City of Richmond

Report to Committee

To:	Public Works and Transportation Committee	**Date:**	March 1, 2016
From:	John Irving, P.Eng. MPA Director, Engineering	**File:**	10-6060-04-01/2016-Vol 01
Re:	**Annual Flood Protection Report 2015**		

Staff Recommendation

That the staff report titled "Annual Flood Protection Report 2015" (dated March 1, 2016, from the Director, Engineering) be received for information.

For John Irving, P.Eng. MPA
Director, Engineering
(604-276-4140)

Att. 3

REPORT CONCURRENCE		
ROUTED TO:	**CONCURRENCE**	**CONCURRENCE OF GENERAL MANAGER**
Roads & Construction Sewerage & Drainage	☑ ☑	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	**INITIALS:** DW	**APPROVED BY CAO**

Staff Report

Origin

The City of Richmond generally has flat topography that is largely at 1 m or higher above mean tide level. The City is protected from the Fraser River and the Straight of Georgia by a system that includes 49 km of dikes. Storm water is drained off Lulu Island via 600 km of drainage pipes, 320 km of ditches and canals and 39 storm water pumping stations.

The 2008 – 2031 Richmond Flood Protection Strategy is the City's guiding framework for ongoing upgrades and improvement of the City's flood protection system. Staff will update this strategy as part of the 2016 work program.

This annual report updates Council on the performance of the flood protection system through the 2015 storm and freshet seasons. It also reports drainage system improvements completed during 2015 as well as improvements planned for 2016.

This report supports Council 2014-2018 Term Goal #6, Quality Infrastructure Networks:

> *Continue diligence towards the development of infrastructure networks that are safe, sustainable, and address the challenges associated with aging systems, population growth, and environmental impact.*

Findings of Fact

Rainfall

- Approximately 1,146 mm of rain fell on the City of Richmond in 2015, which is 7.5% less than the average annual rainfall and 14% less than in 2014 (based on rainfall sensors located at City Hall).

- December was the wettest month of the year with 238 mm of rainfall, accounting for more than 20% of the annual total.

- The rainiest day of the year was on January 4, with 47 mm of rain in a 24-hour period. This rainfall event has a statistical return period of two years but is well below the single-day record of 74 mm from December 1979.

- The most intense storm of 2015 was on August 29 when rain gauges recorded a rainfall intensity of 69.6 mm/hr for a brief 5-minute period. This rainfall event has a statistical return period of over 25 years; however, this intensity was not sustained, as only 21 mm of rainfall was recorded for the day.

- There were two other significant rainfall events in 2015:
    - November 11, two-year return period event over a 12-hour period.
    - December 6, two-year return period event over a 24-hour period.

2015 was notable due to less than average total precipitation (see Attachment 1) combined with a higher than average rainfall intensity. Four storms in 2015 had statistical return periods greater than two years.

The City's storm water system is designed to accommodate a ten-year return period event. The drainage system performed well and no capacity-related flooding issues were identified in 2015. While the drainage system capacity was adequate for 2015, ongoing planning and upgrading are required to maintain the current level of service, considering ongoing climate change and urban growth.

Freshet

Low snow pack (approximately 60% of normal) contributed to a shorter freshet with lower than normal peak Fraser River flows in 2015. By early June, Fraser River flow was receding from a peak of 7,950 m^3/s (the peak in 2014 was 10,083 m^3/s). This resulted in a negligible freshet flood risk in 2015 with no significant impacts on the City's dike and drainage system.

So far in 2016, the snow pack is 77% of normal in the Fraser Basin. This may be further impacted by the current El Nino cycle, which typically brings warmer-than-normal temperatures and an early spring. Staff will continue to monitor environmental conditions that impact the 2016 freshet and will report any significant changes to Council.

King Tide and Storm Surge

The water levels surrounding Richmond are driven primarily by the tide cycles. King tides are extreme high tides that occur in summer and in winter. The impact of king tides is typically more significant in the winter when water levels are also impacted by winter storm surges.

A storm surge is caused when water levels are increased by wind and/or a low pressure weather system. The highest water levels experienced in Richmond generally occur when a king tide coincides with a storm surge. King tides and storm surges combined to create high water levels of 2.31 m geodetic on February 6th and 2.28 m on December 13th. These water levels are well below the typical dike elevation of 3.5 m.

2008 – 2031 Richmond Flood Protection Strategy

The 2008 – 2031 Richmond Flood Protection Strategy is the City's guiding framework for continuing upgrade and improvement of the City's flood protection system. In addition to the on-going drainage and diking projects related to this strategy, there was progress made this year on two major long-term initiatives.

In December 2015, the City received approval from the Province to begin survey and investigation for the construction of a dike on Steveston Island. The investigation is required to further develop the feasibility, impact and cost associated with building the Steveston Island Dike recommended in the Lulu Island Dike Master Plan – Phase 1.

Dike Master Plan – Phase 2 began in 2015. This phase of the plan includes the North West Dike and the Middle Arm Dike west of No. 6 Road. Staff will update Council with the findings of the Dike Master Plan – Phase 2 in 2016.

Drainage System Performance

324 service requests related to drainage issues were recorded by Public Works in 2015. This is a slight decrease over 2014 when there were 330. Service requests were generally associated with local blockage issues. No significant flooding events were recorded and no capacity issues identified in 2015. Attachment 2 charts service requests related to drainage for the last eleven years.

Drainage System Improvements

Staff are continuously upgrading and improving the City's drainage system to accommodate new development and climate change as directed by Council through the operating and capital budgets. Design work and construction are continually underway to replace aging drainage system pump stations as they reach the end of their service life. Drainage station upgrades are designed to meet the ten-year return period storm service level as well as accommodate future development and climate change. Work is underway on the following drainage pump stations:

- Bath Slough (design completed in 2015, construction to be completed in 2016)
- No. 2 Road North (design and construction to be completed in 2016)
- Horseshoe Slough (design work to be completed in 2016)
- No. 7 Road (design work to be started in 2016)

The City's drainage pumping capacity will be improved as each of these projects is completed. Attachment 3 charts pumping capacity improvements over the last eleven years.

The City completed drainage conveyance system improvements on Westminster Highway, from Nelson Road to McMillan Way. The City has also upgraded laneway drainage during 2015 at the following locations:

- 11000 Block Williams Road
- Dennis Crescent (East)
- Seabrook Crescent (East)
- Steveston Highway (6^{th} Avenue to 7^{th} Avenue)
- Swinton Crescent (West)
- Garry Street (East of 2^{nd} Avenue)

In total, there were approximately $4.2 million of drainage system upgrades completed in 2015.

Dike Improvements

Since 2010, the City has performed a large number of dike improvements through capital programs and partnering with development adjacent to the dikes. Improvements have raised the dike to elevations between 4.0 m and 4.7 m geodetic, which is higher than the current Provincial

flood protection standard and will protect the City from medium and longer term sea level rise. The following is a list of key improvements that have been made:

- Dikes adjacent to Bath Slough Pump Station
- 11,000 Block Dike Road (south arm, west of No. 5 Road)
- 21,000 Block River Road (north arm, east of No. 8 Road)
- 21-22,000 Block South Dyke Road (south arm, east of Graybar Road)

Financial Impact

None.

Conclusion

2015 was a warm and dry year characterized by very low snow pack and a negligible freshet flood risk. Lower than average total precipitation combined with statistically high rainfall intensity in 2015 corresponds with climate change theory, and the City can expect this trend to continue. The City's ongoing program to improve drainage and diking infrastructure includes an allowance for climate change to maintain the current level of service into the future. Progress on Phase 2 of the Dike Master Plan and further investigation of the proposed Steveston Island Dike will contribute to the City's ongoing program to maintain dike elevations above climate change induced sea level rise.

For Lloyd Bie, P.Eng.
Manager, Engineering Planning
(604-276-4075)

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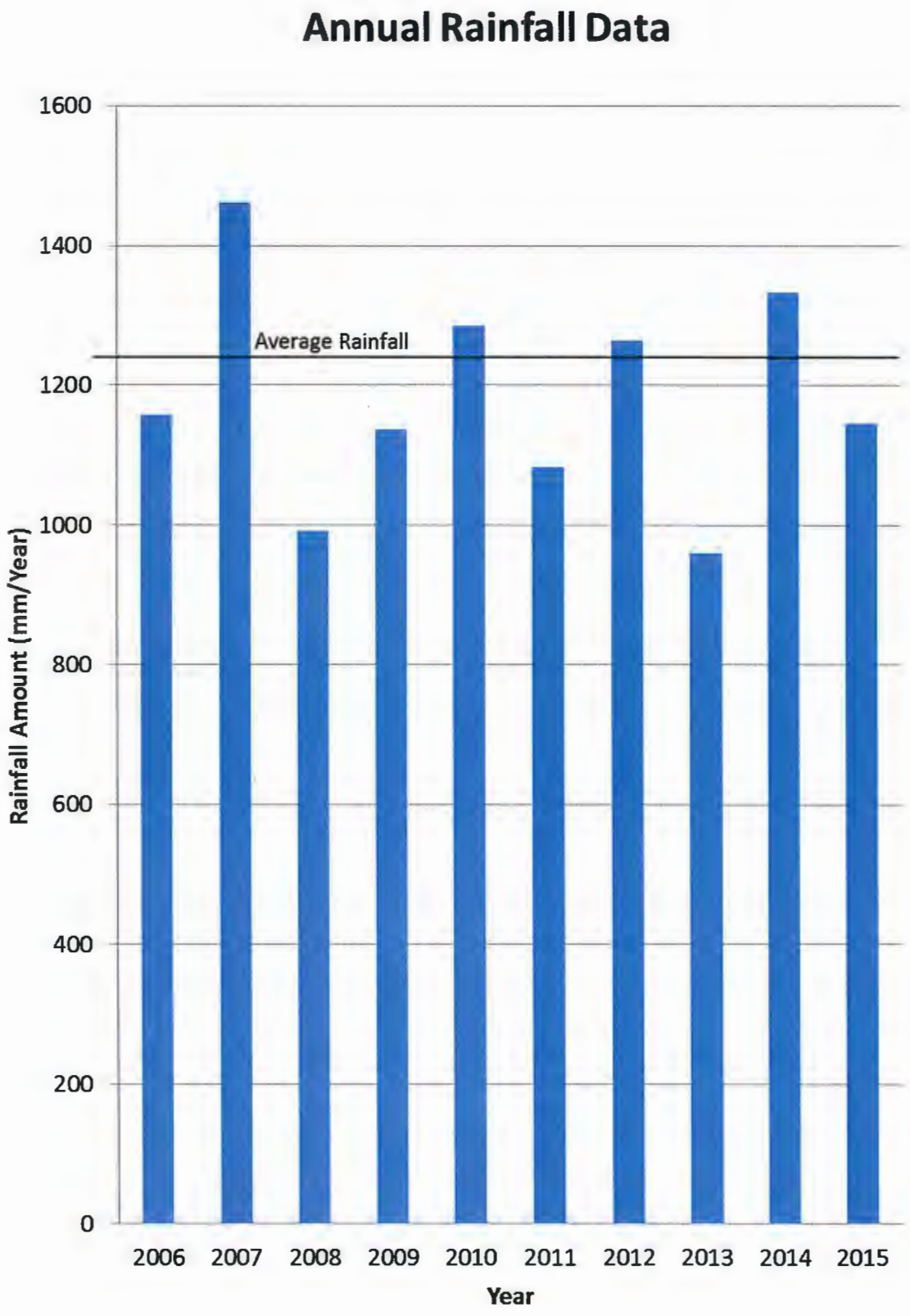
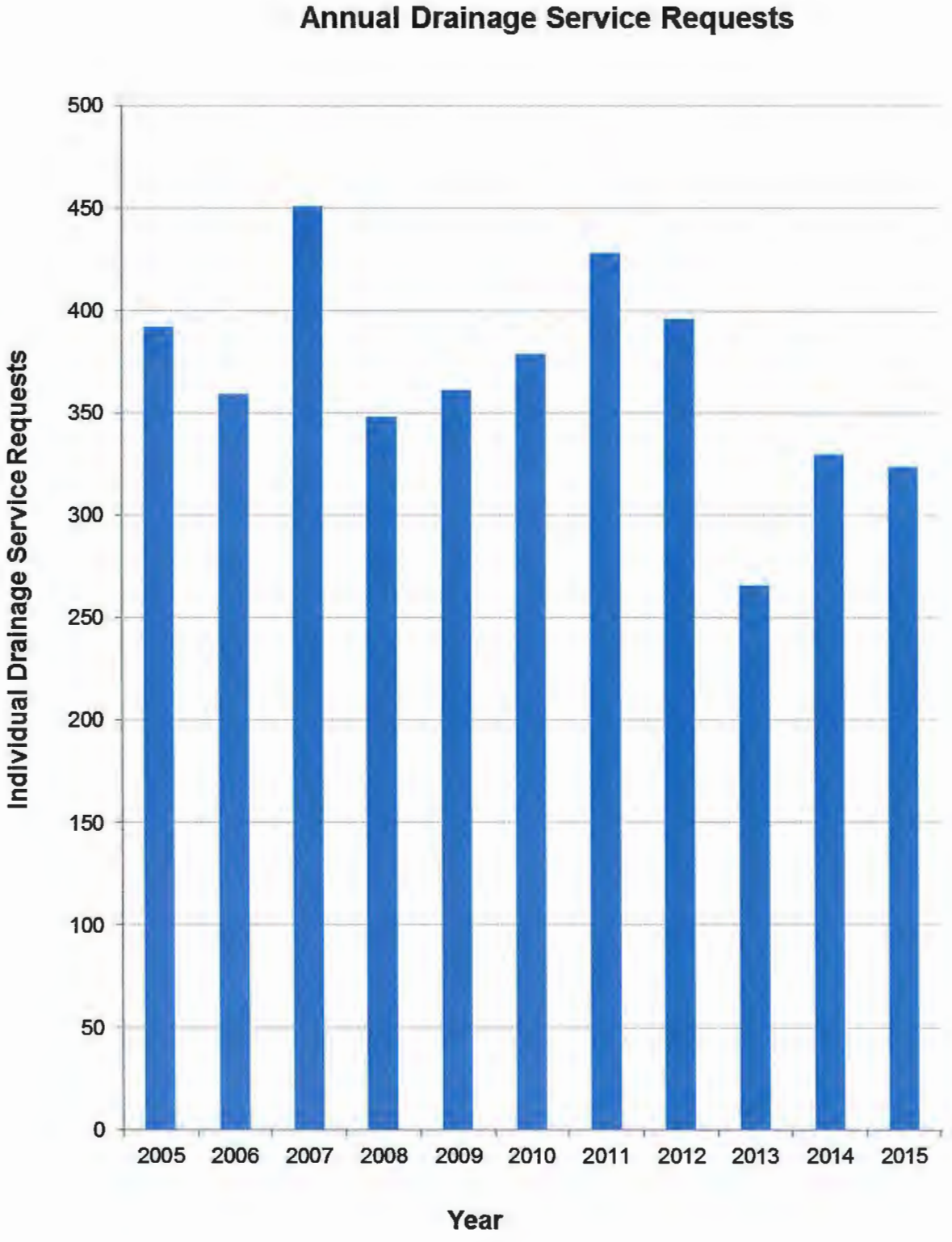
Att. 1: Annual Rainfall Data
2: Annual Drainage Service Requests
3: Drainage Pump Station Capacity 2005-2015


Annual Rainfall Data
1600
1400
1200
1000
800
600
400
200
0
Rainfall Amount (mm/Year)
Average Rainfall
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year


Annual Drainage Service Requests
Individual Drainage Service Requests
500
450
400
350
300
250
200
150
100
50
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year

Total Drainage Pump Station Pumping Capacity 2005-2015