



City of Richmond

Report to Committee

To: Public Works and Transportation Committee **Date:** June 18, 2021
From: Milton Chan, P.Eng.
Director, Engineering **File:** 10-6060-01/2021-Vol
01
Re: **Fraser River Freshet and Flood Protection Update 2021**

Staff Recommendation

That the staff report titled “Fraser River Freshet and Flood Protection Update 2021”, dated June 18, 2021, from the Director, Engineering be received for information.

Milton Chan, P.Eng
Director, Engineering
(604-276-4377)

REPORT CONCURRENCE		
ROUTED TO:	CONCURRENCE	CONCURRENCE OF GENERAL MANAGER
Sewerage & Drainage Roads & Construction	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	
SENIOR STAFF REPORT REVIEW	INITIALS: 	APPROVED BY CAO

Staff Report

Origin

As detailed in the Flood Protection Management Strategy 2019, the City of Richmond is situated approximately 1.0 m above sea level and flood protection is integral to protecting the health, safety, and economic viability of the City. Richmond is protected from flooding by infrastructure that includes 49 km of dikes, 585 km of drainage pipes, 61 km of culverts, 165 km of watercourses and 39 drainage pump stations.

This report provides Council with a summary of the 2021 Fraser River freshet, along with an update on 2020 rainfall statistics and ongoing works regarding the City's Flood Protection Program.

This report supports Council's Strategic Plan 2018-2022 Strategy #1 A Safe and Resilient City:

Enhance and protect the safety and well-being of Richmond.

1.2 Future-proof and maintain city infrastructure to keep the community safe.

Analysis

2021 Fraser River Freshet

The snowpack in the Fraser Basin region was above average at 116% of normal in April. Flows in the Fraser River were between a 2-year and 5-year return period event, with a peak flow of 9,800 m³/s measured at Hope (peaks in 2018, 2019 and 2020 were 11,050 m³/s, 7,200 m³/s and 10,800 m³/s respectively). Fraser River water levels began receding on June 7, 2021 and have attenuated since.

The City's diking system is built to withstand a 500-year return period freshet event and there has been no danger of flooding in Richmond to date during the 2021 freshet.

The City continues to be a leader in flood protection planning and mitigation through Council-endorsed Capital Projects and the annual dike maintenance program. Predicted climate change impacts, which include more extreme weather events, could result in an increased variability in freshet flows in the future, reinforcing the need for the City's continued flood protection upgrade program.

2020 Rainfall and 2020/2021 Winter Storm Events

Attachment 1 identifies the total annual rainfall over the last 10 years. Rainfall highlights for 2020 include the following:

- The City received approximately 1382 mm of rainfall in 2020, which is the third highest rainfall received in the last 10 years. It is also 12% higher than the average annual rainfall (over the last 10 years);

- January was the wettest month of the year, with 328 mm of rainfall at Richmond City Hall and 362 mm of rainfall at Fire Hall No. 7. This accounts for 24% of the total annual rainfall at both of these locations;
- The rainiest day of 2020 was September 23, with 64 mm of rain (10-year return period) recorded at Fire Hall No. 7 and 68 mm of rain (10-year return period) recorded in the Hamilton area over a 6-hour period;
- The most intense storm of 2020 occurred on February 2, when sensors in the Hamilton area recorded a rainfall intensity of 22 mm/hr for a 1-hour period. This rainfall event has a statistical return period of 100 years; however, this intensity was not sustained, as the total rainfall recorded for the day was 54 mm; and
- A total of 11 significant events with statistical return periods of two years or more were recorded in 2020 across the island.

In 2020, the City experienced the third highest rainfall in the past 10 years, with 11 rainfall events that equaled or exceeded the 2-year return period. In recent years, there has been an increase in the occurrences and intensities of significant storms, with the potential for multiple storms exceeding a 10-year return period intensity in a given year. This is consistent with predicted climate change impacts on local weather patterns and reinforces the need for the City's continued flood protection upgrade program.

On January 13, 2021, a significant amount of large logs and woody debris accumulated along the south dike west of Gilbert Road as a result of a king tide event combined with a wind storm. Rip rap repairs and debris removal were required. To mitigate debris accumulations like this, the Province maintains the Fraser River debris trap. This is located between Agassiz and Hope and is designed to intercept large volumes of natural woody debris. It diverts approximately 70% of the large woody debris in the river and is maintained year-round by the Province.

Drainage System Performance

567 service requests related to drainage issues were recorded by Public Works in 2020, which is approximately 40% above the annual average over the past 10 years and is a result of experiencing the third highest rainfall in the past 10 years.

Attachment 2 identifies the total number of service requests related to drainage over the past 10 years.

Infrastructure Improvements

The City's flood protection system is currently valued at an estimated \$2.5 billion, comprising of 585 km of drainage mains, 61 km of box culverts, 165 km of watercourses, 39 drainage pump stations, and 49 km of dikes. Staff are continuously upgrading and improving the City's flood protection system to address the impacts of infrastructure age, growth, and climate change.

Capital Dike Upgrades

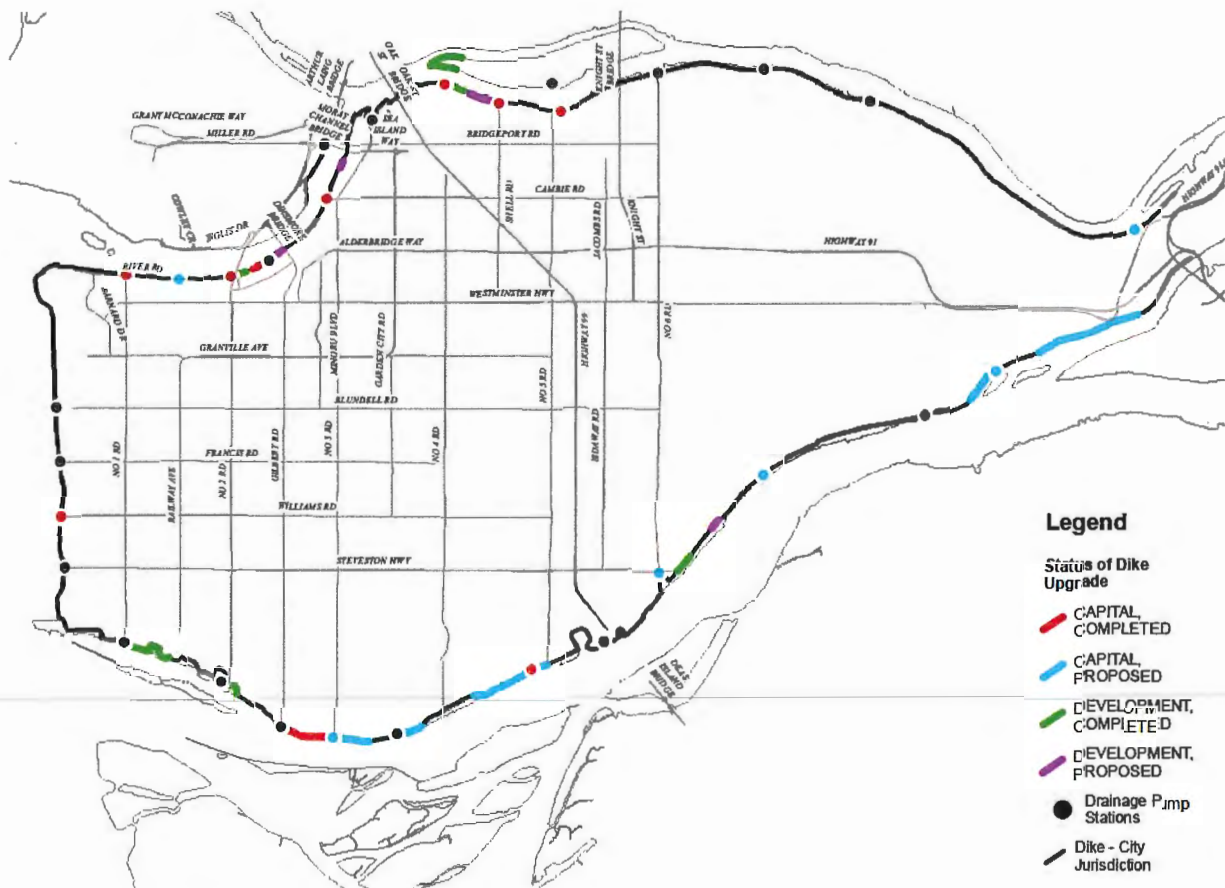
Current climate change science estimates that sea level will rise approximately 1.0 m by the year 2100 and 0.2 m of land subsidence is forecasted over the same time period. The City's Flood Protection Management Strategy is the guiding framework for continual upgrades and improvement to the City's flood protection system. A key action identified in the City's Flood Protection Management Strategy involves continuing to raise the City's perimeter dike to 4.7 m in order to stay ahead of climate change induced sea level rise.

Currently approved dike improvement projects include over 4.25 km and \$20.5 million in upgrades. These projects include:

- South dike upgrade between No. 3 Road to 400 m west of No. 4 Road. Construction is anticipated to begin Summer 2021;
- South dike upgrade between 200 m west of No. 9 Road and the Ewen Road Drainage Pump Station. Construction is anticipated to begin Fall 2021;
- South dike upgrade between No. 4 Road and No. 5 Road. Design is anticipated to begin Summer 2021; and
- South dike upgrade between Graybar Road and Queens Road. Design is anticipated to begin Spring 2022.

Figure 1 identifies completed and anticipated upcoming dike upgrades. Additional dike upgrades will be included in the 5-Year Capital Plan for Council's consideration.

Figure 1. Completed and Anticipated Upcoming Dike Upgrades



Dike Rehabilitation

Staff maintain annual inspection and maintenance programs to ensure that the City's dikes are well-protected against issues such as erosion and seepage. Notable maintenance issues identified and addressed through dike inspections over the past year include:

- Sloughing and deterioration of rip rap in a 300 m section of the south dike west of Gilbert Road as a result of a king tide event together with a wind storm on January 13, 2021. In addition, a significant amount of large logs and woody debris accumulated in the area. Dike re-armouring was implemented and debris removal of over 700 large logs/woody debris pieces were removed from the dike and beach areas;
- Minor seepage at the Britannia Shipyard floodwall was observed during the elevated tide levels that took place January 12, 2021 and January 13, 2021. Grouting to eliminate further seepage will occur late June;
- Sloughing and deterioration of rip rap in a 100 m section of the north dike fronting 12011 and 12151 River Road. Dike re-armouring was implemented to reinforce and protect the dike at this location;

- Significant erosion on the land side of the south dike in a 20 m section fronting 11551 Dyke Road. Restoration was implemented to reinforce the dike at this location;
- Top cap added along the top of the bank to protect against debris in a 142 m section of the north dike at 2811 River Road; and
- Significant erosion and undermining of the North Dike between Nelson Road and just west of the train trestle. Rehabilitation and restoration is scheduled to begin as soon as provincial and federal permits are received. This work precedes extensive dike raising capital works that will be required in the coming decades to address climate change induced sea level rise.

Pump Station Upgrades

Significant progress has been made in upgrading the City's drainage pump stations to accommodate growth and climate change. The total capacity of the City's drainage pump stations has increased by 29% since 2005. Attachment 3 summarizes the pump station capacity increase over the last 10 years.

Over the last 20 years, since the City introduced the Drainage and Diking Utility, the City has rebuilt 14 of its 39 drainage pump stations and has performed significant upgrades on four. Re-construction of the Horseshoe Slough and Shell Road North Pump Stations is complete. Re-construction of the No. 7 Road South Pump Station is nearing completion. Steveston Highway and No. 3 Road and Steveston Highway and Gilbert Road Pump Stations are anticipated to begin construction Summer 2021.

During extreme events, a number of the older pump stations operate near full capacity. These stations have been identified to require upgrades through capacity analysis. Projects to upgrade or replace these stations are either included in current capital programs or will be brought forward for Council consideration as part of future capital programs.

Box Culvert Repair and Preventative Maintenance

The City has approximately 61 km of box culverts, the majority of which are 40 to 50 years in age. Although the box culverts have a design life of 100 years, premature failure of some joints has been observed in recent years.

The City has a box culvert preventative maintenance program to inspect the condition of box culverts and identify sections that require repair or replacement. Staff are proactively managing the condition of box culverts by identifying and repairing deteriorating joints before they cause significant damage. Maintaining a well-managed preventative maintenance program enables more efficient repairs, fewer public disruptions, lower lifecycle costs, and extension of infrastructure lifespan. Inspection and remediation of the City's culvert network are currently performed on a 7-year cycle. Repair of significant defects identified through the program will be presented to Council for consideration as part of future capital programs.

Recent capital projects include the repair of the box culvert under No. 2 Road south of Steveston Highway (completed) and the repair of the box culvert under No. 4 Road, from Blundell Road to Alderbridge Way (ongoing).

Staff inspected 3.3 km of box culvert within 3 drainage catchments in 2020. Results of each inspection are documented through written reports, image and video records, allowing staff to monitor changes to the condition of the culverts, better informing long-term decision making. Minor defects have been identified and remediated. In 2020, significant defects were encountered within the No. 1 Road North, No. 2 Road North and No. 3 Road South drainage catchments. Grouting repairs have been performed at these locations and any required major structural rehabilitation works will be presented to Council for consideration as part of future capital programs.

The Gilbert Road North, No. 3 Road South and Cambie Road drainage catchment areas are scheduled next for inspection.

Flood Protection Improvement Financing

Improvements to the City's flood protection system to address the needs of ageing infrastructure and climate change are funded through three basic funding sources.

Drainage and Diking Utility

The Drainage and Diking Utility was established by Council in 2000 and currently generates \$13.4 million annually to maintain and upgrade Richmond's flood protection infrastructure. Staff are continuously monitoring regional and global climate change science to inform the City's Flood Protection Program.

At the April 6, 2021 General Purposes Committee Meeting, Committee endorsed the following recommendation as outlined in the staff report titled "Accelerated Flood Protection Program Concept and Flood Protection Rate Structure Review", dated February 26, 2021 from the Director, Engineering:

That a target annual revenue level of \$30 million by 2031, for the Drainage and Diking Utility, be endorsed for use in future utility budget planning in order to support Option 1 – 50 Year Implementation Period for an accelerated flood protection program.; and

That implementation of the new utility rates commence in 2023.

Implementation of the new utility rates will be included in the 2023 Utility Budgets and Rates report, including budgeted expenditures for additional staffing, maintenance of the flood protection works, and operational resources for Council's consideration as part of the annual budget process.

Senior Government Grant Funding

The City's Flood Protection Management Strategy aims to acquire senior government funding for a wide range of flood prevention and protection research, monitoring, studies, planning and improvements. As a result of proactive flood protection planning efforts, the City has been successful in securing approximately \$40 million in senior government grants since 2010 that helped fund over \$70 million of dike upgrades, pump station improvements and master planning updates.

Development

The City has successfully partnered with developers to secure dike upgrades through development. In particular, the City is actively pursuing opportunities to construct superdikes, where land supporting development behind the dike is filled to the same elevation as the dike crest. This eliminates visual impacts of a raised dike structure on waterfront views while providing an enhanced flood protection structure for the City. Staff estimate that up to 20% of dike upgrades along Lulu Island's perimeter dikes will be completed through development. Superdikes constructed through development to date include sections near the Richmond Olympic Oval, Parc Riviera and at the Imperial Landing and Kawaki developments in Steveston. Superdike construction is underway at the Western-Citimark development, and is anticipated to begin early next year for the Vancouver Airport Fuel Facility Corporation (VAFFC) and Aspac Lot 17 development.

Financial Impact

None.

Conclusion

The City experienced the third highest rainfall over the last 10 years in 2020 and average freshet flows in the spring of 2021. The drainage and flood protection system performed well, with an above average number of drainage-related service requests and negligible freshet flood risk.

Demands on the drainage and flood protection system will continue to increase with pressures from climate change and development. The Flood Protection Management Strategy 2019 proactively guides the City to forecast, plan, and improve the City's flood protection system to meet long-term requirements. Through the capital improvements and investment in preventative maintenance programs, the City has developed the ability to proactively prepare and respond to flood related concerns. Significant progress continues to be made in advancing the City's dike planning efforts and implementing infrastructure improvements to the City's flood protection system.



Jason Ho, P.Eng.
Manager, Engineering Planning
(604-244-1281)

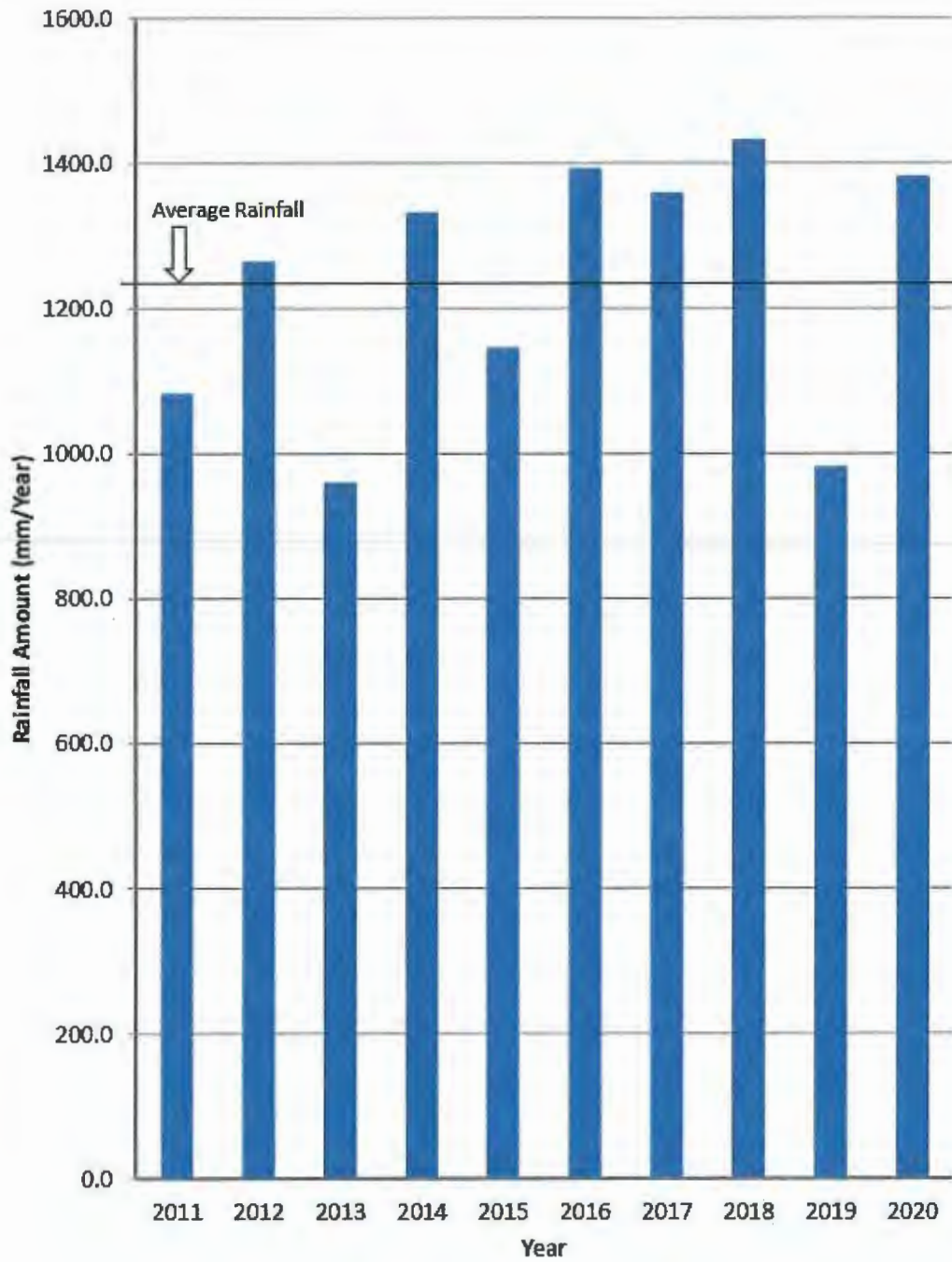


Corrine Haer, P.Eng.
Project Manager
(604-276-4026)

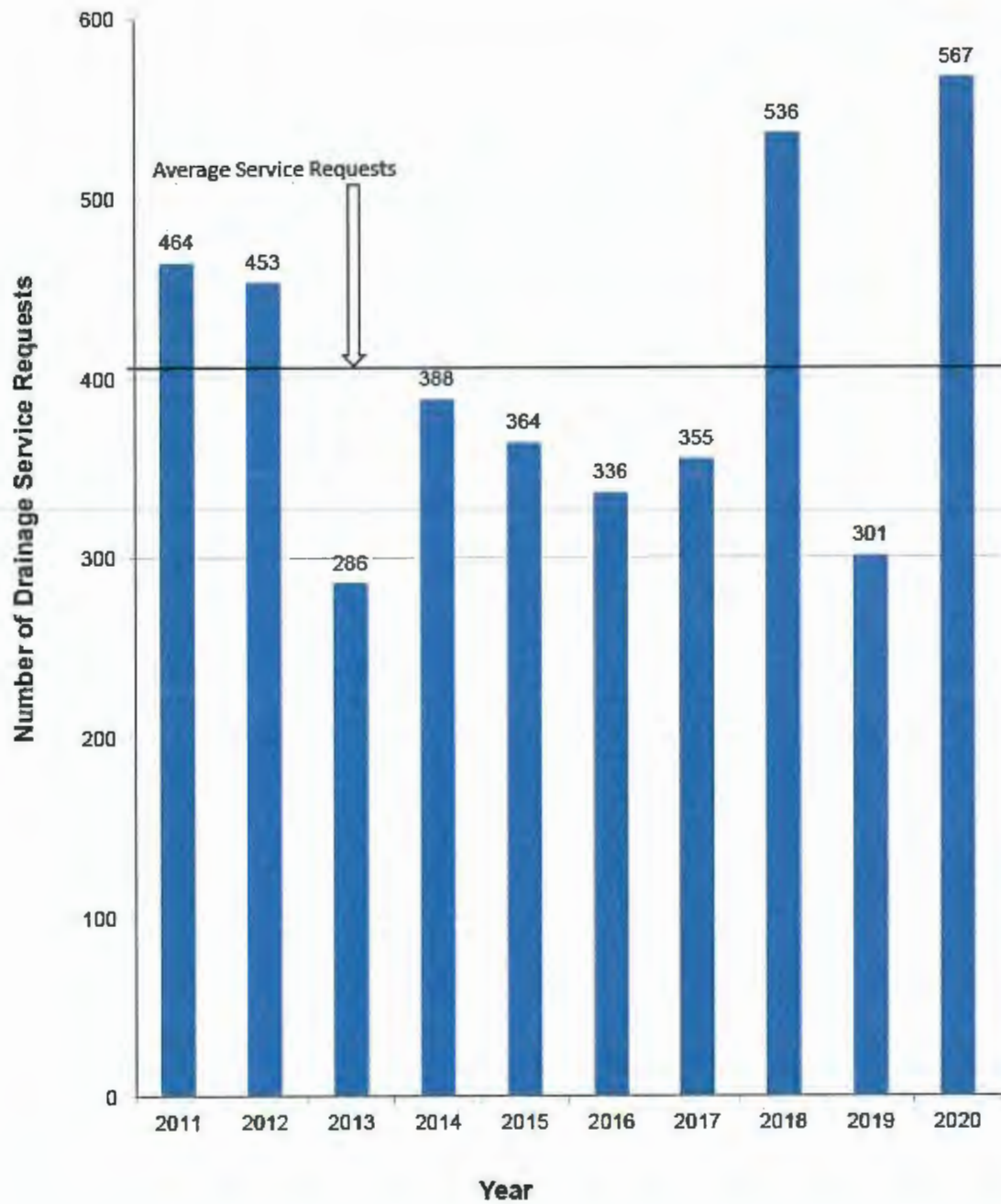
CH:ch

- Att. 1: Annual Rainfall Data 2011-2020
2: Annual Drainage Service Requests 2011-2020
3: Total Drainage Pump Station Pumping Capacity 2011-2020

Annual Rainfall Data 2011-2020



Annual Drainage Service Requests 2011-2020



Total Drainage Pump Station Pumping Capacity 2011-2020

