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City of New Westminster
Floodplain Management Strategy Update

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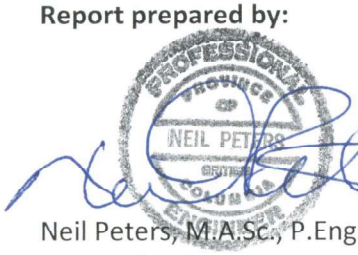

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TRADITIONAL ACKNOWLEDGEMENT

We recognize and respect that New Westminster is on the unceded and unsurrendered land of the Halkomelem speaking peoples. We acknowledge that colonialism has made invisible their histories and connections to the land. As a City, we are learning and building relationships with the people whose lands we are on.

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EXECUTIVE SUMMARY

Introduction

The City's Flood Management Strategy (FMS) was developed in 2009-2011 and provided city-wide flood protection maps/drawings and cost estimates intended as a starting point for funding applications, prioritizing flood protection projects, assessing development applications, and identifying land requirements for dikes. An updated Floodplain Management Strategy is needed to address climate change flood risks, new seismic design requirements for dikes and to help regulate ongoing floodplain land development.

The Floodplain Management Strategy Update expands on the scope of the 2011 Feasibility Plan and takes an integrated approach by including non-structural flood risk mitigation measures as well as structural measures such as dike upgrades. The report assesses and incorporates aspects of emergency response planning, land development regulation, stormwater, environmental considerations, dike inspections/operation/maintenance, and public education campaigns.

The City of New Westminster is located on the unceded land of the Halkomelem speaking peoples along the north bank of the Fraser River, and on the eastern end of Lulu Island in the Fraser River delta. The land-use within the 520 hectare (5.2 square kilometre) floodplain consists of commercial, industrial, single and multifamily residential properties. A seven kilometre long dike protects approximately 350 hectares of Queensborough on Lulu Island while the 170 hectares of floodplain lands on the mainland is unprotected.

The Flood Hazard and Climate Change

Fraser River flood levels at New Westminster are impacted by both sea level rise and by potential increases in Fraser River peak flows. Depending on location, the projected Year 2100 dike design levels could be approximately 1.1 to 1.5 m above the current Provincial design profile, which is based on the 1894 flood of record.

While the sea level rise component is relatively well understood (other than timing), potential climate change caused increases to Fraser River floods are very uncertain. Given this uncertainty, and where cost-effective, it is recommended that the dikes be raised to a lower year 2050 design level with allowances in dike design and land acquisition to accommodate a future raise to year 2100 levels.

Risk Analysis

The approach adopted by the Fraser Basin Council's 2021 "Flood Risk Assessment of BC's Lower Mainland" was applied to the City's floodplain areas. This approach is considered by the Fraser Basin Council to be the current best practice approach for the Fraser Basin Area. Based on historical flood probabilities, dike breach assumptions and data used in the Fraser Basin Council study, the expected annual flood damage (to buildings only) was estimated to be approximately four million dollars per year, with Queensborough accounting for about 75% of the damage. For a single flood event scenario, the building damage in Queensborough from a dike breach during recurrence of the 1894 flood was

estimated to be $284 million. Other types of damage, such as to transportation infrastructure, plus indirect damages were not estimated using this methodology.

Structural Mitigation

Conceptual dike designs and cost estimates were developed for Queensborough, Downtown, and the Braid and West Industrial Areas. Because the alignments of the existing Queensborough dike and proposed mainland dikes are located on developed urban lands, there are numerous constraints and limitations to dike design and construction. Where feasible and cost-effective, the designs were to the Year 2050 Design Crest Levels (DCLs) with provisions for future dike raising. In areas with limited space for dikes (i.e. where sheet pile walls are required) designs were prepared to meet the Year 2100 DCL. Seismic ground improvement was assumed except where the dikes were near existing buildings.

All designs have been developed to minimize encroachment into the Fraser River (e.g. dikes to be widened to the land side). Where encroachment into shoreline habitats cannot be avoided, dike upgrades will require specific environmental considerations.

Class D cost estimates to upgrade the existing Queensborough dikes and to construct new dikes for the mainland areas are summarized in the following table. The costs to upgrade the Queensborough dike, without and with seismic ground improvement, are $56 million and $85 million, respectively. Approximately 60% of these costs are for raising a 2 km long section of South Dyke Road. The total City-wide estimated cost for flood protection improvements, including assumed seismic costs, is $154 million.

Item	Queensborough	Downtown (including Poplar Landing Tie-in Dike)	Braid Industrial Area	West Industrial Area	Total
Dike Length (m)	6,490	2,485	2,290	1,360	**12,625**
Construction $M	55.9	20.5	25.9	17.7	**120**
Seismic $M	28.7	2.5	1.2	1.1	**34**
Total $M	84.6	23.0	27.1	18.8	**154**
Cost $M/km (without seismic)	8.6	8.3	11.3	13.0	**9.5**
Cost $M/km (with seismic)	13.0	9.3	11.8	13.9	**12.2**

Building a new dike for the West Industrial area is considered a lower priority than a new dike for the Downtown. Therefore, to prevent backwater flooding along the low-lying railway corridor into the Downtown, a closure dike to high ground (i.e. The Poplar Landing Tie-in Dike) is required. The design and construction of this tie-in dike, costing approximately $2.6 million, should be coordinated with land development at the Poplar Landing site.

A regular dike maintenance and inspection program is critical to dike safety. Section 5 of this report provides recommendations to improve inspections and to complete a new Operation and Maintenance Manual for the Queensborough dike.

Annual Freshet Response Planning

The technical basis for the City's Annual Freshet Response Plan has been updated using the output from the Fraser River model developed for the Fraser Basin Council in 2019. Criteria and guidance are provided for temporary flood protection, dike and foreshore monitoring, and evacuation planning.

Integrated Floodplain Management/Non-Structural Mitigation

The land use planning tools and floodplain development regulations currently employed by the City are based on historical flood information and guidelines. Given that the Queensborough community will continue to depend on the perimeter dike as the primary defense against flood events, the current policies and development permit requirements for Queensborough are appropriate. However, for the mainland, climate change effects are now a critical factor that must be considered in land development regulation.

The key deficiency in the current approach is the lack of detailed floodplain maps and development permit requirements that consider the projected increases in flood levels due to climate change. Support for implementation of new regulations and flood protection improvements could be gained through a flood education campaign.

Economic Analysis and Project Prioritization

The economic analysis completed by WSP Canada shows a business case for flood protection improvements for both Queensborough and Mainland New Westminster. The analysis shows a stronger business case for improvements to Queensborough, indicating that this section should be prioritized for flood protection improvements. The cost-benefit table with allowances for climate change is provided below.

Cost-Benefit Analysis Summary

	QUEENSBOROUGH			MAINLAND		
Level of Protection	**Investment**	**Reduction in Consequence Cost**	**Cost-Benefit**	**Investment**	**Reduction in Consequence Cost**	**Cost-Benefit**
1:100	$44.7 M	$292.5 M	6.54	$33.8 M	$58.1 M	1.72
1:200	$47.0 M	$321.5 M	6.84	$37.8 M	$64.1 M	1.69
1:500	$49.7 M	$342.7 M	6.89	$42.4 M	$67.8 M	1.60
1:1000	$51.7 M	$351.0 M	6.79	$45.7 M	$69.1 M	1.51

Notes: WSP defines "Cost-Benefit Ratio" to be the "Reduction in Total Cost" divided by the "Cost of Upgrades". The Cost-Benefit ratios shown are for the year 2050 climate change scenario.

Queensborough offers a much higher return on investment, with the highest cost-benefit ratio for protection to the 500-year return period event. For the Mainland section, the cost-benefit ratio is highest for protection to the 100-year return period event. However, it may still be practical, for planning purposes, to improve flood protection to the same return period as Queensborough (500-year) to avoid incurring the costs of phased improvements.

Based on the analysis, Queensborough should be prioritized for capital spending on flood protection.

Recommendations

The City's Floodplain Management Strategy is an integrated, multi-faceted approach that includes both structural flood protection improvements and non-structural measures. Effective mitigation of the flood risks requires ongoing efforts by the City along with increased support from senior governments. While climate change effects on future Fraser River floods are uncertain and the effects of sea level rise will occur over time, the current risks from large Fraser River floods are very significant. Implementation of the following recommendations should begin without delay.

1. Prepare floodplain maps for the mainland that incorporate climate change effects. Establish Development Permit Area requirements for the mainland floodplain areas.
2. Develop and implement a public information and flood education campaign to prepare the community for flood emergencies and to build support for flood protection improvements.
3. Monitor evolving climate change science and design criteria, update the Strategy as required and adopt a phased approach (i.e. where cost-effective, build to Year 2050 design levels but with provisions for future dike raising).
4. With support from the City Emergency Management Office, prepare detailed evacuation plans for Queensborough and Downtown Waterfront Areas to ensure public safety and minimize the impacts of disrupted access.
5. To advance the preliminary designs of Queensborough Dike Upgrades and a new dike for the Downtown Waterfront, the City should complete the following work:
    - Conduct a detailed seismic assessment of the dike alignment, including a Seismic Flood Hazard Assessment and confirm seismic design requirements with the Inspector of Dikes.
    - Identify additional Rights of Way (ROW) requirements. Prepare a Dike Lands Plan to facilitate ROW acquisition and to ensure that development approval processes leave adequate room for and facilitate dike construction, operation and maintenance.
    - Assess the potential for Fraser River channel change that could lead to scour and assess the adequacy of the existing riprap bank protection. Improve erosion protection as may be required.
    - Evaluate the cost effectiveness of alternative designs and phasing for upgrading the 2 km section of the Queensborough dike contiguous with South Dyke Road, integrating seismic design. Conduct a public consultation process.
    - Coordinate preliminary design of the Poplar Landing Tie-in dike with the design of the new housing development at 1400 Quayside Drive. Consider proceeding with construction of the Tie-in Dike as a separate project prior to Waterfront Esplanade flood protection improvements.

6. Complete the preparation of an Operation and Maintenance Manual for the Queensborough Dike and make improvements to the dike inspection program.
7. Build on existing partnerships to increase success of senior government funding applications especially through collaboration with the City of Richmond, as it shares responsibility with the City of New Westminster for the Lulu Island perimeter dike.