



City of Richmond

Report to Committee

To: Public Works and Transportation Committee
From: John Irving, P.Eng. MPA
Director, Engineering
Re: Annual Flood Protection Report 2015

Date: May 29, 2015
File: 10-6060-04-01/2015-
Vol 01

Staff Recommendation

That the staff report titled "Annual Flood Protection Report 2015" (dated May 29, 2015, from the Director, Engineering) be received for information.

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

Att. 4

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

Staff Report

Origin

The City of Richmond has generally 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's of dikes. Storm water is drained off Lulu Island via 617 km of drainage pipes, 181 km of ditches and 39 storm water pumping stations.

The 2008 – 2031 Richmond Flood Protection Strategy is the City's guiding framework for continuing upgrading and improvement of the City's flood protection system. Staff will update this strategy as part of their 2015 work program.

This annual report updates Council on the performance of the flood protection system through the 2014-2015 rain and freshet season as well as improvements completed during 2014.

Findings of Fact

Rainfall

Rainfall data highlights for 2014 include the following:

- Approximately 1,332 mm of rain fell on the City of Richmond in 2014, which is approximately 8% more than the average annual rainfall of 1,239 mm.
- October was the wettest month in 2014 with 193 mm of recorded precipitation (based on rainfall data sensors located at City Hall).
- The rainiest day of 2014 was October 25 with 36.6 mm of rainfall in a 24 hour period, which is well below the single day precipitation record for Richmond of 74 mm on December 16, 1979.
- The most significant storm of 2014 was on January 10, which recorded a rainfall intensity of 6.2 mm / hour over six hours and has a statistical return period of over 10 years.
- A very intense but short storm was experienced on Jun 15, 2014, where peak intensity was 57.6 mm / hour of rainfall for a 10 minute duration which has a statistical return period of over 100 years. However, the extreme intensity of the storm was not sustained, and the return period of the storm was 2 years at the 1 hour duration mark.

In general, 2014 was an above average rainfall year with one 10 year return period storm and a short high intensity 100 year return period storm. The City's storm water system is designed to accommodate a 10 year return period event and the system performed well on all events with no capacity related flooding issues identified. Given factors of safety in drainage network design, the interconnectivity of Richmond's drainage system, and the high degree of variables inherent in storm activity, there are many scenarios where the system will adequately convey very intense but short duration storms greater than the 10 year return period design storm.

By definition, a 10 year return period storm is 10 times more likely to occur in any period than a 100 year return period storm. However, the actual rainfall intensity of a 10 year return period storm is approximately 30% less than a 100 year return period storm. For example, the 10 year return period 1 hour intensity is 15 mm/hr for Richmond while a 100 year return period 1 hour intensity is 20.9 mm/hour.

The occurrence of multiple long return period storms supports climate change theory that predicts higher intensity storms going forward. While drainage upgrades have greatly improved service in areas such as Williams and Shell Road, ongoing planning and upgrading of the drainage system will be required to maintain the current level of service. **Attachment 1** is a chart of annual rainfall.

Freshet

Average snow pack (99% of normal) and limited spring major rainfall events lead to a 2014 freshet that was not remarkable. The high flow period lasted 13 days which is shorter than typical (the 2012 high discharge period was 30 days) and briefly reached a 5 year return period flow peak flow of 10,083 m³/s at Hope. The City's dikes and drainage system performed well, and no related flooding was observed.

For 2015, the snow pack is 60% of normal, which is the lowest it has been in 31 years. There has been very little precipitation so far this spring and Fraser River freshet flows have been below average. Barring a severe weather event, it is unlikely that significant high water levels will be achieved on the Lower Fraser River this season.

2008 – 2031 Richmond Flood Protection Strategy

The 2008 – 2031 Richmond Flood Protection Strategy is the City's guiding framework for continuing upgrading and improvement of the City's flood protection system. The strategy includes a total of 32 short, medium and long term actions listed in **Attachment 2**, which also catalogues the City's considerable progress on these actions. Highlights of accomplishments since 2008 include:

- Approximately \$12.1 million in senior government grant funding for drainage and diking projects has been expended or secured;
- Bylaw 8204 – Flood Plain Designation and Protection was adopted by Council in 2008 and sets the flood control elevations for development in Richmond;
- Ongoing work with the Diking Authority to interpret the January 27, 2011, BC Ministry of Environment "Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use Sea Dike Guidelines";
- Ongoing work with the development community to improve form of development and dike heights for development adjacent to dikes;
- Ongoing feasibility work to utilize Steveston Island as a primary dike as identified in the Phase1 – Dike Master Plan; and

- Initiating master planning for dike upgrading for the North West Dike and the North Dike to accommodate sea level rise due to climate change.

Drainage System Performance

78 service requests related to drainage issues were recorded by Public Works in 2014. Service requests were generally associated with local blockage issues. No significant flooding events were recorded. The drainage system performed very well with no major problems identified.

Attachment 3 charts drainage issue related call outs for the last eleven years.

Drainage System Improvements

Staff are constantly upgrading and improving the City's drainage system to accommodate new development and climate change. In 2014, 3,300 liters per second of pumping capacity was added through replacement of both the No. 1 Road North pump station and the Williams Road pump station. The capacity upgrades at these stations meet the 10 year return period storm service level and ensure that the areas of the City served by these stations are appropriately serviced into the future. Staff are currently working on replacement of three pump stations:

- Bath Slough;
- No. 2 Road North; and
- Horseshoe Slough.

Completion of these stations will improve the City's drainage pumping capacity by 2,700 liters per second. **Attachment 4** charts pumping capacity improvements over the last eleven years and includes a projection for 2015 projects included in the approved 2015 Capital Plan.

The City has also completed drainage conveyance system improvements on Saunders Road and Garden City Road. In 2015, staff will start the first year of an eight year program to upgrade the drainage in Burkeville from ditches to a piped system and will trial a lining system on the box culvert on No. 1 Road that has been prone to sink holes.

Lastly, the City has upgraded laneway drainage at:

- 10,000 Block Williams Road
- 11,000 Block Williams Road;
- Dennis Crescent;
- Ainsworth Crescent;
- Aintree Crescent; and
- Seaton Road.

Further laneway drainage improvements for Swinton Crescent, Seabrook Crescent, and Steveston Highway between 6th and 7th Avenue in 2015.

Dike Improvements

Since 2010, the City has performed a large number of dike improvements through capital programs and partnering with development that is adjacent to the dikes. Improvements have raised the dike to elevations between 4.0 m and 4.7 m geodetic, which is over the current Provincial flood protection standard and will help address long term sea level rise. The following is a list of key improvements that have been made:

- Middle Arm Dike from Cambie Road to the Dinsmore Bridge;
- Dikes adjacent to the No. 1 Road North Pump Station;
- Dikes adjacent to Williams Road Pump Station;
- Dikes adjacent to No. 4 Road Pump Station;
- Dikes adjacent to Cambie Road Pump Station;
- Dikes adjacent to ASPAC west of the Richmond Olympic Oval;
- Dikes fronting Kawaki development site at the south end of No. 2 Road;
- Dikes fronting Park Riviera development site from No. 4 Road East;
- Dikes fronting Translink site on the North side of the Lulu Island in Hamilton; and
- Dikes fronting the Lysander site on Sea Island.

Staff are working to perform feasibility work to utilize Steveston Island as the long term diking solution in Steveston Harbour as recommended in the Phase 1 – Dike Master Plan. Staff is also working on developing Phase 2 – Dike Master Plan which is concerned with long term improvements to the North West Dike and the North Dike. The dike master planning effort is working toward a comprehensive dike improvement program that is an important element of the 2008 – 2031 Richmond Flood Protection Strategy

Financial Impact

None.

Conclusion

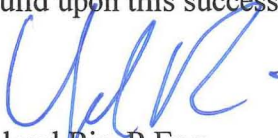
2014 was an above average rainfall year with two significant long return period storms. The drainage system performed well, however, the occurrence of multiple long return period storms supports climate change theory and continuing drainage upgrading will be required to maintain the current level of service. The 2014 freshet water levels in the Fraser River were below average and the freshet period was 13 days, which is shorter than average. The dike and drainage system performed well throughout the year with no significant flooding events reported.

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During 2014, the No. 1 Road North and the Williams Road pump stations were replaced increasing over all pumping capacity by 3.3 meters cubed per second. Staff also completed approximately \$875,000 in pipeline and ditch improvements throughout the year.

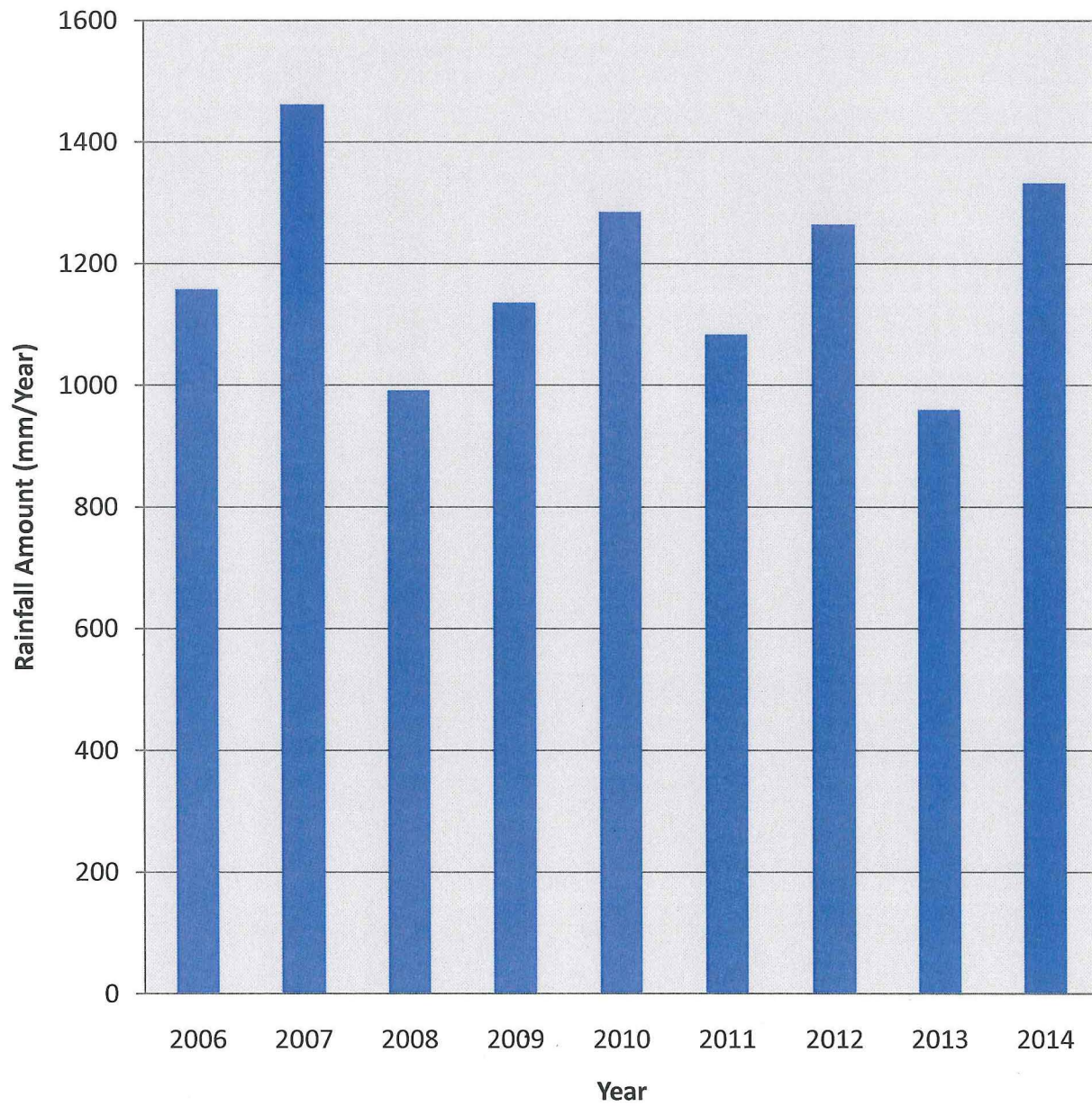
Staff continues to follow the action items identified in the 2008 – 2031 Richmond Flood Protection Strategy. Considerable progress has been made since 2008 and staff will continue to build upon this success.



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- Att. 1: Annual Rainfall Data
2: 2008 – 2031 Richmond Flood Protection Strategy Status
3: Annual Drainage Service Requests
4: Total Drainage Pump Station Capacity 2004 – 2014

Annual Rainfall Data



Key Actions	Status	Comments
Short Term (2008)		
Examine and pursue senior government cost sharing to implement the FPMS (Engineering; Public Works; Finance)	Ongoing	Approximately \$12.1 million in senior government grant money was achieved since 2008 allocated to the following projects: <ul style="list-style-type: none"> • Bath Slough PS • No.3 Road Drainage PS Screens • Middle Arm Dike • No. 4 Road PS • Williams Road Drainage PS • No. 1 Road Drainage PS • South Dike from No. 7 Road to 1000 metres east (2007)
Collaborate among City Engineering, Building Approvals, Policy Planning [PPD], Development Applications, Facilities Divisions to develop a phased plan for overall land grade increases (Engineering; Planning)	Regulation changes complete, Implementation Ongoing	This is largely being achieved through Bylaw 8204 – Flood Plain Designation and Protection. Additional effort is being focused on raising the floor plates of large developments to a level above the flood control level with some success.
Pursue and plan for appropriate grade changes in City area plans (e.g. City Centre Area Plan update) (PPD).	Ongoing	This is ongoing with success in the West Cambie area plan and at the development level with developments including ASPAC.
Consult at timely intervals with experts (e.g., MoE, Canadian Hydrographic Service, FBC) and monitor the latest long-range ocean/climate change forecasts and science for their implications (Engineering)	Ongoing	Canada participates in the Intergovernmental Panel on Climate Change (IPCC). This group gathers climate change information and forecasts future climate change. These results are recognized by senior levels of Canadian Government and are monitored by City staff.
Rescind Floodplain Management Implementation Strategy Policy 7000 (PPD)	Complete 2008	
Prepare a Floodplain Bylaw including the new FCLs and the requirement for covenants/ indemnity (Engineering; PPD; Law)	Complete 2008	Bylaw 8204 – Flood Plain Designation and Protection
Adopt other mechanisms and techniques [All].	Ongoing	Staff is currently reviewing wave attenuation measures as an alternate to raising dikes.
Establish protocol for obtaining dike rights of way for Mitchell Island (Engineering, PPD, Law).	Ongoing	The City has obtained dike rights on one recent development and had another build much higher than the flood control level, relieving the need for a dike in that location.
Work with the BC MoT and others on a program to study, plan and cost share in the	Ongoing	Perimeter dike upgrading was identified as a higher priority than the mid island dike in the

Key Actions	Status	Comments
building of the Highway 99/Knight Street mid-island barrier.		2009 Mid Island Dike Scoping Study. Staff is working with MoT staff to include middle arm dike improvements as part of the George Massey Tunnel replacement project.
Medium Term (2009)		
Improve the City's ability to obtain data and undertake direct measurements (e.g., monitoring local sea level changes through City operated gauging stations (Engineering; Public Works))	Ongoing	The City has installed a salt content measuring device slightly upstream of the No. 6 Road Pump Station that will gather data on the salt wedge protrusion. This will give staff insight into the impact of climate change on the salt wedge and the City's ability to reliably provide irrigation water from the Fraser River for farming purposes.
Direct staff to update the City's Flood Response Plan as part of the overall Emergency Response Plan (updated on basis of new modeling and technical information) (Engineering; Emergency Programs)	Ongoing	The City has developed an evacuation plan (January 26, 2009) which outlines the strategies and considerations for evacuation. Evacuation routes are determined at the time of an emergency to ensure the safety of the public.
Work with VIAA to clarify jurisdiction, maintenance standards and improvement programs for the Sea Island dikes (Engineering)	Complete	Jurisdiction has been clarified and some areas of sub standard dike have been identified and scheduled for improvement by VIAA.
Encourage the City of New Westminster to harmonize its flood protection levels with Richmond's strategy (Engineering)	Complete	Staff are currently in discussion with New Westminster staff regarding dike master planning.
Work with Department of Fisheries and Oceans [DFO] on a plan for widening the perimeter dikes - inside and outside existing dikes, addressing related mitigation and compensation requirements (Engineering)	Ongoing	Staff is currently in discussion with DFO regarding environmental issues associated with replacement of the No. 1 Road and the Williams Road drainage pump stations.
Work with external agencies (such as the Agricultural Land Commission) to develop a protocol that will allow for these changes in use through rezoning, development permits, etc. (PPD)	Ongoing	
Seek direction from Province on new acceptable probability criteria that will address sea level rise and climate related extremes for the next 100 years	Ongoing	On January 27, 2011, the BC Ministry of Environment issued the Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use Sea Dike Guidelines. Staff is working with the Provincial Diking Authority to interpret the guidelines and determine their implications for the City of Richmond.
Prepare and implement a comprehensive perimeter dike improvement program	Ongoing	Phase 1 of the Dike Master Plan was completed at the concept level. Staff is

Key Actions	Status	Comments
(researching, strengthening and widening dikes to reduce the level of risk)		working on feasibility level work recommended by the Phase 1 plan result. Staff are currently working on the Dike Master Plan, Phase 2, which is concerned with the North West Dike and the North Dike.
Establish a program for phasing/prioritizing perimeter dike improvement (e.g., seismically weak areas first, the mid island barrier, overall perimeter dike improvements) (Engineering)	Complete 2009	Technical report outlining the program for phasing/prioritizing perimeter dikes is titled "Prioritization Framework for City of Richmond Perimeter Ring Dike Improvement Projects".
Once Mid Island Barrier technical details are finalized: established a phased implementation program seek senior government cost sharing.	Ongoing	Perimeter dike upgrading was identified as a higher priority than the mid island dike in the 2009 Mid Island Dike Scoping Study.
Longer Term (2010 – 2031)		
Prepare plans and policies [e.g., OCP, area plans, to support increased density adjacent to dikes but require grade increases and contributions to dike improvements. Retain dike rights of ways and access (PPD, real Estate)]	Ongoing	Dikes are being raised in conjunction with adjacent development applications. This has been achieved in the planning phase of a number of developments including ASPAC and Kawaki.
Remove and relocate or replace toe ditches adjacent to dikes (Engineering)	Ongoing	Engineering is looking for opportunities to remove toe ditches as part of development.
Ensure that emergency facilities and refuge areas are located in areas not subject to flooding) (Engineering; Emergency Programs; PPD, Dev Applications)	Ongoing	This is implemented through ongoing coordination between Engineering, Project Development, and Emergency Programs
Review implementation plans for refuge areas, emergency routes, and create public awareness (Engineering; Emergency Programs)	Plans Complete Public awareness work is ongoing	The City has developed an evacuation plan (January 26, 2009) which outlines the strategies and considerations for evacuation. Evacuation routes are determined at the time of an emergency to ensure the safety of the public.
Review this Strategy approximately every 5 years to ensure that new information is reflected. (All)	Ongoing	The first update to the strategy is scheduled for 2013.
Develop on-going public evacuation and communication programs (Engineering; Emergency Programs).	Ongoing	The City has created a public awareness program and uses a variety of mediums to communicate. There is a significant volume of information on the City's web site concerning flooding and the programs in place to prevent flooding.

Key Actions	Status	Comments
Ensure issues of flood protection, grade levels, as well as refuge areas are considered in the development of local area plans (PPD; Engineering; Emergency Programs)	Ongoing	Policy Planning, with other City departments (e.g., Engineering) ensures that appropriate policies and regulations are included in the OCP (current 1999 and proposed 2041 OCP) and all Area Plans.
Review dike maintenance programs at ongoing 3 to 5 year intervals (Engineering; Public Works)	Ongoing	These reviews are ongoing on an annual basis.
Support sustainable funding for a federal [VFPA] river dredging program to maintain river profile (Engineering)	Ongoing	Discussions are ongoing with Port Metro Vancouver
Establish in City budget annual amount for land for access rights to waterfront and dike areas (All)	Complete	Funding is available in the Diking Utility.
Establish and maintain inventory of rights of way and access agreements to diking system (Engineering)	Complete	There is an inventory of dike rights of way in the City's GIS. A catalogue of access agreements has also been completed. Both of these are updated on an ongoing basis.
Update existing procedural policy of comprehensive dike maintenance (Engineering, Public Works).	Ongoing	
Pursue development of the mid island barrier along the Highway 99 / Knight Street Corridor (Construction cost estimate - \$16 million) (Engineering)	Ongoing	Perimeter dike upgrading was identified as a higher priority than the mid island dike in the 2009 Mid Island Dike Scoping Study.

