



City of Richmond

Report to Committee

To: Public Works and Transportation Committee

Date: August 10, 2022

From: Milton Chan, P.Eng.
Director, Engineering

File: 10-6060-01/2022-Vol
01

Re: Fraser River Freshet and Flood Protection Update 2022

Staff Recommendation

That the staff report titled "Fraser River Freshet and Flood Protection Update 2022", dated August 10, 2022, from the Director, Engineering be received for information.

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

REPORT CONCURRENCE		
ROUTED TO: Public Works	CONCURRENCE ☒	CONCURRENCE OF GENERAL MANAGER
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 metre 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, 595 km of drainage pipes, 61 km of culverts, 155 km of watercourses and 39 drainage pump stations.

This report provides Council with a summary of the 2022 Fraser River freshet, along with an update on 2021 rainfall statistics and ongoing works regarding the City's Flood Protection Program.

This report supports the following strategies within 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.

Strategy #5 An Active and Thriving Richmond:

An active and thriving community characterized by diverse social and wellness programs, services and spaces that foster health and well-being for all.

4.2 Ensure infrastructure meets changing community needs, current trends and best practices.

Analysis

2022 Fraser River Freshet

Below-average temperatures were experienced across the province in the months of April, May, and June, which resulted in delayed snowmelt. As such, the snowpack observed in the Fraser Basin region was well above average at 129% of normal in May. The peak Fraser River flow measured at Hope was 10,400 m³/s, which is a 5-year return period event (peaks in 2018, 2019, 2020, and 2021 were 11,050 m³/s, 7,200 m³/s, 10,800 m³/s, and 9,800 m³/s respectively). Fraser River water levels began receding on July 3, 2022 and have attenuated since.

The City's diking system is built to withstand a 500-year return period freshet event and there was no danger of flooding in Richmond during the 2022 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.

2021 Rainfall

Significant Rainfall Events

Attachment 1 identifies the total annual rainfall over the last 10 years. Rainfall highlights for 2021 include the following:

- The City received approximately 1,336 mm of rainfall in 2021, which is 6% higher than the average annual rainfall (over the last 10 years);
- November was the wettest month of the year, with 429 mm of rainfall at Hamilton Community Centre. This accounts for over 28% of the total annual rainfall at this location;
- A total of 8 significant events with statistical return periods of two years or more were recorded in 2021.

November 2021 'Atmospheric River' events

In November 2021, the City experienced significant rainfall events, termed 'atmospheric river' events, as described in the "November 2021 Atmospheric River Events – Summary and Outcomes" report dated March 11, 2022 from the Director, Public Works Operations and Director, Engineering. Since the event, staff have undertaken a number of initiatives to assess and improve the City's drainage system based on observations from the event, including:

- Large scale maintenance activities have been completed at the Horseshoe Slough canal and for drainage pipes within the Horseshoe Slough catchment in response to flooding issues observed in the area during the 'atmospheric river' events, which have resulted in significant flow improvements in this area;
- Staff are assessing the need for a new drainage pump station at Steveston Highway and Shell Road to further improve drainage in the Horseshoe Slough catchment. A temporary pump station will be installed in 2022 prior to the rain season, and a capital project for the construction of permanent drainage improvements will be brought forward for Council's consideration as part of the 2023 capital budget process;
- Construction of the Steveston Highway and No. 3 Road and Steveston Highway and Gilbert Road inland drainage pump stations are complete. Both stations are in operation and will improve flows within the Gilbert Road and No. 3 Road catchments;
- Staff continue to work with the Ministry of Highways and Infrastructure (MoTI) on preventative maintenance of the interconnected City-MoTI drainage infrastructure and identifying opportunities for drainage upgrades as part of the Fraser River Tunnel Project;
- Staff have reviewed street sweeping procedures and resources, and have identified that additional resources are required to keep the drainage system clear and unobstructed.

These will be brought forward for Council's consideration as part of the 2023 budget process;

- Access to independent portable fuel supplies was identified as a requirement to ensure backup generators could be fueled to support pump stations and generators at various City facilities. Staff are currently scoping specifications for acquiring fueling trucks along with required resources and will bring forward a capital project for Council's consideration as part of the 2023 capital budget process;
- Staff are developing communications material to provide residents with information on how to better protect their property during extreme rain events and how to properly maintain private drainage infrastructure. Any associated costs identified as part of this process will be brought forward for consideration as part of the 2023 budget process; and
- Staff are developing a program for sandbag distribution in the case of emergencies to help protect private property. Equipment needs are being reviewed and any associated funding requirements identified will be brought forward as part of the 2023 budget process.

Staff will continue to update Council with the progress of the initiatives identified.

Drainage System Performance

947 service requests related to drainage issues were recorded by Public Works in 2021, 624 of which were recorded in the month of November including those related to the 'atmospheric river' events. The remaining 323 requests are consistent with the average annual number of service requests received over the past 10 years, as identified in Attachment 2.

2021/2022 Winter Storm Events

Seasonal high tides and king tides were not significant this winter, and the City's diking system performed well. Erosion and debris run up continue to be addressed as part of the dike maintenance program.

Infrastructure Improvements

The City's flood protection system has a replacement value (2022 dollars) of \$2.2B, comprised of an extensive drainage network and 49 kilometers of perimeter dike. Staff are continuously upgrading and improving the 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 the following:

- South dike upgrade between No. 3 Road to 400 m west of No. 4 Road. Construction is substantially complete;
- South dike upgrade between 200 m west of No. 9 Road and the Ewen Road Drainage Pump Station. Construction is ongoing;
- South dike upgrade between No. 4 Road and No. 5 Road. Design is underway;
- North dike upgrades between Lynas Lane and No. 2 Road. Design is underway;

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 work completed this year include:

- Large logs and woody debris were removed from the dike and beach areas at the south dike near Gilbert Road after a king tide and wind storm event on January 13, 2021.
- Additional rip-rap was added along the top of bank to protect against debris at the north dike in a 300 metres section at 22760 River Road, a 125 metres section at 21920 River Road and a 90 metres section at 12151 River Road; and
- Dike inspections identified ponding issues along the dike near 15911 River Road. This was addressed through clearing of a plugged drain and reinstating the dike armouring as part of the dike maintenance program.

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 30% 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 15 of its 39 drainage pump stations and has performed significant upgrades on four. Re-construction of the No. 7 Road South Pump Station, Steveston Highway and No. 3 Road Pump Station and Steveston Highway and Gilbert Road Pump Station is substantially complete.

During extreme events, a number of 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 program or will be brought forward for Council consideration as part of future capital program.

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 executed in a 7-year cycle. Staff are proactively managing the condition of box culverts by identifying and repairing deteriorating joints before they cause significant damage. Repair of significant defects identified through the program are presented to Council for consideration as part of the capital program.

Staff inspected 2.5 km of box culvert within 6 drainage catchments in 2021. Results of each inspection are documented through written reports as well as 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 2021, significant defects were encountered within the Woodward's Slough drainage catchment. Repair of this culvert has been included in the 2022 capital program. Other recent capital projects include 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 between Blundell Road and Alderbridge Way (ongoing), with repairs between Blundell Road and Granville Avenue complete.

The Shell Road North, Woodward's Slough, and No. 3 Road South drainage catchment areas are scheduled next for inspection.

Flood Protection Public Engagement

In 2022, staff successfully participated in 14 community events and hosted five online engagement sessions to present the public with information on Richmond's flood protection initiatives, including ongoing diking efforts, Dike Master Plan Phase 4, and the City's Accelerated Flood Protection Program. Additionally, an online public engagement platform for Flood Protection was set up through Let's Talk Richmond. The flood protection page has had over 900 visits since it was first launched in June 2022.

The public engagement efforts are valuable as they help make the community aware of the upcoming projects and initiatives and allow them to provide their feedback to the City.

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 main funding sources.

Drainage and Diking Utility

The Drainage and Diking Utility was established by Council in 2000 and currently generates \$14.6 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 12, 2021 Regular Council meeting, Council endorsed a target annual revenue level of \$30 million by 2031 for the Drainage and Diking Utility in order to support a 50 year implementation period to improve the City's flood protection infrastructure well in advance of anticipated climate change impacts.

To support this target, implementation of the new utility rates will be included in the 2023 Utility Budgets and Rates report 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.

Superdikes constructed through development to date include sections near the Richmond Olympic Oval, along the north dike near No. 4 Road, along the south dike at Riverport Way, and in Steveston. Superdike construction is underway by Western-Citimark, Vancouver Airport Fuel Facility Corporation and ASPAC Developments.

Financial Impact

None.

Conclusion

The City observed the fifth highest annual rainfall over the last 10 years in 2021 and above-average freshet flows in the spring of 2022. The drainage and flood protection system performed well, with negligible freshet flood risk and an above average number of drainage-related service requests, resulting from the 'atmospheric river' events.

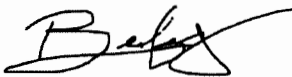
Demands on the drainage and flood protection system will continue to increase as a result of climate change and development. The Flood Protection Management Strategy guides the City to proactively forecast, plan, and improve the City's flood protection system to meet long-term requirements. Through the capital improvements and investment in preventative maintenance programs, the City is able to manage flooding risks and maintain a high level of service to Richmond's residents. 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.



for Jason Ho, P.Eng.
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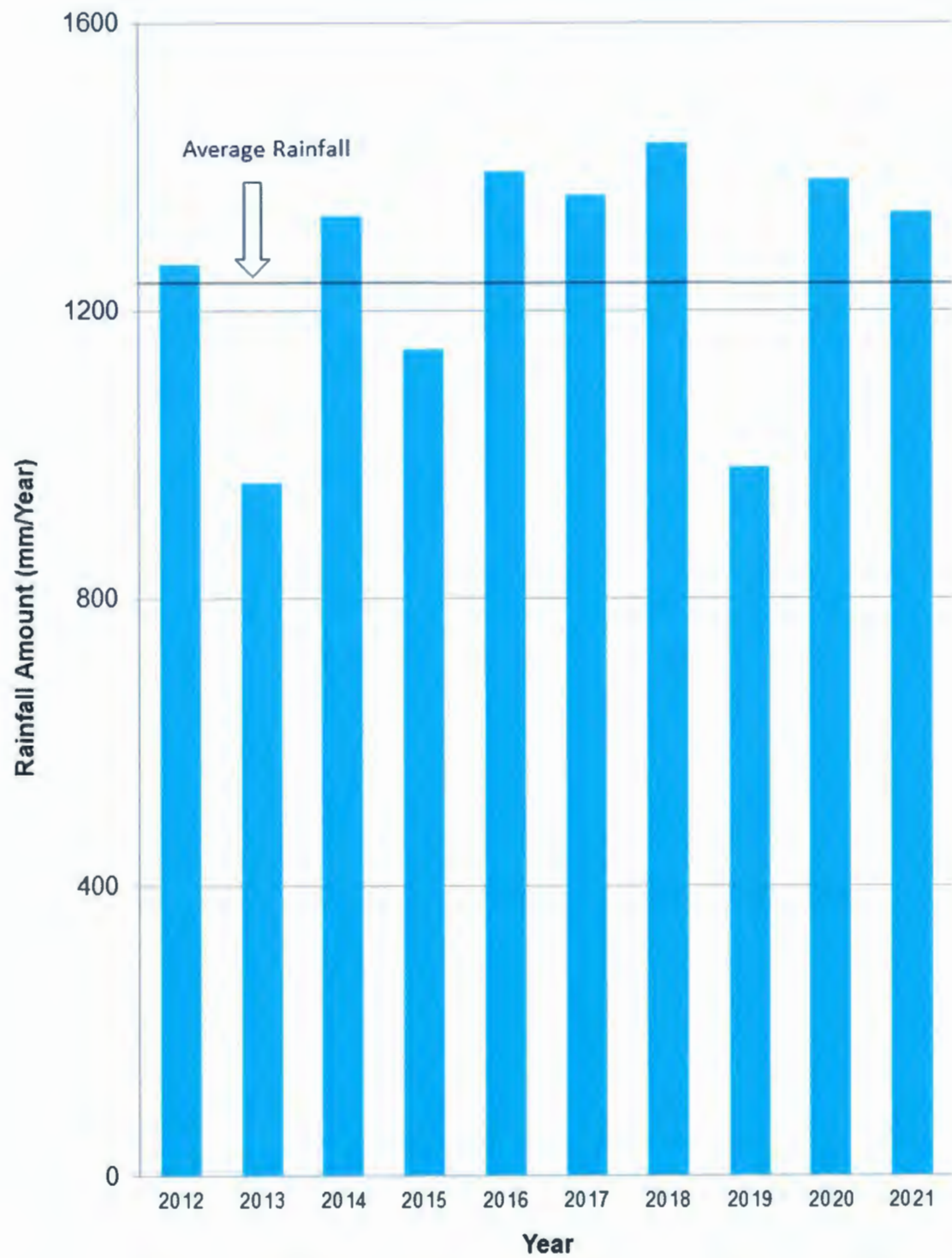


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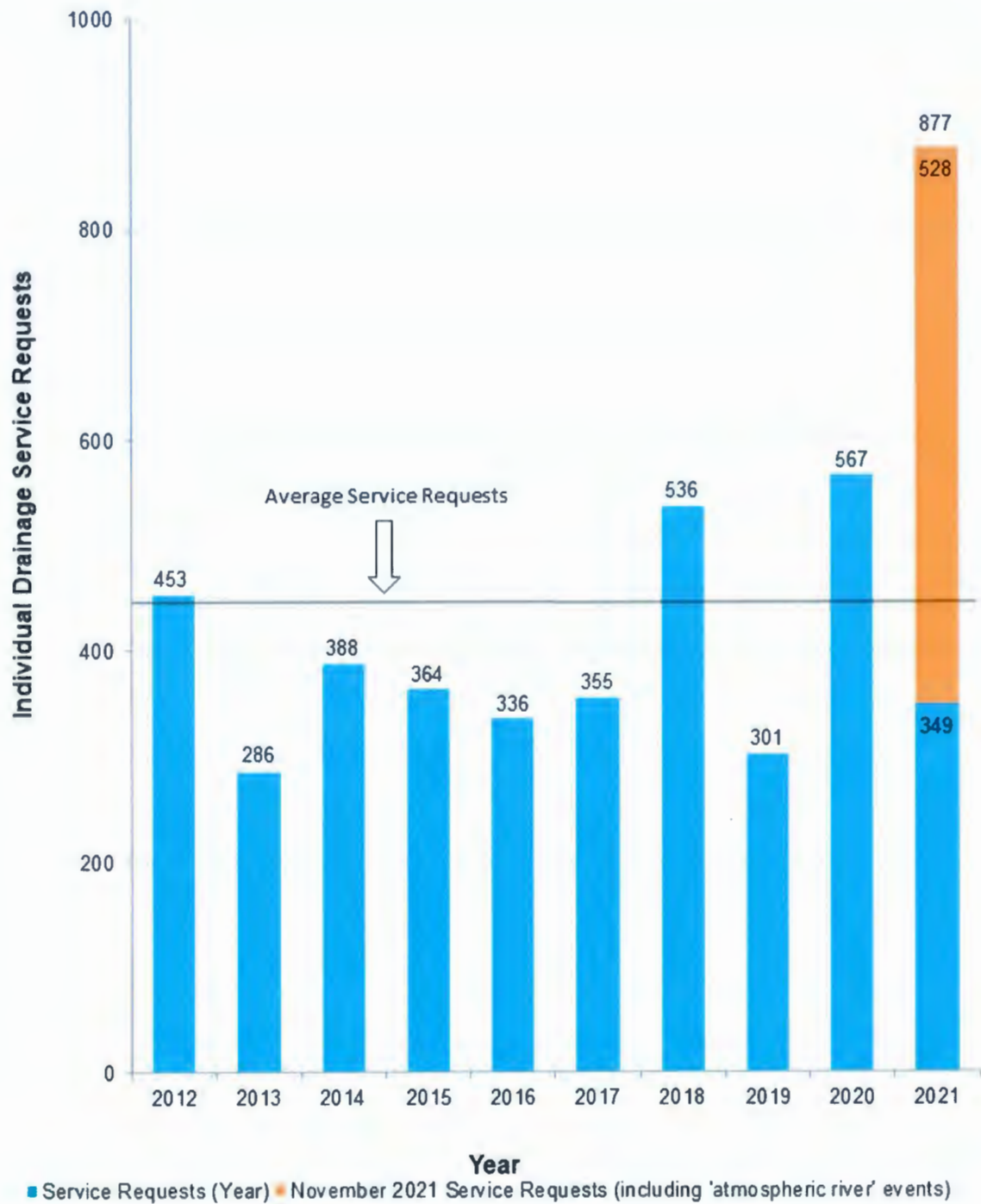


Beata Ng, P.Eng.
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- Att. 1: Annual Rainfall Data 2012-2021
2: Annual Drainage Service Requests 2012-2021
3: Total Drainage Pump Station Pumping Capacity 2012-2021

Annual Rainfall Data 2012-2021

Annual Drainage Service Requests 2012-2021



Total Drainage Pump Station Pumping Capacity 2012-2021