langley Wastewater Treatment Plant and Iona Island Secondary Plant.

An important component of the odour control program is odour monitoring, where a third-party collects odour samples monthly between May and October for each wastewater treatment plant. This information is used to assess the effectiveness of the odour control systems.

See Figure 5 on page 27 for the Odour Controls and Complaints mapping.

Action 1.3.9-	Develop and implement air emissions management programs for standby power generators and biogas production, including assessment of desirability of retrofit and accelerated asset replacement where appropriate *(2014).*

Purchases of new or replacement standby generators aim to meet the most stringent emission standards available, with consideration of potential emission reductions and costs. This approach is typically used for purchases of any non-road diesel engines and equipment, and is based on availability of equipment meeting current emission standards. Some of the projects outlined in Action 1.3.10 result in improved biogas management systems, which will reduce greenhouse gas emissions and are expected to reduce air contaminant emissions as well.

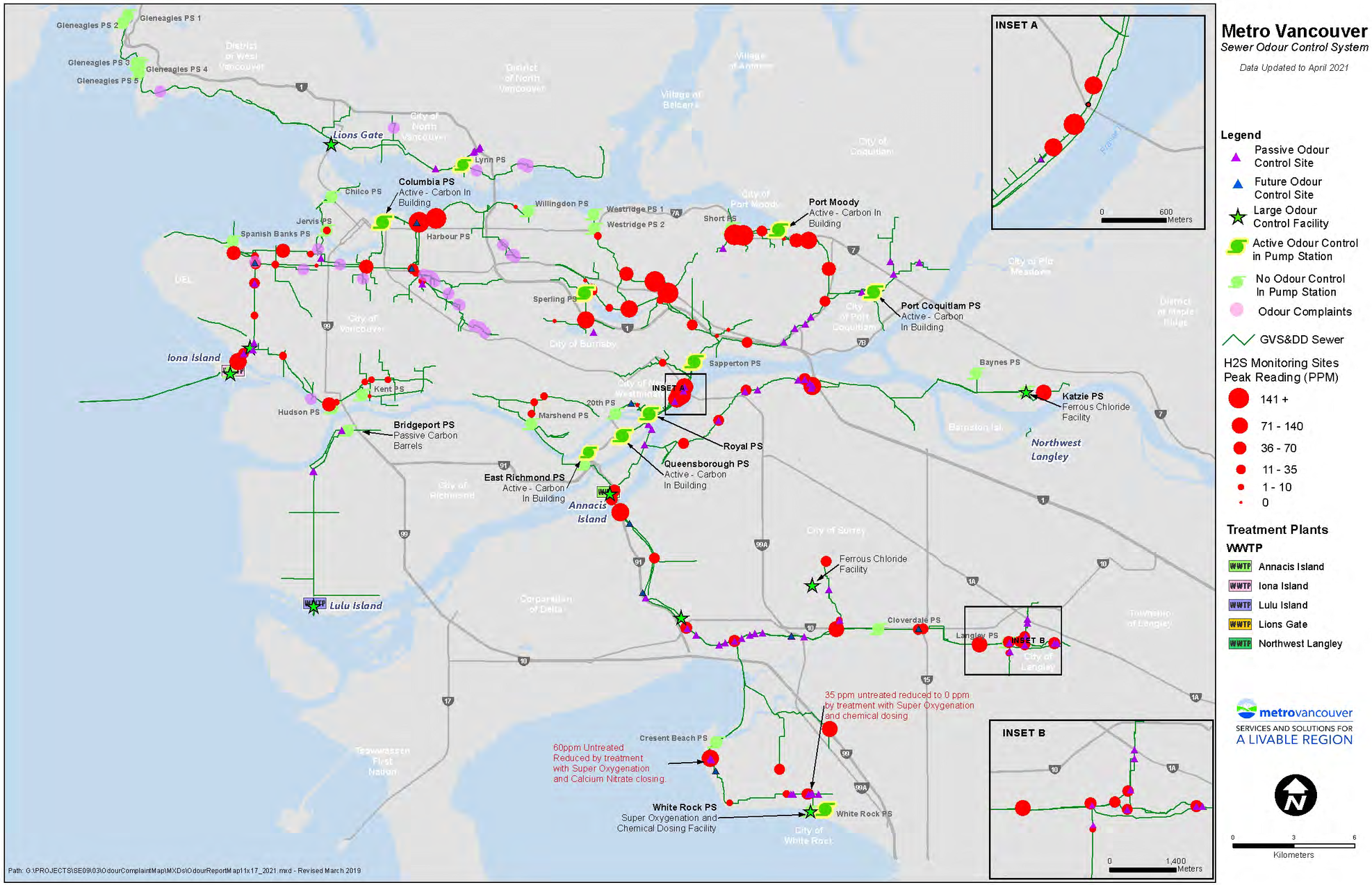


Figure 5 Sewer Odour Controls and Complaints

Action 1.3.10 – Develop and implement programs to reduce greenhouse gas emissions from the regional liquid waste management systems to help achieve federal, provincial and Metro Vancouver greenhouse gas targets, see Action 3.3.4 *(2015).*

Greenhouse gas (GHG) emissions are directly and indirectly produced by the regional liquid waste management system. Direct GHG emissions are from natural gas and digester gas combustion in boilers, engines, and flares at the wastewater treatment plants; from vehicle activity (both corporate vehicles operated by the liquid waste utility and contracted vehicles used for residuals management); and from fugitive methane emissions. Indirect emissions are associated with the electricity used in the liquid waste collections system and at the wastewater treatment plants. The operation of the regional liquid waste management system produced approximately 8,100 tonnes of GHG emissions in 2019. This includes emissions from contracted fuel use for residuals hauling. The energy and emissions dataset for 2020 was incomplete at the time of publishing this report. Promising GHG reduction projects that have been examined and/or pursued in 2019 and 2020 include:

- Biosolids drying facility - The Metro Vancouver Board endorsed biosolids drying as a management option; the biosolids dryer will create pellets that displace the use of fossil fuels at local cement kilns and reduce regional GHG emissions.
- Hydrothermal Processing Pilot Project - Preliminary design process for the pilot facility at Annacis Island Wastewater Treatment Plant was initiated. The project will design, fabricate, commission and evaluate an advanced biofuel production facility converting wastewater biomass to a biocrude oil, which will then be processed at a local petroleum refinery.
- Renewable Natural Gas (RNG) Optimizer - Metro Vancouver is working on the development of a bioreactor (RNG Optimizer) that shifts anaerobic digestion microbiome community to more methane-producing micro-organisms to increase methane production at wastewater treatment plants. The goal of 25% boost in RNG production would displace conventional natural gas use and reduce regional GHG emissions. A patent was filed in June 2020 by Metro Vancouver for this enhanced digestion process.
- Advanced Resource Recovery from Wastewater – A 5-year Industrial Research Chair (IRC) program funded by the Natural Sciences and Engineering Research Council (NSERC) and Metro Vancouver was established at UBC Okanagan. The IRC program is focusing both on the operational optimization and resource recovery from hydrothermal processing as well as the development of a bioreactor that will boost renewable methane production of existing anaerobic digesters at wastewater treatment plants.
- Design for a pilot anaerobic digester (AD) at Lulu Island WWTP was completed and procurement initiated. A pilot digester will facilitate the investigation of innovative sludge digestion optimization techniques, including testing of the RNG optimizer, and enable operational wastewater treatment improvements that can result in reduced greenhouse gas emissions.
- Lulu Island Wastewater Treatment Plant Effluent Heat Recovery System Feasibility Study. Capture of unused effluent heat that will make additional renewable natural gas available to the region, displacing natural gas use;

- Lulu Island Wastewater Treatment Plant Biogas Cleanup Project - Excess gas not required for use by the plant needs to be cleanup and sold for use as renewable natural gas, displacing conventional natural gas use.
- Trenchless technology was used to install an 800m section of pipe as part of the twinning of the South Surrey Interceptor, avoiding the release of GHG emissions from tunneling.
- Biosolids drying for use as a low-carbon fuel in cement kilns.

Action 1.3.18 – Include Metro Vancouver and municipalities in the Ministry's processes to review and establish official water uses and official water quality objectives for specific water bodies within Metro Vancouver.

Following the development of the *Burrard Inlet Action Plan: A Tsleil-Waututh Perspective* in 2016, the BC Ministry of Environment and Tsleil-Waututh First Nation jointly initiated a review of Burrard Inlet Water Quality Objectives. Metro Vancouver has been participating in the work of the Water Quality Roundtable and Technical Working Group since their inception, and has provided a considerable amount of monitoring and other data for this initiative, and has also provided feedback on the draft objectives.

1.2. Goal 2: Use Liquid Waste as a Resource

1.2.1. Strategy 2.1 Pursue liquid waste recovery in an integrated resource recovery context.

Action 2.1.1 – Assess each sewerage area using an integrated resource recovery business case model that: (a) evaluates opportunities to expand the recovery of energy, nutrients and water from the liquid waste system, specifically: Energy from biogas at wastewater treatment plants including investigating new sludge and wastewater treatment technologies and the co-digestion of other organic wastes such as organics in municipal solid waste, oils and greases, Heat energy from new pump stations, sewer replacement and rehabilitation and major wastewater treatment plant projects, Biodiesel from trucked liquid waste, waste grease and sewer grease, Energy from biosolids and sludge, Nutrients, such as phosphorous from liquid waste and biosolids, Alternatives to potable water for non-drinking purposes, such as rainwater harvesting, greywater reuse and reclaimed treated wastewater, (b) identifies linkages between liquid waste resource recovery opportunities and other systems (solid waste, drinking water, land use/buildings, parks, air quality, energy), (c) develops and evaluates business cases for integrated resource recovery/use opportunities *(2012).*

Integrated Resource Recovery

Integrated resource recovery (IRR) studies were carried out for the North Shore Sewerage Area (2011), the Vancouver Sewerage Area (2012-2014), The Lulu Sewerage Area (2016-2017). The Request for

Proposal for the Fraser Sewerage Area IRR study was issued in late 2019 and contract was awarded in 2020. Results are expected in 2021.

The Integrated Resource Recovery (IRR) study for the Lulu Island West Sewerage Area (LSA) was completed in 2017. (Studies for the Vancouver Sewerage Area and North Shore Sewerage Area were completed in 2013 and 2011, respectively.) The study explored opportunities associated with the integrated management of solid and liquid wastes originating within the LSA and resulted in an "IRR Framework", an overall strategy for developing IRR projects in the LSA, and an "Actions List" defining specific activities to implement the strategy. Two main potential IRR scenarios were identified, one focusing on the development of district energy and water recycling systems at Richmond City Centre and a second involving the development of bioenergy resources and conducting research on agricultural end uses for residuals from the Lulu Island Wastewater Treatment Plant (LIWWTP).

The most promising concepts from the evaluation led to the identification of near-term concrete steps. Some of these steps have been already completed, such as the analysis of alternative digestion optimization techniques for LIWWTP and the predesign for a pilot-scale facility for distribution of bulk recycled water completed in 2017 and 2018 respectively. Other initiatives are currently under way, including the BC Biogas Project, to be constructed at LIWWTP in 2019. Additional initiatives, such as the collaboration with local universities on the microbial activity within wastewater to optimize treatment processes and pilot testing of hydrothermal processing technology will continue.

An IRR study was undertaken as part of the conceptual design for the new Northwest Langley WWTP, which will serve a substantial portion of the Fraser Sewerage Area. A broad range of IRR opportunities were analyzed, and several promising concepts were included in the approved conceptual design, including co-digestion of trucked liquid waste, reclaimed water for onsite and offsite use, grit reuse, biosolids reuse, nutrient recovery, and biogas use. In some cases, space will be reserved for necessary infrastructure, which will be installed later, dependent on the market and incentives for sustainability projects. The larger Fraser Sewerage Area IRR study will begin in 2019.

Co-digestion of Trucked Liquid Waste

Studies prior to 2019 indicated that Metro Vancouver cannot currently compete with the private sector for the types of waste best suited for co-digestion. No further studies were undertaken during 2019 and 2020.

Sewer and Effluent Heat Projects

The Sewer Heat Policy, which was approved by Metro Vancouver in 2014, enables member jurisdictions and businesses to evaluate the use of sewer heat, and provides a clear implementation path for promising situations. Member jurisdictions have assessed the potential use of sewer heat in coordination with Metro Vancouver at many locations since the policy was approved. As a result, some projects will not proceed, due to technical or economic challenges.

The City of Vancouver (CoV) is planning to increase energy supply at the Southeast False Creek

Neighbourhood Energy Utility (SEFC NEU) to supply low carbon energy that will meet growing demand as the system expands to new developments. CoV intends to extract additional sewer heat from a Metro Vancouver trunk sewer or a City sewer to add capacity. In 2017 and 2018, the City carried out further studies to screen options for sewerage diversion to the SEFC NEU plant and developed the design basis for the SEFC NEU expansion. Metro Vancouver's staff has continued to collaborate with CoV to explore the various proposed configurations. Final decision on sewage sourcing is anticipated in March 2019.

In 2019 and 2020, plans were advanced to develop policy and coordinate investments in sewer and effluent heat-sourced district energy projects, in collaboration with member jurisdictions, including the City of Vancouver, the City of New Westminster, the City of Richmond, the City of Surrey, and the City of North Vancouver. These plans are expected to lead to policy changes and investment decisions in 2021.

Funding for one project, the North Shore Wastewater Treatment Plant effluent heat recovery project, was approved by the Metro Vancouver Board. A contract was established with Lonsdale Energy Corporation for sale of recovered heat from the project. The project initiated design in 2020.

Projects are under development in the City of New Westminster, the City of Surrey, the City of Richmond, and the City of Vancouver, as well as with private development partners in certain locations. Several of these projects are in the early stages of project design. Collaborative capital investments in these projects are under consideration, as part of the policy changes described above.

In 2019 and 2020, the installation of a pipeline to deliver effluent for heat recovery by district energy systems and to deliver reclaimed water to nearby member jurisdictions was recommended during the conceptual design phase of the Iona Island WWTP. Further examination of the concept, including partner development and business case assessment, is expected to take place in 2021 and 2022.

Effluent Heat Recovery at Iona Island Wastewater Treatment Plant

No changes from the 2017 – 2018 Biennial report.

Biogas Energy Recovery

Biogas is created through anaerobic digestion processes at the four principal wastewater treatment plants in the region. At all Metro Vancouver WWTPs, some of the generated biogas is used to meet nearly all of the plants' heating needs, avoiding the use of natural gas and consequent greenhouse gas emissions. Excess biogas is used at the Iona Island and Annacis Island WWTPs to co-generate heat and electricity, and the new North Shore WWTP will do so as well. Plants that co-generate electricity reduce the need for additional electricity generation by BC Hydro, providing a complementary green and renewable electricity source.

In 2019 and 2020, construction was underway for the Lulu Island Renewable Natural Gas facility. This facility will clean up excess biogas, and sell the resulting renewable natural gas to FortisBC. The facility is expected to begin operation in early 2021.

In 2020, a feasibility study was conducted to determine the economic feasibility of recovering heat from effluent, to displace biogas use for heating at the Lulu Island WWTP. The concept was determined to be feasible, and approval was received for the Lulu Island WWTP Effluent Heat for the RNG project to be initiated in 2021.

In 2020, a feasibility study was initiated to determine the economic feasibility of switching from using excess biogas in co-generating engines to cleaning up and selling excess biogas as renewable natural gas to FortisBC. The study will be completed in 2021, and next steps determined as appropriate. Existing levels of recovered energy are shown in Table 10.

Phosphorous Recovery

In 2019 and 2020, the installation of phosphorus recovery equipment was considered during the conceptual design phase of the Iona Island WWTP. The business case for phosphorus recovery at this point is not strong enough to recommend equipment installation during the initial construction of the plant. However, it was recommended that space be allocated at the new plant for such equipment in the future.

Reclaimed Water

Reclaimed water fill stations are planned at the North Shore WWTP and at the Northwest Langley WWTP.

In 2019 and 2020, the installation of a reclaimed water fill station, and installation of a pipeline to deliver reclaimed water and to deliver effluent for heat recovery by district energy systems in nearby member jurisdictions, was recommended during the conceptual design phase of the Iona Island WWTP. Further examination of the concept, including partner development and business case assessment, is expected to take place in 2021 and 2022.

In 2019, it was determined that a Reclaimed Water Policy should be developed, to govern planned reclaimed water fill stations that are planned at the North Shore WWTP, the Northwest Langley WWTP, and may be incorporated to planning at the Iona Island WWTP. Policy development was deferred due to staffing constraints, but is scheduled to proceed in 2021.

It is anticipated that future reclaimed water fill stations will need market assessment and development to ensure that they are beneficially used. Such work in anticipated to take place in 2022.

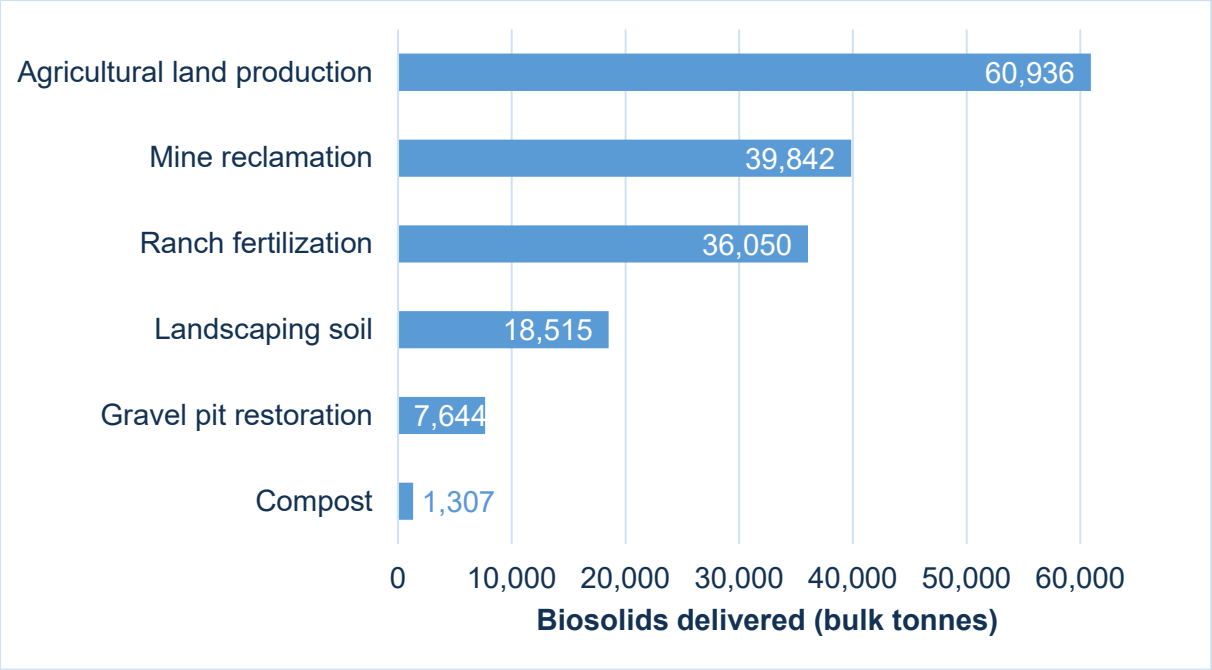
Biosolids

The beneficial use of biosolids recovers valuable nutrients from liquid waste. Metro Vancouver's biosolids are high in nutrients and organic matter that, when applied to land, improve soil health and water retention capability, increase vegetation growth, and enhance carbon sequestration.
In 2019 and 2020 Metro Vancouver's biosolids were used to:

- rehabilitate disturbed lands and create level fields for agricultural use in the BC Interior;

- reclaim mine sites through the provision of nutrients and organic matter to rebuild soil and re-introduce native vegetation;
- fertilize rangeland in the BC Interior that was degraded by overgrazing in the past;
- fabricate topsoil that was used for landscaping at major infrastructure projects, new developments and parks in the region;
- restore gravel pits through the placement of biosolids-amended soil; and
- create high quality compost, a new market for Metro Vancouver biosolids.

Figure 6 Metro Vancouver Biosolids Beneficial Use Program 2019-2020



Approximately 99.5 percent of the Organic Matter Recycling Regulation compliant biosolids produced at Metro Vancouver Wastewater Treatment Plants in 2019 and 2020 was beneficially used and returned nutrients to the land. The remainder was disposed in landfills due to pre-emptive action during incidents of elevated metals in the influent at our wastewater treatment plants.

Energy from Biosolids

The most feasible option for recovering energy from biosolids was previously determined to be a regional dryer that would produce dried pellets that can be used as a low-carbon fuel in local cement kilns. In 2019, the Metro Vancouver Board endorsed biosolids drying as a biosolids management option. A value-for-money analysis of procurement models for implementation of a regional biosolids drying facility was completed in 2020.

Action 2.1.2 – Implement appropriate business cases based on the results of 2.1.1 *(Ongoing).*

Reclaimed Water

For reclaimed water updates please see action 2.1.1

Action 2.1.3 – Work with municipalities to adapt plans and infrastructure for long term needs based on the results of 2.1.1 *(Ongoing).*

Plans and projects with member jurisdictions are described in section 2.1.1 under the Sewer and Effluent Heat Projects section and the Reclaimed Water section.

1.3. Goal 3: Effective, affordable and collaborative management

1.3.1. Strategy 3.1 Manage assets and optimize existing sanitary sewerage operations

Action 3.1.1 – Assess the performance and condition of regional sewerage systems by: (a) inspecting regional sanitary sewers on a twenty-year cycle and, (b) maintaining current maps of sewerage inspection, condition, and repairs *(Ongoing).*

GVS&DD has developed a program to inspect regional sewers using a variety of inspection techniques. It is possible to inspect most of the system using in-sewer CCTV (video) technology and in 2019 and 2020 a total of 66.9 km (approximately 13%) of GVS&DD sewers were inspected this way.

Many GVS&DD sewers are normally full (e.g. forcemains, pressure sewers, river crossings) and are not able to be inspected using traditional video inspection. GVS&DD has been developing a program to inspect these different types of sewers and several pilot projects have been completed in 2020 for a total of 1.4 km of full pipe inspections. This work will continue and expand in the future.

Sewer condition data is regularly summarized and added to Metro Vancouver's GIS mapping system to provide visual representation of the condition of the wastewater collection system.

Action 3.1.2 – Create incentives to reduce inflow and infiltration by adjusting Tier 1 sewerage cost allocation formulae within each sewerage area from an average dry weather flow basis (25^{th} percentile) to average wet weather flow (75^{th} percentile) with appropriate adjustments for combined sewerage areas. Tier 2 cost allocation would remain unchanged *(2010).*

Options for wet weather costing have been reviewed in 2020 with REAC and its Liquid Waste Subcommittee, including during pre-engagement activities for the review and update of the Integrated Liquid Waste and Resource Management Plan. This is anticipated to be a major focus during the forthcoming review and update of the ILWRMP.

Action 3.1.3 – In consultation with municipalities, review Metro Vancouver's safe operating head for regional sewers *(2011).*

A multi-year review of the original Safe Operating Head (SOH) levels in coordination with member jurisdictions was completed in 2020 fulfilling the requirement for Action 3.1.3. Review and development of SOH's will continue on an ongoing basis.

Action 3.1.4 – Develop and implement asset management plans targeting a 100-year replacement or rehabilitation cycle for regional sewerage infrastructure *(2013 for plans).*

Metro Vancouver has been managing the regional liquid waste infrastructure using various asset management approaches for several years. The utility is working towards formalizing these work processes and guidelines for asset management.

As noted in the 2017-2018 Biennial Report, replacing infrastructure on a 100-year age-based cycle without understanding the risk to "Levels of Service" is not necessarily the most cost effective or best asset management strategy. Many complex, often competing factors such as capacity (growth), condition, performance, and reliability influence decisions.

Metro Vancouver has developed a draft 30-year capital and operating spending projections including infrastructure renewal to address longer term risks to the services that Liquid Waste Services (LWS) provide. These are currently under internal review.

Metro Vancouver has also developed an asset assessment framework that outlines requirements to conduct asset condition and performance assessments in a standard and repeatable manner. The data generated from these assessment activities will be used to identify infrastructure investment needs and will be reported in asset management plans. Until the condition and performance data is available, asset age can be used as a proxy.

Metro Vancouver will be developing asset management plans as identified in the Asset Management for Liquid Waste Services policy approved in September 2018.

The age of Metro Vancouver's sewers is shown on Table 7.

Action 3.1.5 – Update and implement asset management plans for wastewater treatment plants which address risks, including climate change and seismic events, and maintain performance in wet weather (2013*).*

Metro Vancouver considers risks to the regional WWTPs in its design and facility planning. As an example, through the Project Definition Phase, the new North Shore WWTP was designed to adapt to the sea level rise due to climate change, and is being constructed in accordance with the National Building Code of Canada to address risks associated with seismic events. Plant capacity will be sufficient to treat twice the average dry weather flow through secondary treatment components and convey excess flows through primary treatment. The design flows incorporate future reduction in inflow and infiltration by member jurisdictions.

The risks for the Iona Island WWTP treatment upgrade will be addressed during the Project Definition Phase of the project. Other projects such as the Annacis Stage 5 Expansion and Northwest Langley Expansion are being designed to consider long term resiliency requirements, such as major seismic events, floods and sea level rise. Projects to improve the reliability of treatment processes including the Annacis Island Cogeneration Backup Power upgrade are also being implemented.

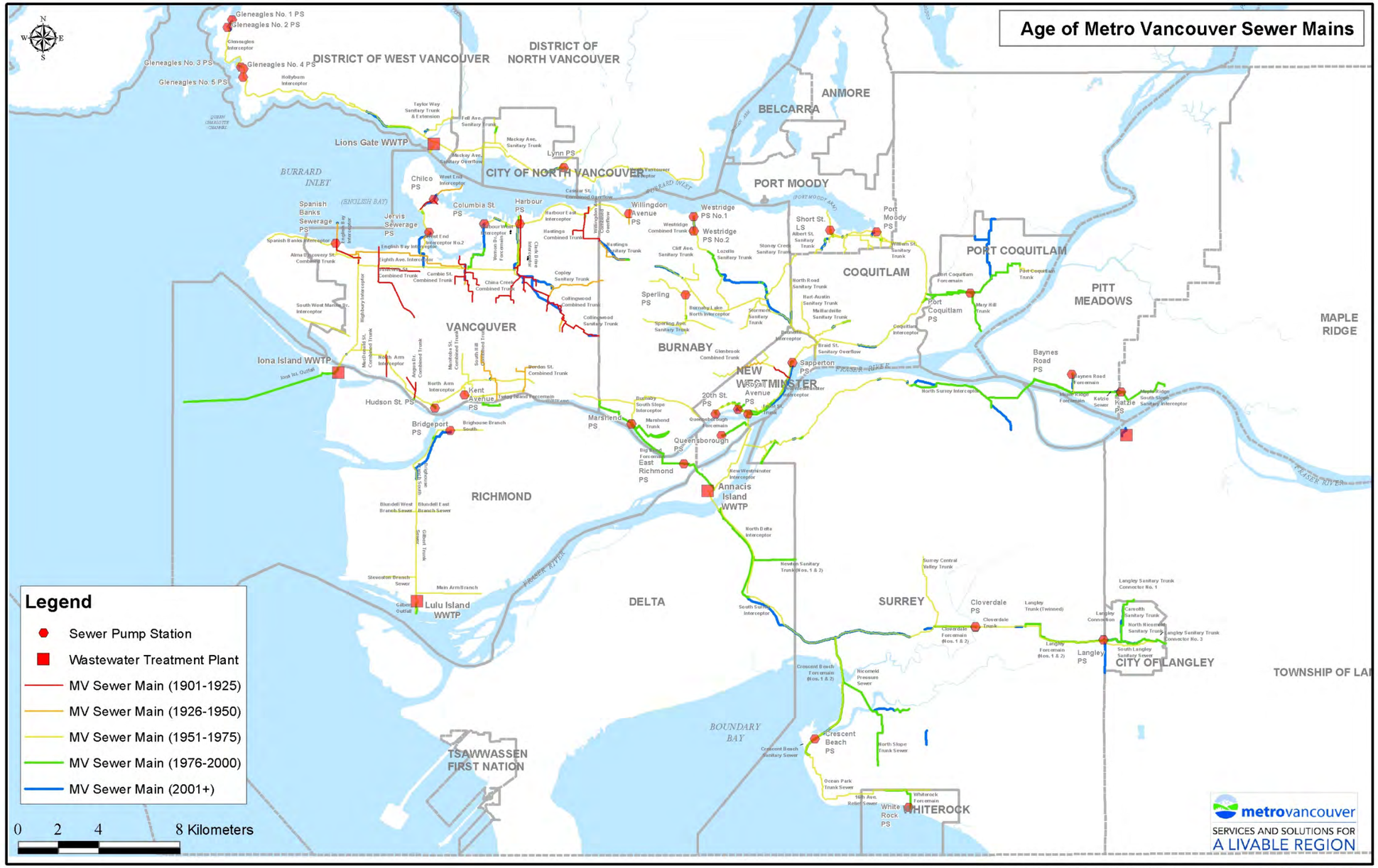


Figure 7 Age of Metro Vancouver Sewers

1.3.2. Strategy 3.2 Use innovative approaches and technology

Action 3.2.1 –	With financial support from provincial and federal governments and the University of British Columbia, develop the Annacis Island Sustainability Academy to support innovative research and demonstration projects in liquid waste management *(Facility by 2011).*

Wastewater Research

The Annacis Research Centre (ARC), which is located next to the Annacis Island Wastewater Treatment Plant, exists to support liquid waste research, training, conferences, and education. Many research projects were conducted in 2019 and 2020, including trials by private sector firms, by Metro Vancouver, and by the University of British Columbia. Many projects were undertaken in partnership among these parties and other agencies, such as the Vancouver Aquarium. Projects included techniques for enhancing sludge destruction; annamox bacteria for ammonia removal; methods of detecting contaminants of emerging concern; detecting microplastics to better understand their impacts on aquatic life; H_2S mitigation in sewer collection systems; water treatment technologies for capturing water and chemicals from industrial processes; and other privately patented technologies for removing contaminants from wastewater.

Several projects have been developed in collaboration and with support from other agencies and funders such as NSERC. Techniques for enhancing sludge destruction were explored in collaboration with the University of British Columbia, with additional funding received from NSERC. Methods of detecting contaminants of emerging concern were explored in collaboration with Simon Fraser University. Microplastics concentrations in wastewater are being explored in collaboration with the Vancouver Aquarium.

Several private firms and academic institutions undertook research at ARC during 2019 and 2020, including Axine Water Technologies; Mangrove Water Technologies; Prongineer R&D; Sanzfield Technologies; and the University of British Columbia (in collaboration with Metro Vancouver).

Action 3.2.2 –	Collaborate with local and senior governments, academic institutions and industry in research on wastewater treatment technology and stormwater management and associated demonstration projects, training and development of educational toolkits *(Ongoing).*

Wastewater Biomass to Biocrude – Hydrothermal Processing (HTP):

Preliminary design process for the demonstration facility at AIWWTP was initiated in 2019 and continued in 2020. A risk analysis was also carried out. Project includes the design, fabrication, commissioning, and evaluation of an advanced biofuel production facility converting wastewater biomass to a biocrude oil.

Request for Statement of Qualifications (RFQ) for a design-build contract for the Inside Battery Limits portion of the pilot facility was issued in Q3 2020.

Genomics Approach to Anaerobic Digestion Optimization (GAADO)

Design for a pilot anaerobic digester (AD) at Lulu Island WWTP was completed and procurement initiated. A pilot digester will facilitate the investigation of innovative sludge digestion optimization techniques, including testing of the RNG Optimizer, and enable operational wastewater treatment improvements that can result in reduced greenhouse gas emissions.

Advanced Resource Recovery from Wastewater

A 5-year Industrial Research Chair (IRC) program funded by the Natural Sciences and Engineering Research Council (NSERC) and Metro Vancouver was established at UBC Okanagan. The IRC program is focusing both on the operational optimization and resource recovery from hydrothermal processing as well as the development of a bioreactor that will boost renewable methane production from existing anaerobic digesters at wastewater treatment plants.

Renewable Natural Gas (RNG) Optimizer: Metro Vancouver is developing a bioreactor (RNG Optimizer) that shifts anaerobic digestion microbiome community to more methane-producing micro-organisms to increase methane production at wastewater treatment plants. The goal of 25% boost in RNG production would displace conventional natural gas use and reduce regional GHG emissions. A patent was filed in June 2020 by Metro Vancouver for this enhanced digestion process.

Action 3.2.3 – Undertake an annual internal audit of the best practices of one regional liquid waste management sub program and environmental management system to identify opportunities for innovation and improvements *(Annually).*

In 2019 and 2020, Metro Vancouver worked with LWS management and staff in reviewing requested improvement initiatives as discussed below.

- In 2019, a business process review of the Annual Sewer Pipe Inspection Program was completed. This review focused on the current "as-is" inspection practices by work team members who were actually involved in the process. Program challenges, causes and effects, and ideas for improvement were identified and provided to the responsible manager for improvement consideration.

- In 2019, an employee survey was initiated to determine the efficiency and effectiveness of the Technical Knowledge Management Program. This project was specifically focused on the model adopted for the delivery of technical knowledge. Work included staff interviews to collect information regarding the process for developing technical knowledge content and the processes and tools used to deliver technical knowledge content to staff. The employee survey results were

compiled and reviewed and were provided to the responsible manager for improvement consideration.

- In 2019, a business process review on Engineering Design and Construction (EDC) Project Management Framework was initiated. A work team comprising of selected project managers was established to map, study and analyze the current state "as-is" process. Improvement ideas were identified and are currently being prioritized for design and implementation in 2021.

1.3.3. Strategy 3.3: Monitor the performance of the liquid waste system and impacts on the receiving environment

Action 3.3.1 – Continue to monitor the ambient environment conditions of relevant water bodies in the region in conformance with the Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CWS-MMWE) requirements, and work with the Ministry of Environment in developing Environmental Quality Objectives *(Ongoing).*

In 2019 and 2020, Metro Vancouver conducted ambient environment monitoring of water bodies that may be influenced by the liquid waste discharges in the region (refer to Ministerial Condition 6 for details). The results of these monitoring programs were shared with the BC Ministry of Environment and Climate Change Strategy and with other members of Metro Vancouver's Environmental Monitoring Committee on an ongoing basis. The information that may be pertinent for development of environmental quality objectives was made available to the regulatory agencies mandated with development of Provincial environmental quality objectives.

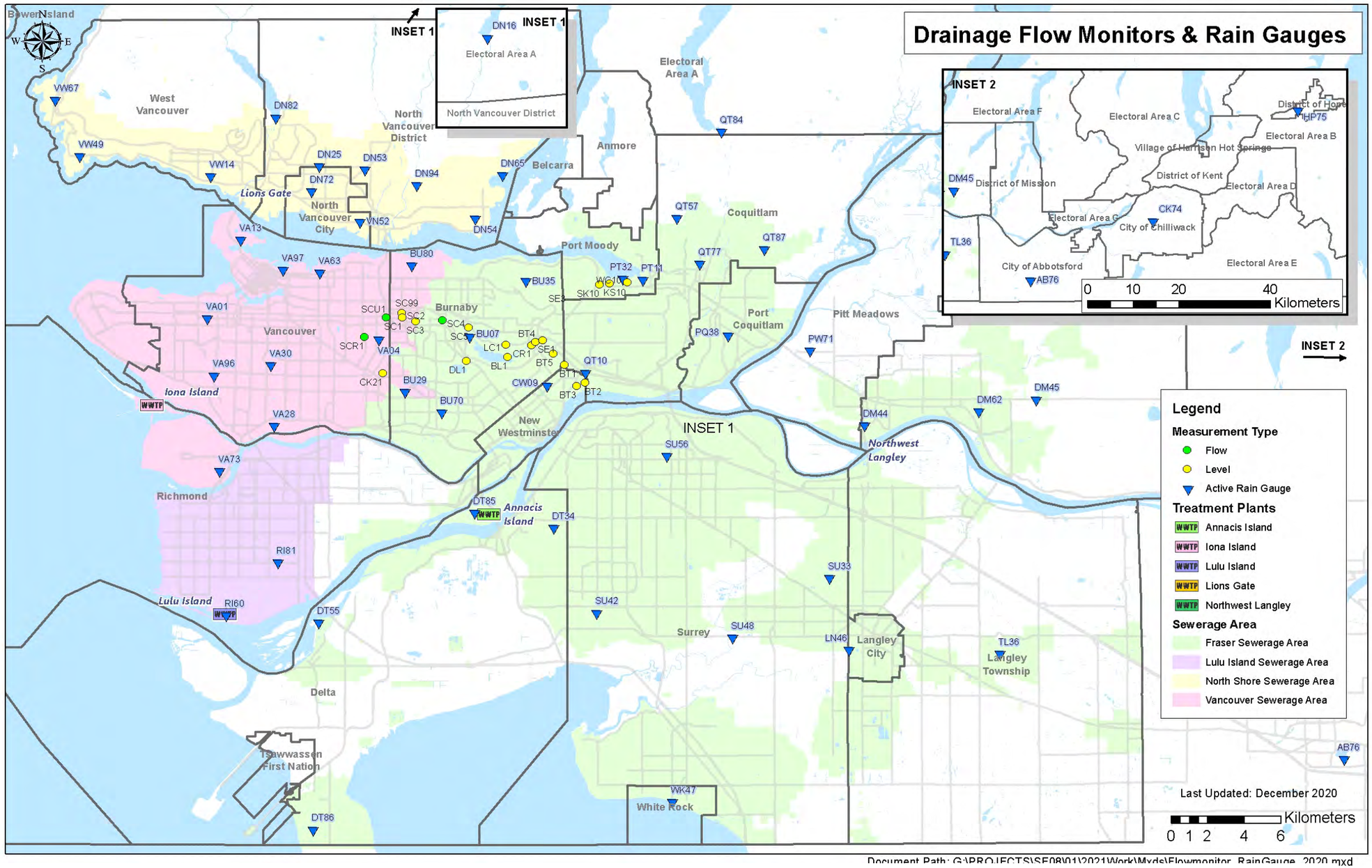
Action 3.3.2 – Continue to monitor the quality and characteristics of Metro Vancouver's liquid waste point discharge to the environment in conformance with the Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CWS-MMWE) requirements to meet Environmental Discharge Objectives *(Ongoing).*

The Environmental Management and Quality Control Annual Reports for GVS&DD summarize the regulatory and process monitoring information through the programs in place at Metro Vancouver. The Annual Report for 2019 is available on Metro Vancouver's website: http://www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/2017GVSDD-EMQCAnnualReport.pdf.

The 2020 Annual Report is being prepared and will be available on the Metro Vancouver web site in the second half of 2021.

Action 3.3.3 – Continue to operate its regional data collection network for sewers, rainfall and streams and use that data to assess the effectiveness of actions taken under this plan *(Ongoing).*

The location of Metro Vancouver's sewer flow meters, stream gauges and rain gauges are shown on Figure 8 Sewer and Drainage Monitoring Sites – Metro Vancouver Rain Gauge Network to Figure 13.



.Figure 8 Sewer and Drainage Monitoring Sites – Metro Vancouver Rain Gauge Network

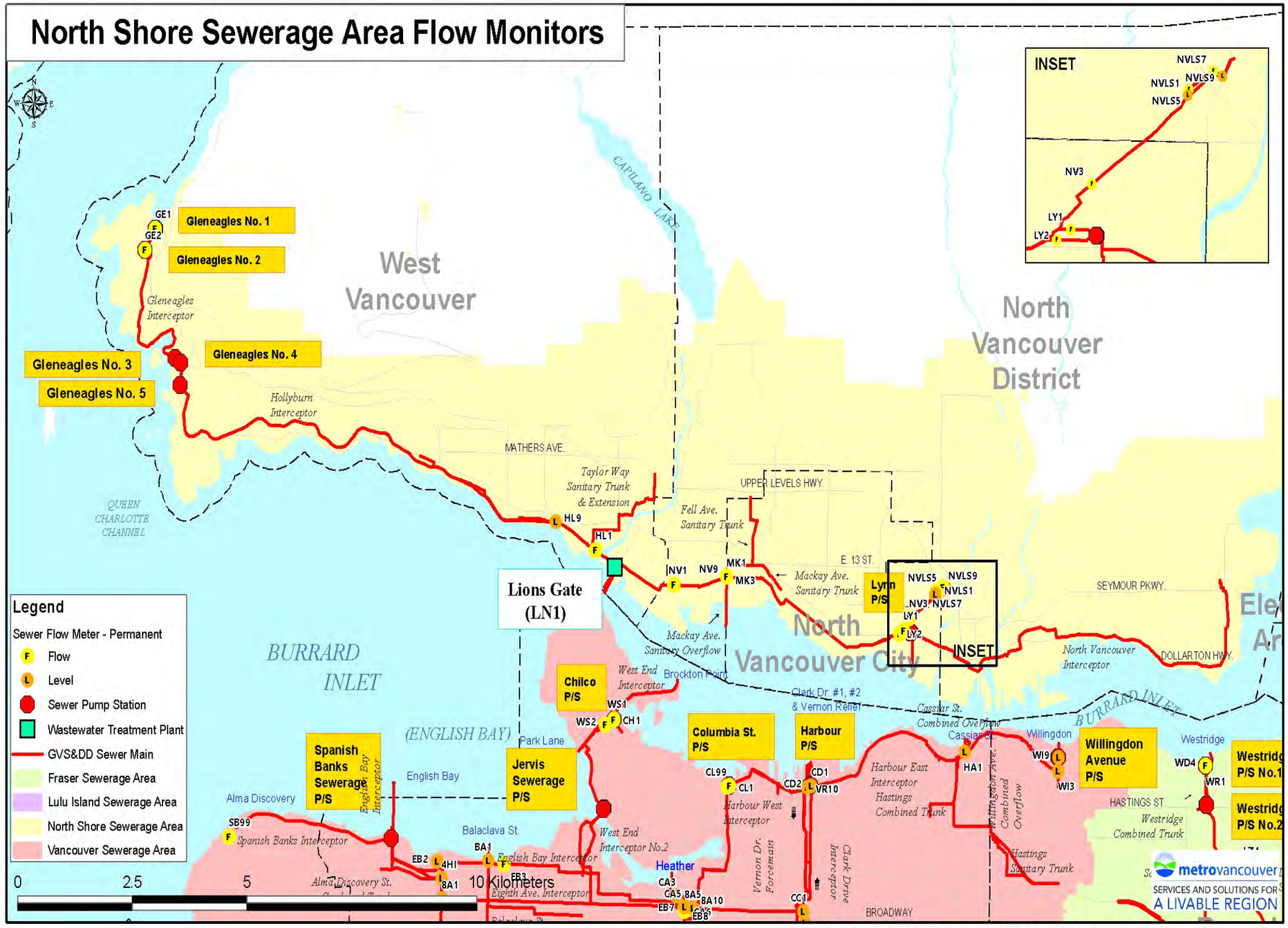


Figure 9 Sewer and Drainage Monitoring Sites – North Shore

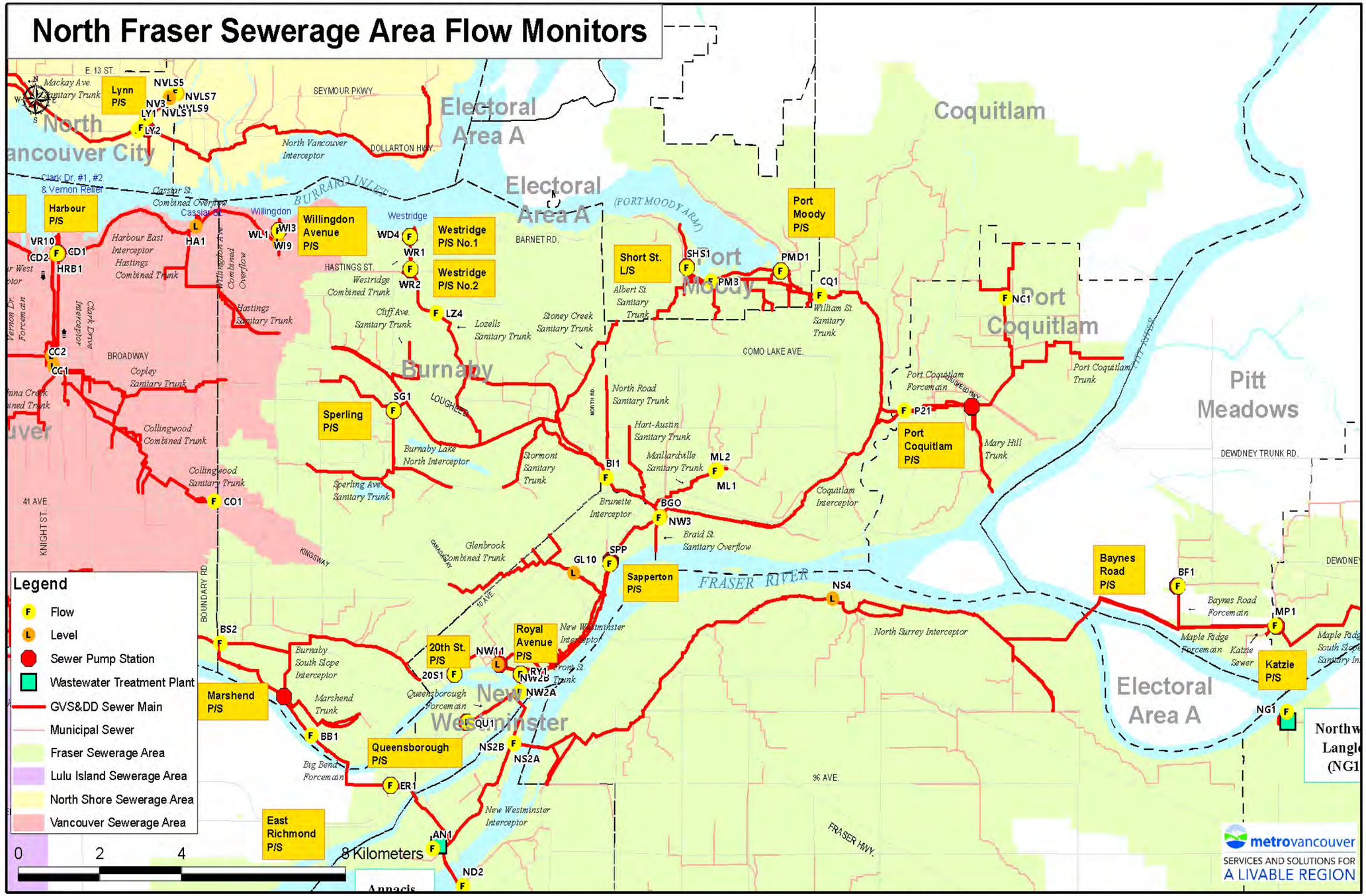


Figure 10 Sewer and Drainage Monitoring Sites – North Fraser

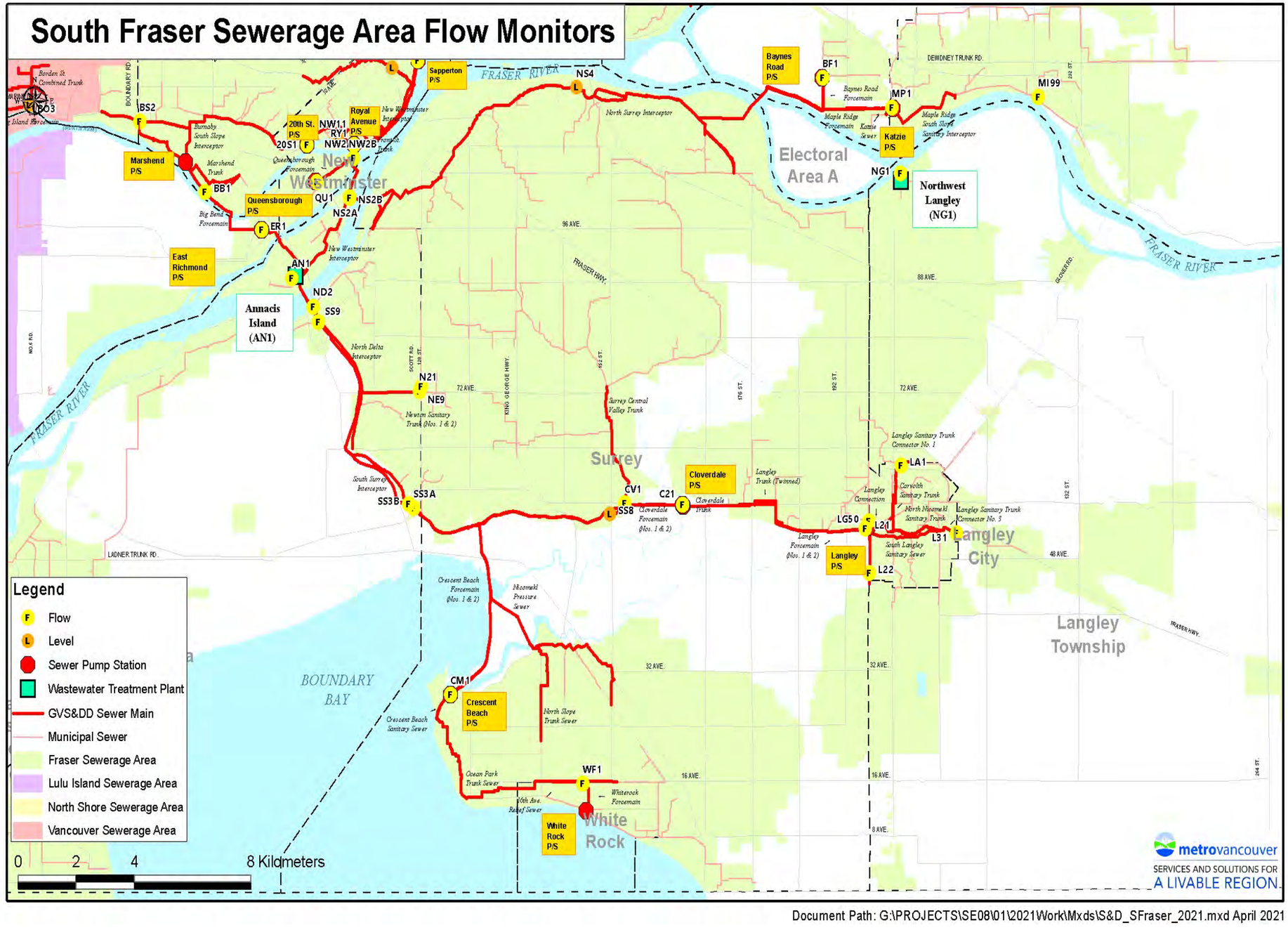


Figure 11 Sewer and Drainage Monitoring Sites 1- South Fraser

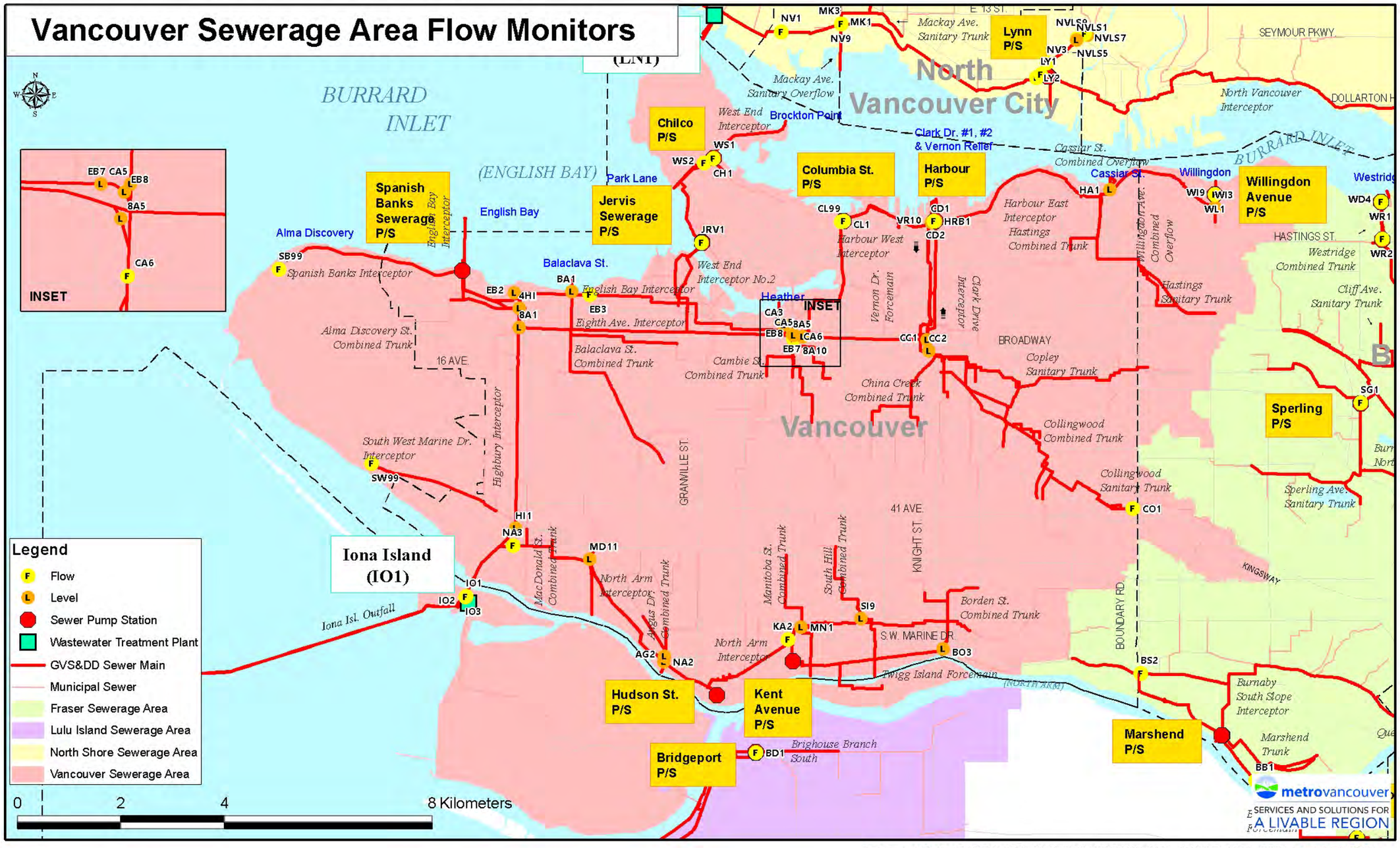


Figure 12 Sewer and Drainage Monitoring

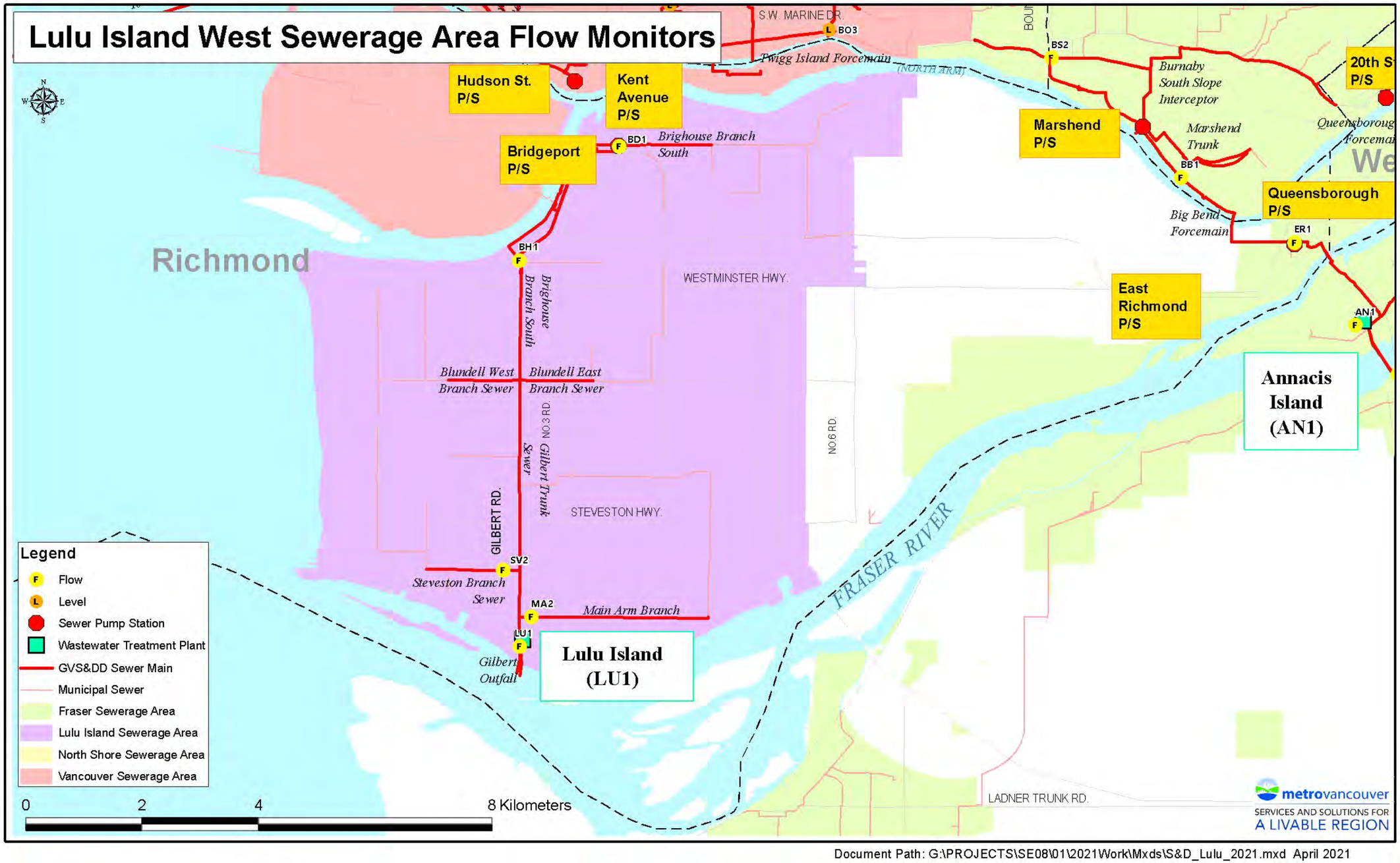


Figure 13 Sewer and Drainage Monitoring Sites – Lulu Island

Action 3.3.4 – In collaboration with municipalities, estimate and document the greenhouse gas emissions and odours associated with the operation of the municipal and regional liquid waste management systems, see Actions 1.3.8, 1.3.10, 1.3.15, and 1.3.17 *(2012).*

Liquid Waste management-related greenhouse gas emissions and energy use in 2019 and 2020 are shown in Figure 7 and Figure 8, respectively. Hauling and fleet data is now included.

Table 7 Liquid Waste Greenhouse Gas Emissions 2017-2018 (Tonnes of CO2e)

Location	2019	2020
Annacis Island WWTP	1,849	692
Iona Island WWTP	2,598	371
Lulu Island WWTP	426	212
Lions Gate WWTP	397	392
Northwest Langley WWTP	878	56
Residuals	1,024	Not available
Collections System	259	242
Fleet	658	Not available
TOTAL	8,086	1,965

Table 8 Estimates of Annual Energy Use (GJ)

Location	Energy Use: Purchased and Self-generated	
	2019	2020
Annacis Island WWTP	439,149	485,917
Iona Island WWTP	268,569	206,168
Lulu Island WWTP	78,965	70,032
Lions Gate WWTP	55,332	54,325
Northwest Langley WWTP	29,931	18,802
Residuals	13,558	0
Collections System	77,307	81,635
Fleet	9,649	0
TOTAL	972,459	916,879

Action 3.3.5 – Estimate and report on the frequency, location and volume of sewerage overflows from regional combined and sanitary sewers, and where feasible identify and address the probable causes *(Ongoing).*

Metro Vancouver has developed public awareness material and is participating in a national initiative to control the production of pump clogging materials that are being flushed into the sewerage system.

During the 2019-2020 period there were a total of 128 SSOs, 81 of which were wet weather related. The locations and details of the overflows are provided in Figure 17 through Figure 20, pages 81 to 84 of this report.

1.3.4. Strategy 3.4: Provide resilient infrastructure to address risk and long-term needs

Action 3.4.1 – Design and adapt infrastructure and operations to address identified risks and long-term needs, including risks associated with climate change *(Ongoing).*

Climate Change Risk

The construction of the AIWWTP Expansion and the new AIWWTP Outfall have taken sea level rise into account. Similarly, the design of the new Glen Eagles Pump Station 1 in Horseshoe Bay has taken revised sea level projections into account. Also, the NLWWTP is 200-year flood including climate change and a 0.5-meter safety factor. The new NSWWTP and the future IIWWTP are being designed/constructed with climate change in mind, including taking sea level into account.
Climate 2050 is Metro Vancouver's overarching long-term strategy that will guide our region's climate policies and collective actions over the next 30 years. Within Climate 2050, Metro Vancouver is developing a Water and Wastewater Infrastructure Roadmap that will outline actions to ensure that our water and wastewater systems are carbon neutral and climate resilient by 2050. The Roadmap development process is underway and began with a discussion paper published in early 2021 and will be aligned with the review and update of the ILWRMP.

Seismic Risk

The construction of the AIWWTP Expansion and the new AIWWTP Outfall are designed to take seismic risks into account, and the AIWWTP Expansion is designed as a post disaster structure.

Action 3.4.2 – In collaboration with municipalities and the Integrated Partnership for Regional Emergency Management (IPREM), develop emergency management strategies and response plans for municipal and regional wastewater collection and treatment systems, including identifying and maintaining a system of emergency wastewater overflow locations *(2015).*

Work continued on the development of an operational level communications and decision making guideline for regional water and liquid waste services (the regional Utility Operational Coordination Guide or UOCG). A table-top exercise was held in November 2019 with 76 participants representing 17 of the member jurisdictions of Metro Vancouver. This exercise confirmed the efficacy of the UOCG and identified areas for improvement. This exercise was the last condition for RAAC adoption of the Coordination Guide. In addition to the UOCG progress, the establishment of a mutual aid agreement between all GVS&DD member jurisdictions has been initiated.

Action 3.4.3 –	Ensure liquid waste infrastructure and services are provided in accordance with the Regional Growth Strategy and coordinated with municipal Official Community Plans *(Ongoing).*

No change from the 2017-2018 Biennial Report.

The regional growth strategy continues to be used to direct the provision of liquid waste services. *Metro Vancouver 2040: Shaping our Future* (Metro 2040), remains the regional growth strategy and was adopted by the Metro Vancouver Board as Bylaw 1136 on July 29, 2011. Through the strategy, the GVS&DD is directed not to extend sewer services into those areas outside the urban containment boundary as defined by *Metro 2040* unless the MVRD Board considers the application to be consistent with the provisions of *Metro 2040* or grants an exception. *Metro 2040's* Guideline #7 - Extension of Regional Sewerage Services, provides assistance with the interpretation of sewer service extension. Refer to Figure 14 on page 51.

1.3.5. Strategy 3.5: Use collaborative management to address evolving needs

Action 3.5.1 –	Establish a new overarching committee, the Integrated Utility Management Advisory Committee (IUMAC), to advise Metro Vancouver on plan implementation, particularly from the perspectives of integrated planning and resource recovery across utility systems *(2010).*

Refer to the last 2017 – 2018 Biennial Report.

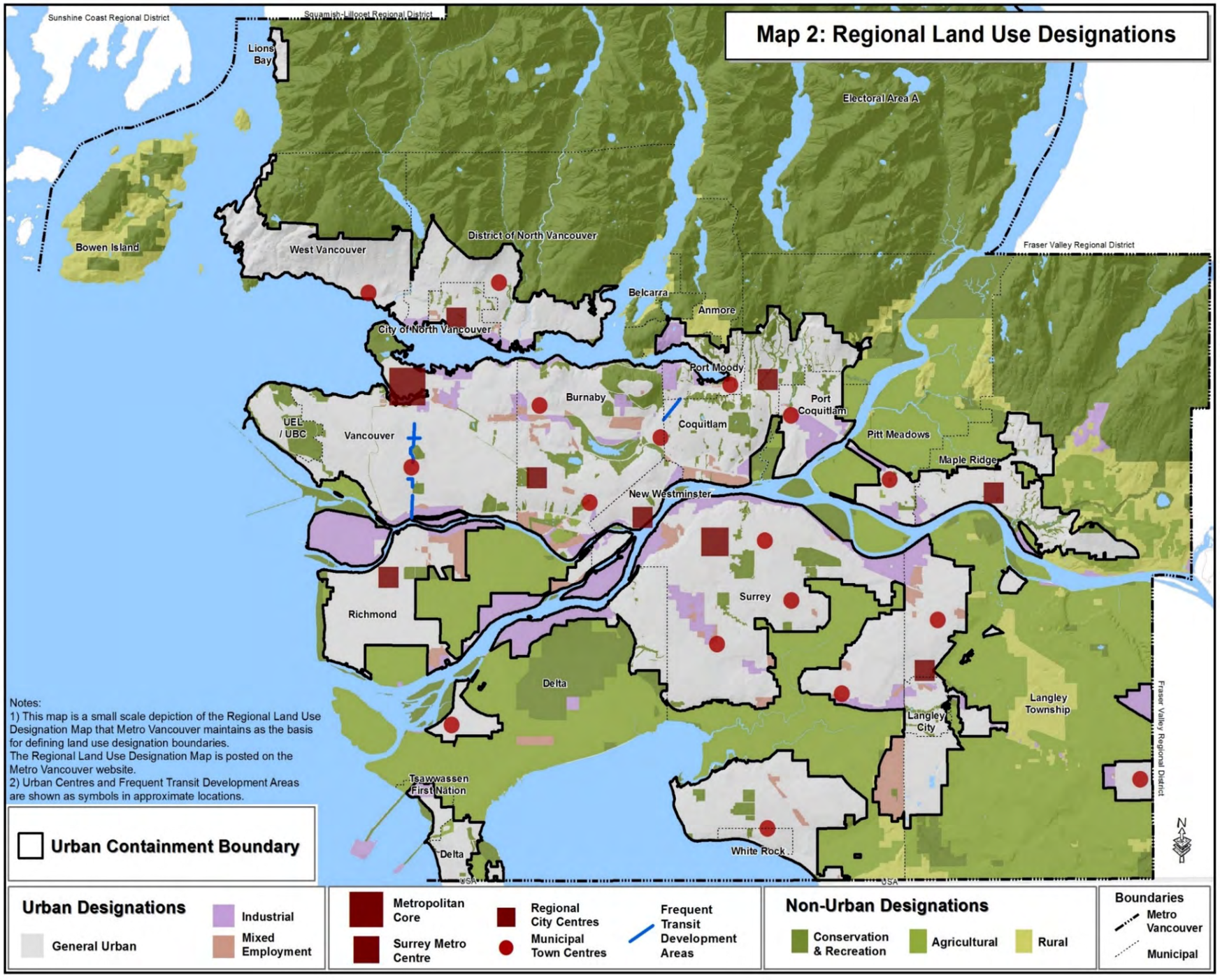


Figure 14 RGS Urban Containment Boundary

Action 3.5.2 – Continue to receive advice from the Environmental Monitoring Committee (EMC) and Stormwater Interagency Liaison Group (SILG) as subcommittees under IUMAC *(Ongoing).*

The EMC and SILG continued to meet regularly in 2019 and 2020. Major EMC activities included discussions associated with:

- The ongoing review of the ambient, receiving environment, and recreational water quality monitoring programs, and the new approaches to environmental monitoring in the region;
- The development of the EDOs associated with the Northwest Langley WWTP upgrade;
- Updating the terms of reference for the EMC;
- Investigation of viruses in wastewater;
- Updates on the status of the Northwest Langley WWTP expansion, and Iona Island WWTP Upgrade;
- Iona Island WWTP dye dispersion study;
- The results of the sediment surveys in the vicinity of selected Metro Vancouver's CSO outfalls;
- Results of the Monitoring and Adaptive Management Framework for Stormwater;
- Burrard Inlet 3-D estuarine circulation and effluent transport model;
- Public notification of sewer overflows and WWTP process interruptions; and
- Review and update of the ILWRMP.

Major SILG activities for this reporting period included discussions on:

- Stormwater tree trench research and preliminary monitoring results;
- Neighbourhood scale stormwater management;
- Groundwater issues;
- Purple roof (detention plus retention) research;
- Environmental technology performance and verification process;
- Bioretention soil, planting and maintenance strategies;
- Erosion and sediment control best practices and municipal regulatory approaches;
- Effective maintenance and operation of green infrastructure including staff training and certification options;

- Development of Watershed Condition Objectives for BC's South Coast Region by Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD);
- Adaptive Management Framework Development and Municipal Implementation, data sharing and interpretation;
- Stormwater source controls in public spaces;
- UBC Sustainability Scholar research findings related to stormwater source controls;
- Oceanwise initiatives on microplastics in urban watersheds and the Pollution Tracker monitoring in receiving environments.

In 2020, SILG also reviewed its membership and 5-year work plan and elected a new Chair.

Action 3.5.3 –	Use the Burrard Inlet Environmental Action Program and the Fraser River Estuary Management Program Management Committee (BIEAP-FREMP) as the senior level forum for discussion of policy and assessment of the scientific work related to the plan, and for resolving toxicity concerns and any disputes among its members related to implementing the Plan *(Ongoing).*

BIEAP-FREMP was dissolved in March 2013; see the 2015-2016 Biennial report for context. In late 2020, the GVS&DD Board endorsed inviting senior government agencies to participate in a multi-stakeholder task force to consider the feasibility of reinstating the BIEAP – FREMP. This motion also included direction to write letters to provincial and federal ministers, the Port and First Nations whose territories encompass the Burrard Inlet or the Fraser River, as recorded in British Columbia's Consultative Areas Database.

Action 3.5.4 –	Biennially produce a progress report on plan implementation for the distribution to the Ministry of Environment that: (a) summarizes progress from the previous two years on plan implementation, for all Metro Vancouver actions, including the status of performance measures, (b) includes summaries and budget estimates for proposed LWMP implementation programs for the subsequent two calendar years *(By July 1st biennially)*

The first biennial report under the ILWRMP, covered the three-year period 2010-2012 to address the transition from the previous LWMP. Subsequent biennial reports under the ILWRMP cover the period 2013-2014, 2015-2016, and 2017-2018. This is the fifth biennial report under this plan and covers the period 2019-2020. A total of four biennial reports were produced under the previous LWMP that was approved in 2002.

Action 3.5.5 – Hold a public accountability session based on the biennial reports (Actions 3.5.4 and 3.5.8) by making the report available through Metro Vancouver's website and by holding a special meeting of the Metro Vancouver Waste Management Committee to receive public comments and input on the report *(Biennially).*

This action was completed in 2019.

Action 3.5.6 – Report directly to the Ministry of Environment annual progress on integrated stormwater management plan implementation and all occurrences of sanitary sewer overflows *(By March 1st annually).*

The latest annual report under the IWLRMP was submitted to the Ministry of Environment on March 1, 2020 as the *Interim Report: 2019*. It included a figure showing locations and volumes of all wet weather sanitary sewer overflows and municipal ISMP progress for 2019. The annual reporting for 2020 is included in this biennial report.

Action 3.5.7 – In collaboration with members and the Ministry of Environment, undertake a comprehensive review and update of the Plan on an eight-year cycle (Every eight years).

The ILWRMP was approved in 2011 which would have resulted in the comprehensive review of the plan starting in 2019. In 2019, the Ministry of Environment and Climate Change Strategy granted Metro Vancouver an extension to the review cycle of the LWMP. As part of the extension, Metro Vancouver submitted to the Ministry in 2020 a proposed strategy to review and update the plan. Ministerial approval to proceed to implement the strategy was granted in 2021 Q1.

Ministerial Conditions

Ministerial Condition 1 – The ministry supports upgrading to secondary level treatment the Lions Gate Wastewater Treatment Plant by 2020 and Iona Island Wastewater Treatment Plant as soon as possible, but no later than 2030 and not contingent on the availability of senior government funding. The Ministry of Environment is not a funding agency. While I understand the cost of the upgrades is significant, they are necessary to meet current environmental standards. The Ministry will support Metro Vancouver pursuing senior government and alternative funding options, but cannot guarantee any provincial commitment in that regard, nor compromise the Ministry's mandate to protect the environment.

Construction of a new North Shore WWTP to replace the Lions Gate WWTP started in 2017. The budget for this work is $1.058 billion, with $212.3 million in grant funding from the federal government and $193 million in grant funding from the provincial government. Once the new secondary level wastewater treatment plant is operational in 2024, the existing Lions Gate WWTP will be decommissioned. The final phase of the Iona Island Wastewater Treatment Plant project definition and

indicative design process started in the Fall of 2018 and is planned for completion in early 2022. Early site preparation, permitting and consultation work continues. The project definition report will identify capital and operating cost impacts and affordability options

Ministerial Condition 4 - Metro Vancouver must use receiving environmental and effluent monitoring data from combined sewer overflow (CSO) and sanitary sewer overflow (SSO) in the regional system to interpret the overall status of CSOs and SSOs. Metro Vancouver will continue the fate and effects studies on CSOs with the Clark Drive location and other significant sites as determined by the Environmental Management Committee. Metro Vancouver will establish similar studies representative of significant SSO locations, in particular the Cloverdale, Katzie and Lynn locations. The interpretation and assessment should demonstrate whether there has been any improvement or degradation along with any measures taken to address such discharges. Metro Vancouver will report out in the Quality Control Annual Report.

Sanitary Sewer Overflows

Metro Vancouver continues to conduct receiving environment water quality monitoring following each SSO event. Receiving environment water quality data, observations and impact assessments are provided to regulatory agencies and member jurisdictions in end-of-spill reports that include information on SSO location, date and time (start/end), duration, volume, estimated cause, immediate actions taken to minimize duration of the SSO and mitigate the impact, and planned long-term actions to eliminate it.

In 2020 a comparative risk assessment was completed for Metro Vancouver's 33 sewer pump stations. Using hydrodynamic modelling of potential overflows and historical SSO data, each pump station was risk assessed and then ranked to determine the level of risk that overflows may have on human health and the receiving environment. Similar work was completed in 2018 for 24 recurring SSO locations. This pump station risk assessment was integrated with the 2018 SSO risk assessment to allow prioritization of resources to the highest risk spills in the event of multiple emergency spills. An updateable risk ranking tool was also developed to enable reassessment of risks as new information becomes available or infrastructure upgrades take place.

Combined Sewer Overflows

The CSO Receiving Environment Monitoring Program includes determination of receiving environment water quality; sediment monitoring, chemical analysis and toxicity testing; and benthic invertebrate community structure assessments. In 2019 and 2020, Metro Vancouver completed a receiving environment effects survey report for the Angus and Glenbrook CSOs, continued work for English Bay and Borden CSOs, and completed field work for Heather and South Hill CSOs. Location of CSO receiving environment monitoring surveys conducted in 2019 and 2020 and are shown on Figure 16. Findings of the Angus and Glenbrook CSOs surveys were presented to the EMC and results will be reported in the

2020 EMQC Annual Report for GVS&DD which will be available on the Metro Vancouver website at http://www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/2017GVSDD-EMQCAnnualReport.pdf when complete.

Metro Vancouver's CSO discharge monitoring and characterization work is discussed under Ministerial Condition 6.

In 2020, a comparative risk assessment was completed for Burrard Inlet CSOs. Using discharge and receiving environment data and hydrodynamic modelling of potential discharges, each CSO was risk assessed and then ranked to determine the level of risk that overflows may have on human health and the receiving environment. A risk ranking tool was also developed to enable reassessment of risks as new information becomes available or infrastructure upgrades take place.

Ministerial Condition 5 – Metro Vancouver is encouraged to continue to build upon previous studies associated with studying endocrine-disrupting chemicals, persistent organic pollutants and other micro-contaminants found in the wastewater by developing source control initiatives through education (for example, target outreach), regulation and inspection programs.

Please refer to sections 1.1.12(f) and 1.1.5 of this report.

In 2020, Metro Vancouver initiated efforts to develop a *compounds of environmental concern (CECs) management strategy* that will concurrently pursue source control as a primary line of defense; invest in feasible advanced treatment technologies; and pursue research and innovation to better assess these complex contaminants and the risks they present.

Ministerial Condition 6 – Metro Vancouver will continue the receiving and ambient monitoring programs specified in the approved 2002 LWMP, including, but not limited to, recreational water quality (beach monitoring); monitoring near the outfalls for all five wastewater treatment plants, including the extensive deep sea monitoring near the Iona Island plant; and CSO effluent quality and monitoring of small urban streams relating to impacts from urbanization and stormwater.

Environmental Monitoring Programs

Metro Vancouver conducts receiving and ambient environment monitoring programs in areas where water quality has the potential to be affected by wastewater and stormwater discharges. The information and data collected from the monitoring work are used to provide baseline environmental quality data, determine whether the discharges meet water quality guidelines and site-specific objectives, develop indicators of environmental change, characterize changes in environmental quality, and evaluate trends within the monitoring areas over time.

Metro Vancouver has established receiving environment monitoring (REM) programs for Iona Island, Lions Gate and Annacis WWTPs and ambient monitoring programs for the water bodies into which they discharge: the southern portion of the Strait of Georgia, Burrard Inlet and the lower Fraser River, respectively. Although there are no WWTP discharges to Boundary Bay, during 2019 and 2020 Metro Vancouver also monitored Boundary Bay.

Additional receiving environment programs include recreational water quality monitoring and monitoring in the vicinity of SSO and selected CSO discharge points. In addition, monitoring is done to characterize the discharge quality of combined sewer overflows.

In 2019, reports were completed for additional monitoring efforts conducted in 2017 and 2018 in support of the Annacis Island and Northwest Langley WWTP upgrades. This information will also enhance existing, and provide a basis, for new environmental monitoring programs, as and when needed.

Ambient Environment Monitoring

The Strait of Georgia ambient environment monitoring program is currently being conducted in partnership with the University of British Columbia (UBC) Department of Earth, Ocean and Atmospheric Sciences under a five-year Natural Science and Engineering Research Council of Canada (NSERC) Collaborative Research and Development (CRD) grant awarded in the summer of 2016. The five-year program's objective is to understand the scale of Metro Vancouver's Iona Island WWTP marine outfall footprint, and pathways, cycling, fate and variability of organics and selected metals.

The Fraser River, Burrard Inlet, and Boundary Bay ambient environment monitoring programs are intended to evaluate the effects of point and non-point source discharges in the Region to receiving water bodies in the context of the Metro Vancouver liquid waste discharges. Each program operates on a five-year cycle and consists of water column monitoring every year, sediment monitoring every two to five years and biota monitoring approximately every five years. A review of each program is carried out on a five-year cycle. Monitoring results are compared to applicable environmental criteria. The plans and results of all monitoring programs are regularly discussed by the Environmental Monitoring Committee.

Metro Vancouver is reviewing its Receiving Environment Monitoring (REM) and ambient monitoring Programs to refine/improve sampling methodology as well as to identify efficiencies from conducting them as amalgamated programs. This will allow for a more holistic water body approach. In Burrard Inlet, the Ambient Monitoring Programs for the water column and sediment quality have been fully incorporated into the Initial Dilution Zone Boundary water column and the Sediment Effects Survey for the Lions Gate REM program, respectively. With further progress of amalgamation of the Burrard Inlet-Lions Gate environmental monitoring programs similar efforts will be made toward the integration of environmental monitoring programs in the Strait of Georgia and the Fraser River.

In 2020, Metro Vancouver undertook a comprehensive review of its environmental monitoring programs within the Fraser River, Burrard Inlet and Strait of Georgia to better understand the influence of wastewater discharges from the region's wastewater treatment plants (WWTPs), CSOs and SSOs.

Considering that no WWTPs discharge treated effluent into Boundary Bay, it was deemed that the 2018 review of the monitoring programs for Boundary Bay already provides a comprehensive overview of the point and non-point sources impact on the environmental quality of this water body. The review focused primarily on environmental monitoring programs conducted between 2014 and 2019 for the Fraser River and 2014 to 2018 for the Burrard Inlet and the Strait of Georgia. The overall objective was to provide a comprehensive and integrated analysis of Metro Vancouver's environmental monitoring program results and determine whether there are any significant environmental impacts on the Region's waterbodies from WWTP, CSO, and SSO discharges.

Table 9 outlines the work completed in 2019 and 2020 for Metro Vancouver's receiving and ambient environment monitoring programs.

Table 9 Environmental Monitoring Program

Program	**Program Initiation**	**Ambient Environment Monitoring Programs (component conducted in each year)**	
		2019	2020
Strait of Georgia	2004	Water-2019 Iona REM IDZ Sediment-2019 Iona REM Water-ambient-2019 Contaminant Dispersion and Removal	Water-2020 Iona REM IDZ-in progress Sediment-2020 Iona REM – in progress Water-ambient-2020 Contaminant Dispersion and Removal–ambient-in progress 2014-2018 Comprehensive Review
Fraser River	2003	Water-2019 ambient Water-2019 Annacis IDZ REM (winter, summer) Water and Sediment – 2017-2018 Northwest Langley - REM Pilot Sediment – 2018 Annacis REM	Water-Annacis REM (winter) and ambient amalgamated 2018 Fish 2014-2019 Comprehensive Review
Burrard Inlet	REM 2003 / Ambient 2007	Burrard Inlet Environmental Monitoring – 2019 Water Column (includes Lions Gate IDZ boundary) Lions Gate REM - 2019 Sediment Effects Survey (ambient amalgamation in-progress)	Burrard Inlet Environmental Monitoring – 2020 Water Column (includes Lions Gate IDZ boundary) Lions Gate REM - 2020 Sediment Effects Survey (ambient amalgamation in-progress) 2014-2018 Comprehensive Review

Strait of Georgia Ambient Monitoring

Iona Deep-Sea Outfall Receiving Environment Monitoring Program:

Metro Vancouver continued with its annual water-column monitoring of the regulatory initial dilution zone (IDZ) boundary as a component of the overall environmental monitoring program for the Iona Deep-Sea Outfall. The purpose of the monitoring program is to establish compliance with water quality guidelines at the boundary of the IDZ. Currently, there are no site-specific objectives available for the Strait of Georgia, and the BC Water Quality Guidelines apply.

In 2019, all parameters at the IDZ boundary met the applicable water quality guidelines with the exception of dissolved oxygen, total boron and a single sample for copper. The 30-day average dissolved oxygen concentrations at both the reference area and IDZ boundary were below the minimum guideline of 8 mg/L, which is a reflection of dissolved oxygen conditions in the intermediate water of the Strait of Georgia rather than a result of the Iona Island WWTP effluent discharge. Total boron concentration in samples from both the IDZ boundary and the reference area were above the guideline, and representative of the coastal marine environment (for context, the Iona Island WWTP effluent boron concentration met the guidelines). The copper concentration for a single sample was marginally higher than the short-term guideline. Copper met the long-term average guideline for the monitoring period. The 2020 report preparation is in progress.

For sediment, in 2019, water quality near the sediment surface (bottom-water) was within average ranges for coastal marine environments. Sediment chemistry values were mostly below provincial and federal guidelines for the protection of aquatic life. The noted exceedances of metals included arsenic, copper, and nickel; however, these metals were also above guidelines at the prescribed reference sites. As for organics, dibenzo(a,h)anthracene and fluoranthene marginally exceeded the lower sediment quality guideline at a single station located adjacent to the outfall. Sediment biotic indicators of organic enrichment have shown some changes at the near-field stations. As in previous years, the changes in the benthic infaunal community were predominantly driven by the prevalence of opportunistic polychaetes and the absence of one organism sensitive to disturbance at stations close to the outfall. Further monitoring of the area will provide additional information to help determine significance of these observations, and if they are solely outfall related, are due to short or long-term changes in oceanographic conditions, or due to a combination of these or other factors. The 2020 report preparation is in progress.

Strait of Georgia Ambient Environment Monitoring Program:

Continued effort has been devoted to qualify the underlying circulation and mixing in the Strait and the dispersion of Fraser River fresh water and suspended particles. The surface and near surface water properties (temperature, salinity, chlorophyll) in the southern Strait of Georgia are strongly influenced by the Fraser River plume. Water properties within and outside of the Fraser River Plume and timing of the spring bloom established since 2003 have been updated to include the latest data set. Long-term trends of intermediate and deep-water properties (temperature, salinity, dissolved oxygen) of the Strait of Georgia have also been extended using the latest archival data. In general, observed long-term

changes are small compared to seasonal and inter-annual variability. Historical observations indicate that mean temperature rose considerably in 2015 at both intermediate and deep waters. Deep water oxygen levels reached significantly lower levels in early 2015, but have returned to more typical conditions, based on long term records from Ocean Networks Canada's (ONC) instrument moorings.

The 2019 program focussed on analysis of data collected from extensive field programs conducted in 2017 and 2018. In general, the concentrations of particulate PBDEs were lower than dissolved PBDEs and accounted for less than 20% of the total PBDEs concentration in a given sample. Analyses of samples collected from Burrard Inlet, the Fraser River and the Strait of Georgia indicated that the Iona Island WWTP plume, central Burrard Inlet and the Fraser River (in the summer) are notable sources of particulate PBDEs to the Strait of Georgia. Accurate measurements of seawater PBDEs in the dissolved and particulate phase remain challenging and the development of passive samplers for PBDE analysis is ongoing.

The Fraser River and Pacific Ocean incoming waters were evaluated as sources of silver and cadmium to the Strait of Georgia. Conservative mixing calculations indicated that upwelled Pacific water is expected to be the largest source of dissolved silver into the Strait of Georgia due to its high volume flux. Furthermore, fluxes of dissolved and total silver from three major outfalls located in Metro Vancouver and Capital Regional District were low compared to continental runoff from rivers (e.g. Fraser River). The mass-balance calculation concluded that water upwelled from the Pacific Ocean is also the dominant source of dissolved cadmium to the Strait of Georgia. There is evidence that dissolved cadmium may be precipitating as cadmium sulfide in sediment pore water in the region of the Iona Island WWTP outfall due to the release of organic-rich particles in the effluent. These particles can sustain sulfidic microenvironments and facilitate the formation of cadmium sulfide. Further evaluation of this pathway is needed. Work is underway to determine trace metal concentrations in pelagic organisms from the Strait of Georgia food web. The 2020 report preparation is in progress.

Strait of Georgia Environmental Monitoring Programs Comprehensive Review:

In 2020, a comprehensive integrated analysis was conducted for Metro Vancouver's Strait of Georgia environmental monitoring programs over the five-year period from 2014 to 2018. The objective of the review was to assess the performance of Metro Vancouver's liquid waste discharges with respect to ecological health effects in the Strait of Georgia, including a critical assessment of the existing environmental monitoring programs and to provide recommendations for future programs.

A critical review of approximately 45 monitoring reports and scientific publications was conducted and included the Iona Island WWTP effluent discharge quality monitoring, Iona Sediment Effects Surveys, Iona Initial Dilutions Zone Boundary Monitoring, and Strait of Georgia Ambient Monitoring Program annual reports and published peer-reviewed journal articles. All available Metro Vancouver monitoring data for the Strait of Georgia programs from 2014 to 2018 inclusive were compiled and synthesized. The data included Iona Island WWTP wastewater discharge chemistry, microbiology and toxicity; Iona Island WWTP IDZ water chemistry and microbiology; Iona Island WWTP sediment chemistry, microbiology and toxicity; Iona Island WWTP benthic invertebrate community structure; and, fish tissue

chemistry and community health. Statistical analyses were completed to determine spatial and temporal trends and the data was compared to Guidelines and Objectives where applicable. A Weight of Evidence (WOE) approach was used to integrate the various data sets (lines of evidence) to assess the potential of environmental effects of the Iona Island WWTP on the Strait of Georgia.

The review concluded that Metro Vancouver's existing environmental monitoring programs are robust and effective at assessing the effects of effluent discharges from the Iona Island WWTP on the receiving environment and address specific program objectives. Over the five years reviewed, effluent from the Iona Island WWTP met the requirements of its Operational Certificate with a few exceptions and water and sediment chemistry in the receiving environment met regulatory requirements. Spatiotemporal analysis indicated that the benthic invertebrate species located in the area near the Iona Island WWTP outfall have shifted towards species more tolerant of low-oxygen sediment conditions. It was recommended that the interconnection between sediment organic carbon content and sediment oxygen demand be further evaluated for their potential role in the benthic community shift. Tissues from fish collected near the Iona Island WWTP had slightly higher concentrations of effluent-associated substances; however, the health and reproductive success of the fish appeared to be unaffected.

The WOE integration found that effects from the Iona Island WWTP discharges were localized to the immediate receiving environment, suggesting that the magnitude of overall environmental effects of the Iona Island WWTP discharges to the Strait of Georgia was low between 2014 and 2018. Minor refinements to the existing environmental monitoring programs were proposed including additional characterization of sediment background, additional characterization of sediment organic carbon and sediment oxygen demand, and increased collection of fish samples in the fish health monitoring program.

Fraser River Environmental Monitoring

Receiving Environment Monitoring Program for Metro Vancouver's Fraser River Wastewater Treatment Plants:

Metro Vancouver continued its annual water-column monitoring of the regulatory IDZ boundary as a component of the receiving environment monitoring program for Metro Vancouver's secondary wastewater treatment plants discharging into the lower Fraser River. The objective of this monitoring is to assess compliance with applicable water quality guidelines and site-specific objectives.

Monitoring is primarily focused at the Annacis Island WWTP outfall, as the previous attempts to monitor the receiving environment near the Lulu Island and NW Langley WWTPs were only partially successful due to the highly transient nature of their outfall discharge plumes. The Annacis effluent discharge rate is substantially greater than either the Lulu Island or Northwest Langley WWTPs; consequently, indicators of potential effects, if present, would likely be detected first in the Annacis Island WWTP receiving environment. A pilot study was undertaken in 2014-2015 at the Lulu Island WWTP outfall, and the report for the 2017–2018 pilot water and sediment study at the Northwest Langley WWTP outfall was completed in 2019.

Annacis Island WWTP REM Water Monitoring:

At the Annacis Island WWTP, water samples are collected in winter during low river flows from within the effluent plume at the IDZ boundary, as well as three reference stations upstream of the Fraser River trifurcation in New Westminster. Summer monitoring was conducted in the same manner in 2019. In 2019, all parameters at the IDZ boundary met the applicable Fraser River Water Quality Objectives, BC Water Quality Guidelines, or Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines, except for un-ionized ammonia. Concentrations of un-ionized ammonia in several samples collected in summer from the IDZ boundary, during four of the five weeks, were above the 16-µg/L CCME guideline. However, the 30-day average un-ionized ammonia concentration was below the CCME guideline and total ammonia concentrations met the corresponding Fraser River Water Quality Objective for all samples in each weekly event.

In 2020, all parameters at the IDZ boundary met the applicable Fraser River Water Quality Objectives, BC Water Quality Guidelines, or Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines, except the Total Suspended Solids (TSS) objective was exceeded in one sample. However, the TSS concentration in the Annacis effluent was not high enough to account for the concentration at the IDZ boundary. The findings of the 2020 Fraser River ambient and Annacis Island WWTP REM water monitoring programs were combined into one report. The results for ambient monitoring are presented in the ambient monitoring section below.

Over the 18 years of the Annacis Island WWTP REM and ambient monitoring programs, on average peaks were observed in fecal coliforms, ammonia, phosphorous, and copper concentrations at the Annacis Island WWTP IDZ boundary, when compared to ambient sites. There were statistically significant increasing trends in total ammonia and total phosphorus concentrations at the Annacis Island WWTP IDZ boundary. No trends in water quality were observed at the reference area.

Annacis Island WWTP REM Sediment Monitoring:

In 2019, the report was completed for a 2018 sediment monitoring study carried out in the Fraser River in the vicinity of the proposed Annacis Island WWTP Stage V Upgrade Outfall. The purpose was to improve the spatial resolution of pre-construction baseline sediment data collected in 2016 and 2017, in areas surrounding the proposed outfall and to inform design of the post outfall sediment monitoring program. Phase 1 consisted of collecting and characterizing 34 sediment samples (grain size, total organic carbon, and moisture content) in an area 500 m upstream and downstream of the proposed outfall. Grain size distributions were mapped to determine suitable sample locations, representative of sediments near the proposed outfall. Phase 2 consisted of collecting sediment samples from 11 locations selected in Phase 1 for analyses of phase 1 parameters, as well as bacteria, conventional parameters, metals, and selected organics. Results indicate that fine-grained substrates near the Annacis Island WWTP outfall are comparable to the Fraser River ambient sites substrates.
Most measured parameters met the applicable Fraser River Objectives, BC sediment quality guidelines, and Canadian Council of Ministers of the Environment sediment quality guidelines, with the exception of chromium, copper, iron, manganese, and nickel, which were slightly greater than the applicable BC

lower SQGs and/or CCME ISQGs. Chromium, copper, and nickel concentrations were consistent with Fraser River Ambient Monitoring Program (FRAMP) sediment concentrations in the Main Arm and Main Stem. Iron and manganese were not analyzed during the 2016 FRAMP, so comparisons were not possible; however, the marginal exceedances are likely related to the natural geology of the Fraser River watershed.

Northwest Langley WWTP REM Water and Sediment Monitoring:

In 2020, the report was completed for a 2017 and 2018 Northwest Langley WWTP receiving environment pilot monitoring study to determine the practicality of an IDZ monitoring program. Sediment samples were initially collected within a zone of probable influence and analyzed for grain size to determine if fine sediment was present. A second survey sampled sediment locations with fine sediment for additional analyses, and investigated additional locations. Water quality samples were also collected in a grid pattern to determine if the plume could be detected.

Water sampling was only marginally successful at locating the Northwest Langley WWTP effluent plume. All water samples met the applicable Fraser River Water Quality Objectives, BC Water Quality Guidelines, or Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines, with the exception of TSS in two samples collected 195 m downstream of the outfall and one sample collected 295 m south of the outfall. The elevated TSS was not attributed to the Northwest Langley WWTP effluent.

The pilot study identified sediment depositional areas downstream and immediately upstream of the Northwest Langley WWTP outfall; however, it was not possible to demonstrate an exposure gradient using either bacteria or metals. Therefore, the value of a sediment monitoring program is questionable.

2019 and 2020 Fraser River Ambient Water Monitoring:

Water quality is monitored annually within one meter below surface at seven ambient sites in the Fraser River within the geographic region of Metro Vancouver. Water samples are collected once a week for five consecutive weeks during the annual low flow period (February-March). Sediments are monitored at seven sites once in five years, and fish tissue and health are monitored approximately once in five years. In 2018, the fish monitoring program was modified to amalgamate ambient and WWTP receiving environment exposure areas.

The water quality and chemistry monitoring results were compared with applicable Fraser River Water Quality Objectives, BC Water Quality Guidelines, or CCME Canadian Environmental Quality Guidelines. Concentrations of all measured water quality parameters met the applicable objectives or guidelines at ambient sites in 2019 and 2020, with a few exceptions. Total arsenic, copper, iron and manganese in 2020 did not meet the maximum objectives or guidelines at some ambient sites, primarily during Week 2, when flows and TSS concentrations were high in the Fraser River. In addition, 30-day average total copper concentrations were above the average objective at Tilbury Island, Ewen Slough, and McDonald Slough, while the 30-day concentration at Boundary Road site was slightly above but equal to the objective within the limits of analytical precision. Dissolved copper 30-day average concentrations were above the new BC chronic guideline at Barnston Island, Sapperton Bar, and Boundary Road sites.

Spatial patterns have been relatively consistent over the 18-year period of the Fraser River Ambient Monitoring Program. Average concentrations for specific conductance, total ammonia, nitrate, fecal coliforms, total suspended solids, total phosphorus and total metals (copper, iron, zinc) increased from upstream to downstream.

No statistically significant temporal trends in ambient water quality were observed over the 18 years of ambient water quality monitoring, with the exception of total phosphorous and total copper. Total phosphorus concentration decreased significantly at the mouth of the North Arm near McDonald Slough, but not at the other six monitoring stations. There were significant increases in total copper in the Main stem and upper Main Arm. This contrasts with no trend observed in total copper at the Annacis Island WWTP IDZ boundary.

Fraser River Fish Monitoring:

In 2020, the 2018 Fraser River Fish Survey report was completed. The 2018 program was modified to amalgamate aspects of earlier ambient and WWTP receiving environment monitoring into an environmental monitoring program for the Fraser River. The objective of this amalgamation was to provide for a more holistic approach and understanding of potential effects of treated wastewater discharged to the aquatic environment. Historically three areas were monitored: upstream of the Annacis Island WWTP, and mouths of the North Arm and Main Stem. The combined program now includes two additional sites downstream of the Annacis Island and Northwest Langley WWTP outfalls. Five sites were monitored in the autumn of 2018: Upriver Reference, Northwest Langley WWTP exposure, Annacis Island WWTP exposure, Lulu Island WWTP exposure, and Downriver Reference (North Arm).

In 2018, peamouth chub were generally in good health both internally and externally with high levels of mesenteric fat. Fewer fish contained parasites in 2018 than in 2012 when the previous fish survey was undertaken. For male fish, there were no significant differences in Cytochrome P450 activity (EROD) among sampling areas; for female fish. EROD activity was significantly lower at Lulu Island as compared to the North Arm and Annacis Island (EROD was not measured in Parsons Channel and Up-river due to insufficient sample size). The highest concentration of PAH metabolites in fish bile was measured at Lulu Island, and the lowest at Up-river sampling location.

In 2018, the concentrations of PBDE-100 exceeded the Federal Environmental Quality Guidelines for whole-body tissue at all sampling areas except the North Arm while in 2012 PBDE-100 concentrations exceeded the Guideline at all sites. Total PBDEs exceeded the Federal Environmental Quality Guidelines for the protection of aquatic life and the protection of mammalian consumers of fish at all sampling areas in both 2018 and 2012. Overall, total PBDE concentrations decreased between 2012 and 2018. In 2018, total PCB TEQs in tissue exceeded the CCME Guidelines for the protection of avian consumers of fish at Lulu Island and mammalian consumers of fish at Lulu Island and Annacis Island. There were no guideline exceedances observed for metals, pesticides or dioxins and furans.

Higher concentrations of PBDEs in the Annacis Island and Lulu Island study areas may be associated with WWTP discharges; differences in PCB, organochlorine pesticides, and arsenic are not likely associated with WWTP discharges, since higher concentrations of these parameters were observed at one or both of the reference areas. No other consistent site-specific effects on fish health were identified suggesting that WWTP discharges are not having substantial effects on fish health relative to other anthropogenic processes in the lower Fraser River.

Fraser River Environmental Monitoring Programs Comprehensive Review 2014 – 2019:

In 2020, a comprehensive review of Metro Vancouver's Fraser River discharges and environmental monitoring programs was completed. All available Metro Vancouver Fraser River monitoring reports and data for the period 2014 to 2019 inclusive were reviewed, compiled and synthesized. The data included wastewater discharge chemistry, microbiology and toxicity; Fraser River water chemistry and microbiology; sediment chemistry, microbiology and toxicity; benthic invertebrate community structure; and, fish tissue chemistry, health and community composition. Statistical analyses were completed to determine spatial and temporal trends and the data was compared to applicable guidelines and objectives to assess compliance and regulatory status.

A Weight of Evidence (WOE) approach was used to integrate the various data sets (lines of evidence) to assess the potential of environmental risk. Risk assessment models were applied to estimate diet-related health risk to people and wildlife consuming fish from the Fraser River.

Results

The review concluded that Metro Vancouver's existing Fraser River environmental monitoring programs are effective at describing environmental conditions in the vicinity of Metro Vancouver's discharges and provide useful information to identify potential effects of these discharges. Over the six years reviewed, effluent from the Annacis Island, Lulu Island and Northwest Langley WWTPs met the requirements of their Operational Certificates, with a few exceptions.

Metro Vancouver's wastewater discharges affect the water and sediment quality of the Fraser River in the immediate vicinity of the discharge; concentrations of several biological and chemical wastewater constituents were measured at elevated concentrations near and downstream of the outfalls in water, sediment and fish. These increases were generally small, typically below relevant guidelines and objectives, and no effects on benthic invertebrates and fish were apparent. Results are confounded by the complex tidal flow, extensive urban and industrial development and other non-Metro Vancouver discharges, as evidenced by the large-scale variation in the Fraser River being equal to or greater than the local effects of Metro Vancouver discharges.

Results of the Fraser River Ambient Water Quality Monitoring Program (FRAMP) indicated concentrations of most water quality and bacteriological indicators increased from upstream to downstream, a trend that follows the increased urbanization and industrial activity of the river from upstream to downstream. Ambient sediment quality monitoring showed a similar overall trend.

The Weight-of-Evidence indicated that the risk of ecological effects was moderate for the Annacis Island WWTP and low for the Lulu Island and Northwest Langley WWTPs, combined sewer overflows and sanitary sewer overflows. Risks to human consumers of fish were negligible for the Annacis Island and Northwest Langley WWTPs, and low for Lulu Island WWTP.

Burrard Inlet Environmental Monitoring

In 2018, Metro Vancouver started reviewing and amalgamating both the Lions Gate WWTP Outfall Receiving Environment Monitoring (REM) Program and the Burrard Inlet Ambient Monitoring Program (BIAMP) and will continue to amalgamate and fine-tune the programs in the coming years. The BIAMP was established in 2007 to monitor and assess the spatial and temporal differences in water, sediment, and fish tissue quality within Burrard Inlet.

Water sampling is done weekly for five consecutive weeks in October-November. Sediment quality is monitored every two to three years at the same seven sites in the Burrard Inlet, and sediment monitoring is continued in the amalgamated Lions Gate REM program. Fish tissue sampling is conducted about every five years. Several changes towards amalgamation have already occurred and are outlined below.

The Lions Gate WWTP REM programs continued through 2019 and 2020 with annual data collection for the IDZ and SES programs. Additionally, the Burrard Inlet Biota Monitoring Program, a portion of the BIAMP, was executed in 2017. Through a detailed program review, components of the BIAMP Water Column and Sediment Monitoring Programs were amalgamated into the existing REM programs. This amalgamation was conducted in order to find efficiencies in sampling activities and data analysis, allowing potential effects of wastewater discharge to be assessed within the regional context of Burrard Inlet.

2019-2020 Burrard Inlet Water Column Monitoring results:

In 2018, Burrard Inlet water column monitoring consisted of a pilot study, conducted in conjunction with UBC's Earth and Ocean Sciences Department. The focus of the pilot study was to refine a new sampling methodology and data analysis techniques for water column monitoring in Burrard Inlet.
The new methodology employed a compact sea carousel integrated with a Conductivity-Temperature-Pressure (CTD) profiler. The previously developed methodology relied upon continuous measurements of Coloured Dissolved Organic Matter (CDOM) to determine WWTP effluent plume presence and manually close water bottles based on real-time observations of CDOM and CTD profiles in the field at the initial dilution zone boundary of the Lions Gate WWTP outfall.

In 2019-20, the sampling methods used during the 2017 pilot study, and refined in 2018 were continued under the amalgamated water column program. The amalgamated program samples all seven established Ambient Monitoring Program sites while also conducting detailed sampling at the Lions Gate WWTP IDZ boundary. All samples were collected on a single day each week in conjunction with

continuous water column profiles for five-weeks in the autumn. Multiple water grabs were also collected at various depths related to the effluent plume or the observed halocline.

In 2019, all water quality objectives guidelines at the IDZ boundary were achieved, except for dissolved oxygen, total boron, Total Organic Carbon (TOC) and a single-sample measurement for temperature. A statistical analysis comparing the newly defined effluent plume concentration metric CDOM anomaly confirmed no significant relationship between the Lions Gate WWTP effluent plume and either of dissolved oxygen or total boron. In the case of TOC, the water quality guidelines were also not met due to natural background conditions rather than to the Lions Gate WWTP. This conclusion is supported by the Burrard Inlet-wide data; which also consistently reported concentrations that did not meet the relevant water quality guidelines.

Burrard Inlet Environmental Monitoring for the 2020 Water Column program was conducted in November 2020, following the new methods described above. The report is currently under preparation.

Burrard Inlet Environmental Monitoring – Sediment Monitoring:

In 2018, the Burrard Inlet Sediment Monitoring program was absorbed into the larger Lions Gate REM Sediment Effects Survey. Three of the seven sites used in the Burrard Inlet program overlapped with the Lions Gate program; therefore, the four additional ambient sites were collected during the course of the Lions Gate Sediment Effects Survey. This amalgamation, while ensuring a consistent suite of chemical parameters throughout Burrard Inlet, also allowed for the inclusion of additional analysis including benthic infauna. The reporting of the combined results from 2018-2020 is pending.

Lions Gate WWTP Receiving Environment Monitoring - 2019/20 Sediment Effects Surveys:

Sediment effects survey is conducted annually in the spring. The 2019 survey was conducted in March, and showed similar findings to those observed in previous years, with polycyclic aromatic hydrocarbons (PAHs) and several metals often exceeding their respective water quality guidelines.

Sediment chemistry was used to define stations as influenced or non-influenced by the Lions Gate WWTP based on a cluster analysis using the established biochemical fingerprint of the Lions Gate WWTP effluent. From this analysis, it was determined that two stations in southwest Burrard Inlet (northwest of Point Grey) were consistently found to be influenced by wastewater; however, currents and dispersion models suggest that this influence was from the Iona WWTP. The two stations in the Inner Harbour were also consistently found to be influenced by wastewater (likely from Lions Gate WWTP), although contributions from combined sewer overflows and the heavily industrial nature of the Inner Harbour likely confounds the influence. Based on these results, sediment contaminant deposition likely occurs from a wide range of sources throughout the heavily developed and urbanized Burrard Inlet.

The Lions Gate WWTP discharges appear to have contributed to conditions more favourable for infaunal recruitment, growth, and reproduction by creating geochemical changes from organic deposition that

favour tolerant species. However, there was no correlation between wastewater indicators and biotic indicators, suggesting that both nutrient and contaminant distributions in Burrard Inlet are confounded by sources other than the Lions Gate WWTP (e.g., riverine inputs). Therefore, the observed changes in the infaunal community are more influenced by other factors rather than the Lions Gate WWTP.

The Lions Gate REM 2020 Sediment Effects Survey was conducted following the same methods. The report is currently under preparation.

Burrard Inlet Environmental Monitoring Programs Comprehensive Review:

In 2020, a comprehensive review of Metro Vancouver's Burrard Inlet discharges and environmental monitoring programs was completed. All available Metro Vancouver Burrard Inlet monitoring data for the period 2014 to 2018 inclusive were compiled and synthesized. These data included wastewater discharge chemistry, microbiology and toxicity; Burrard Inlet water chemistry and microbiology; sediment chemistry, microbiology and toxicity; benthic invertebrate community structure; and, fish tissue chemistry, health and community composition. Statistical analyses were completed to determine spatial and temporal trends, and data were compared to applicable guidelines and objectives to assess compliance and regulatory status.

A Weight of Evidence (WOE) approach was used to integrate the various data sets (lines of evidence) to assess the potential of environmental risk. Risk assessment models were applied to estimate diet-related health risk to people and wildlife consuming fish from Burrard Inlet. After completion of statistical analyses and WOE-based environmental risk assessment, a technical assessment of the Burrard Inlet environmental monitoring programs was prepared, and based on the monitoring results improvements to the design of the monitoring programs were recommended.

According to the Burrard Inlet Environmental Monitoring Programs Comprehensive Review 2014–2018, Metro Vancouver's Burrard Inlet environmental monitoring programs are effective at describing environmental conditions in the vicinity of Metro Vancouver's discharges and provide useful information to identify potential effects of these discharges on Burrard Inlet. The following key findings were presented:

- Effluent from the Lions Gate WWTP met the requirements of its Operational Certificate with few exceptions.
- Water quality guidelines were typically met throughout Burrard Inlet, and for those that were not met, the cause was not linked to Metro Vancouver discharges.
- Sediment concentrations of many metals, PAHs, PCBs, and other persistent organic substances exceeded guidelines throughout Burrard Inlet. These elevations were likely the result of a combination of background sources and point source contributions.
- Concentrations of some substances in fish tissues, including arsenic, selenium, and PBDEs, exceeded guidelines. However, there was no consistent pattern in these concentrations across Burrard Inlet, which may implicate background conditions rather than direct effects of Metro Vancouver discharges as the cause.

The WOE approach aggregated the key findings from all the monitoring programs to assess the probability and magnitude of potential environmental effects from Metro Vancouver discharges during the review period. The WOE integration found that effects from Metro Vancouver discharges in Burrard Inlet were low overall. The largest effects of Metro Vancouver discharges on the marine environment of Burrard Inlet are the discharge of PBDE compounds by the WWTP, CSOs, and SSOs, and the local-scale effects associated with discharges from CSO outfalls.

Overall, the review found that the environmental monitoring programs were effective for their purpose. Minor refinements to the existing environmental monitoring programs were proposed including enhanced/updated modelling to better inform monitoring site selection, pilot studies to assess the potential to better characterize spatial and temporal variation, an assessment of the biota program to identify alternate/additional sentinel fish or shellfish species, and further exploration into the fate of PBDEs from Metro Vancouver discharges in Burrard Inlet.

Boundary Bay Ambient Monitoring

In 2019, two additional reports relating to recommendations in the 2017 Program Assessment Report were completed. These two reports provided additional interpretations and recommendations on 2014 benthic community analysis and caged mussel contaminant biomonitoring programs.

Following an extensive mapping and evaluation of the benthic community structure in Boundary Bay, it was concluded that it is not possible to design a monitoring program that could distinguish natural variation from changes due to external impacts and recommended that benthic infaunal community composition be discontinued as a BBAMP biomonitoring approach.

The mussel tissue chemistry, survival, and growth data merit were reviewed in more detail. Results for 70 individual analytes, including metals, PAHs, PCBs, PBDEs, and chlorinated pesticides, from the Boundary Bay caged mussel study were compared to data accessed from the NOAA Mussel Watch database for 110 locations routinely monitored in the Pacific Northwest. The comparison indicated:

- The concentrations of analytes measured in Boundary Bay are generally low relative to other sites in the Pacific Northwest;
- low PAH and metals results suggest limited impacts from stormwater discharges; and
- concentrations of PCBs and PBDEs are consistent with global atmospheric redistribution as opposed to local point source inputs.

A subsurface instrument mooring near Semiahmoo Bay was redeployed in 2019. This mooring was initially deployed in 2018 for continuous measure of conductibity, temperature, and dissolved oxygen.

In 2020, Metro Vancouver consulted with BC Ministry of Environment and Climate Change Strategy (BCMOECCS) on the requirements relating to Metro Vancouver's involvement in BBAMP. This was in light of the improvements to the Metro Vancouver's wastewater collection system that have resulted in the reduction of overflows to Boundary Bay and the existence other Metro Vancouver's monitoring programs (i.e. Recreational Water Quality Monitoring and receiving environment monitoring in response to SSOs).

In agreement with BCMOECCS, BBAMP was discontinued after recovering an instrument mooring installed near Semiahmoo Bay in the summer of 2020.

Combined Sewer Overflow Characterization Monitoring Program

Metro Vancouver monitors for the occurrence, duration and volume of combined sewer overflows at each of its 19 CSO sites at 15 locations that discharge to Burrard Inlet and Fraser River. Volumetric estimates of CSOs are not indicative of the quantity of sanitary sewage in the overflow, as the overflow volume is primarily stormwater. Overflow water quality (CSO discharge) is monitored at select CSO locations and monitoring locations are rotated over an approximate five-year cycle. Metro Vancouver maintains a database on its CSO discharge quality. In 2019 and 2020, Metro Vancouver characterized the discharge quality of selected CSOs. These are summarized in Table 6 and Figure 15 along with the number of events sampled. Targeted monitoring parameters include bacteria, conventional parameters, metals, and selected organics as well as periodic toxicity testing. The CSO samples collected and tested for acute toxicity to rainbow trout were not toxic.

Table 10 Number of Samples Collected at each CSO Location 2019-2020

CSO sites	2019	2020
Angus	7	8
Balaclava	0	0
Borden	0	0
Cassiar	0	0
Chilco/Brockton	0	0
Clark Drive #2	0	0
English Bay	8	9
Glenbrook	0	0
Heather	12	0
Macdonald	2	2
Manitoba	0	0
New West tank	1	6
South Hill	1	6
Westridge	0	0
Willingdon	0	0

Recreational Water Quality Monitoring Program

Metro Vancouver monitors the bacteriological quality of recreational waters on a weekly basis starting in April and throughout the bathing season from May to September and less frequently outside of the summer season. Both bathing (swimming) and non-bathing beaches are monitored. The 2019 and 2020 program included monitoring of 114 sites at 41 locations (Figure 16 on page 73). *Escherichia coli*

bacteria are used as an indicator of fecal contamination. The weekly results are forwarded to the Health Authorities and Beach Operators. The Health Authorities make the decision regarding the safety of recreational water in the region and the need to post a beach use advisory at a given beach.

Bacteriological quality was met for most bathing beach recreation areas in 2019 and 2020 (see Table 11 for exceptions):

Table 11 Bathing beaches with swimming advisories, 2019-2020

Year / Beach	Days 30-day Geomean Guideline was Exceeded	Days Single Sample Maximum Guideline was Exceeded	Days Swimming Advisory Posted
2019 – Bathing Beaches			
Sunset Beach	6	26	25
Ambleside	-	9	6
Kitsilano Beach	-	12	6
Deep Cove	-	2	2
2020 – Bathing Beaches			
Sasamat Lake - White Pine Beach North	29	21	37
Sunset Beach	-	6	5

For non-bathing beach areas, the monitoring data indicated West and Central False Creek met the 30-day geomean working guideline for secondary contact activities for the 2019 season, but only West False Creek in the 2020 season. False Creek East did not meet the applicable secondary use recreation working guideline in 2019 or 2020.

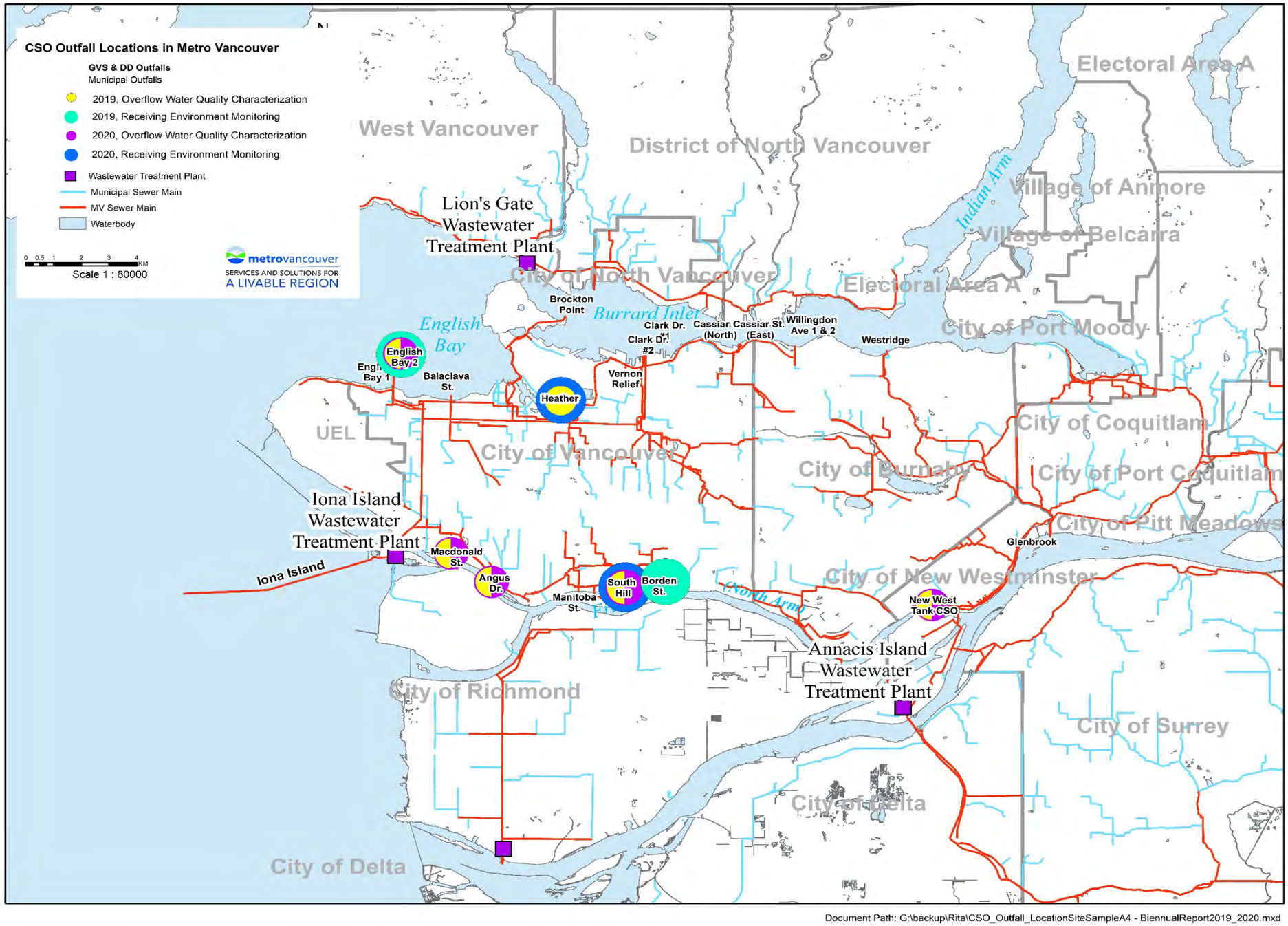


Figure 15 Metro Vancouver CSO Locations (2019-2020)

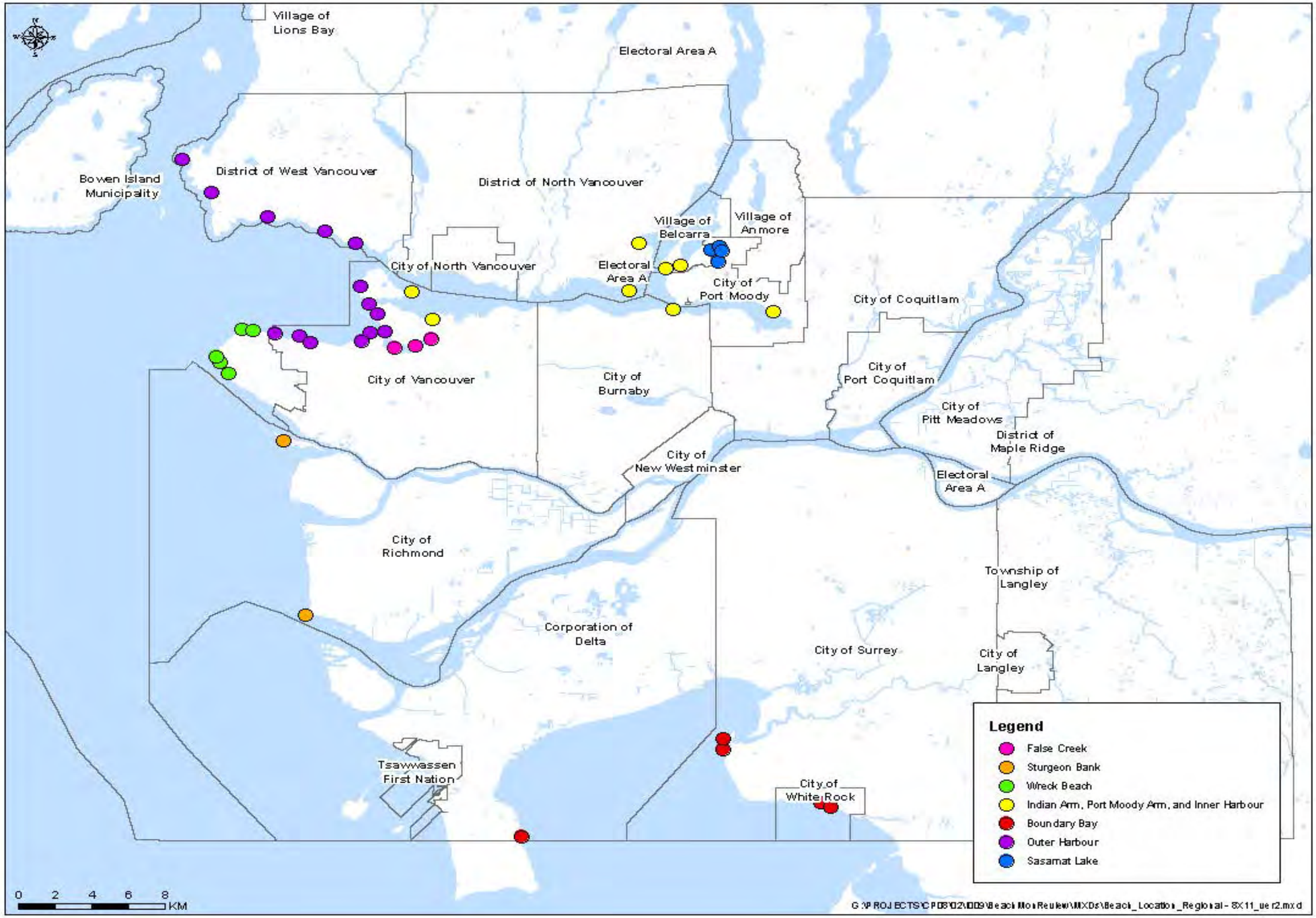


Figure 16 Metro Vancouver Recreational Water Quality Monitoring Locations (2019-2020)

Ministerial Condition 7 – Member municipalities will, with MV planning and coordination, and to the satisfaction of the Regional Manager, develop a coordinated program to monitor stormwater and assess and report the implementation and effectiveness of Integrated Stormwater Management Plans (ISMPs). The program will use a weight-of-evidence performance measurement approach and will report out in the Biennial Report. The Regional Manager may extend the deadline for completion of ISMP by municipalities from 2014 to 2016 if satisfied that the assessment program could result in improvement of ISMP and protect stream health.

This Ministerial Condition was completed in 2012.

Ministerial Condition 8 – Bypass conditions that occur at wastewater treatment plants will be reported out in the annual quality control report. The report on each activity will include a description of the event, cause, environmental effect and monitoring that occurred and any mitigation measures undertaken to prevent reoccurrence and remediate detrimental environmental effect.

Please refer to the Quality Control Annual Reports available on Metro Vancouver's website: http://www.metrovancouver.org/services/liquid-waste/plans-reports/reports/Pages/default.aspx

Ministerial Condition 9 – The ILWRM has a goal of protecting public health and the environment. In keeping with this goal and to ensure alignment with other national, provincial and regional initiatives, Metro Vancouver and member municipalities are encouraged to: (a) Have local land use planning consider the direction provided by the ISMPs, (b) Consider how the degree, type and location of land development within a drainage can affect the long-term health of the watershed, (c) Consider how to protect the stream, including the riparian areas that exert an influence on the steam, from long-term cumulative impacts; and (d) Use scenarios and forecasting to systematically consider environmental consequences/benefits of different land use approaches prior to build-out (for example , Alternative Future type approaches).

Metro Vancouver continues to facilitate the SILG and RPAC forums where member jurisdictions explore options on shared policy and technical issues such as land use planning, land use interactions, and ISMPs.

Ministerial Condition 10 – Metro Vancouver will continue to consult with First Nations during the implementation of the Plan – in particular, engaging, as appropriate, with First Nations likely to be impacted by the secondary upgrades.

The Metro Vancouver region is home to the communities of 10 local First Nations:

- Katzie First Nation
- Kwantlen First Nation
- Kwikwetlem First Nation
- Matsqui First Nation
- Musqueam Indian Band
- Qayqayt First Nation
- Semiahmoo First Nation
- Squamish Nation
- Tsawwassen First Nation
- Tsleil-Waututh Nation

In addition, there are 35 other First Nations, Tribal Councils and treaty groups, from Vancouver Island to the Fraser Valley, that have traditional territories and/or Indigenous interests that cover the Metro Vancouver region, in whole or in part.

Metro Vancouver has an Indigenous Relations program within Legal Service and Indigenous Relations Services. Indigenous Relations staff provide information, advice and support to Metro Vancouver entities on First Nations' interests and issues, and analyze how First Nations' interests and issues may affect corporate programs, processes and projects.

Indigenous Relations staff also respond to pan-municipal First Nation issues and represent and support Metro Vancouver local government interests at treaty negotiation tables in the region as well as at provincial and federal venues.

As one of the services provided, Indigenous Relations assesses the needs for engaging with First Nations on capital and infrastructure projects on a case-by-case basis and provides advice to regional district staff in other departments, including project managers and community engagement staff.

In 2019 and 2020, Indigenous Relations, comprising two professional staff and one administrative support position, responded to 1,575 requests; in 2020, 2,268 requests were addressed. In each of these two years, over 90% of the requests related to First Nations engagement.

Metro Vancouver's Approach to Engaging with First Nations

The Metro Vancouver Regional District's *Board Strategic Plan, 2019-2022* has as one of its strategic directions: "Enhance relationships between Metro Vancouver and other orders of government, First Nations, adjacent regional districts, and key stakeholders." In this regard, one of the goals of the regional district is to "strengthen relationships with First Nations."

In this regard, Metro Vancouver, as a local government and project proponent:

- acknowledges and respects the history and presence of Indigenous peoples in the region;
- aims to build meaningful and enduring relationships with First Nation governments; and
- is committed to working with First Nation communities through information sharing, engagement and ongoing communication.

When engaging with First Nations, Metro Vancouver undertakes these leading best practices as advised by the Provincial government in its guidelines to project proponents:

- Provide information in meaningful and understandable formats
- Recognize the significance of cultural activities and traditional practices of the First Nation
- Demonstrate a respect for First Nation knowledge and uses of land and resources
- Understand the importance of youth and elders in First Nation communities
- Act with honour, openness, transparency and respect
- Create a presence in the community
- Understand the nature of First Nation economies
- Engage before planning is completed and leave room for modifications
- Be prepared to listen and allow time for meaningful discussion
- Convey willingness to describe the project and consider any concerns

Metro Vancouver's Policies Related to Engaging with First Nations

The following two policies, both approved in 2017, facilitate working with First Nations on construction and other projects, including upgrades to wastewater treatment plants:

1. Information Sharing and Engagement Process with First Nations for Construction Projects; and
2. Procurement and Real Property Contracting Authority.

These policies explain the process for engaging, as appropriate, with First Nations, and procuring services either directly from local First Nations or from their preferred service providers.

1. Information Sharing and Engagement Process with First Nations for Construction Projects

For construction projects requiring statutory approval through a permitting or other process, Metro Vancouver applies a consistent and documented approach to information sharing and engagement with

First Nations. Metro Vancouver adopted a Crown Regulatory Process in 2017 to respond to the Province's permitting requirements.

To ensure all First Nations with an interest in the project are aware of the project and have an opportunity to share their interests related to the project, Metro Vancouver:

- Identifies the First Nations who have treaty rights or asserted or proven rights or title in the area of the project, using the Province's Consultative Areas Database.

- Sends an introductory letter to the respective Chiefs and Councils of First Nations identified through the First Nations Consultative Areas Database; copies of the letter are also emailed to the referral coordinators for each First Nation.

- Sends a second letter to the Chiefs and Councils with an invitation for input, a proposed project schedule and a time period for response (typically 45 business days); copies of each letter are also emailed to the referral coordinator for each First Nation.

- Follows up by phone to ensure the receipt of letters and to invite input.

- Sends a third letter closer to the close of the response period, as a courtesy reminder.

- Records all correspondence, meetings, telephone calls, input and responses in a Correspondence Tracker.

Typically, Metro Vancouver sends hardcopy letters to each of the First Nations. Due to COVID-19 restrictions, Metro Vancouver has been emailing letters to First Nations since March 2020.

For large both large infrastructure and capital projects, such as wastewater treatment upgrades, the above process represents only part of the engagement efforts, which may also be accompanied by some or many of the following opportunities which are determined on a case-by-case basis:

- staff-to-staff communications
- leadership-level meetings
- technical working group meetings
- establishment of steering committees
- First Nation-specific or multi-party workshops
- presentations to First Nation councils and community members
- community to community forums involving elected officials
- project displays and staff resources at special First Nation community events
- meetings and correspondence with other regulators (e.g. Port of Vancouver) to satisfy requirements related to potential First Nations' interests
- bilateral agreements

1. Procurement and Real Property Contracting Authority

In July 2017, the Metro Vancouver Regional District Board amended its 2014 policy on *Procurement and Real Property Contracting Authority* to include more opportunities for First Nations' economic development opportunities, including archaeological and environmental studies and monitoring, Indigenous artistic opportunities, civil construction, and other services that may be needed for

infrastructure and capital works projects (e.g. clearing and grubbing, security, traffic control) as well as graphic design, catering and other miscellaneous services.

Contracting authority grants designated employees the ability to commit the organization's funds with external vendors, such as First Nation entities. First Nation entities are defined as "any business arrangement in which First Nation individuals and/or First Nation communities have an ownership or other interest, and includes a business entity identified by a First Nation community as its designated business partner."

Unbundling of large procurement competitions prior to construction or giving preference to a proponent that sub-contracts a portion of the work to a First Nation entity will provide procurement opportunities for First Nations businesses that may not be able to participate in the bidding process under the current policy.

The first of two Procurement clauses relates to partnerships that may already exist between a First Nation and other non-First Nation businesses. For example, some First Nations in the region have existing agreements with construction companies and other industry sector companies that employ and train First Nation members. A proponent wishing to have First Nation involvement can either contact the First Nation directly to solicit participation or contact one of the First Nation's partner companies which will employ that First Nation's members. This reference-based approach can be accommodated under this clause.

A second related clause of the policy specifically deals with archaeological work which is especially significant to First Nations who wish to protect their cultural and heritage interests. Some First Nations have their own archaeological consulting firms. Other First Nations may wish to utilize their preferred independent archaeological consultants. Still other First Nations may have a business arrangement with its trusted archaeological firms that work exclusively for them. This clause takes into consideration all of these various arrangements, is respectful of First Nations' input, and does not preclude Metro Vancouver's underlying consideration to seek best value wherever possible.

Policy Application

In 2019 and 2020, Metro Vancouver continued to apply these two policies towards capital and infrastructure projects requiring Crown regulatory permits and approvals, including Liquid Waste Services projects such as the:

- Iona Island Wastewater Treatment Plant Upgrade
- North West Langley Wastewater Treatment Plant Upgrade
- Annacis Island Wastewater Treatment Plant improvements, including the Annacis Outfall project

Issues and requests emerging from First Nation engagement efforts have included:

- Capacity funding and support for engagement
- Project mitigation measures, including technical questions and issues
- Archaeological interests, Chance Find Protocols and monitoring opportunities

- Need for environmental studies and remediation, as well as monitoring opportunities
- Requests for employment and training opportunities
- Expanded procurement opportunities
- Communication protocols and agreements
- First Nations cultural/heritage awareness training for work crews and contractors
- Processes and principles for engagement of First Nation community members
- Applicability of the Province's *Declaration on the Rights of Indigenous Peoples Act* (DRIPA) in current engagement efforts

2.0 PERFORMANCE MEASURES

2.1. Goal 1: Protect Public Health and the Environment

WWTP Compliance

The overall performance of Metro Vancouver's five wastewater treatment plants met most of the Operational Certificate requirements. A review of the effluent monitoring program results showed the percent passing in 2019 was 99.91% and 99.83% in 2020, with an average of 99.87%. Therefore, the requirements listed in the operational certificates were met each year. The few exceptions, for example, were the result of exceeding permitted load limits due to high flows through the plants and power interruption.

Discharges Not Meeting Provincial Water Quality Guidelines

Site-specific water quality objectives and guidelines were largely met at the boundary of the initial dilution zones for Metro Vancouver wastewater treatment plants. For the few exceptions, none could be attributed to the treatment plants.

Sanitary Sewer Overflows

Overflows from sanitary sewers fall into two categories: wet weather overflows due to excessive amounts of rainfall and stormwater entering into sanitary sewers, and dry weather due to reasons other than rainfall or stormwater.

While the Ministry of Environment has set a target for wet weather overflows not to occur for storms associated with a statistical occurrence once every 5 years, high rates of rainwater inflow during and after storms have led to overflows. These are shown in Figure 17 and Figure 18.

The locations and dates of dry weather overflows are shown in Figure 19 and Figure 20. These overflows may be caused by equipment failure, power failure, or unexpected events such as sewer pipe blockage and third party actions.

Combined Sewer Overflows

Combined sewer overflows occur during wet weather when there is insufficient combined sewer capacity to handle additional stormwater inflows. Dry weather overflows from combined sewer systems are reported as sanitary sewer overflows. These wet weather overflows are flow reliefs which redirect the excess combined sewage and stormwater to the receiving environment. Combined sewer overflows are listed in Table 7 and Table 8.

The Cities of Burnaby, New Westminster and Vancouver as well as the University Endowment Lands continue to eliminate their combined sewers and replace them with separate storm sewers and sanitary sewers. This process will eventually result in all sanitary sewage conveyed to the wastewater treatment plants with stormwater redirected away; combined sewer overflows locations will ultimately discharge only stormwater. In the meantime, the characteristics of the combined sewer overflows will continue to slowly transform as there will be decreasing percentages of sanitary sewage mixed with stormwater.

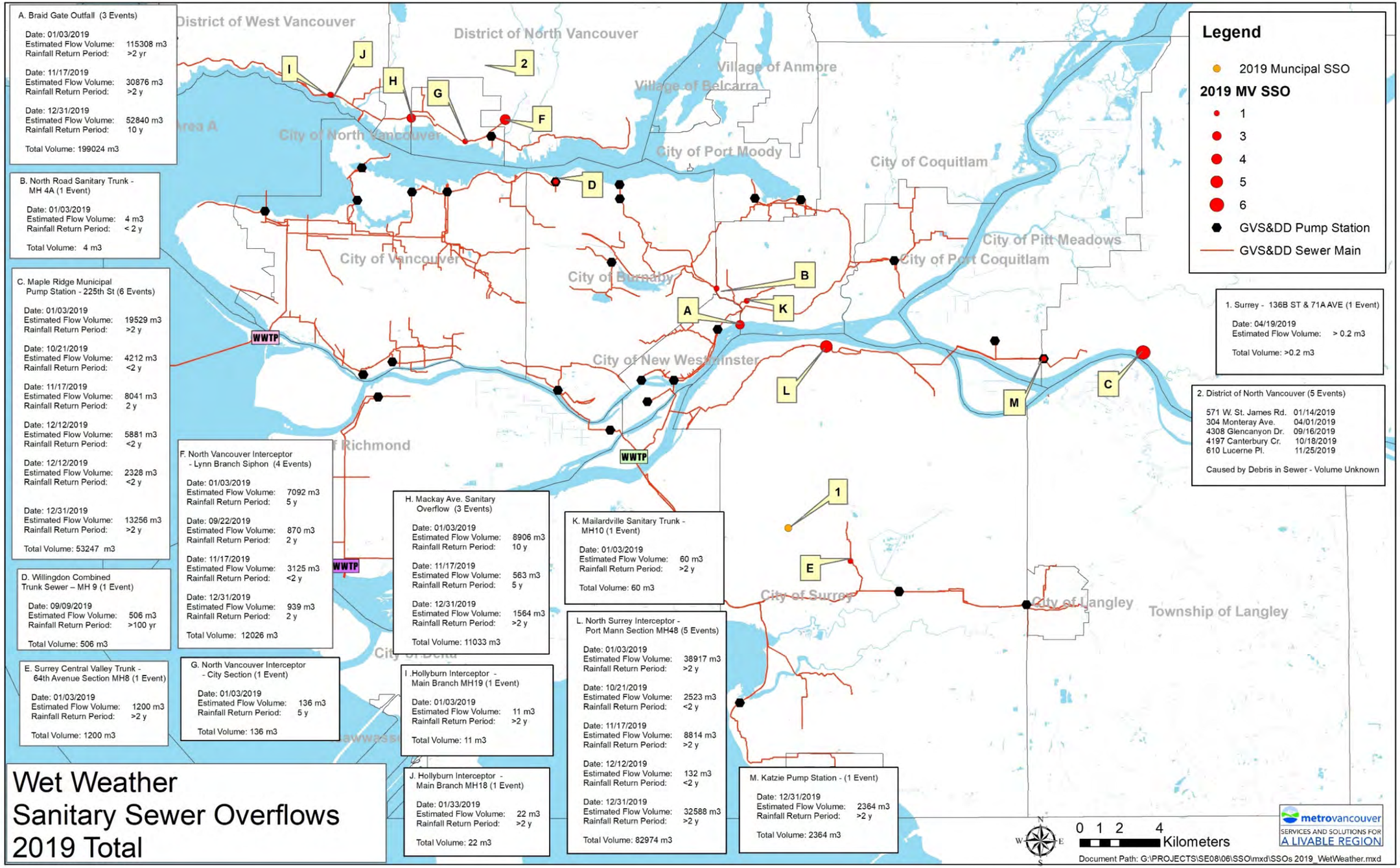


Figure 17 Wet Weather Sanitary Sewer Overflows 2019

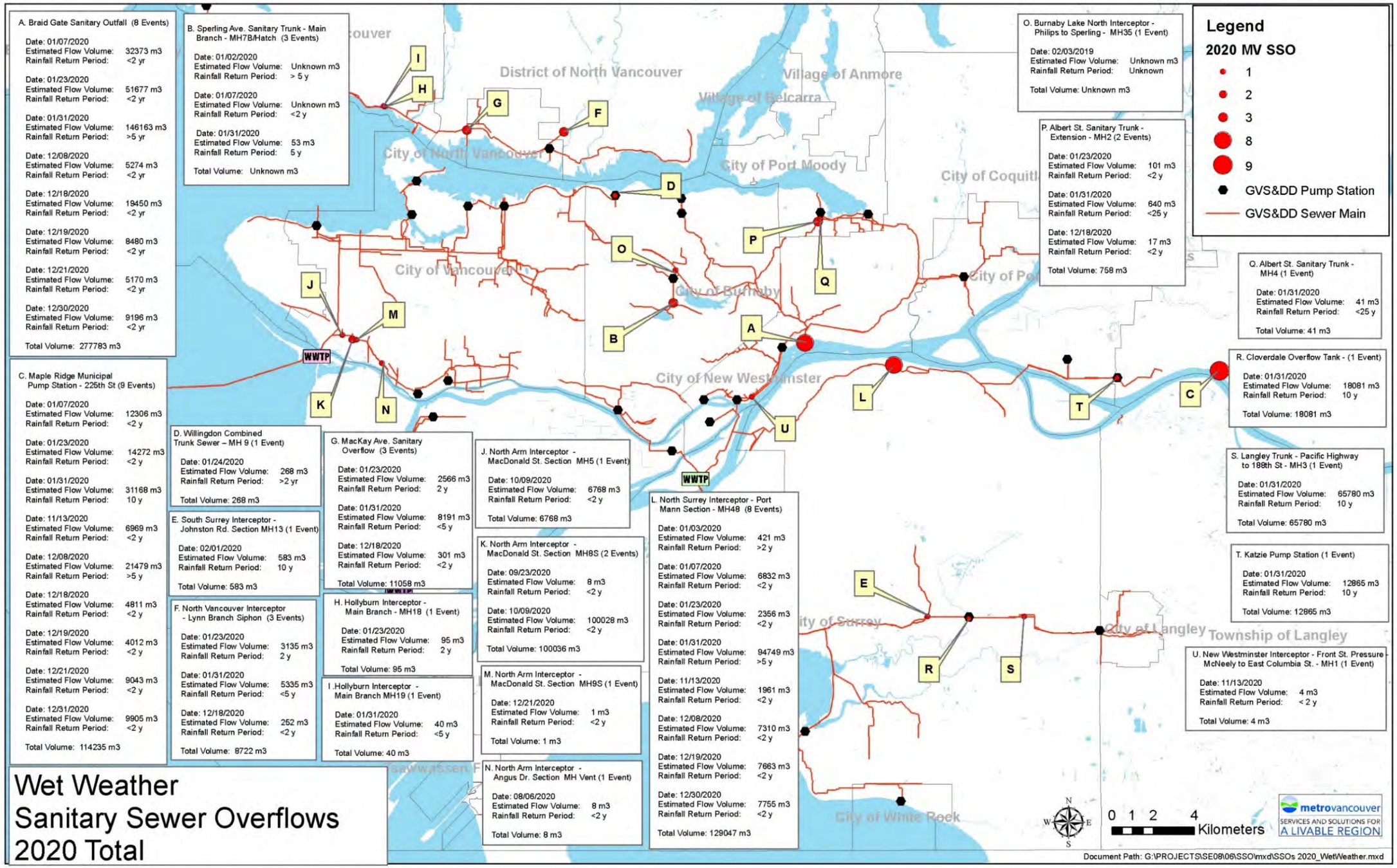


Figure 18 Wet Weather Sanitary Sewer Overflows 2020

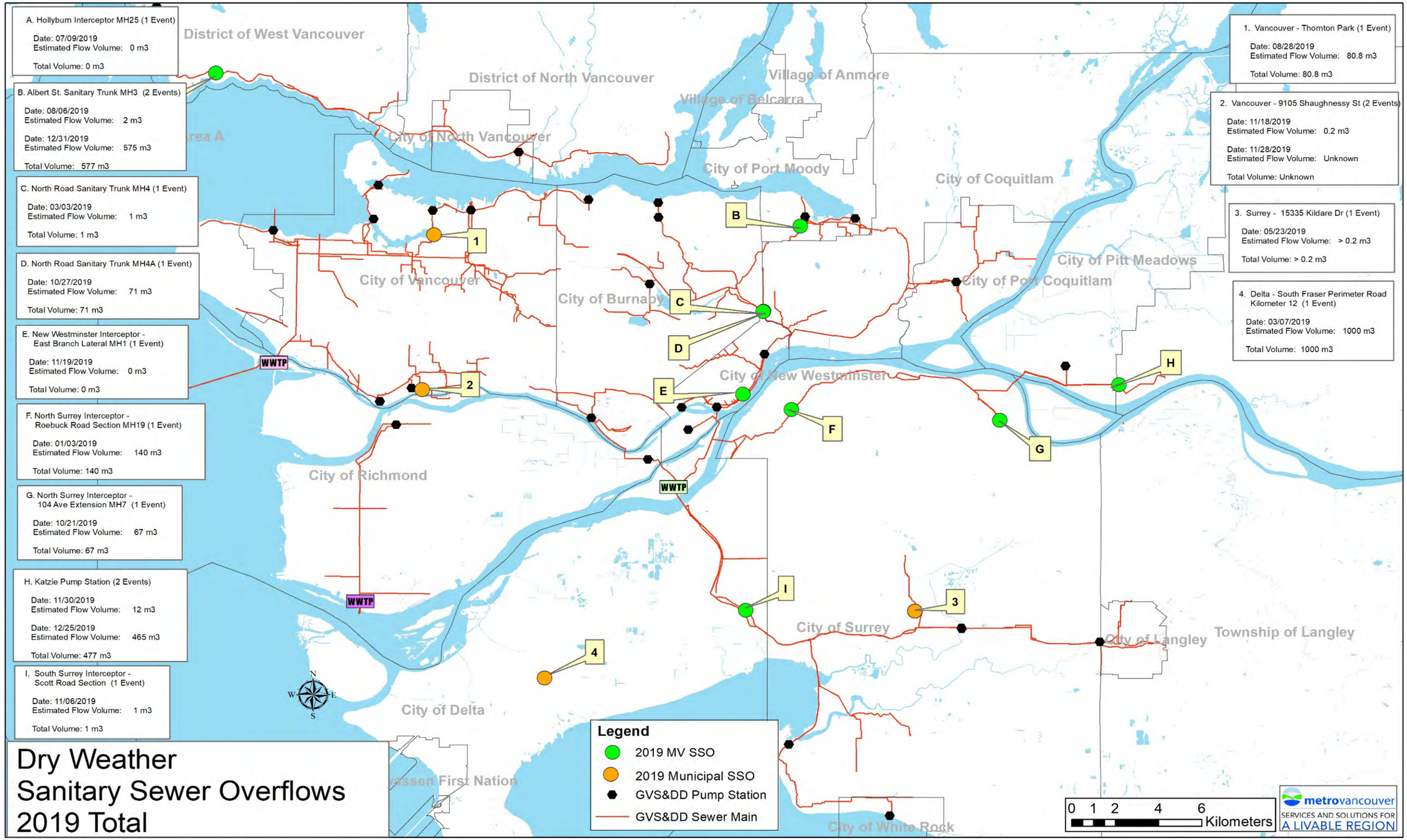


Figure 19 Dry Weather Sanitary Sewer Overflows 2019

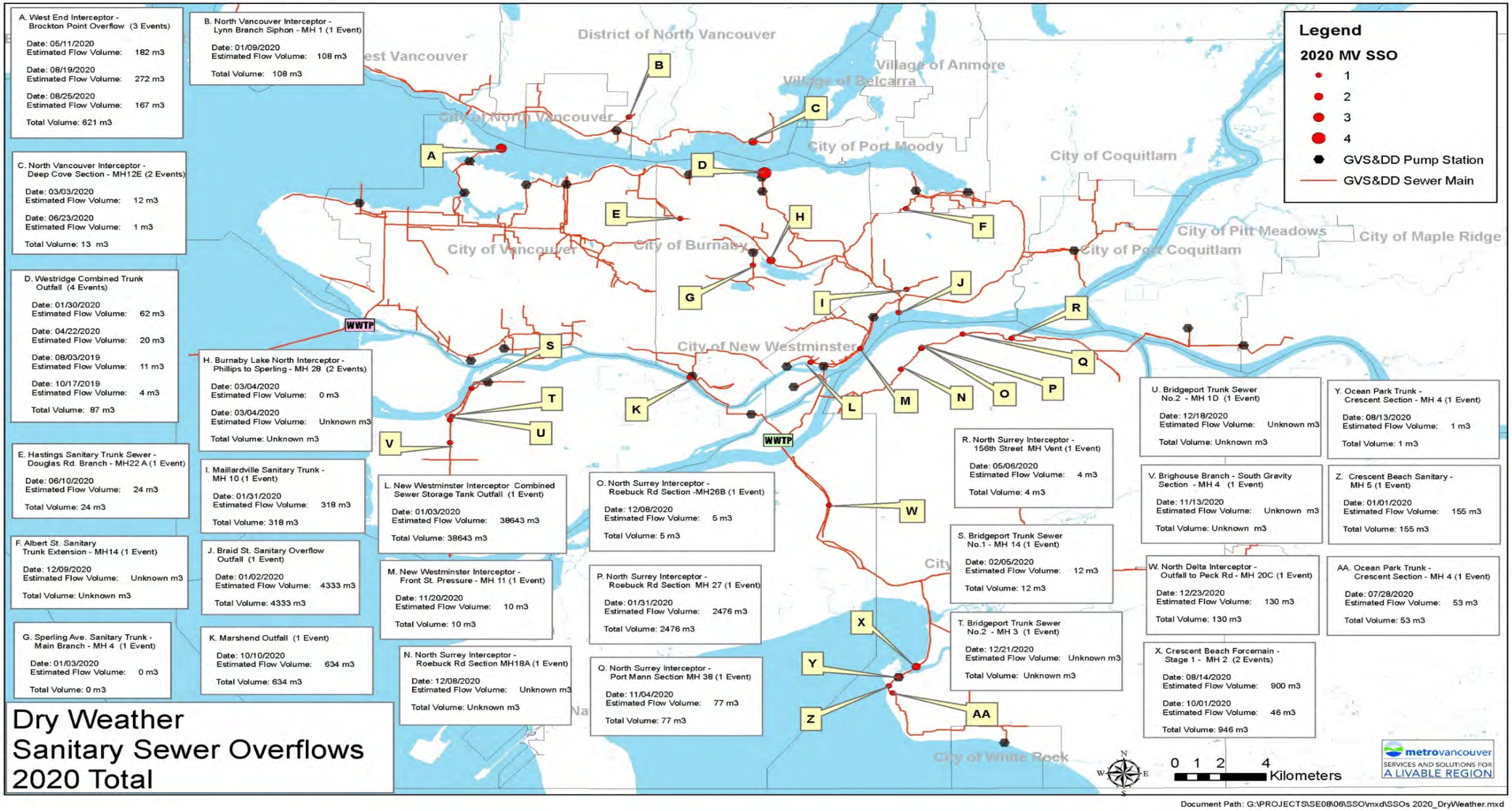


Figure 20 Dry Weather Sanitary Sewer Overflows 2020

Table 12 GVS&DD CSO Summary 2019

2019 CSO OVERFLOW SUMMARY WSER RESULTS - ILWRMP FORMAT					
Outfall Site Information		Annual Total			
Name	Site Code	Number Of Days[1]	Number of Events[2]	Duration (hr)	Total Est. Volume (m^3)
Angus Drive[3]	AG2 & NA2	27	27	69	1,481,000
Balaclava	BA1	40	38	119	1,124,000
Borden	BO3	109	85	870	349,000
Chilco / Brockton	CH7	11	10	73	112,000
Cassiar East	HA1	133	95	1,308	2,119,000
Cassiar North	HA1	133	95	1,308	2,119,000
Clark Drive #1	CD1	96	73	813	1,870,000
Clark Drive #2	CD2	73	54	488	6,293,000
Vernon Drive	VR10	88	90	286	578,000
English Bay #1	EB2	46	45	112	154,000
English Bay #2	4HI	24	26	52	15,000
Glenbrook	GL10	106	93	629	2,073,000
Heather	CA3	61	57	161	495,000
Macdonald	MD11	9	9	12	7,000
Manitoba	MN1	44	43	133	1,105,000
New West. CSO Tank	NW11	19	10	173	368,000
South Hill	SI9	88	83	343	918,000
Westridge	WD4	79	64	525	409,000
Willingdon #1	WI3	116	95	797	245,000
Willingdon #2	WI3	116	95	797	245,000
	Total[4]	1,418	1,187	9,068	22,078,000

[1] Number of days during the year that wastewater was deposited.

[2] A six hour inter-event time is used to define the number of CSO events. This is a standard methodology that takes into consideration the variations in rainfall intensity over the storm duration.

[3] The greater of the days, events and duration, and sum of the discharges from the two monitoring sites.

[4] The Total Estimated Volume does not equal the sum of the values above it due to roundoff error.

Table 13 GVS&DD CSO Summary 2020

2020 CSO OVERFLOW SUMMARY WSER RESULTS - ILWRMP FORMAT					
Outfall Site Information		**Annual Total**			
Name	**Site Code**	**Number Of Days[1]**	**Number of Events[2]**	**Duration (hr)**	**Total Est. Volume (m^3)**
Angus Drive[3]	AG2 & NA2	48	49	136	2,223,000
Balaclava	BA1	56	56	184	1,264,000
Borden	BO3	147	97	1,524	632,000
Chilco / Brockton	CH7	22	23	73	102,000
Cassiar East	HA1	175	99	2,283	3,783,000
Cassiar North	HA1	175	99	2,283	3,783,000
Clark Drive #1	CD1	139	93	1,523	3,244,000
Clark Drive #2	CD2	101	78	1,043	11,731,000
Vernon Drive	VR10	97	99	464	904,000
English Bay #1	EB2	54	56	177	221,000
English Bay #2	4HI	46	46	70	18,000
Glenbrook	GL10	138	108	1,207	3,558,000
Heather	CA3	72	66	246	617,000
Macdonald	MD11	8	8	6	8,000
Manitoba	MN1	64	63	205	1,485,000
New West. CSO Tank	NW11	30	21	334	728,000
South Hill	SI9	120	111	660	1,516,000
Westridge	WD4	102	66	874	697,000
Willingdon #1	WI3	138	104	1,089	215,000
Willingdon #2	WI3	138	104	1,089	215,000
	Total[4]	1,870	1,446	15,471	36,946,000

[1] Number of days during the year that wastewater was deposited.

[2] A six hour inter-event time is used to define the number of CSO events. This is a standard methodology that takes into consideration the variations in rainfall intensity over the storm duration.

[3] The greater of the days, events and duration, and sum of the discharges from the two monitoring sites.

[4] The Total Estimated Volume does not equal the sum of the values above it due to roundoff error.

Beach Closure Days

Metro Vancouver monitors the bacteriological quality of recreational waters. The monitoring information is shared with local health authorities and others, and is used by the health authorities to determine the need to post notice of beach closures.

Table 14 Beach Closure Days in 2019

Year/ Beach	Days 30-day Geomean Guideline was Exceeded	Days Beach was Posted
2019 – Bathing Beaches		
Sunset Beach	6	25
Ampleside	-	6
Kitsilano	-	6
Deep Cove	-	2
2020 – Bathing Beaches		
Sasamat Lake - White Pine Beach North	29	37
Sunset Beach	-	5

2.2. Goal 2: Use liquid waste as a resource

Energy and Materials Recovery

Metro Vancouver makes use of the biogas generated on-site at its wastewater treatment plants to provide treatment process heating and electricity for the plants.

Table 10 provides a summary of the energy recovered. Opportunities to increase biogas production are being explored and are discussed under their respective actions starting on page 31.

Table 14 Energy Recovered for all 5 Wastewater Treatment Plants 2010-20201

Year	*Electricity Generated (kWh)*	*Total Biogas Used (GJ)*
2010	39,934,650	247,919
2011	42,108,590	239,773
2012	38,692,239	300,163
2013	40,106,181	424,109
2014	41,317,709	477,732
2015	39,012,898	505,333
2016	41,142,259	522,179
2017	36,936,606	536,226
2018	13,757,056	414,484
2019	18,798,150	464,636
2020	28,993,237	515,905

Biosolids produced at the wastewater treatment plants are recovered for their nutrients and organic matter for use in land restoration or as components in soil products, refer to Figure 21. Quantities of biosolids generated at the wastewater treatment plants will continue to increase as a result of population growth and treatment process upgrades.

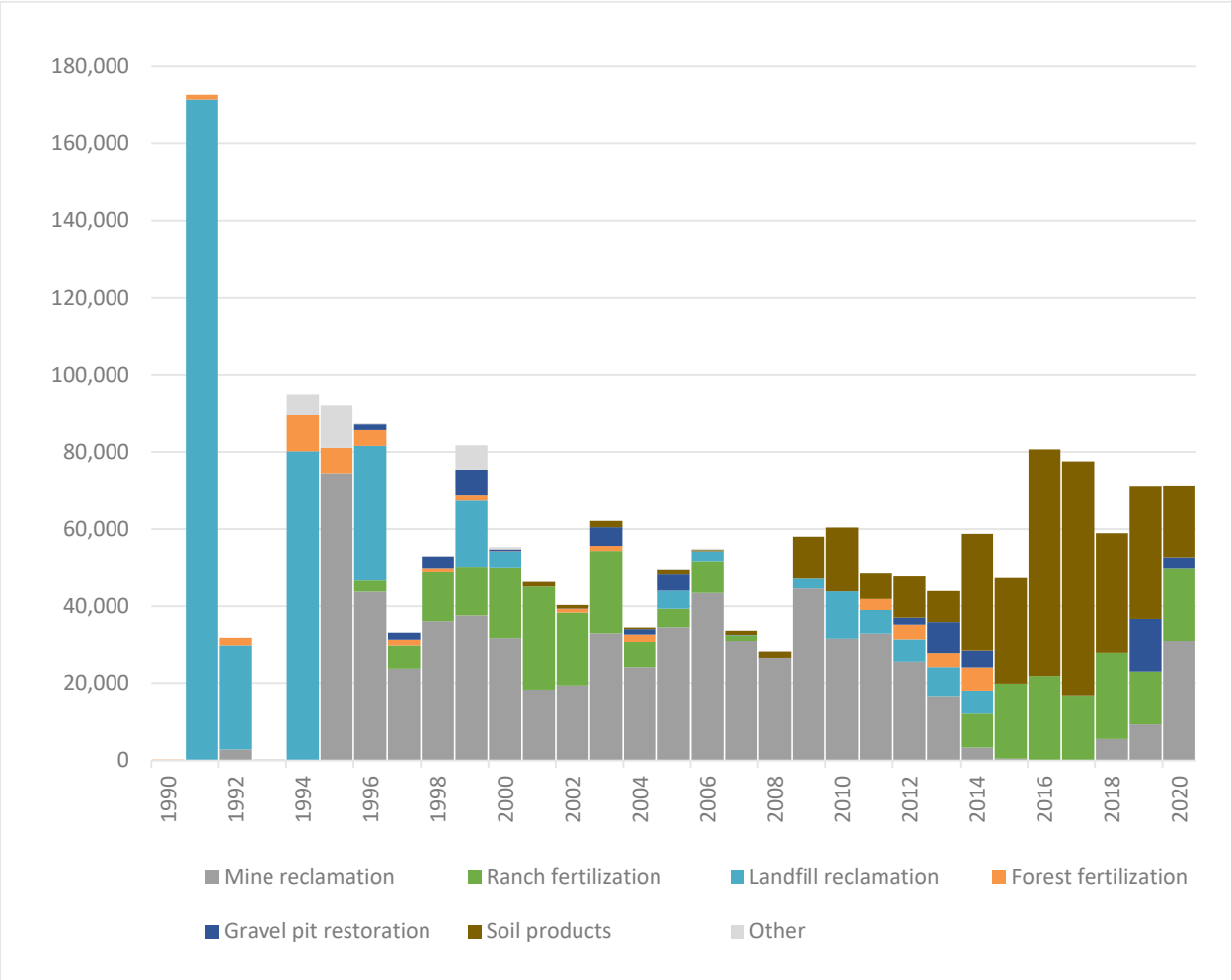


Figure 21 Recycled Biosolids Quantities

2.3. Goal 3: Effective, affordable and collaborative management

Daily Flows at WWTPs with Rainfall

How the sewer system responds to rainfall is indicative of whether there is too much rainwater entering sanitary sewers from cross-connected storm or building foundation drains. In sanitary sewer systems, excessive amounts of stormwater add additional pumping and treatment costs, as well as consume sewer capacity that has been dedicated to serve anticipated population growth. Figure 22 and Figure 23 show how sewage flows change at wastewater treatment plants in response to rainfall. Low flow trends can be seen for all locations for summer months, with sharp response to autumn rainfall.

While high peak flows at the Iona Island WWTP are a normal response to rainfall for its combined sewer system, the sharp peaks in flows at the Annacis Island WWTP indicate that there are still significant

amounts of rainwater entering its sanitary sewer system. This is due in part to combined sewers in New Westminster as well as high I&I occurring in some sewers leading to this plant.

Similarly, the peak flows of the Lions Gate WWTP indicate that there are large amounts of I&I entering the North Shore sewers and are a contrast to the limited rainfall responses shown at the Lulu Island and NW Langley WWTPs.

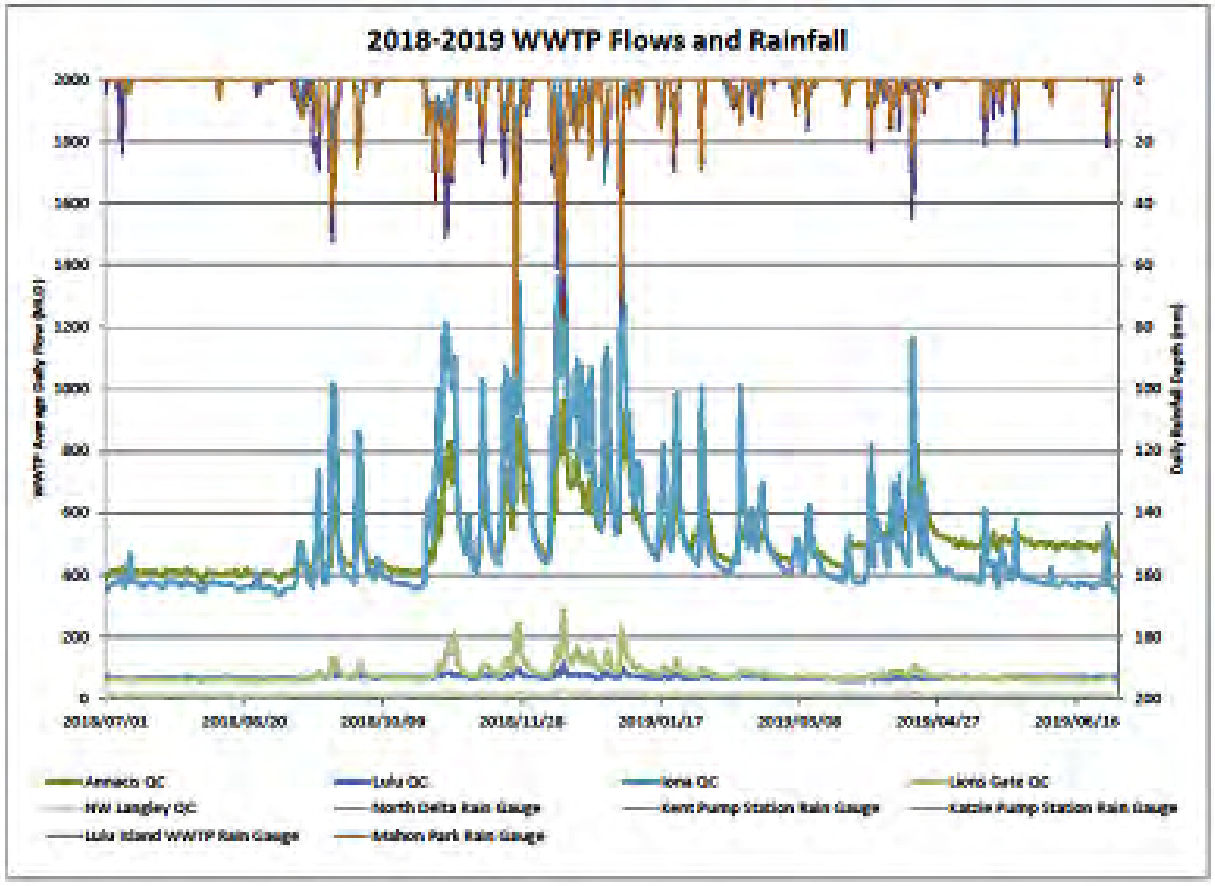


Figure 22 Average 24-hour Flows and Rainfall at WWTPs 2018 and 2019

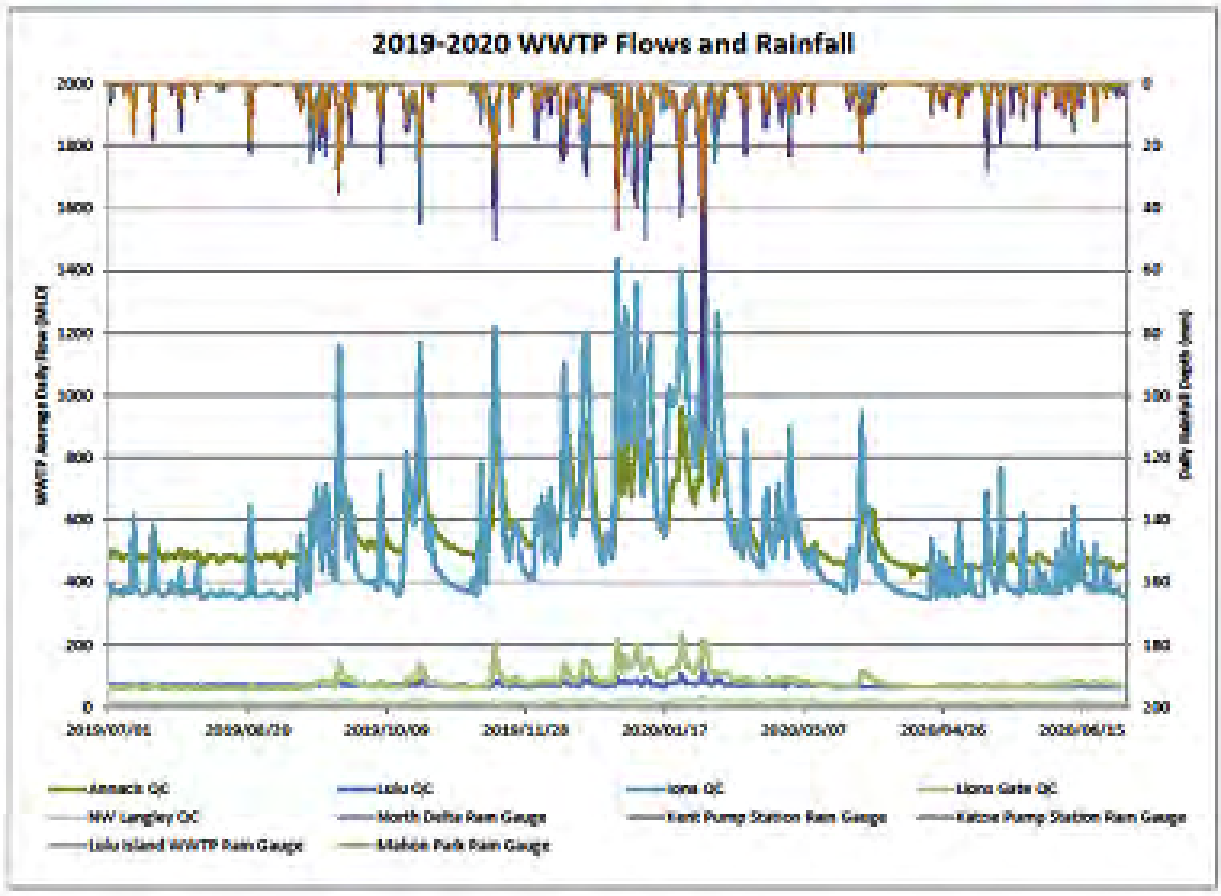


Figure 23 Average 24-hour Flows and Rainfall at WWTPs 2019 and 2020

Wet Weather Peaking Factors at Key Metro Vancouver Monitoring Points

The magnitude of wet weather peaking factors varies with I&I rates and the tributary catchment size (Table 11). Smaller catchments should have greater peaking factors than larger ones. The flow meter locations are shown on Figure 9 to Figure 13 (pp 43-47) and corresponding I&I estimates are shown on Figure 1 to Figure 4 (pp 13-16).

Due to the large catchment sizes, Metro Vancouver has not normalized the I&I estimates around the 1:5-year return period storm. Therefore, the estimates shown are strongly impacted by the differences in rainfall volume and intensity for each reporting period. Consequently, a catchment may move up or down within the I&I grouping categories due to different rainfall patterns. Municipal I&I estimates are considered more reliable as the finer catchment resolution allows for I&I estimates to be normalized to the 1:5-year storm return period. This permits better catchment-to-catchment and before-and-after comparison.

Table 15 Wet Weather Peaking Factors

			Ratio PWWF : ADWF*	
Meter	**Site**	**Gross Area (Ha)**	**2018-2019**	**2019-2020**
AN1	Annacis Island WWTP Effluent	42224.78	2.85	2.91
BB1	Marshend Pump Station	1478.31	3.85	3.52
BF1	Baynes Pump Station	390.91	2.28	2.57
BH1	Brighouse Branch Sewer	1250.30		9.29
BI1	Brunette Interceptor	4815.01	3.68	
BS2	Burnaby South Slope Interceptor	216.30	2.91	2.98
C21	Cloverdale Pump Station	4897.37	2.71	4.86
CA6	Cambie Combined Trunk Sewer	257.77	9.71	
CH1	Chilco Pump Station	144.41	4.16	5.35
CL1	Columbia Pump Station	115.80	5.74	6.39
CM7	Crescent Beach Pump Station	60.65	4.98	12.46
CQ1	Coquitlam Interceptor	1290.36	4.44	1.66
CV1	Surrey Central valley Trunk Sewer	5483.85		5.54
EB3	English Bay Interceptor	765.60	16.69	18.64
ER1	East Richmond Pump Station	158.69	2.46	2.20
GE1	Glen Eagles 1 Pump Station	51.12	6.98	5.83
GE2	Glen Eagles 2 Pump Station	58.05	6.76	5.85
HL1	Hollyburn Interceptor	2697.44	4.55	
IO1	Iona Island WWTP Effluent	9806.20	4.43	4.19
KA2	Kent Avenue Pump Station	473.44	2.50	2.36
L21	Langley Pump Station	3049.28	3.52	4.04
L22	Langley Connector #2	109.21	4.07	8.23
L31	Langley Connector #3	1254.86	3.26	4.74
LA1	Langley Connector #1	502.62	3.16	3.47
LG50	Surrey flow to Langley Pump Station	106.42	6.52	9.96
LN1	Lions Gate WWTP Effluent	4290.91	6.97	5.66
LU1	Lulu Island WWTP Effluent	4894.66	2.33	2.20
LY1/LY2	Lynn Pump Station	1387.81	6.15	7.24
LZ4	Lozells Sanitary Trunk Sewer	207.30	10.48	11.16
MA2	Main Arm Branch Sewer	9.60		10.01
MK3	Mackay Avenue Trunk Sewer	340.02	4.23	4.51
ML2	Maillardville Trunk Sewer Twinning	585.60	3.93	4.04
MP1	Katzie Pump Station	2634.75	3.48	3.27
N21	Newton Sanitary Trunk Sewer No. 2	498.36	2.08	2.05

NA3	North Arm Interceptor	2393.70	4.62	
NC1	North East Coquitlam Trunk Sewer	176.96	3.22	
ND2	North Delta Interceptor	1690.96	2.38	6.07
NE9	Delta Flow to Newton Sanitary Trunk Sewer No. 2	138.39	2.70	2.49
NG1	Northwest Langley WWTP Effluent	1295.16	2.59	2.44
NS2	North Surrey Interceptor	6836.57	4.64	3.93
NV1	North Vancouver Interceptor - Capilano Section	2594.90	4.80	
NV9	North Vancouver Interceptor - City Section	2420.40	5.27	4.47
NVLS	North Vancouver Interceptor - Lynn Branch	680.30	6.43	5.79
NW2	New Westminster Interceptor	13490.51	3.57	3.93
NW3	New Westminster Interceptor - Sapperton Section	12077.03	2.74	2.28
P21	Port Coquitlam Pump Station	2184.87	3.66	4.23
QU1	Queensborough Pump Station	148.36	5.49	4.60
SS3	South Surrey Interceptor	14986.12	2.16	4.12
SS9	Tilbury Force Main	2580.29	3.53	3.65
SV2	Steveston Branch Sewer	716.80		8.15
WR1	Westridge Pump Station #1	170.20	9.41	8.60
WF1	White Rock Pump Station	501.47	3.74	5.67

**Calculated as the max hourly flow on the max flow day divided by the 25th percentile of average daily flows for the full year*

Sewer Condition Inspection

Sewer condition inspection is part of an ongoing cycle of asset evaluation and repair. Keeping assets in good repair reduces I&I, lowers pumping and treatment costs, and extends the lifecycle of existing infrastructure investments. Metro Vancouver's 530 km of sewers represent less than three percent of the region-wide total sewer network.

Table 16 Meters of Sewer Pipe Inspected and Renewed Annually

	Planned (km)	Actual (km)	Rehabilitated (km)
2012	27.5	24.5	0.7
2013	33	31	0
2014	29.7	20.5	0.2
2015	29.7	27.5	0
2016	37	22.4	0.35
2017	26.5	14.4	0.15
2018	26.5	26	0
2019	26.5	33.4	0.14
2020	26.5	33.5	0.03

Integrated Stormwater Management Planning

Integrated stormwater management plans (ISMPs) were initiated under the 2002 LWMP, with members initially given 12 years to complete the development of these plans. From 2002 onwards, Metro Vancouver has worked with the Stormwater Interagency Liaison Group to develop supporting processes and material to help facilitate the ISMP development and implementation.

In 2010, through the updated LWMP, GVS&DD members reaffirmed their commitment to develop ISMPs by the end of 2014, and implement these plans.

In 2014, a Monitoring and Adaptive Management Framework (AMF) was developed to fulfill Ministerial Condition 7, which also allows for the extension of the ISMP completion deadline to 2016.

A summary of ISMP status by location is provided by Figure 24. ISMPs are not required for the entire region; in general, they are not required for watersheds which are 20% or more rural or forested area. Watershed specific details for ISMP progress are provided by each member jurisdiction in Volume 2: Municipal Reports, under Action 3.4.7. In addition, watershed specific summaries were also reported as part of the Interim Report: 2019.

As of the end of 2020, there are 100 ISMPs developed and in implementation phase and 6 ISMPs being developed.

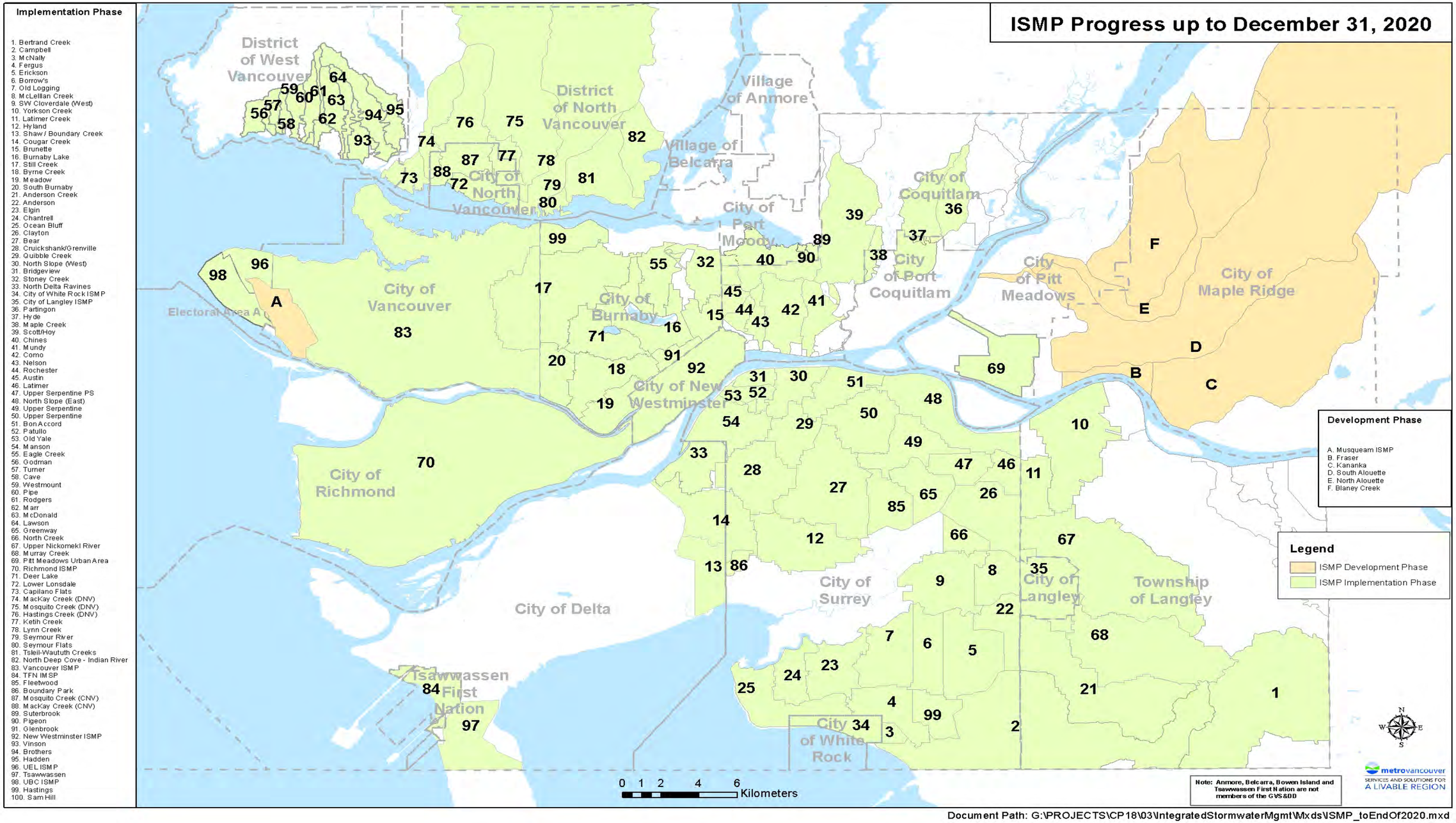


Figure 24 ISMP Status as of December 31 2020

Financial

A summary of Metro Vancouver's liquid waste budgets is provided in Table 17: details and context are available at:
http://www.metrovancouver.org/services/financial-services/programs-budget/Pages/default.aspx

Table 17 Liquid Waste GVS&DD Operating/Capital Budgets ($ Millions) (2017 to 2020)

	Final Budget	Actual	Final Budget	Actual	Final Budget	Actual	Final Budget
Type of Expenditure / Revenue:	2017	2017	2018	2018	2019	2019	2020
Operations & Maintenance	$153.5	$145.0	$166.6	$159.0	$177.9	$165.6	$187.1
Debt Service	$18	$14.2	$25.6	$23.8	$54.3	$48.8	$57.2
Contribution to Capital	$64.8	$64.8	$74.7	$74.7	$78.7	$78.7	$86.8
Total Operating Budget - S&D (Expenditures)	$236.3	$224.0	$266.9	$257.5	$310.9	$293.1	$331.1
Municipal (S&D) Levy - Liquid Waste	$213.9	$213.9	$232.1	$232.1	$255.8	$255.8	$274.2
User Fees	$2.4	$2.5	$2.5	$2.5	$2.4	$2.5	$2.5
Transfer from DCC reserves	$6.8	$5.2	$12.9	$10.8	$31.7	$30.4	$34.2
BOD-TSS Industrial Charges	$8.6	$9.8	$10.2	$11.3	$11.0	$11.2	$11.2
Other External Revenues	$0.2	$1.1	$0.2	$0.8	$0.6	$0.8	$0.6
Other Funds / Reserves / Surplus	$4.4	$0.2	$9.0	$5.8	$9.4	$1.3	$8.4
subtotal - other revenues/reserves	$22.4	$18.8	$34.8	$31.2	$55.1	$46.2	$56.9
Total Operating Budget - S&D (Revenues)	$236.3	$232.7	$266.9	$263.3	$310.9	$302.0	$331.1
Operational Surplus Sewerage & Drainage		$8.7		$5.8		$8.9	
Sewerage & Drainage Capital - Expenditures	$163.7	$167.8	$380.4	$297.9	$564.9	$417.6	$883.4

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