



Public Works and Transportation Committee

Anderson Room, City Hall
6911 No. 3 Road

Wednesday, January 18, 2017
4:00 p.m.

Pg. # ITEM

MINUTES

PWT-5 *Motion to adopt the **minutes** of the meeting of the Public Works and Transportation Committee held on November 23, 2016.*



NEXT COMMITTEE MEETING DATE

February 22, 2017, (tentative date) at 4:00 p.m. in the Anderson Room

PLANNING AND DEVELOPMENT DIVISION

1. **TRAFFIC SAFETY ADVISORY COMMITTEE – PROPOSED 2017 INITIATIVES**
(File Ref. No. 01-0100-30-TSAD1-01) (REDMS No. 5222032)

PWT-27

See Page PWT-27 for full report

Designated Speaker: Victor Wei

STAFF RECOMMENDATION

- (1) *That the proposed 2017 initiatives for the Traffic Safety Advisory Committee, as outlined in the staff report titled “Traffic Safety Advisory Committee - Proposed 2017 Initiatives” dated November 22, 2016 from the Director, Transportation, be endorsed; and*

- (2) *That a copy of the above staff report be forwarded to the Richmond Council-School Board Liaison Committee for information.*

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2. **RICHMOND ACTIVE TRANSPORTATION COMMITTEE – PROPOSED 2017 INITIATIVES**

(File Ref. No. 01-0100-20-RCYC1) (REDMS No. 5227687 v. 2)

PWT-33

See Page PWT-33 for full report

Designated Speaker: Victor Wei

STAFF RECOMMENDATION

- (1) *That the proposed 2017 initiatives of the Richmond Active Transportation Committee, as outlined in the staff report titled “Richmond Active Transportation Committee - Proposed 2017 Initiatives” dated December 15, 2016 from the Director, Transportation, be endorsed; and*
- (2) *That a copy of the above report be forwarded to the Richmond Council-School Board Liaison Committee for information.*

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ENGINEERING AND PUBLIC WORKS DIVISION

3. **DIKE MASTER PLAN - PHASE 2**

(File Ref. No. 10-6060-01) (REDMS No. 5178299 v. 3)

PWT-43

See Page PWT-43 for full report

Designated Speaker: Lloyd Bie

STAFF RECOMMENDATION

That the public and key external stakeholders be consulted to provide feedback on the medium and long term dike improvements required for part of Richmond’s West Dike (between Williams Road and Terra Nova Rural Park) and part of the North Dike (between Terra Nova Rural Park to No. 6 Road) as identified in the staff report titled “Dike Master Plan – Phase 2” from the Director of Engineering, dated December 6, 2016.

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4. **DCC RESERVE FUND EXPENDITURE (4000 MAY DRIVE) BYLAW NO. 9643**

(File Ref. No. 03-1000-08-030) (REDMS No. 5203346 v. 5)

PWT-104

[See Page PWT-104 for full report](#)

Designated Speaker: Lloyd Bie

STAFF RECOMMENDATION

That DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643 be introduced and given first, second and third readings.



5. **WATER SHORTAGE RESPONSE PLAN – PROPOSED CHANGES**

(File Ref. No. 10-6060-01) (REDMS No. 5268702 v. 3)

PWT-126

[See Page PWT-126 for full report](#)

Designated Speaker: Lloyd Bie

STAFF RECOMMENDATION

That the comments on Metro Vancouver's proposed changes to the Water Shortage Response Plan, as summarized in the staff report titled "Water Shortage Response Plan – Proposed Changes," dated January 3, 2017, from the Director, Engineering be submitted to Metro Vancouver.



6. **T.5651 - 2016 PAVING PROGRAM (LAFARGE CANADA INC.) CONTRACT EXTENSION AND CHANGE ORDER FOR 2017 PAVING PROGRAM**

(File Ref. No. 10-6340-20-P.16207) (REDMS No. 5267595)

PWT-132

[See Page PWT-132 for full report](#)

Designated Speaker: Milton Chan

STAFF RECOMMENDATION

That Contract T.5651 – 2016 Paving Program with Lafarge Canada Inc. be extended to include the 2017 Paving Program, and that a Change Order be issued to increase the value of this Contract by \$2,700,000.



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Pg. # ITEM

7. MANAGER’S REPORT

ADJOURNMENT





Public Works and Transportation Committee

Date: Wednesday, November 23, 2016

Place: Anderson Room
Richmond City Hall

Present: Councillor Chak Au, Chair
Councillor Harold Steves
Councillor Derek Dang
Councillor Ken Johnston
Councillor Alexa Loo

Also Present: Councillor Linda McPhail
Councillor Carol Day

Call to Order: The Chair called the meeting to order at 4:00 p.m.

MINUTES

It was moved and seconded

That the minutes of the meeting of the Public Works and Transportation Committee held on October 19, 2016, be adopted as circulated.

CARRIED

NEXT COMMITTEE MEETING DATE

December 21, 2016, (tentative date) at 4:00 p.m. in the Anderson Room.

Public Works & Transportation Committee
Wednesday, November 23, 2016

DELEGATIONS

1. (1) Erich Harvey, 9460 Alberta Road, cycling teacher and recreational cyclist, presented images to the Committee (attached to and forming part of these minutes as Schedule 1) of roads in Richmond which are used frequently by cyclists. Mr. Harvey referred to several roads in his presentation and noted that the concerns for cyclists on these roads in Richmond were (i) the speed of traffic, (ii) the narrow space for cyclists, (iii) the size of the vehicles occupying the roads, (iv) parked vehicles, (v) merging vehicles, and (vi) construction.

In reply to questions, Mr. Harvey noted that some additions which would be useful to cyclists include (i) plastic bars and concrete barriers placed in the key areas of the road, (ii) widening of paths and lanes, and (iii) the addition of separate paths for cycling alongside roads.

- (2) James White, 3226 Pleasant Street, former professional cyclist and a current recreational cyclist, summarized his concerns to the Committee and stated that (i) there are three types of cyclists – professional, recreational, and commuters, (ii) clear and long open roads allow professional cyclists to keep their heart rate up, (iii) Richmond and Ladner are frequently used as recreational cycling areas of the flat topography, (iv) commuters seek safe, clear and visible areas for cycling. Mr. White emphasized that all types of cyclists need to be catered to in order to promote a healthy and active lifestyle for different members of the population.

In response to a query, Mr. White noted that building a route around sea island way would be too short to meet cyclists' needs.

- (3) Linda Love, 3031 Williams Road, Chair of the Richmond Active Transportation Committee (RATC), explained to the Committee that the focus of the Committee is to improve active transportation in the City. Ms. Love remarked that at the time there were no competitive cyclers on committee and hopes that the addition of more cyclists would help to provide better feedback to Council with feedback on possible improvements for Richmond's roads.
- (4) Victor Wei, Director, Transportation, expressed his condolences towards the recent fatality in the cycling community and informed the Committee that the investigation into the cause of the death is still ongoing. Mr. Wei confirmed that there would be a report coming forward which would address the safety concerns and roadways needing improvement in Richmond. However, there will be no contribution to any high cost solutions until the cause for the fatality is known.

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A handout, containing text from an article in the Richmond News, was distributed to the Committee and is attached to these minutes as Schedule 2. Mr. Wei noted that a response was being prepared to this article. Mr. Wei then encouraged the public to bring forward their recommendations for road safety improvements to the RATC and also noted that posted on the City's website was an invitation for people to come speak at future RATC meetings.

In response to questions, Mr. Wei confirmed that (i) there was a limited amount of funding dedicated to traffic roadway improvements and cycling, (ii) given limited funding, feedback is being requested from the RATC to determine what are the areas which need funding immediately, (iii) the incorporation of cycling paths is always being implemented into the new roadways, and (iv) delays in construction work at certain areas in Richmond is being caused by external factors.

PLANNING AND DEVELOPMENT DIVISION

2. **PROVINCIAL 2017/18 BIKEBC PROGRAM SUBMISSION**

(File Ref. No. 01-0150-20-THIG1) (REDMS No. 5200523)

In reply to queries, Victor Wei stated that (i) it is possible that enough external funding will be collected to support the project, (ii) option one is to fill in the canal and put in a new path, (iii) option two, which is less costly, is to build on the nearby right of way, and (iv) the anticipated completion time is the end of next year.

It was moved and seconded

- (1) *That the submission for cost-sharing to the Province's 2017/2018 BikeBC Program for the River Drive multi-use pathway, as described in the report, titled "Provincial 2017/2018 BikeBC Program Submission" dated October 21, 2016, from the Director, Transportation, be endorsed; and*
- (2) *That, should the above application be successful and the project receive Council's approval via the annual capital budget process, the Chief Administrative Officer and the General Manager, Planning and Development, be authorized to execute the funding agreement and that the 2017 Capital Plan and the 5-Year Financial Plan (2017-2021) be updated accordingly.*

CARRIED

3.

Public Works & Transportation Committee
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3. TRANSLINK DRAFT REGIONAL GOODS MOVEMENT STRATEGY
(File Ref. No. 01-0154-04) (REDMS No. 5201462 v. 3)

Victor Wei noted that (i) the document is fairly high level, (ii) there is no detailed action plans yet, and (iii) staff will come back to committee to update on detailed action plans. Comments and concerns were made regarding the parking of the trucks.

It was moved and seconded

- (1) *That TransLink be advised that the City supports the draft Regional Goods Movement Strategy in principle, subject to continued dialogue with the City on key items as described in the staff report, titled "TransLink Draft Regional Goods Movement Strategy" dated October 26, 2016, from the Director, Transportation, to ensure that urban freight movement and associated economic benefits are enhanced without diminishing the City's authority over local roadways or resulting in negative impacts to the community;*
- (2) *That the City continue to work with TransLink and relevant stakeholders to finalize the draft Regional Goods Movement Strategy; and*
- (3) *That staff be directed to report back on the detailed action plans when completed.*

CARRIED

ENGINEERING AND PUBLIC WORKS DIVISION

4. HORSESHOE SLOUGH PUMP STATION
(File Ref. No. 10-6340-20-P.15305) (REDMS No. 5209602)

It was moved and seconded

That the design concept for the Horseshoe Slough Drainage Pump Station Upgrade as detailed in Attachment 1 of the staff report titled, "Horseshoe Slough Pump Station," be approved.

CARRIED

5. ELECTRIC VEHICLE FLEET AND CHARGING STATION INFRASTRUCTURE
(File Ref. No. 02-0780-01) (REDMS No. 5201896 v. 5)

In response to questions, Suzanne Bycraft, Manager, Fleet and Environmental Programs, stated that the reasonable lifespan for a vehicle's battery would be 10 years and that only the publicly available charging stations are noted in the report.

4,

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It was moved and seconded

- (1) *That the tiered approach and key considerations for acquiring electric vehicles within the City's vehicle fleet, as outlined in the staff report titled "Electric Vehicle Fleet and Charging Station Infrastructure," dated October 22, 2016 from the Director, Public Works Operations, be endorsed; and*
- (2) *That staff report back regarding the potential installation of community Level 3 charge stations, including an energy cost recovery approach, as part of advancing greenhouse gas emissions under the City's Community Energy and Emissions Plan.*

CARRIED

6. UPDATE ON 2016/2017 SNOW AND ICE RESPONSE PREPARATIONS

(File Ref. No. <#>) (REDMS No. 5195272 v. 2)

It was moved and seconded

That the staff report titled "Update on 2016/2017 Snow and Ice Response Preparations," dated October 20, 2016, from the Director, Public Works Operations be received for information.

CARRIED

7. MANAGER'S REPORT

Suzanne Bycraft briefed the Committee on the garbage and recycling calendar for the upcoming year and noted that (i) the annual calendar is anticipated to be sent out in January, (ii) the package will contain a short insert showing the collection guide, and (iii) many residents have already signed up for the garbage collection reminder on the Richmond app.

ADJOURNMENT

It was moved and seconded

That the meeting adjourn (4:55 p.m.).

CARRIED

Public Works & Transportation Committee
Wednesday, November 23, 2016

Certified a true and correct copy of the Minutes of the meeting of the Public Works and Transportation Committee of the Council of the City of Richmond held on Wednesday, November 23, 2016.

Councillor Chak Au
Chair

Shaun Divecha
Legislative Services Coordinator

River Road





YVR – Iona







Westminster hwy











Russ Baker Way



Sidaway



An open letter on cycling safety to mayor Malcolm Brodie

City of Richmond says it improves cycling network based on priorities (see below)

Geordie McGillivray / Richmond News

November 18, 2016 11:31 AM



A new bike path on Westminster Highway is not only covered in shrapnel-like materials from passing vehicles, it also ends in a dangerous bottleneck around No. 9 Road, says cyclist Geordie McGillivray.

To Mayor Malcolm Brodie,

I'm saddened that I did not send this letter before the death of cyclist Brad Dean, who was killed (Nov. 6) on River Road in Richmond.

I've been a clubmate of Brad's for some years now, having cycled with him on many rides and shared transportation to out of town rides.

Let me introduce myself, and why I ask that you take what I say seriously.

I'm Geordie McGillivray. I was born in Richmond, and have lived in Richmond for 44 years. I ride my bike more than 20,000 kms per year. I would say that about 10,000 to 12,000 of those kilometres are in Richmond; I ride almost every day, rain or shine.

I am a cyclist — not a person who rides a bike. Let me explain the difference.

I am an experienced cyclist; I have competed in events; I am a ride leader for Just Giver cycling group (which Brad was part of); I volunteer to coach elementary school children bike safety and skills, and every year I renew my cycling insurance through Cycling BC. I ride on the road, with traffic if need be, but otherwise on the roadside bike lanes. My average speed is 30 km/h but I can keep up with traffic if needed. I'm serious about cycling, and coming home alive after every ride.

A person who rides a bike, many times, will have their helmets strapped to their backpack, or handlebars; They will ride on the sidewalks; They will ride on gravel paths while texting. They will do more to give cyclists a bad name in the eyes of pedestrians and vehicle drivers than anyone. That is not who this letter is about.

Over the years, I've identified every road, every intersection, and every section of road in Richmond where a cyclist could, or will be injured or killed.

What I am proposing is that I be brought in as an advisor, if you will, to help with the decisions and changes that are so sorely need in Richmond to prevent more carnage. Along with identifying all of the hot spots, I have solutions that would work. Simply, my solutions will save lives.

Coun. Ken Johnston, who thinks shutting down roads to cyclists (may be) the answer, is obviously a man who is not a cyclist and has no idea of the popularity of River Road with cyclists from all over the Lower Mainland.

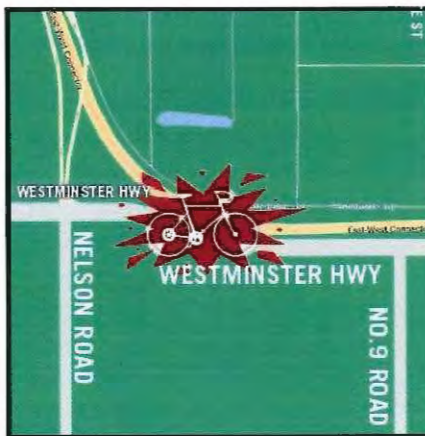
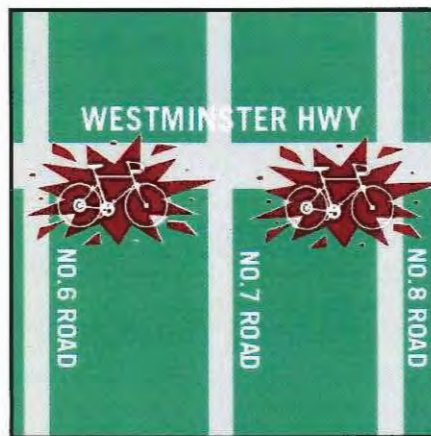
That stretch of road, from No. 6 Road up to what is the equivalent of No. 10 Road, is the third most popular road for cyclists in all of Richmond. It is also one of only two roads where cyclists feel a sense of freedom since there are no traffic lights to interrupt the ride.

This road along with Dyke Road in south Richmond are the two main draws. The Railway Avenue corridor is also in the top three.

Let me quickly list a few of the areas in Richmond where I expect another cyclist will be injured or killed within the next two years.

River Road was on the list, and this has already happened, so we are now left with four locations.

I ask that you use my knowledge to make Richmond safer and bike routes designed by someone who actually rides a bike in this city instead of a designer sitting behind a desk who doesn't know how cyclists actually flow with and without traffic around them. I have solutions for each of these listed below and would love to help.



Richmond cyclist Geordie McGillivray has pointed out to the City of Richmond and the mayor these danger hot spots for fellow cyclists in the east of the city.

1. Westminster Highway, between No. 9 and Nelson roads.

This disaster area started over 18 months ago and is still a death waiting to happen.

There was a bike lane "shoulder" on both sides of the road which worked perfectly well.

Then they were removed and a multi-use path was created on the south side of the road.

However, it stops before it gets to the railway tracks between Nelson and No. 9 roads.

So, now cyclists and pedestrians must merge with all of the 18-wheelers, which now have their nice two-lane roads coming from each direction, and squeeze over the tracks.

Plus, construction parts are still lying around, and the multi-use path is useless as it can't be swept and is full of glass and debris most of the time.





Piecemeal cycling routes can do more harm than good, say cyclists

2. Westminster Highway between No. 6 and No. 8 roads

A few years ago, someone said, "let's make a multi-use path along this two miles stretch of road — it will be great!" And it is, if you want to get injured while riding your bike.

The path is on the south side of the road. What else is also on that side? A ton of driveways for farms, houses and businesses. What's the issue? Every driveway has a thick hedge that goes right to the multi-use path, which a vehicle must then cross to get onto the road. Simple physics here. The average driver of a car sits about nine feet back from the front of the vehicle. The multi-use path is about eight feet wide. If a car comes out of it's driveway, the only way the driver can see of there is a cyclist or pedestrian coming is by driving out all the way so the nose of the vehicle is touching Westminster Highway. Whoever thought this would work, obviously never rode a bike along this route.

As well, most days through the spring and summer there is a farm vehicle, utility vehicle or police car either parked, or driving on this multi-use path. Solution: this two-mile stretch happens to contains some of the widest, single vehicle lanes in all of Richmond. There is more than enough room for proper cycling lanes on each side of the road — just like on Railway.

3. River Road between No. 6 Road and its end (de facto No. 10 Road)

A. The fact there is no controlled traffic lights at this intersection is a crime, given the amount of traffic using this road as a shortcut to Highway 91 and Westminster Highway. I've seen line-ups of cars half a mile long as drivers try to turn onto Westminster.

B. River Road, for all its traffic, including dump trucks, is one of the safest roads to ride on in Richmond. Why? The majority of traffic on it is familiar with the road and expect cyclists. Have you ever ridden a bike on Marine Drive in North Vancouver to Horseshoe Bay? It is twisty, there are no bike lanes, and when traffic builds up behind bikes, drivers understand and they wait. Even all of the buses on that road know it's a cycling route. Technically, it's the most dangerous "popular" road in North Vancouver for cyclists, and yet it's the most used. You don't see North Vancouver councillors saying they need to shut it down.

Solution: There is an extra gravel shoulder on both sides that could be used to widen the road for a bike shoulder. Also, the 30/kmh speed limit that is already in effect for part of River Road should be extended.

Since Brad's death, cars are giving me a very wide berth, which is nice, but they are crossing into the other lane of oncoming traffic, and it's getting dangerous for everyone.

4. Highway 99 between Rice Mill Road and Steveston Highway

This small section of road, where the old Richmond Information Centre used to be, is one of the most used sections of road for cyclist in all of Richmond — travelling in both directions. It's the only way to directly connect from the bike shuttle service to Sidaway Road, which is the designated safe route. It is vital to completing a complete lap of Lulu Island and is used for all charity bike rides.

Solution: Installing reflective pylons around the shoulder corner leading from the information centre area to the bus stop at Steveston Highway to deter vehicles from cutting that corner. If a vehicle "needs" to pull off to the shoulder, it still can as the pylons bend.

I'm aware of at least 10 more sections of road in Richmond similar to the above. I have solutions to all of those, as well. I have short term, and long term solutions, both economical and expensive. I'm not sure how much Richmond City Hall thinks Brad's life is worth, or the life of any of us cyclists, but I'd like to find out. Richmond is flat and has hardly any blind corners — the fixes are easy compared to other cities.

Most people who drive vehicles would never know about these issues (and I drive a car, too.) They are oblivious to the situation that doesn't apply to their big metal box. I'm a single father of an 11-year-old girl, and getting home every day safely is my priority.

I want to make something very clear: If Ken Johnston wants to shut down River Road, cyclists will have to be rerouted onto Westminster Highway. This will inevitably lead to more injury and death.

I've been thinking about this for a year, and now a friend has been killed. I regret I have sat on this for so long. Perhaps no road improvements would have prevented this tragedy, but I can't sit back now.

Geordie McGillivray

Richmond

Bike upgrades made along side larger projects: City

A spokesperson for the City of Richmond says improving the municipality's cycling networks is a matter of priorities and funding.

"We are working to incrementally add to our cycling network," said Ted Townsend.

"It's a question of priorities. If we were prepared to throw more money at it, then sure, we could do more. But we have to balance it with many other priorities," said Townsend.

As it stands Townsend said the city is investing in improvements to cycling lanes, particularly when senior governments assist in funding.

For example, last year the federal government granted the city \$3.5 million to widen No. 2 Road from Steveston Highway to Dyke Road, as part of improving access to Steveston Harbour (Asia-Pacific Gateway funding). The \$7.3 million project will be topped up with municipal funds. It will see utility poles moved to accommodate a bike path on the east side of the road from the highway to just beyond Andrews Road. The bike lane will shift to the west until Dyke.

Many cycling network upgrades also occur when there is redevelopment. For instance, when a new street is built, cycling lanes are added, such as in the Oval Village.

A common criticism of Richmond's cycling network is the gaps that exist.

"Obviously there are gaps that exist. We want to address the gaps, but there's a whole wide variety of criteria that come into play with what projects get built," Townsend said.

He explained, for example, the Westminster bike path was built when the federal government provided funding for the Nelson Road interchange (for port truck traffic).

That path is incomplete because the city is waiting on CN Rail to upgrade its crossing.

There are also smaller, incremental upgrades, said Townsend.

"We also make significant investments annually in other traffic safety improvements such as traffic calming measures, new traffic signals and intersection improvements."

Last year the city invested \$300,000 directly in such improvements.

-Graeme Wood/Richmond News

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City of Richmond

Report to Committee

To: Public Works and Transportation Committee **Date:** November 22, 2016
From: Victor Wei, P. Eng.
Director, Transportation **File:** 01-0100-30-TSAD1-01/2016-Vol 01
Re: Traffic Safety Advisory Committee – Proposed 2017 Initiatives

Staff Recommendation

1. That the proposed 2017 initiatives for the Traffic Safety Advisory Committee, as outlined in the staff report titled "Traffic Safety Advisory Committee - Proposed 2017 Initiatives" dated November 22, 2016 from the Director, Transportation, be endorsed.
2. That a copy of the above staff report be forwarded to the Richmond Council-School Board Liaison Committee for information.

Victor Wei, P. Eng.
Director, Transportation
(604-276-4131)

Att:1

REPORT CONCURRENCE		
ROUTED TO:	CONCURRENCE	CONCURRENCE OF GENERAL MANAGER
Community Bylaws	☒	
Fire Rescue	☒	
RCMP	☒	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS: DW	APPROVED BY CAO

Staff Report

Origin

Council endorsed the establishment of the Traffic Safety Advisory Committee (TSAC) in 1997, in order to create a co-operative partnership between City staff, community groups and other agencies that seek to enhance traffic and pedestrian safety in Richmond. The Committee provides input and feedback on a wide range of traffic safety issues such as school zone concerns, neighbourhood traffic calming requests and traffic-related education initiatives. TSAC has representation from the following groups: Insurance Corporation of BC (ICBC), Richmond School District, Richmond RCMP, Richmond Fire-Rescue, Richmond District Parents Association, and the City's Transportation and Community Bylaws Departments. This report summarizes the Committee's activities in 2016 and identifies proposed initiatives for 2017.

Analysis

The Committee's major activities and accomplishments in 2016 are summarized below.

Road and School Zone Safety Initiatives in 2016

The Committee provided input on and/or participated in the following measures aimed at improving the safety of Richmond roads for all users, particularly in school zones.

- *Pedestrian Zone Markers – School Zones*: Given the past success of in-street mounted school zone signage in school zone locations in Richmond, two signs were installed within the school zone on Odlin Road fronting Tomsett Elementary School. Identical signs were also installed on the section of Westminster Highway north of Highway 91 in front of Choice School for the Gifted. However, due to repeated vandalism (i.e., illegal removal of the signs) at this location, staff are now considering the installation of speed humps in the school zone, subject to expressed support by local residents.
- *Traffic Calming*: Installation of speed humps in Burkeville (two on Airport Road in front of Burkeville Park) and on Dyke Road (two in the 23,000-block). Modifications to the existing traffic circle on Saunders Road at Whelan Road to improve driver awareness at the traffic circle and reinforce the requirement to yield to other traffic that comprised road markings and delineation to channel drivers to the right as they approach the traffic circle, painted white hatched "stop" bars to provide reference for vehicle staging, improved placement and enlarging of yield signage, and the addition of yield ahead signs at each approach to the traffic circle.
- *Potential Pilot Project for Pedestrian Safety*: Members discussed the feasibility of implementing a pilot project intended to enhance the safety of pedestrians at signalized intersections, particularly those with high pedestrian volumes. The pilot project would assess the effectiveness of a "Leading Pedestrian Interval (LPI)," which is a traffic signal strategy whereby pedestrians are given the "Walk" signal typically three to seven seconds prior to the activation of a green light for motorists. Research indicates that by giving pedestrians a head start, it is less likely that there will be conflict between pedestrians and turning vehicles. LPIs increase the percentage of motorists who yield the right-of-way to pedestrians because

pedestrians are in the crosswalk by the time the traffic signal turns green for parallel vehicle movements. The Committee is currently considering a potential location (likely in the City Centre) for the pilot project.

- *School Travel Planning*: Continuation of a pilot program with the Richmond School District, TravelSmart (part of TransLink) and HASTe (Hub for Active School Travel, contractor to TravelSmart) to develop a customized School Travel Plan for three elementary schools: Garden City, AB Dixon and Walter Lee. The Plans aim to create an environment that encourages healthy and active transportation to and from school, improves the journey for those who use vehicles or take school busses, and improves transportation safety for everyone. Attachment 1 provides a draft “Safe Routes to School” map, which is one component of the plan, for Walter Lee Elementary School developed in consultation with parents and City and Richmond School District staff.

Amendments to Traffic Bylaw 5870

The Committee provided input on the development of amendments to the City’s Traffic Bylaw 5870, which include permitting motorcycle and bicycle parking at intersections corner clearances and new regulations and fines for jaywalking, pedestrians disobeying a traffic control device and drivers yielding to pedestrians at crosswalks. The amendments were adopted at the November 14, 2016 Council meeting and staff are preparing to convey the key changes to the public via avenues such as a City Board notice in the Richmond News, updating the City’s website, safety pamphlets to be handed out at future pedestrian safety campaigns, and social media.

TransLink Regional Goods Movement Strategy – Commercial Vehicle Staff Working Group

Through City staff participation on the TransLink Working Group, the Committee is providing input on proposed actions to harmonize regulations concerning truck size, weight and noise across the region and develop a centralized regional permit system that is coordinated with the provincial permit system to provide a single point of contact for trucking companies operating within Metro Vancouver to obtain needed permits, including for oversize/overweight trucks.

Traffic and Pedestrian Safety Campaigns in 2016

Committee members participated in the following ICBC- and Richmond RCMP-led road and pedestrian safety campaigns.

- *Pedestrian Safety*: In Fall 2016, Richmond RCMP in partnership with ICBC and Richmond Fire-Rescue conducted four pedestrian safety education and enforcement campaigns (e.g., distribution of reflectors and proactive engagement with pedestrians) in Richmond.
- *“Project Swoop”*: During this event held in May, Speed Watch volunteers set up a speed reader board at a high incident crash location and those drivers who choose to continue to speed even after being clocked by the Speed Watch volunteers will receive a speeding ticket from an RCMP officer a few blocks down the road. Four officers and 28 volunteers were deployed at eight locations and checked over 4,000 motorists.

- *Distracted Driving*: As part of this campaign that is conducted year-round, RCMP officers and community police volunteers conducted two “Cell Watch” blitz days in March and September and checked over 11,000 motorists. Community police volunteers conducted a further two “Cell Watch” blitz days in March and June.
- *Auto Crime Awareness*: As part of this annual campaign, community police volunteers conducted two “Lock Out Auto Crime” blitz days in February and issued 1,850 notices. Lock Out Crime audits are also conducted year-round by community police volunteers.

Proposed Traffic Safety Activities for 2017

In addition to developing and providing input on corrective measures to address identified traffic safety concerns, the Committee will undertake a number of proactive initiatives to enhance traffic safety in 2017.

- *Traffic Calming*: The assessment, implementation and monitoring of road safety and traffic calming measures where warranted in local neighbourhoods, together with consultation with Richmond RCMP and Richmond Fire-Rescue prior to the implementation of any traffic calming measures.
- *School Zone Traffic Safety*: On-going review and improvement of traffic and pedestrian safety in school zones through improving vehicle parking and circulation layout at schools, supporting the enforcement of school zone traffic violations, and introducing new walkways and crosswalks as well as upgraded crosswalks to improve pedestrian safety. Specific schools planned for review and potential improvement include Cambie Secondary School, Hamilton Elementary School and Choice School for the Gifted.
- *Pedestrian and Traffic Safety Projects and Campaigns*: Implement and assess a pilot “Leading Pedestrian Interval” project at a selected City Centre intersection, provide input on potential road safety improvement measures on River Road in the vicinity of Westminster Highway and continue to support and participate in on-going multi-agency efforts to increase the level of pedestrian and traffic safety, such as annual campaigns held by ICBC and Richmond RCMP.
- *Discouraging Vehicle Speeding*: The member agencies of the Committee will continue to jointly work on initiatives to curb vehicle speeding in the community, such as the targeted enforcement program of Richmond RCMP.
- *Special Events*: Provide comment and input from a traffic safety perspective on the development and implementation of traffic management plans to support special events.

Financial Impact

Costs associated with the installation of traffic control devices, walkway construction and other road and traffic safety improvements are normally accommodated in the City’s annual capital budget and considered as part of the annual budget review process. Some of these projects are eligible for financial contribution from external agencies (e.g., ICBC and TransLink). If successful, staff will report back on the amount of financial contribution obtained from these

external agencies through the annual staff reports on ICBC and TransLink cost-sharing programs respectively.

Conclusion

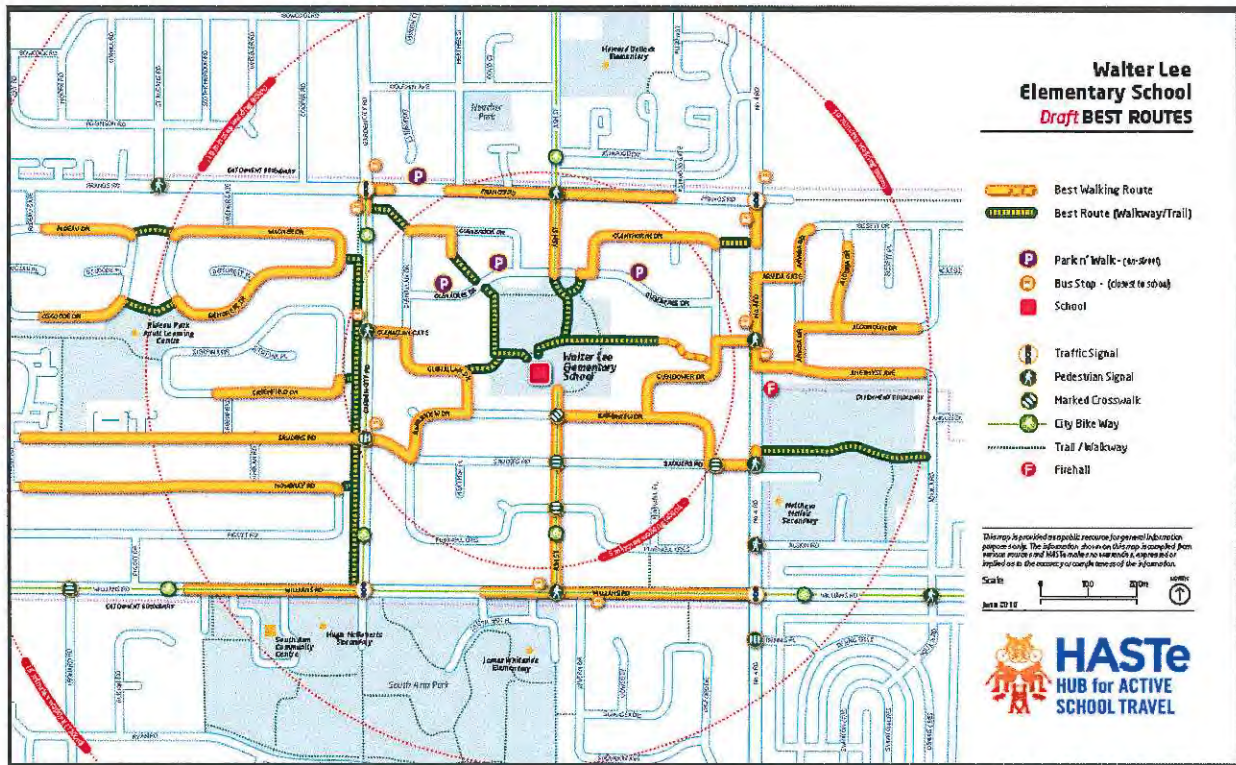
The Traffic Safety Advisory Committee is one of the few multi-agency forums in the region dedicated to enhancing pedestrian and traffic safety within its home municipality. Since its inception in 1997, the Committee has provided input on and support of various traffic safety improvements and programs and initiated a range of successful measures encompassing engineering, education and enforcement activities. Staff recommend that the proposed 2017 initiatives of the Committee be endorsed and this staff report forwarded to the Richmond Council-School Board Liaison Committee for information.



Joan Caravan
Transportation Planner
(604-276-4035)
(on behalf of the Traffic Safety Advisory Committee)

Att. 1: Draft Safe Routes to School Map for Walter Lee Elementary School

Draft Safe Routes to School Map for Walter Lee Elementary School





City of Richmond

Report to Committee

To: Public Works and Transportation Committee

Date: December 15, 2016

From: Victor Wei, P. Eng.
Director, Transportation

File: 01-0100-20-
RCYC1/2016-Vol 01

Re: Richmond Active Transportation Committee – Proposed 2017 Initiatives

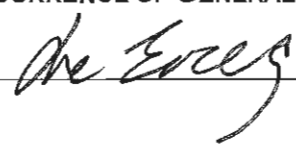
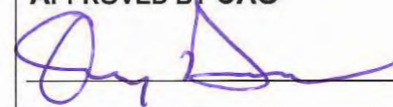
Staff Recommendation

1. That the proposed 2017 initiatives of the Richmond Active Transportation Committee, as outlined in the staff report titled "Richmond Active Transportation Committee - Proposed 2017 Initiatives" dated December 15, 2016 from the Director, Transportation, be endorsed.
2. That a copy of the above report be forwarded to the Richmond Council-School Board Liaison Committee for information.



Victor Wei, P. Eng.
Director, Transportation
(604-276-4131)

Att. 2

REPORT CONCURRENCE		
ROUTED TO:	CONCURRENCE	CONCURRENCE OF GENERAL MANAGER
Parks Services	☒	
Recreation Services	☒	
Sustainability	☒	
Engineering	☒	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS: 	APPROVED BY CAO 

Staff Report

Origin

The Richmond Community Cycling Committee was formed in 1993 to allow City staff to work in partnership with the community to promote commuter and recreational cycling in Richmond. In 2013, Council approved the evolution of the Committee into the Richmond Active Transportation Committee (RATC) to reflect a broader mandate that includes skateboarding, in-line skating and low-speed scooters. The Committee provides input and feedback to the City on infrastructure projects designed for these modes and undertakes various activities in co-operation with the City that encourage, educate and raise awareness of active transportation.

This report reviews the 2016 activities of the RATC and identifies a number of initiatives for 2017 that would support its mandate to provide input and advice to the City on issues in the planning, development, improvement, and promotion of an active transportation network that supports a greater number of trips by cycling, walking and rolling.

This report supports Council's 2014-2018 Term Goal #2 A Vibrant, Active and Connected City:

2.3. Outstanding places, programs and services that support active living, wellness and a sense of belonging.

This report supports Council's 2014-2018 Term Goal #3 A Well-Planned Community:

3.3. Effective transportation and mobility networks.

Analysis

The RATC undertook and participated in a number of activities in 2016 that contributed to enhanced cycling and rolling opportunities, and increased education and awareness of active transportation in Richmond.

Planning, Expansion and Improvement of Active Transportation Network in 2016

The City continued to add to Richmond's active transportation network in 2016, which now comprises nearly 71 km of on- and off-street bike and rolling routes. The Committee provided feedback on the planning, design, construction, and/or improvement of the following facilities.

- *Parkside Neighbourhood Link*: Completion of this north-south route on Ash Street between Williams Road and Garden City Park with the upgrade of the special crosswalk on Blundell Road to a pedestrian signal and the addition of pavement markings and signage (Figure 1). A future phase will extend the route north to Westminster Highway to connect to the planned perimeter trails around the Garden City Lands.



Figure 1: Parkside Wayfinding Signage

- Crosstown Neighbourhood Link: Upgrade of special crosswalks to pedestrian signals to facilitate cyclists crossing major arterial roads at No. 2 Road-Colville Road and Gilbert Road-Lucas Road. Currently under development, the east-west Crosstown Neighbourhood Link is aligned between Blundell Road and Francis Road and will link the Railway Greenway to the Parkside Neighbourhood Link on Ash Street.

- Green Surface Treatment: Addition of green-coloured anti-skid surface complete with bike stencils within bike lanes at strategic locations where there is a higher potential for conflicts between cyclists travelling straight through and motorists needing to cross the bike lane in order to merge or make a turn. The vibrant colour is the approved national standard that is intended to highlight and raise awareness to both cyclists and motorists to watch out for each other and use caution when in the area. The green treatment was added within the bike lane at southbound No. 2 Road south of the No. 2 Road Bridge (Figure 2).



Figure 2: Green Surface in No. 2 Road Bike Lane

- Railway Avenue Greenway: Enhancements to the northern section of the greenway that included: upgrade of the special crosswalk at Westminster Highway-McCallan Road to a pedestrian signal; the addition of signage and “sharrow” pavement markings on McCallan Road between Westminster Highway and River Road; construction of a paved ramp from River Road to the Middle Arm Trail; and addition of new crosswalk with green surface treatment on River Road at McCallan Road (Figure 3).



Figure 3: Railway Greenway Crossing at River Road-McCallan Road

- New Crossing on Granville Avenue: The Committee provided feedback on the design for a new pedestrian-cycling crossing to be located on Granville Avenue at the main entrance to the new Minoru Complex between Minoru Gate and Gilbert Road.
- Detailed Design for Road Improvement Projects: The Committee provided feedback on the progress of detailed design for the following planned roadway improvement projects that each include the provision of a two-way paved multi-use pathway: No. 2 Road (Steveston

each include the provision of a two-way paved multi-use pathway: No. 2 Road (Steveston Highway-Dyke Road) and Lansdowne Road (Minoru Blvd-Alderbridge Way).

- *River Road*: The Committee, other cyclists and members of HUB Cycling and the BC Cycling Coalition provided feedback on road safety improvement options for potential implementation on River Road between No. 6 Road and Westminster Highway at its December 2016 meeting. Feedback was obtained from one of the individuals who spoke on this topic at the November meeting of the Public Works & Transportation Committee; the other individual who spoke was invited but was unable to attend. The individual who wrote a letter to Mayor and Councillors on the topic (also published in the Richmond News) was invited but did not attend. Staff will address the Council referral to “examine the circumstances and the area around the accident that occurred on River Road on November 6, 2016 and report back” in a separate report anticipated to be presented in early 2017.
- *George Massey Tunnel Replacement Project*: As part of staff’s participation in the Cycling Working Group established by the Ministry of Transportation and Infrastructure for the Project, the Committee provided feedback on potential alternative north-south cycling routes in Richmond that would parallel Highway 99 given that cycling facilities will not be provided within the highway right-of-way.

Promotion of Active Transportation Network in 2016

The Committee participated in the following activities in 2016 to promote cycling and other active transportation modes in Richmond.

- *Bike to Work Week (May and October 2016)*: The Committee worked with organizers of this region-wide annual initiative to continue to successfully stage these events in Richmond. Region-wide, the two events recorded year-over-year increases for the number of people registered online (a combined total of over 17,400 cyclists) and the number of commutes logged

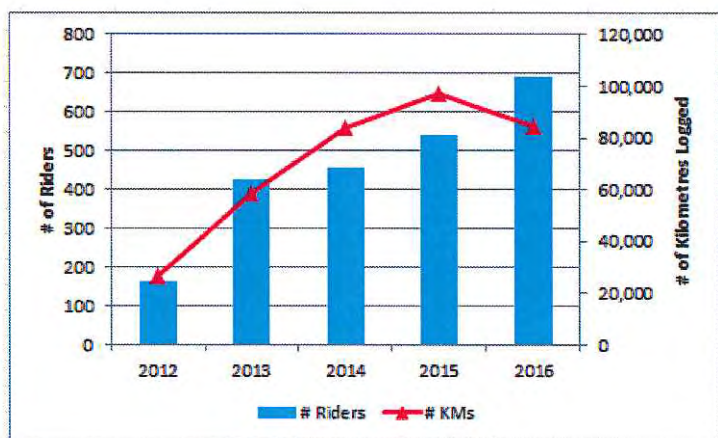


Figure 4: Participation of Cyclists who work in Richmond in Bike to Work Week

(nearly 96,000, up 12 per cent from 2016). A total of 692 riders who work in Richmond registered on-line for both events (up from 543 participants in 2015), and collectively logged 5,906 trips for a total distance of 84,000 kilometres thereby avoiding the emission of 18.2 tonnes of greenhouse gases (see Figure 4). Within this group were three teams from the City of Richmond comprising 33 cyclists. Together, the City teams logged 321 trips for a total distance of 2,947 kilometres, thus avoiding the emission of 639 kilograms of greenhouse gases.

Celebration stations for cyclists were held at the Canada Line Bridge and Flight Path Park on Russ Baker Way for both the Spring and Fall events plus at Richmond General Hospital during the Fall event. Collectively, these celebration stations logged numbers comparable to 2015 despite wetter weather conditions.

- 16th Annual “Island City, by Bike” Tour (June 12, 2016): Each year in June, as part of regional Bike Month activities and the City’s Environment Week events, the Committee and the City jointly stage guided tours for the community of some of the city’s cycling routes. The 16th annual “Island City, by Bike” tour was based at Cambie Community Centre and offered short (6.5-km) and long (22-km) rides with escorts provided by volunteer members of the Richmond RCMP bike squad. The loops featured the Bath Slough and Bridgeport Trails as well as quiet roads in east Richmond (e.g., No. 7 Road). Activities included a bike and helmet safety check prior to the ride plus a barbecue lunch and raffle prize draw at the finish. Richmond RCMP also provided registration services for an anti-theft bike initiative. The event attracted 70 cyclists of all ages and ability. Attendance at the event over the past five years has averaged 100 participants.
- All Aboard! (August 6, 2016): The Committee participated in this annual event held at the Steveston Interurban Tram Building, which celebrates the history of transportation in Richmond. Members provided information on how to get around Richmond in fun, safe and environmentally friendly ways.
- Update of Cycling & Trails Map: The Committee provided input into the update of the 2013 edition of the Richmond cycling and trails map that will incorporate recent improvements to the local cycling and trails network including the Parkside Neighbourhood Link. The new map will be produced in a more portable format (i.e., folds down to slightly larger than a credit card) and will be distributed in early 2017 to community centres, libraries and other civic facilities as well as handed out at various City events.

Active Transportation Education in 2016

The City provided funding to *HUB: Your Cycling Connection*, a non-profit organization focused on making cycling better through education and events, to operate cycling education courses for local residents with input from the Committee. The City’s support for cycling education generates multiple benefits including increased safety, encouragement of a life-long healthy activity and sustainable mode of travel, and potential to reduce traffic congestion around schools as more students choose to ride a bike, all of which align with the City’s Official Community Plan goals. Beginning in 2015, the City is eligible for a 30 per cent discount off program costs as a result of Council’s endorsement in October 2014 of the City becoming a TravelSmart partner municipality with TransLink.

- Bike to School Education for Students: Nearly 600 students from Grades 4 and 5 at Jessie Wowk and McKinney Elementary Schools (two classes at each school) and Grades 6 and 7 at Garden City, AB Dixon and Walter Lee Elementary Schools (two classes at each school) participated in five-day bike education courses, held in co-operation with Richmond School District. The courses include in-class lessons, on-bike playground cycling safety training for younger students and neighbourhood road ride education for older youth. The courses were well received and enjoyed the enthusiastic participation of all students. Following the

course, students reported a 43 per cent increase in cycling, which is higher than the regional average of 32 per cent. Attachment 1 provides a summary of the outcomes and feedback.

- *Learn to Ride Education for Adults*: Four beginner's courses targeted to recent immigrants were held in co-operation with Immigrant Services Society of BC. A total of 13 new riders of varied immigrant backgrounds, who live in Richmond, took to the classroom, an empty parking lot, and eventually to the road to learn to ride safely and confidently on Richmond streets. Attachment 2 provides a summary of the course outcomes.

Proposed Active Transportation Network Initiatives in 2017

The Committee will provide input at the earliest conceptual stage on the prioritization, planning, design, and implementation of the following projects that expand and/or improve the network of infrastructure that can be used by active transportation modes.

- *Planned Active Transportation Network Expansion*: Projects include further progress on the Crosstown Neighbourhood Link and improvements to Westminster Highway (conversion of bike lanes to two-way multi-use path between No. 8 Road and Nelson Road), Great Canadian Way (upgrade of sidewalk to two-way multi-use path between Bridgeport Road and Van Horne Way) and River Drive (construction of new two-way multi-use path between Van Horne Way and No. 4 Road).
- *Active Transportation Network Spot Improvements*: Potential projects include localized improvements to existing on-street cycling facilities such as improved pavement markings (e.g., green painted bike lanes at potential conflict areas), additional signage, new ramps to facilitate access to off-street pathways, and installation of delineators to prevent motorists from encroaching into bike lanes.
- *Planned Park, Road and Development Projects*: The Committee will review additional City and external agency projects that impact existing or would incorporate new active transportation infrastructure as part of the overall project such as the George Massey Tunnel Replacement, No. 2 Road upgrade (Steveston Highway-Dyke Road), and new civic facilities at Minoru Park.

Proposed Education and Promotion of Active Transportation in 2017

The Committee will encourage and promote active transportation as sustainable travel modes that also have significant health benefits via the following activities.

- *Distribution of Cycling & Trails Map*: Identify locations and facilitate distribution of the new map to ensure it is broadly accessible to the community (e.g., deliver to local bike shops).
- *17th Annual "Island City, by Bike" Tour*: Assist in the planning, promotion and staging of the seventeenth annual bike tour of Richmond during Bike Month in June 2017, which is set for Sunday, June 11th at West Richmond Community Centre. Both the long and short routes will feature the recent improvements to the Railway Greenway at its northern end and a preview of the Crosstown Neighbourhood Link to raise community awareness of the neighbourhood facilities that support walking, cycling and rolling activities.

- *Bike to Work & School*: Assist in the planning, promotion and staging of this region-wide event during May and October 2017, which includes the provision of celebration stations in Richmond for cyclists.
- *Bicycle Education for Students and Adults*: In co-operation with HUB, the Richmond School District and a variety of community agencies to expand the delivery of safe cycling education courses to additional elementary schools and recent immigrants in Richmond.
- *Promotion of Active Transportation Network*: Continue to participate in City events related to health and transportation to raise the awareness of new active transportation facilities both locally and regionally. Continue to update, revise and enhance related information on the City's website and Facebook site.

Financial Impact

Project costs associated with the expansion and improvement of the active transportation network for 2017 are accommodated in the City's annual capital budget and considered as part of the annual budget review process. Some of these projects are eligible for financial contribution from external agencies (e.g., ICBC and TransLink). If successful, staff will report back on the amount of financial contribution obtained from these external agencies through the annual staff reports on ICBC and TransLink cost-sharing programs respectively.

Conclusion

The Richmond Active Transportation Committee continues to build its diversity of users' experience to support its broader mandate that includes other rolling transportation modes. The Committee's proposed 2017 initiatives would continue efforts to further encourage greater and safer use of active transportation modes in Richmond, which in turn will support progress towards meeting the City's target for the reduction of greenhouse gas emissions as well as the travel mode share targets of the City's Official Community Plan.



Joan Caravan
Transportation Planner
Staff Liaison to Richmond Active Transportation Committee
(604-276-4035)

Att. 1: Summary of 2016 Bike to School Program Results

Att. 2: Summary of 2016 Streetwise Immigrant Newcomer Program Results

HUB Cycling 2016 Instruction for City of Richmond Youth

The City of Richmond allocated an active transportation / sustainability budget in 2016 which, matched with TransLink TravelSmart subsidies, allowed HUB to deliver two Learn2Ride courses and three Ride the Road courses in Richmond schools providing positive impact for approximately 588 Richmond youth.

Learn2Ride Courses:

- **Jessie Wowk Elementary:** delivered to four classes of grade 3 to 6 students. Sept 14 and 21.
- **McKinney Elementary:** delivered to six classes of grade 3 to 5 students. Sept 12 and 19.

Ride the Road Courses:

- **Garden City Elementary:** instruction to four classes of grade 4 to 7 students. May 9-13
- **Walter Lee Elementary:** instruction to three classes of grade 5 to 7 students. June 13-17
- **AB Dixon Elementary:** instruction to four classes of grade 5 to 7 students. Sept 13-27

Richmond Teacher Feedback

"It is an excellent program (and delivery). I look forward to booking again next year." – Walter Lee Elementary

"Staff voted to use our limited school resources to purchase extra sessions above what we won so that we could make sure that every student from grade 2-5 (and some 6's) got the lessons. Staff enthusiastically signed up their classes and in some cases split classes to fill us sessions so we could be sure we reached as many as possible." – James McKinney Elementary

Photos of Garden City Ride the Road bike maintenance day:



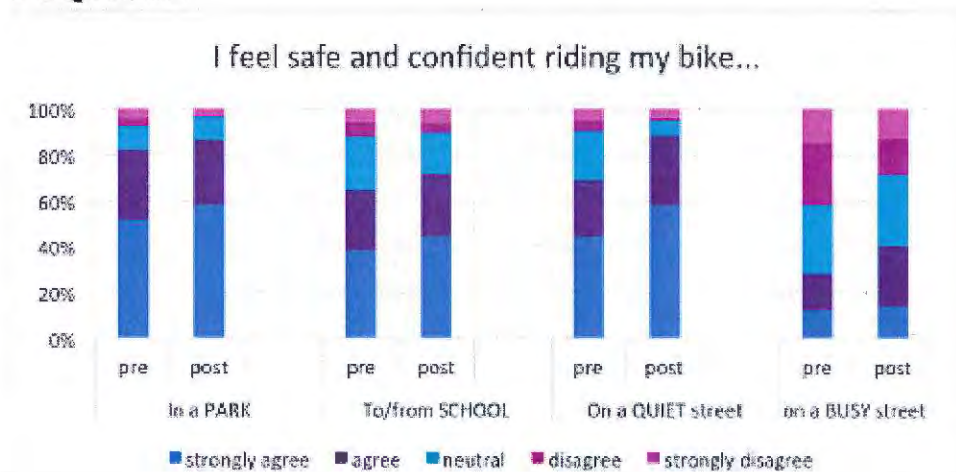
Following are indicators about potential transportation habit changes related to the delivery of HUB Ride the Road courses at Richmond schools.

52% of students said they were more likely to ride a bike after the course

78% of students said the course was effective in teaching them bike safety skills

Students reported a **43%** increase in riding after the course - *higher than regional average of 32%*

2.2% of students say they have never ridden a bike prior to the course – *on par with regional average of 2.3%*



Students reported some increased sense of safety and confidence in cycling in all settings post course.



The proportion of students who said they were "Fairly" or "Very" knowledgeable about road cycling safety increased from 61% to 82% after the course.

HUB 2016 StreetWise Immigrant Newcomer Course in Richmond

The City of Richmond Transportation and Sustainability Departments funded HUB to deliver one *Immigrant Learn to Ride* course in 2016. The *Immigrant Services Society of BC* (ISSofBC) acted as HUB's primary partner for organizing and recruiting for the course.

HUB divided participants into two different classes, depending upon whether each had prior cycling skills. For the participants getting their first introduction to cycling, HUB delivered a Level 1: *Learn to Ride* course. For the participants with good general cycling skills but wanting more city riding knowledge, we delivered Level 2: *Ride the Road* which included a short on-road instruction session.

Immigrant Newcomer Course Delivery

Level 1 Course (Intro to Cycling): 2 participants

Level 2 Course (Urban Cycling Skills): 11 participants

Friday July 8, Friday July 15; courses delivered at ISSofBC Richmond and Garden City Park

Course Outcomes

All immigrant newcomer course participants (Levels 1 and 2):

- Developed their ability to balance, pedal, steer and brake on a bicycle
- Built their basic cycling skills including straight-line riding, turning, braking, shoulder checks, and hand signals

Immigrant newcomers with prior cycling experience (Level 2):

- Learned about the Canadian road use context, specific traffic law (BC Motor Vehicle Act) and how insurance applies to cycling
- Gained knowledge about urban cycling infrastructure and safety equipment
- Became familiar with various types of cycling gear including clothing, helmets, lights and reflectors, cargo carriers, tools and rain gear
- Understood the dynamics of bike storage, security, and theft prevention
- Learned how to assess their bike's condition, and make basic adjustments to keep their bike operating well
- Built practical urban cycling and collision avoidance skills in a group ride setting
- Found out about the most useful Metro Vancouver cycle route planning resources and how to use them
- Assessed their individual course learning outcomes through applied road and written tests.



City of Richmond

Report to Committee

To: Public Works and Transportation Committee

Date: December 6, 2016

From: John Irving, P.Eng. MPA
Director, Engineering

File: 10-6060-01/2016-Vol
01

Re: Dike Master Plan - Phase 2

Staff Recommendation

That the public and key external stakeholders be consulted to provide feedback on the medium and long term dike improvements required for part of Richmond's West Dike (between Williams Road and Terra Nova Rural Park) and part of the North Dike (between Terra Nova Rural Park to No. 6 Road) as identified in the staff report titled "Dike Master Plan – Phase 2" from the Director of Engineering, dated December 6, 2016.

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

Att. 1

REPORT CONCURRENCE		
ROUTED TO:	CONCURRENCE	CONCURRENCE OF GENERAL MANAGER
Parks Services	☒	
Roads & Construction	☒	
Real Estate Services	☒	
Sewer & Drainage	☒	
Development Applications	☒	
Policy Planning	☒	
Transportation	☒	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS: 	APPROVED BY CAO

Staff Report

Origin

The 2008 – 2031 Richmond Flood Protection Strategy identified the need to “Prepare and implement a comprehensive dike improvement program.” On February 11, 2014, Council approved \$200,000 from the 2014 Capital Budget to prepare Phase 2 of a Dike Master Plan.

By the year 2100, climate change scientists estimate that sea level will rise approximately 1.0 meter, combined with 0.2 meters of subsidence that is expected in that same time period. Richmond will be required to raise dikes to accommodate these changes.

Richmond lies in the Fraser River delta, and is surrounded by the Fraser River estuary. The estuary provides critical habitat for many species of fish and wildlife, and important ecosystem services such as erosion control, shoreline stabilization and storm surge protection.

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

6.1. Safe and sustainable infrastructure.

The purpose of this staff report is to present the medium and long term dike improvements along part of the West Dike and part of the North Dike (Phase 2 Study Area) that will be required to address climate change induced sea level rise. The West Dike spans between Williams Road and Terra Nova Rural Park. The North Dike section of the study area spans between Terra Nova Rural Park and No. 6 Road. Staff request Council’s endorsement to consult public and key external stakeholders on the long term dike improvements in the Phase 2 Study Area.

Analysis

The City of Richmond is approximately 1.0 meter above mean sea level and protected by 49 kilometers of dike. Climate change scientists estimate that sea level will rise approximately 1.0 meter by the year 2100, combined with 0.2 meter of subsidence that is expected in that same time period. Guided by the 2008 – 2031 Richmond Flood Protection Strategy, the City continues to adapt its flood protection system to protect against climate change induced sea level rise primarily through raising dike crest elevations. The City’s target dike elevation for 2100 is 4.7 m geodetic with the ability to expand it to 5.5 m geodetic. Dike improvements are ongoing through the Capital Program and the strategy forecasts that implementation completion will be required within the next 25 to 50 years to stay ahead of rising sea levels (current climate change science predicts sea level rise will be approximately 0.2 m by 2050). Implementation may include intermediate dike improvements where they make sense and would extend the timing for achieving 4.7 m geodetic dike heights for those reaches. Ultimately, the timing of implementation completion will be influenced by evolving climate change science and observed sea level rise. Staff will update Council on significant updates for sea level rise predictions and any impact they have on the Dike Master Plan implementation as they occur.

The Dike Master Plan is intended to be a comprehensive guide to upgrade the City's dikes to:

- Protect Richmond from both ocean storm surges and Fraser River freshet events;
- Adapt to sea level rise;
- Be seismically resilient;
- Integrate the Ecological Network Management Strategy principles and goals;
- Follow the five strategic directions of the City's 2009 Waterfront Strategy; and
- Prioritize dike improvement phasing to efficiently use resources.

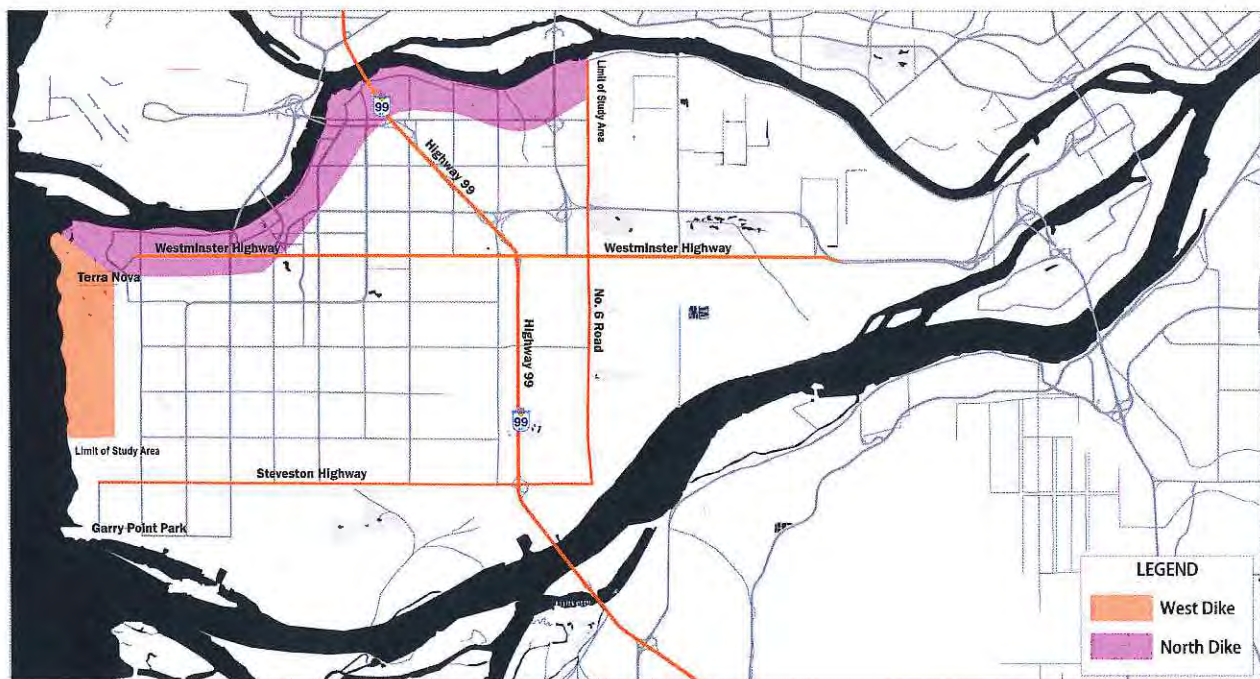
Phase 1 of the Dike Master Plan, adopted by Council on April 22, 2013, focussed on Steveston and a portion of the West Dike south of Williams Road.

Phase 2 of the Dike Master Plan focusses on the north portion of Richmond's West Dike between Williams Road and Terra Nova Rural Park and part of Richmond's North Dike between Terra Nova Rural Park and No. 6 Road (Phase 2 Study Area), as shown in Figure 1.

The City engaged Parsons as the lead consultant to complete Phase 2 of the Dike Master Plan (see Attachment 1). The Phase 2 Study Area dike improvements required to address climate change induced sea level rise, as outlined in the Parsons report, are summarized in this report.

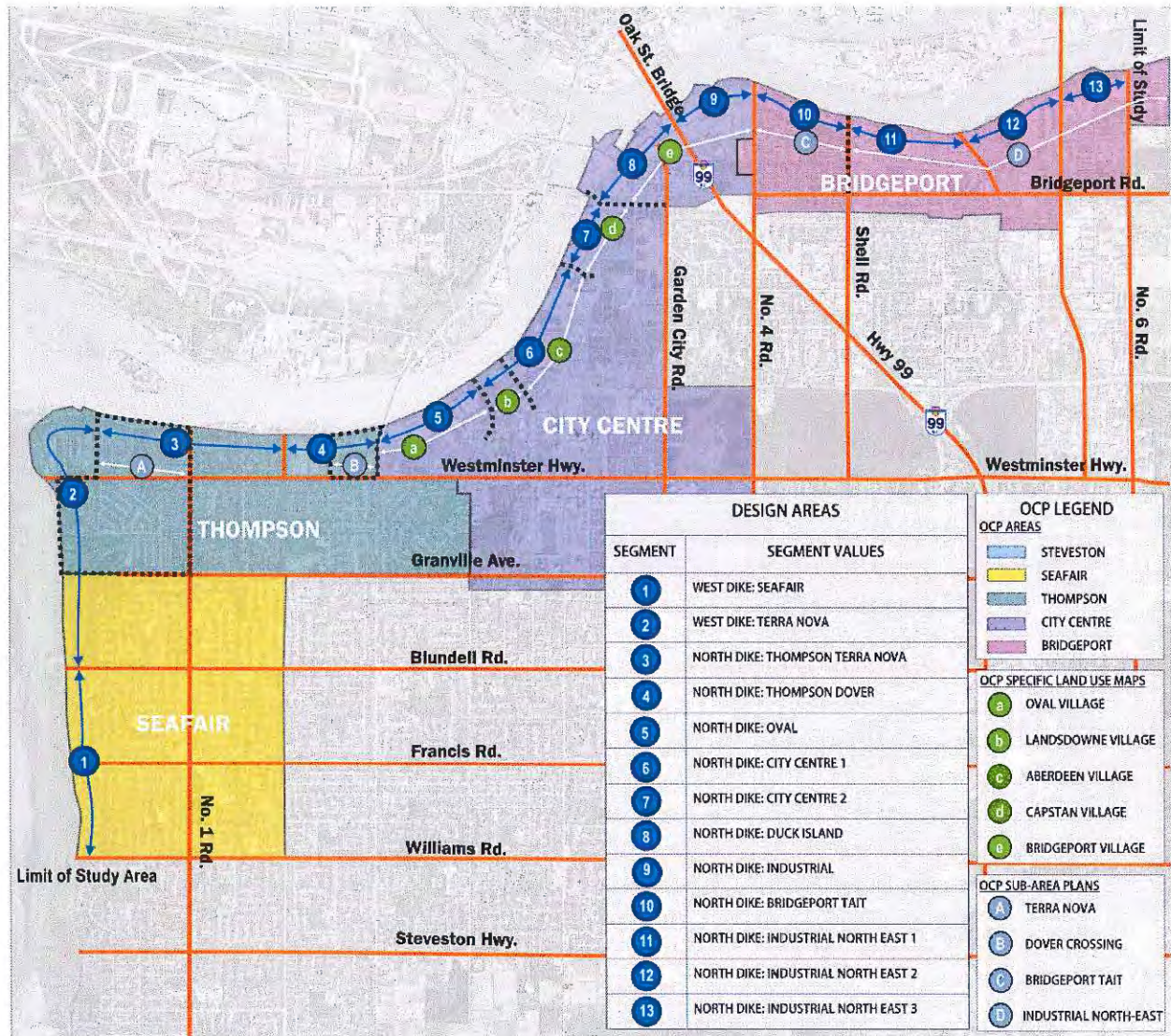
The City is committed to avoid, mitigate or compensate for environmental impacts on all capital projects. In general, the dike in the Phase 2 Study Area cannot be raised without environmental impacts and mitigation or compensation will be pursued in alignment with the City's ecological policies and strategies.

Figure 1: Phase 2 Study Area



The Phase 2 Study Area is separated into thirteen design areas based on the planning boundaries established in the Official Community Plan (OCP). The thirteen design areas are shown in Figure 2.

Figure 2: Phase 2 Design Areas and OCP Boundaries



West Dike (Williams Road to Terra Nova Rural Park)

The Phase 2 Study Area includes part of the West Dike between Williams Road and Terra Nova Rural Park. Constraints, opportunities and recommendations for the Phase 2 Study Area of the West Dike separated by design area are summarized in Table 1.

Tables 1 and 2 identify environmental information pertinent to this area. FREMP refers to data from the Fraser River Estuary Management Program that identifies habitat productivity mapping. Though FREMP is no longer in place, this data continues to be pertinent to dike master plans. RMA refers to Riparian Management Areas which are City designated riparian habitats with associated 5 or 15 metres setbacks in response to the provincial Riparian Areas Regulation. In addition, the Fraser River shoreline within the LIDMP area is a City designated Environmental Sensitive Area with an associated development permit and applies to the entire study area.

The trigger for implementation of the long term dike improvement recommendation between Williams Road and Terra Nova Rural Park is sea level rise as has been projected by various expert panels through the year 2100.

Table 1: Summary of constraints/opportunities/recommendations for part of the West Dike

Design Area	FREMP Data			RMA		Constraints	Opportunities	Long Term Dike Improvement Recommendation
	Red Coded	Yellow Coded	Green Coded	Presence	Absence			
1) Seafair	☒	☐	☐	☒	☐	• Infilling of drainage ditches impacts potential storage in the City's local drainage network	• Barrier islands may be considered to reduce wave run-up, mitigating the need for future dike crest increases	• Raise dike on existing alignment • Further study required to determine the ecological and technical advantages/disadvantages of land side and water side expansion
2) Terra Nova	☒	☐	☐	☒	☐			

North Dike (Terra Nova to No. 6 Road)

The Phase 2 Study Area includes part of the North Dike between Terra Nova Rural Park and No. 6 Road. Constraints, opportunities and recommendations for the Phase 2 Study Area of the North Dike separated by design area are summarized in Table 2.

The triggers for implementation of the long term dike improvement recommendation between Terra Nova Rural Park and No. 6 Road are sea level rise, development, redevelopment and River Road reconstruction.

Table 2: Summary of constraints/opportunities/recommendations for part of the North Dike

Design Area	FREMP Data			RMA		Constraints	Opportunities	Long Term Dike Improvement Recommendation
	Red Coded	Yellow Coded	Green Coded	Presence	Absence			
3) Thompson Terra Nova	☒	☐	☐	☐	☒	Residential driveway access and drainage along River Road may be complicated by raising the dike	No easements or land acquisitions required for dike raising	- Raise the dike on existing alignment with land side expansion - Plan for the long-term raising of River Road
4) Thompson Dover	☒	☐	☐	☐	☒		River Road may be raised in a single event as driveway access to multi-family complexes can be maintained in this area	- Raise the dike on existing alignment with land side expansion - Plan to raise River Road
5) Oval	☒	☐	☐	☒	☐		Future dike raising can take place on the existing dike alignment and integrate into adjacent landscaping	Existing dike has been raised
6) City Centre 1	☐	☒	☒	☐	☒	Mature trees near land side toe of existing dike	This section of River Road will ultimately be realigned to the former rail corridor	Raise the dike on existing alignment with land side expansion
7) City Centre 2	☐	☒	☒	☐	☒	Access to existing marinas may be complicated by raising the dike	- This section of River Road will ultimately be realigned to the former rail corridor - Redevelopment is occurring in this area	Raise the dike on existing alignment with land side expansion in conjunction with redevelopment
8) Duck Island	☒	☒	☒	☐	☒		Redevelopment is occurring in this area	Dike improvements will be a part of the Duck Island development plan.
9) Industrial	☒	☐	☒	☐	☒	- Easements will be required - Waterfront lands constrained by private industrial uses		- Raise the dike on existing alignment with land side expansion - Site specific solution may be required to accommodate waterfront lands constrained by private industrial uses
10) Bridgeport Tait	☒	☒	☐	☐	☒		Future dike raising can take place on the existing dike alignment and integrate into adjacent landscaping	Existing dike has been raised
11) Industrial North East 1	☐	☒	☒	☒	☐	- Driveway access along River Road may be complicated by raising the dike - Property will need to be acquired to complete dike raising	Waterfront trail can be constructed over the dike when property is acquired	Raise the dike on existing alignment with land side expansion
12) Industrial North East 2	☒	☒	☒	☒	☐	- Mature trees near water side toe of existing dike - Street parking will be impacted - Driveway access along River Road may be complicated by raising the dike - Property may need to be acquired to complete dike raising - Infilling of drainage ditches impacts potential storage in the City's local drainage network	Waterfront trail can be constructed over the dike	- Raise the dike on existing alignment - Further study required to determine the ecological and technical advantages/ disadvantages of land side and water side expansion
13) Industrial North East 3	☒	☐	☒	☒	☐	- Mature trees near water side toe of existing dike - Street parking will be impacted - Driveway access along River Road may be complicated by raising the dike - Infilling of drainage ditches impacts potential storage in the City's local drainage network	- Waterfront trail can be constructed over the dike - No easements or land acquisitions required for dike raising	- Raise the dike on existing alignment - Further study required to determine the ecological and technical advantages/ disadvantages of land side and water side expansion - Site specific solution may be required to accommodate waterfront lands constrained by private industrial uses

Land Acquisition

Some dike reaches are constrained by land ownership and will likely require land acquisition to facilitate dike raising. Land acquisition will primarily be achieved through redevelopment, however, where redevelopment does not occur; the City may consider opportunistic land purchase over the next 25 to 50 years. The Dike Maintenance Act allows the City through the Provincial Inspector of Dikes to access the entire dike protecting Lulu Island for the purpose of dike maintenance or improvement regardless of land ownership. However, long term strategic acquisition of land and cooperative work with the development community will reduce the impact of dike improvements on the community as compared to reliance on the Dike Maintenance Act.

Next Steps

Staff will consult with key external stakeholders and the public on the long term dike improvements in the Phase 2 Study Area. Key stakeholders include:

- Adjacent residences and the general public
- Port of Vancouver
- Department of Fisheries and Oceans
- BC Inspector of Dikes
- Advisory Committee on the Environment
- Urban Development Institute

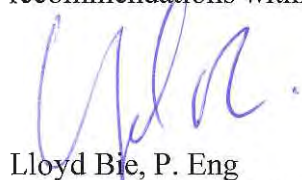
The key external stakeholder group will be engaged through ongoing meetings and communications. Public consultation will include two public open houses.

Financial Impact

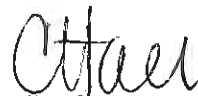
Capital projects will be brought forward for Council's consideration.

Conclusion

Consistent with the City's 2008 – 2031 Richmond Flood Protection Strategy, Phase 2 of a Dike Master Plan has been drafted. Dike Master Plan Phase II presents the medium and long term dike improvements along part of the West Dike (Williams Road to Terra Nova Rural Park) and part of the North Dike (Terra Nova Rural Park to No. 6 Road) that will be required to address climate change induced sea level rise. Staff request Council's endorsement to consult public and key external stakeholders in order to obtain feedback on the long term dike improvement recommendations within the Phase 2 Study Area.



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

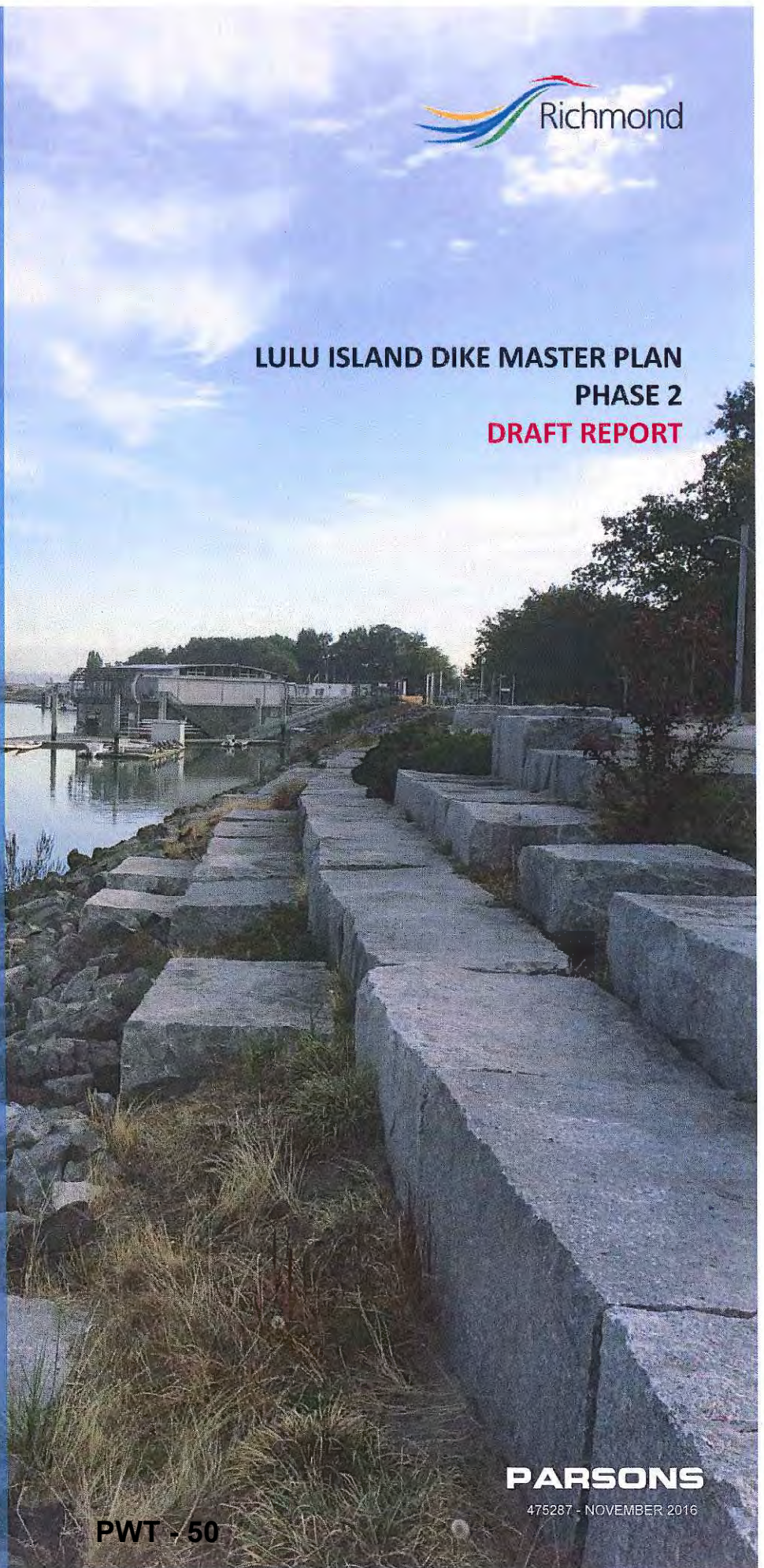
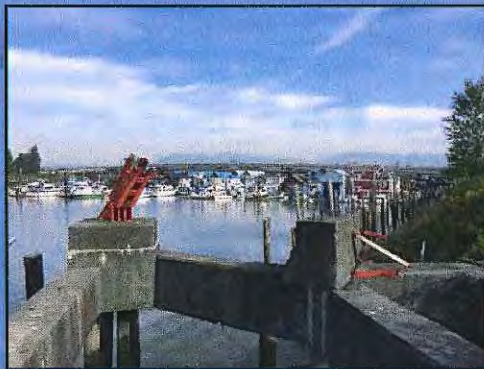


Corrine Haer, EIT
Project Engineer
(604-276-4026)

Att. 1: Dike Master Plan -- Phase 2

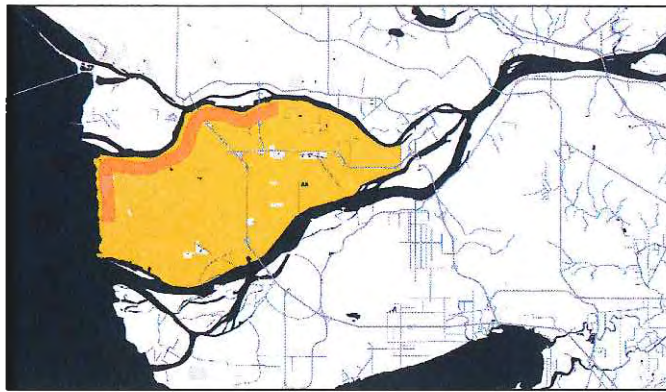


**LULU ISLAND DIKE MASTER PLAN
PHASE 2
DRAFT REPORT**



Executive Summary

The purpose of the Lulu Island Dike Master Plan (LIDMP) is to identify preferred methods for implementing the objectives of the City of Richmond's 2008 – 2031 Flood Protection Strategy. The Lulu Island Dike Master Plan is being prepared in phases. Parsons (as Delcan) prepared Phase 1 of the plan for the Steveston and southern West Dike areas¹ (Phase 1 LIDMP). The Study Area for Phase 2 has been defined from Williams Road on the West Dike to No. 6 Road on the North Dike. The Study Area is highlighted orange within Lulu Island in the figure below. Lulu Island lies in the Fraser River Delta, and is surrounded by the Fraser River Estuary. The estuary provides critical habitat for many species of fish and wildlife, and important ecosystems services such as erosion control, shoreline stabilization and storm surge protection.



Phase 2 LIDMP Study Area on the West Dike and North Dike within Lulu Island

The Phase 1 LIDMP focused largely on technical issues of assessing significant changes in dike alignment. Instead of adapting upgrades to the existing shoreline alignment which may have impacted heritage structures in Steveston, the engineering feasibility of a future dike and flood-gate along Steveston Island was presented.

In the Phase 2 Study Area, the existing dike alignment along the waterfront is established and well defined. There is limited basis to support any major changes to the alignment of the existing dike, thus the recommendations are generally in keeping with traditional dike crest increases, with consideration for localized constraints and opportunities. The Study Area

has been segmented into thirteen design areas to make these recommendations on an area specific basis. There are also opportunities to consider flood protection strategies that are applicable throughout the entire Study Area. These area wide strategies may be implemented to fortify the area specific adaptations.

The City has identified a target dike crest elevation of 4.7 m, with consideration for raising the dike to 5.5 m in the long term future. Dike adaptations that achieve the target crest elevation are considered by area, forming the area specific adaptations. These include dikes and floodwalls in any conformation. Area wide adaptations are those which may not achieve the target dike crest elevation on their own, but contribute to overall flood protection. For example, barrier islands that reduce wave run-up to eliminate the need for additional target crest increases, or policy changes that facilitate the implementation of dike adaptations are both categorized as area wide adaptations. Both area wide and area specific strategies will be presented in the LIDMP, forming a comprehensive plan to achieve the objectives of the Flood Protection Strategy. Area wide and area specific strategies will be considered within the context of the City's Ecological Network Management Strategy (ENMS) such that the recommendations presented in the LIDMP are consistent with strengthening the City's green infrastructure, while managing and enhancing ecological assets.

Area Wide Protection Strategies

A number of area wide approaches can be considered to enhance long term flood protection in the City and create resiliency in addressing climate change and sea level rise. Preferred strategies are summarized below.

Plan for the long-term raising of lands adjacent to and inland of the existing dikes: Long term raising of land levels has previously been recommended (2008-2031 Flood Protection Strategy). Maximizing the width of raised land adjacent to the river decreases flood and seismic risks by increasing the integrity of the dike. Plan to raise the ground elevation of waterfront development sites to the prescribed dike crest elevation.

¹ Lulu Island Dike Master Plan Phase 1, Delcan, March 2013

Enhance floodproofing through amendments to the FCL By-law: The City's Flood Construction Level (FCL) Bylaw establishes minimum levels to which land needs to be raised. Amending the FCL bylaw is the recommended area wide strategy to regulate raising ground elevations with redevelopment to improve flood protection throughout the Study Area.

Support site assemblies along the waterfront that promote cohesive adaptations for flood protection: Large developments along the waterfront allow for major improvements to flood protection infrastructure and often result in robust superdike conditions.

Plan for implementation of offshore protection on Sturgeon Banks: If climate change and sea level rise predictions materialize, increased depths offshore could simultaneously increase wave heights, particularly in the Georgia Strait. Upland limitations to natural accretion within the Sturgeon Bank Wildlife Management Area may also contribute to increased offshore depths beyond the West Dike. Offshore barrier islands are one option to consider to dissipate wave energy prior to waves reaching the West Dike and stabilize shorelines, thereby minimizing future dike crest increases. Enhancement of intertidal habitat alongside the creation of offshore barrier islands may provide natural ecosystem mechanisms to further dissipate wave energy. The City may consider offshore protection in its long-term plans for flood protection along the West Dike.

Area Specific Flood Protection Strategies

In practice, when dike upgrades have been made, they have been made along the existing alignment. Apart from select site specific constraints and opportunities, the recommended future dike alignment for the Phase 2 Study Area matches the existing dike alignment. Area specific strategies were selected with consideration for: flood protection, environmental, geotechnical, infrastructure, site-specific constraints, social, property, economic, operational and cost considerations. The City is committed to avoid, mitigate or compensate for any environmental impacts that may result from dike adaptation projects. Completely avoiding any impact on an environmental area may not be feasible in some cases, for example where dikes are highly constrained. In these instances, mitigation or compensation that follows a net gain approach may be pursued.

Area specific strategies for the Phase 2 study are summarized below:

West Dike: Raise the dike on the existing alignment. Additional studies required to quantify drainage impacts of land side expansion, habitat impacts and costs associated with water side or land side expansion, and long term resiliency of a constrained dike solution. Consider routing the dike inland through Terra Nova Rural Park.

North Dike: Terra Nova to No. 2 Road Bridge: Raise the dike on the existing alignment with land side expansion. Plan for the raising of River Road.

North Dike: No. 2 Road Bridge to Dinsmore Bridge: Existing and proposed developments are raising elevations to 4.0 m to 4.7 m. Future raisings to 5.5 m can take place on the existing alignments and integrate into the adjacent landscaping.

North Dike: Dinsmore Bridge to Moray Bridge: Raise the dike with land side expansion. Consider creation of a set-back dike and inland raising (superdike) in conjunction with the future Middle Arm Waterfront Park construction. Ensure any interim dike upgrades are compatible with the long term strategy of constructing superdikes.

North Dike: Moray Bridge to Oak Street Bridge: Implement flood protection with approved development plans for Duck Island and the River Rock Casino when available. If required to address sea level rise and climate change prior to implementation of the approved strategy at the Duck Island or River Rock Casino sites, plan for a temporary adaptation, such as a demountable floodwall, to protect City assets

North Dike: Oak Street Bridge to No. 4 Road: Raise the dike on the existing alignment. Site specific solutions may be required at the Fraser River Terminal site. Plan for temporary dike along the alternate alignment if required to address sea level rise and climate change prior to implementation of a strategy at the Fraser River Terminal site.

North Dike: No. 4 Road to Shell Road: Existing and proposed developments will raise the area generally to an elevation of 4.7 m. Future raisings to 5.5 m can take place on the existing alignments and integrate into the adjacent landscaping.

North Dike: Shell Road to No. 6 Road: Raise the dike on the existing alignment. Land acquisition may be required to facilitate construction of a trapezoidal dike (through redevelopment or otherwise). Implementation of a temporary floodwall

adjacent to the waterfront lots may be required in advance of a permanent adaptation to address sea level rise and climate change. Consider Bath Slough Revitalization Initiative for future designs. Additional studies are required to quantify drainage, habitat impacts, and costs associated with land side expansion of a trapezoidal dike. A constrained land side slope may be required to integrate with the existing drainage infrastructure.

Next Steps

Parsons has characterized the existing conditions and constraints of the Study Area, and has established and recommended preferred area wide and area specific adaptation strategies for the City's consideration.

The recommended next steps to finalize the Phase 2 LIDMP are:

- 1) Council Review;
- 2) Key External Stakeholder Review;
- 3) Public Information Session and Consultation;
- 4) Revise the Draft Final Master Plan Report per consultation if required; and
- 5) Council adoption of the Final Dike Master Plan Phase 2 Report.

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Attachment 1	Technical Memo #1 – Parsons
Attachment 2	Technical Memo #2 – Parsons
Attachment 3	Geotechnical Input Memo – Thurber
Attachment 4	Environmental Technical Brief – Envirowest
Attachment 5	Seismic Deformation Analysis – Thurber

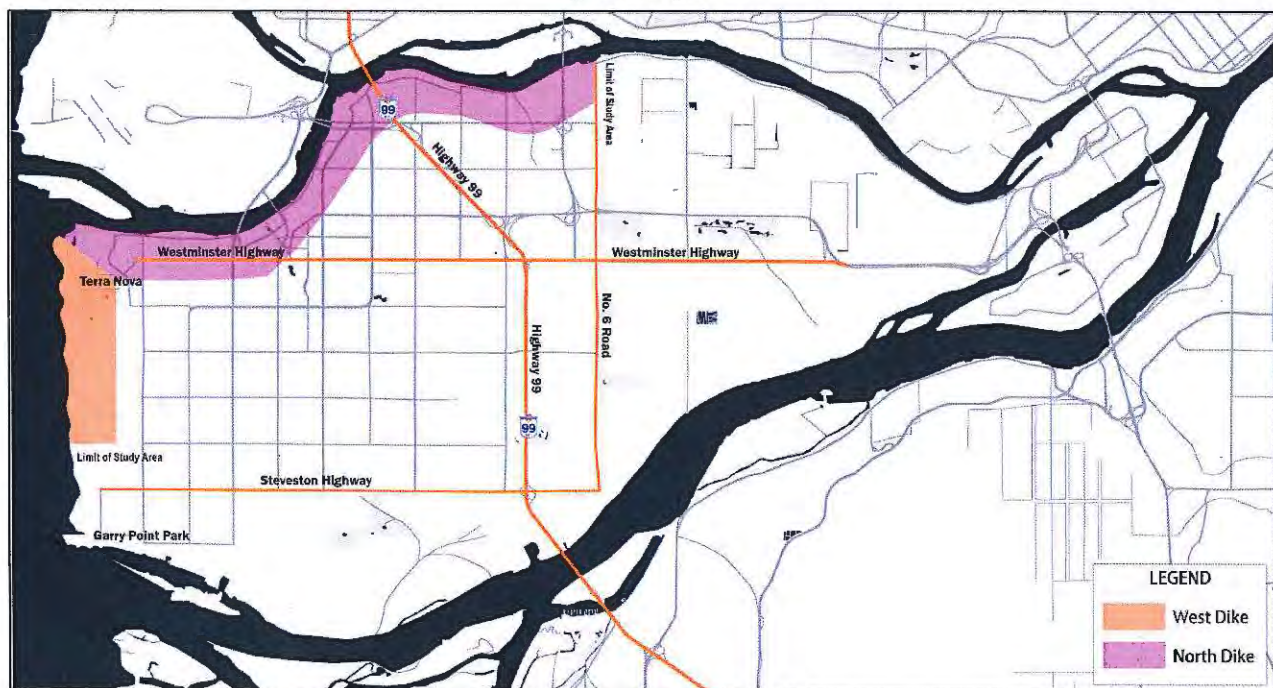
1 Introduction

Richmond is a city of over 200,000 people in 130 square kilometres with considerable assets to be protected from flood damage. The City has endeavoured to adapt its flood protection systems to changing flood risks, including anticipated increases to flood levels resulting from climate change and sea level rise. With the establishment of the 2008 – 2031 Flood Protection Strategy, the City committed to prepare and implement a perimeter dike improvement program. The purpose of the Lulu Island Dike Master Plan (LIDMP) is to identify preferred methods for implementing the objectives of the City of Richmond's 2008 – 2031 Flood Protection Strategy.

With Richmond located at the mouth of the Fraser River, and the flood protection infrastructure interfacing with the high ecological value of the Fraser River Estuary, the LIDMP also works to integrate the objectives of key City documents such as the City's Ecological Network Management Strategy (ENMS), and put forward recommendations that will strengthen the City's green infrastructure network.

The LIDMP is being prepared in phases. Parsons (as Delcan) prepared Phase 1 of the LIDMP for the Steveston and southern West Dike areas² (Phase 1 LIDMP). The Study Area for the second phase of the LIDMP (Phase 2 LIDMP) includes the West Dike from Williams Road to Terra Nova Rural Park, and the North Dike from Terra Nova Rural Park to No. 6 Road as shown in *Figure 1*.

Figure 1: Study Area



The Phase 2 LIDMP provides the framework to direct future dike improvement projects and ensure that diking requirements are considered as waterfront lands are redeveloped. It establishes a well-planned strategy to identify future flood protection infrastructure requirements along the waterfront. The Phase 2 LIDMP presents recommended adaptations for flood protection, including guidelines for incorporating flood protection into future waterfront developments. It also presents considerations for any dike adaptation project in the Study Area to minimize impacts and to integrate adaptations within the public and natural realms.

² Lulu Island Dike Master Plan Phase 1, Delcan, March 2013

1.1 SCOPE

The recommended flood protection adaptations forming the Phase 2 LIDMP are assessed for their ability to achieve a minimum crest elevation of 4.7 m, and accommodate a future increase to 5.5 m as prescribed by the City. No independent evaluation of these crest elevations has been conducted by Parsons. These target elevations have been accepted as the basis for the Phase 2 LIDMP.

Recommendations have been categorized as either area wide or area specific adaptations. Area wide strategies encompass adaptations that are applicable for the entire Study Area, or a substantial part of it. These include policy adaptations, as well as structural adaptations that would fortify the primary dike, but would not achieve the City's target crest elevation on its own. The Phase 2 LIDMP recommends adaptations in both categories to produce a comprehensive strategy for improving flood protection in the Study Area.

Area specific strategies are structural adaptations that modify the existing dike or replace it to achieve the City's target dike crest elevation of 4.7 m. The Study Area has been broken into thirteen design areas to recommend area specific adaptations. The design areas have been delineated according to the boundaries for planning areas in the City's Official Community Plan (OCP). The design areas are described further in **Section 2** and **Section 4.2**.

The Phase 2 LIDMP is a guidance document for future dike adaptation design and construction projects. No detailed design, nor any construction will be undertaken as part of the Phase 2 LIDMP. Design and construction projects are beyond the scope of the current planning exercise. Proponents of diking design and construction projects will need to confirm their projects are in compliance with all regulatory requirements, in addition to adhering to the Master Plan, when projects move forward.

1.2 APPROACH

In preparation of the Phase 2 LIDMP, Parsons previously prepared and submitted two technical memos to the City. Technical Memo #1³ (TM #1) presented potential flood protection options that may be appropriate for implementation in the Study Area, based on a detailed review of current and future land uses, environmental and geotechnical conditions, and other City guidance documents. Technical Memo #2⁴ (TM #2) outlined the evaluation of potential flood protection adaptations within the Phase 2 Study Area, and presented the preliminary concept for the Phase 2 LIDMP. Both technical memos have been attached to the Phase 2 LIDMP as **Attachment 1** and **Attachment 2** for reference.

Both technical memos were circulated internally to relevant City departments for review. The feedback received from these stakeholders was integrated into the technical memos before each was finalized. The final Phase 2 LIDMP is derived from these previous studies and as such, City feedback has been incorporated into the Phase 2 LIDMP.

1.3 ADDITIONAL GUIDANCE DOCUMENTS

The recommendations in the Phase 2 LIDMP have been prepared in keeping with other City strategies and plans. Any proposed diking projects should be designed and constructed with consideration for the Phase 2 LIDMP, as well as any other City guidance documents in effect at the time an adaptation project proceeds to design and construction. Policy adaptations should also be implemented with consideration for compatibility with other City strategies and guidelines. City guidance documents considered in the development of the Phase 2 LIDMP included:

2009 Waterfront Strategy:

The five Strategic Directions of the 2009 Waterfront Strategy were considered in the development of the Phase 2 LIDMP. The Strategic Directions include: 1) Working Together; 2) Amenities and Legacy; 3) Thriving Ecosystems; 4) Economic Vitality; and 5) Responding to Climate Change and Natural Hazards.

³ Lulu Island Dike Master Plan Phase 2 – Technical Memo No. 1: Review of Existing Conditions, Parsons, Oct 5, 2016

⁴ Lulu Island Dike Master Plan Phase 2 – Technical Memo No. 2: Analysis of Flood Protection Alternatives, Parsons, Oct 5, 2016

Flood Plain Designation and Protection By-Law 8204:

The Phase 2 LIDMP considers the existing Flood Plain Designation and Protection By-Law, and will consider outlines potential options to amend or accelerate increasing flood construction levels adjacent to the foreshore.

2008 – 2031 Richmond Flood Protection Strategy:

The Phase 2 LIDMP has been developed to address the goals of the Flood Protection Strategy.

2015 Ecological Network Management Strategy:

The Phase 2 LIDMP is informed by the strategic goals outlined in the 2015 Ecological Network Management Strategy (ENMS) to promote the Ecological Network. The City's ENMS is an ecological blueprint for the preservation of natural land City-wide. Through the ENMS the City will protect, restore and connect natural lands to avoid habitat fragmentation. The strategic goals outlined in the ENMS are: 1) Manage and Enhance Ecological Assets; 2) Strengthen City Green Infrastructure; 3) Create, Connect, and Protect Diverse and Healthy Spaces; 4) Engage through Stewardship and Collaboration. The objective of developing an Ecological Network was initially outlined in the OCP under Chapter 9: Island Natural Environment (and Ecological Network Approach).

2006 Riparian Response Strategy:

The Phase 2 LIDMP is consistent with the Riparian Response Strategy (RRS), which protects Riparian Management Areas that form part of the City's Ecological Network. The RRS identifies 5 m and 15 m Riparian Management Area (RMA) setbacks on minor and major watercourses that flow into and support fish life in the Fraser River, and are to remain free from development in accordance with requirements under the provincial Riparian Area Regulation. The RRS applies to riparian habitat on the City's inland watercourses but does not apply to the Fraser River, which is protected through designation as Environmentally Sensitive Area (ESA) in the OCP.

2008 Climate Change Response Agenda:

The recommendations from the Phase 2 LIDMP are made with consideration of the 3rd pillar of the City's Climate Change Response Agenda – implement strategies for adapting to unavoidable changes. Strategies have been considered that can meet the short and long term goals with respect to crest elevations; however, they must also be adaptable to change.

2010 Richmond Trail Strategy:

The Phase 2 LIDMP is developed with regard for the goal of maximizing access to the waterfront, as identified in the Richmond Trail Strategy.

2 Study Area

The Phase 2 Study Area includes parts of the West Dike and the North Dike. The West Dike section of the Study Area spans from Williams Road to Terra Nova Rural Park at the Middle Arm of the Fraser River. The North Dike section of the Study Area spans from Terra Nova Rural Park to No. 6 Road.

On the water side of the West Dike is Sturgeon Bank, a provincially designated Wildlife Management Area (WMA) within the Fraser River Estuary. It is comprised primarily of near shore and intertidal brackish marsh, sandflats, mudflats, and open water. It is a protected area for the conservation of critical, internationally significant habitat for year-round migration and wintering waterfowl populations and important fish habitat. The water side of the North Dike includes pockets of mud flat, salt marsh, and eelgrass habitat.

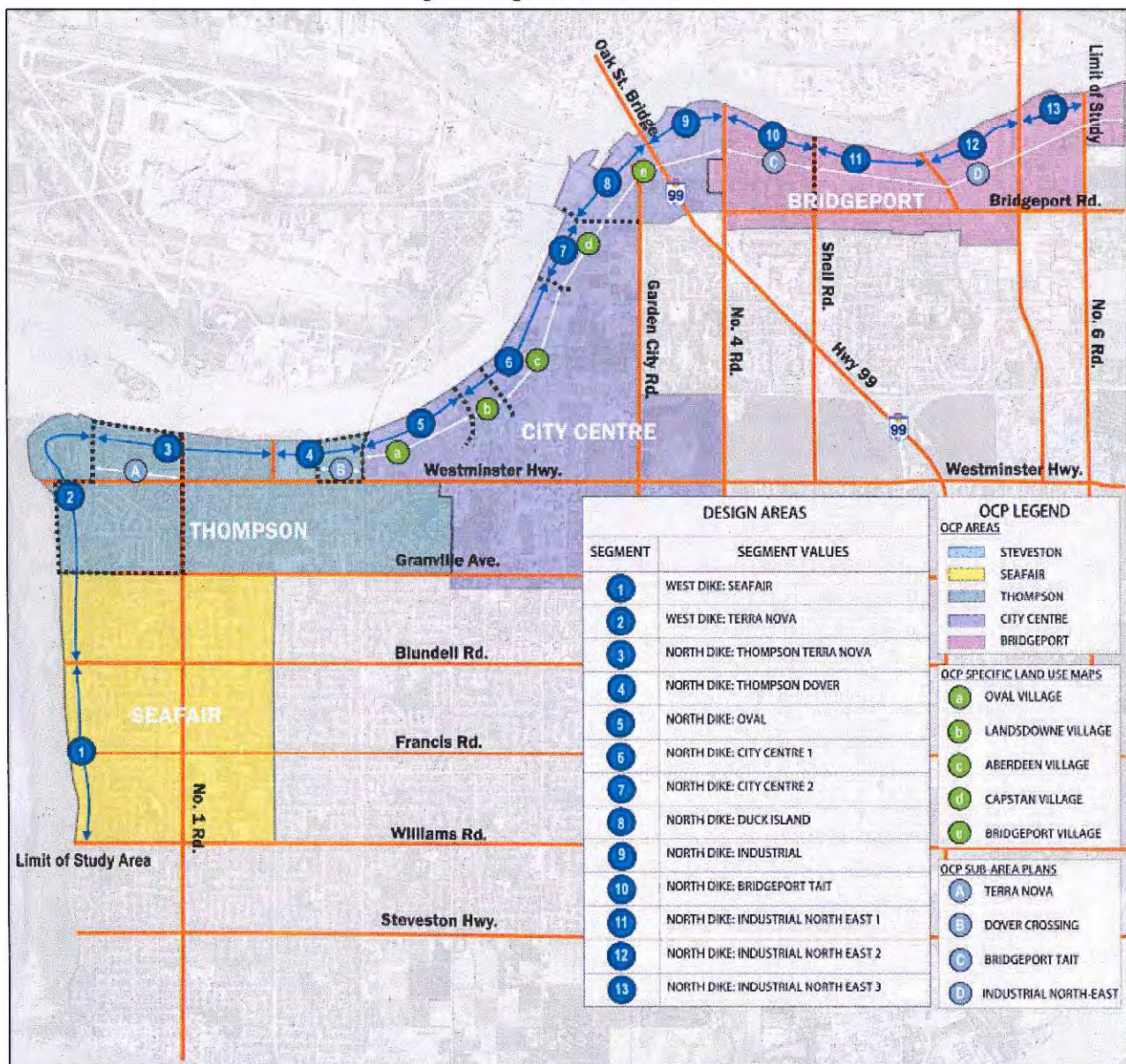
On the land side of the West and North Dikes, Riparian Management Areas (RMA's) are interspersed throughout the Study Area. RMA designated watercourses are wetted the majority of the year and flow into and support fish life in the Fraser River. The City's RMA's have predetermined setbacks of 5 m or 15 m from top of bank to delineate areas that support the form and function of the watercourses. These areas are protected under the provincial Riparian Area Regulation and form

a key component of the City's ENMS. The entire Study Area is also designated Environmentally Sensitive Area (ESA) within the OCP.

For the purposes of evaluating current and future land conditions and recommending appropriate structural adaptations, the Study Area has been broken into thirteen design areas. These areas are based on the planning boundaries established in the OCP for OCP Areas, OCP Sub-Area Plans, and OCP Specific Land Use Maps. The relevant OCP figures showing these areas are provided for reference in *Appendix A*.

The design areas have been delineated using the OCP boundaries to ensure that the recommendations in this Master Plan can be readily integrated with other City guidelines and City planning initiatives. Area specific adaptations are recommended by area, with consideration for special sites within the thirteen design areas. Existing conditions for each design area, as well as future conditions as provided for in the OCP, are described in *Section 2.1*. The design areas within the Study Area are illustrated in *Figure 2*.

Figure 2: Design Areas and OCP Boundaries



2.1 PRESENT AND FUTURE LAND USE

A brief summary of existing conditions and planned future uses (as outlined in the OCP) for each of the thirteen design areas is provided in **Table 1**. Site conditions or future uses having an anticipated impact on dike planning are discussed in more detail in the discussion of each design area in **Section 4.2**, where the recommended adaptation is presented for each design area.

Table 1: Summary of Existing and Future Conditions

DESIGN AREA	BOUNDARIES	DESCRIPTION OF EXISTING AND FUTURE CONDITIONS PER OCP	
SEAFAIR	Williams Rd to Granville Ave	Existing	Primarily established single family and low-rise residential. Sturgeon Bank is west of the dike. The West Dike Trail is over the dike, with natural areas on either side. The northern third of the plan is the Quilchena Golf & Country Club, situated on Agricultural Land Reserve (ALR) lands. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	No major changes anticipated.
TERRA NOVA	Granville Ave to Terra Nova Rural Park	Existing	Situated entirely on ALR lands. Primarily open space, with few buildings. Includes Quilchena Golf & Country Club, Terra Nova Rural Park, and agricultural areas. Sturgeon Bank is west of the dike; includes the Grauer Lands, an enhanced habitat site. West Dike Trail continues north. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	No major changes anticipated.
THOMPSON TERRA NOVA	Terra Nova Rural Park to McCallan Road	Existing	Established residential neighbourhood of single family homes. River Road is substantially offset from the waterfront, with a wide open space from the road to the dike, which includes a trail. Typical park amenities are in the open space, including benches, sign posts and washroom facilities. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	No major changes anticipated.
THOMPSON DOVER	McCallan Road to No. 2 Rd Bridge	Existing	Half industrial, a City works yard and recycling depot. Half residential neighbourhood of townhouses and medium-density apartment complexes. Buildings are set back from River Road, and built on higher land than the road elevation. No driveway access from River Road to the condo complexes. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	No major changes anticipated.
OVAL	No. 2 Rd Bridge to Dinsmore Bridge	Existing	Mostly redeveloped in the past fifteen years, with the Olympic Oval, high-rise condos and offices. River Road is realigned behind waterfront development. A waterfront trail and recreational areas are along the waterfront, including intertidal zones and park amenities, such as benches. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	Development is currently underway for the remaining sites, and nearly complete. These areas are designated for mixed use in the OCP. Retail and other commercial uses will be at the main levels of new developments.
CITY CENTRE 1	Dinsmore Bridge to Cambie Rd	Existing	Low-rise office industrial lands and parking lots. Office sites have substantial footprints. River Road is adjacent to the waterfront. The UBC Boathouse and other marinas are on the water. Along the waterfront there is a thin linear park including a dike trail with park amenities and public art. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	The area from the waterfront to the former rail corridor is planned to be the proposed Middle Arm Park, a large park surrounded by high density mixed use and commercial uses of the planned Pedestrian-Oriented Retail Precincts. A museum and arts centre are proposed for this area.
CITY CENTRE 2	Cambie Rd to Moray Bridge	Existing	Low-rise office industrial lands and parking lots. Office sites have smaller footprints with narrow frontages on the water. River Road is adjacent to the waterfront, with parking lots along the dike. Marinas are present along this entire area. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	Intensification of the urban area with high density mixed use and commercial zones in planned Pedestrian-Oriented Retail Precincts. Expansion of marinas for residential and non-residential boats. The proposed Capstan Canada Line Station.

DESIGN AREA	BOUNDARIES		DESCRIPTION OF EXISTING AND FUTURE CONDITIONS PER OCP
DUCK ISLAND	Moray Bridge to Oak St Bridge	Existing	Former industrial lands, currently vacant lots that host the Richmond Night Market during the summer. River Rock Casino & Marina, and large parking lots. A constructed wetland between the parking lot and the marina. Smaller industrial sites west of the Oak Street Bridge. Disused CP Rail bridge. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	Parklands and marinas along the waterfront. Development of urban commercial and residential uses. A bridge for the Canada Line and a new Skytrain station. NOTE: Private developers are currently submitting development plans to the City for approval.
INDUSTRIAL	Oak St Bridge to No. 4 Rd	Existing	Industrial facilities and parking lots. Fraser River Terminal, BC Hydro power station. Canada Line and Bikeway bridge. River Drive in aligned inland. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	No major changes anticipated. Industrial lands for the foreseeable future. Residential uses are prohibited.
BRIDGEPORT TAIT	No. 4 Rd to Shell Rd	Existing	Formerly industrial, presently existing high-rise condos; approved condo and townhouses currently under development. River Road at the waterfront was decommissioned on this section. Small light industrial site remains. Single family residential south of the waterfront area. Log booms on the water. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	Ongoing redevelopment to be completed in the near future. No major changes anticipated once redevelopment is complete.
INDUSTRIAL NORTH EAST 1	Shell Rd to Bath Slough	Existing	Industrial area. Businesses and associated parking lots on the narrow strip of land between River Road and the waterfront. Log booms on the water. ESA type is Shoreline, Intertidal or Freshwater Wetland.
		Future	No major changes anticipated.
INDUSTRIAL NORTH EAST 2	Bath Slough to Knight St Bridge	Existing	Industrial area. Offices and parking lots. River Road is against the waterfront. Large trees and established vegetation on the waterfront area north of River Road. A small vacant lot under Port Metro Vancouver ownership is west of the Knight Street Bridge. Drainage ditches south of River Road. ESA type is Shoreline, Intertidal or Freshwater Wetland.
		Future	No major changes anticipated.
INDUSTRIAL NORTH EAST 3	Knight St Bridge to No. 6 Rd	Existing	Industrial area. Large lumber processing yard and waterfront log transport facilities. Large trees and established vegetation on the waterfront. Public access to River Road is blocked by gates however the City has a ROW. ESA type is Shoreline on the land side and Intertidal on the water side.
		Future	No major changes anticipated.

2.2 GEOTECHNICAL CONDITIONS

Thurber Engineering Ltd (Thurber) conducted a review of the Study Area to assess the anticipated geotechnical conditions. Based on their review, the anticipated subsurface conditions within the Study Area are primarily fill and silt overlying alluvial Fraser River deposits. The silt is clayey near the surface and becomes sandier with depth. This layer is generally about 2 to 4 m thick, although it ranges from about 1 m to 6 m thick. Below the silt, there is a zone that transitions from silt to sand at about 7 m depth. The sand layer below about 7 m depth becomes cleaner and coarser with depth and is typically 8 to 25 m thick. This sand layer is susceptible to seismically induced liquefaction. Below the sand there is a sequence of silt and sand layers. Underlying the silt and sand sequence, there is a thick deposit of silt, which is underlain by dense till-like soil at depths of 50 m or more. Geotechnical investigations and modelling may be required at the design stage of a dike adaptation project to establish site-specific subsurface conditions, and any associated geotechnical requirements.

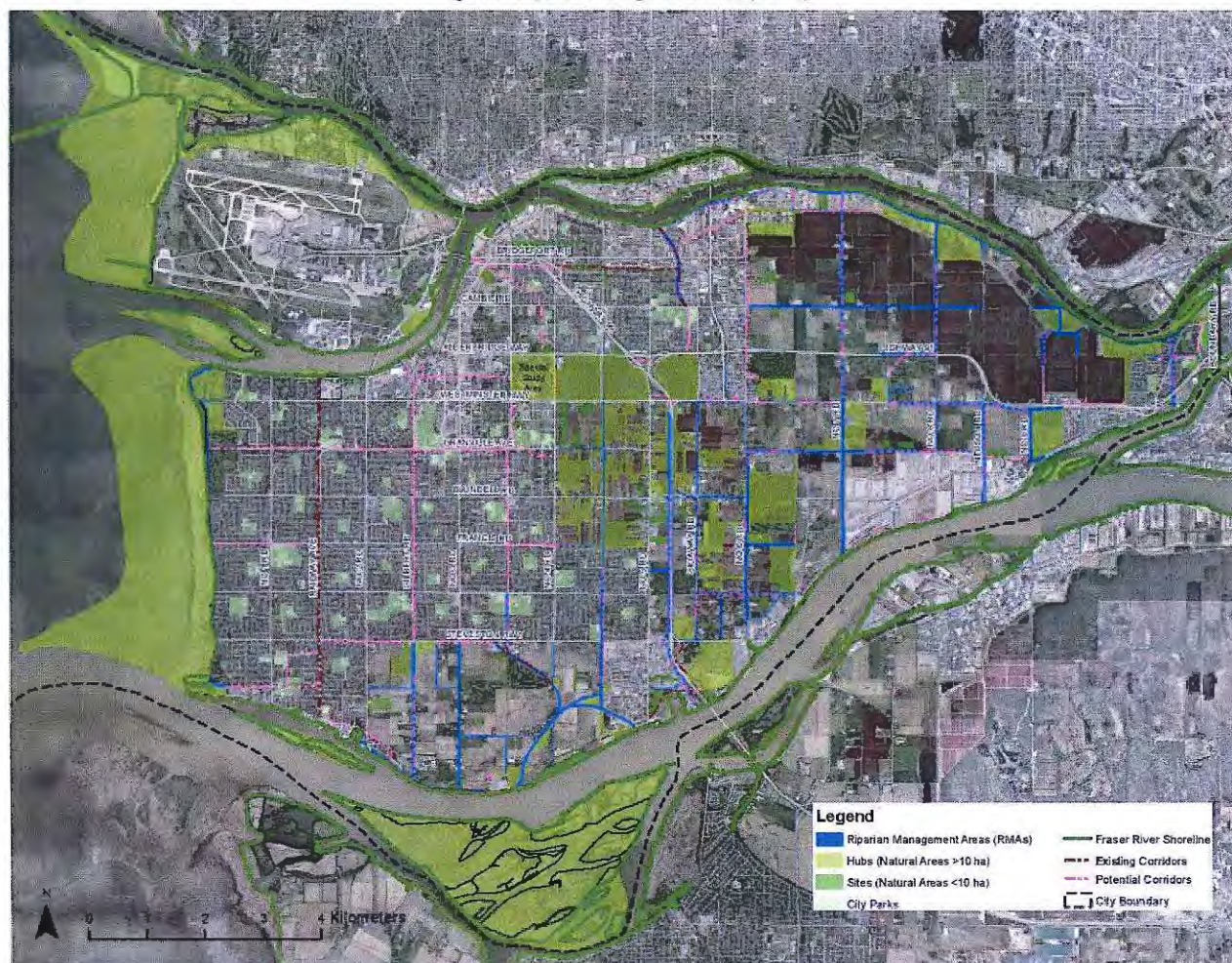
The report⁵ prepared by Thurber in support of the Phase 2 LIDMP is included as **Attachment 3** for reference.

⁵ Lulu Island Dike Master Plan - Phase 2: Geotechnical Input, Thurber Engineering Ltd., October 6, 2016

2.3 ENVIRONMENTAL CONDITIONS

Richmond is located at the mouth of the Fraser River, an urban and agricultural City juxtaposed within the high ecological values of the Fraser River Estuary. The City's Ecological Network Management Strategy (ENMS) provides context for the protection, enhancement and connectivity of an interconnected system of natural areas that make up Richmond's distinctive landscape. The ENMS recognizes the essential ecosystem services integral to the subtidal, intertidal and upland riparian areas within the Study Area, such as water storage and filtration, wave energy attenuation, temperature mitigation and prevention of soil erosion. Green infrastructure, which refers to components of the natural and built environment that provide ecosystem services, are also promoted within the ENMS. A map of Riparian Management Areas (RMA's) of Lulu Island is shown below in *Figure 3* and provided in full size in *Appendix B*.

Figure 3: Riparian Management Areas (RMA's)



Ecological lands within the LIDMP Study Area include City parks, RMA's and ESA's designated in the OCP, as well as other ecologically valuable lands such as the provincially designated Sturgeon Bank WMA. The LIDMP Study Area includes six of the ten geographic strategy areas identified within the ENMS: Traditional Neighbourhoods, City Centre, West Dike, WMA's, Industrial Area and the Fraser River. The ENMS and associated Strategy Areas inform the LIDMP.

The ENMS encompasses all ecological lands in the City, regardless of tenure. Priorities to reduce the fragmentation of natural habitats is central to the ENMS principles. The LIDMP Study Area includes some of the City's highest ecological values within the Fraser River delta. An overview of the City and non-City designated ecological attributes within the Study

Area is provided below. Further detail is provided in the Envirowest Technical Brief⁶ included as **Attachment 4** for reference. The following discussion presents environmental factors, regulations and guidance documents in place at the time of this writing. Any additional regulations that may be in place in future at the time that any diking project moves forward should also be reviewed and considered in the preparation of dike design and construction plans.

Riparian Management Areas (RMA's) and Channelized Watercourses

Richmond has interconnected drainage catchments that are delineated by the operation of pump stations that discharge into the Fraser River. The inland watercourses are slow moving and wetted the majority of the time. The high groundwater table that feeds local watercourses and sloughs contains naturally-occurring dissolved iron and other metals, and low levels of dissolved oxygen. These water quality conditions are generally inhospitable to salmon and trout; however, other species of fish, reptiles and amphibians may utilize the inland aquatic areas.

The City's watercourses flow into and contribute to fish and wildlife resources sustained by the Fraser River. As such the watercourses are designated fish habitat under the federal Fisheries Act, the provincial Water Sustainability Act, and the provincial Riparian Areas Protection Act. While the majority of these watercourses have been historically realigned into road grid to support agricultural development, they are identified by the City as channelized watercourses and not stormwater ditches. To support the form and function of these channelized watercourses, pre-designated riparian setbacks of 5 m and 15 m are designated by the City on minor and major watercourses, respectively. These setbacks, developed in consultation with the Department of Fisheries and Oceans (DFO), are identified by the City as Riparian Management Areas (RMA's) and protected from development. Channelized watercourses, and their associated RMA's, are interspersed on the landside of the West and North dikes within the LIDMP Study Area. Locations of RMA's are shown on the map included in **Appendix B**.

Environmentally Sensitive Areas

The City has designated Environmentally Sensitive Areas (ESA's) throughout the City. As identified in Chapter 9 of the OCP, intertidal and shoreline ESA Development Permit (DP) areas are in place around the Lulu Island perimeter. The intertidal DP area is defined as 30 m out into the intertidal or subtidal area measured from the High Water Mark as defined in the Riparian Area Regulations. The shoreline DP area is defined as 30 m inland of the shoreline into upland riparian habitat. This ESA recognizes the estuarine values surrounding Lulu Island and provide direction for application of the DP through DP permit guidelines. Along the West Dike section of the Study Area, ESA DP areas contain upland riparian, brackish marsh, sandflats, mudflats, and open water habitat. Along the North Dike section of the Study Area, ESA DP areas contain pockets of mud flat, salt marsh, eelgrass and upland riparian habitat. This ESA recognizes the estuarine values surrounding Richmond and provides direction for application of the DP through DP permit guidelines. Along the West Dike section of the LIDMP Study Area, the ESA Development Permit Area contains upland riparian, brackish marsh, sandflats, mudflats, and open water habitat. Along the North Dike section of the LIDMP Study Area, the ESA Development Permit Area contains pockets of mud flats, salt marsh, eelgrass and upland riparian habitat. Locations of ESA's are shown on the map included in **Appendix C**.

City Parks

The West Dyke Trail and Terra Nova Rural Park are both City park attributes contained within the Study Area. There is habitat functionality and ecological value comprised within these lands.

Bath Slough

The Study Area includes Bath Slough at the boundary between the Industrial North East 1 and Industrial North East 2 design areas. Bath Slough forms part of the historical watercourse complex that stretched across Lulu Island, and receives run-off from industrial and residential lands in the Bridgeport area. Through the 2014 Bath Slough Revitalization Initiative, the City has conducted a number of innovative ecological initiatives along Bath Slough including water quality improvements, riparian enhancements and native pollinator pasture initiatives. The Bath Slough Revitalization Initiative should be considered in the design and construction phase of proposed dike upgrade projects in this area.

⁶ Lulu Island Dike Master Plan Phase 2: Technical Brief, Envirowest Consultants, November 2, 2016.

Ecological Network Management Strategy (ENMS) Strategy Areas

Both inland and foreshore ecological values are embedded within the six ENMS Strategy Areas. The ENMS and associated Strategy Areas provide key ecological context within the Study Area. ENMS Strategy Areas as shown on the map included in *Appendix D*.

Wildlife Management Area (WMA) – Sturgeon Bank

Sturgeon Bank is a provincially designated Wildlife Management Area (WMA) established in 1998 and is located on the water side of the West Dike. It is protected for the conservation of critical, internationally-significant habitat for year-round bird migration and wintering waterfowl populations. It is also important fish habitat. It is comprised primarily of near shore and intertidal brackish marsh, sandflats, mudflats, and open water. The WMA foreshore marsh and mudflat habitats provide critical ecological values as well as ecosystem services for wave energy attenuation and shoreline erosion and stabilization. Consideration for these key climate change adaptation and resiliency attributes along Sturgeon Bank should be considered in the design and construction phase of proposed dike upgrade projects in this area.

Fraser River Estuary Management Program (FREMP) Mapping

Since the mid-1980's habitat productivity mapping has been undertaken along the Fraser River shoreline from the mouth of the Fraser River Delta upstream to the Pitt River/Maple Ridge area. This mapping was undertaken by the former Fraser River Estuary Management Program (FREMP). FREMP was a cooperative agreement amongst member agencies, including Environment Canada, Fisheries and Oceans Canada, Transport Canada, Fraser River Port Authority, North Fraser Port Authority, BC Ministry of Environment, and the Greater Vancouver Regional District. Though FREMP ceased to exist in 2013, the City continues to utilize this data resource to inform activities in and along the City's Fraser River foreshore. The FREMP classification system comprises a three tiered colour-coded system: habitats are colour-coded red, yellow or green. Red-coded shorelines sustain highly productive fish and wildlife habitats. Yellow-coded shorelines sustained moderately productive habitats, while green-coded shorelines were characterized by habitats of low productivity. Generally development constraints are greatest within red-coded habitats, while development within green-coded habitats are constrained the least. Habitat productivity within the LIDMP Study Area includes a majority of red-coded reaches along the West Dike and North Arm.

Detailed maps showing habitat coding throughout the Study Area are presented in *Appendix E*. An overview of the foreshore habitat coding in the Study Area is shown in *Figure 4*. High productivity habitat is depicted to extend along the north dike generally from No. 6 Road to the Knight Street bridge, along the Tait Waterfront Park, from No.4 Road to the Canada Line bridge, under the Oak Street Bridge, immediately west of the River Rock casino, south of the Canada Line YVR line, and west of Hollybridge Way to the Terra Nova Rural Park. Moderate and low productive habitat are interspersed along this shoreline between Hollybridge Way and Knight Street bridge. High productivity habitat is depicted to extend along the entire seaward edge of the west dike fronting Sturgeon Bank and Terra Nova Rural Park.

Fraser River Fish and Species at Risk Values

The Fraser River Estuary contains rich habitat for many species of fish and wildlife. Estuary marshes support a significant portion of the regions migrating salmon. While the inland watercourses are generally considered to not be hospitable to salmon and trout species, they do flow into and support fish life in the Fraser River and are therefore considered to be nutrient providing fish habitat.

A desktop review for species of management concern (i.e. included in Schedule 1 of the Federal Species at Risk Act, and Provincial Conservation Data Centre red- and blue-listed species) was undertaken on the Provincial Conservation Data Centre web map. The search provided a single result, specifically utilization of the Fraser River by white sturgeon. The search did not provide any results along the seaward extent of the west dike, or along inland channelized watercourses. The absence of search results does not indicate that species at risk or of management concern are absent, but that they have either not been observed and/or recorded within these areas. A detailed species at risk assessment will need to be undertaken at the time of design construction as the potential for listed species such as white sturgeon, Vancouver Island beggartick, streambank lupin etc. within the Study Area is high.

Figure 4: Foreshore Habitat Coding in the Study Area



2.4 EXISTING FLOOD PROTECTION INFRASTRUCTURE

At present, Lulu Island is protected from flood hazards by a perimeter ring dike consisting of the West Dike, the North Dike, and the South Dike. The Study Area comprises the waterfront and lands protected by the West Dike, and part of the North Dike from Terra Nova Rural Park to No. 6 Road. These dikes provide flood protection from storm surges and Fraser River freshet events. Generally the dike is a standard trapezoidal earth dike in most locations, with a trail or a road over the dike crest.

The existing dike crest elevations in the Study Area vary from 3.0 m to 4.7 m depending on when the dike was last upgraded, or when surrounding lands were last redeveloped. Drainage ditches and storm sewers behind the dikes convey storm flows and flood waters to pump stations discharging to the Fraser River and the Georgia Strait. Public dikes and all drainage infrastructure are now owned solely by the City of Richmond.

The West Dike protects the City from high tides and storm surges originating in the Strait of Georgia. Sturgeon Bank, a mudflat and marshland, extends up to 6 km into the Strait of Georgia from the toe of the dike. These lands consist of a relatively flat face with grass cover next to the dike, then marsh and mudflats further out towards the sea. Sturgeon Bank currently provides some protection from wave run-up to the West Dike.

The North Dike protects the City from high tides and storm surge impacts originating in the Strait of Georgia and migrating up the North and Middle Arms of the Fraser River. To a lesser extent, these dikes protect from high Fraser River freshet events. Generally the North Dike is bounded by the Fraser River foreshore and River Road. Through the City Center OCP Area, the dike is primarily a linear park on the waterfront bounded on the land side by River Road or development. Waterfront developments that have been constructed in the past ten years have often elected to raise their lands to the

dike crest elevation, forming a superdike. A superdike is formed whenever the lands behind the dike are filled to the same elevation as the dike crest, and development is built on a ground elevation equal to the dike crest. Superdikes are discussed in greater detail in **Section 4.1.2**. Through the industrial areas north of the City Center, the dike remains generally earthfill with sections of sheet pile and floodwalls associated with specific sites.

2.5 EXISTING FLOOD PROTECTION POLICY

The City of Richmond has two primary policies in place that guide flood protection initiatives. The OCP establishes flood protection as a priority in the context of land use planning. Flood proofing objectives are enforced through Bylaw No. 8204.

At present, the OCP states that ESA's serve the dual purpose of planning for environmental and flood protection needs. Flood protection has been established as a priority alongside environmental priorities within the OCP, especially in areas that are designated ESA's. This includes the entire waterfront of the Study Area. The OCP also establishes a priority for a green infrastructure network throughout the City's ecological network, including the intertidal, shoreline and upland riparian areas. A green infrastructure network integrates the built and natural environment to realize associated ecosystem services such as flood mitigation, and stormwater management.

The City currently enforces flood proofing through the Flood Plain Designation and Protection Bylaw No. 8204, established in 2008 to set minimum Flood Construction Levels (FCL's) throughout the City. The FCL prescribes the minimum elevation where the underside of a floor system can be constructed. The By-law also provides for diking needs such as ROWs by specifying that lands at a certain distance from the dike or waterfront must be dedicated to dike works.

Proposed developments at the waterfront must commit to implementing flood protection measures in order to secure approval for development plans. These are typically negotiated with the City on a site-by-site basis. In recent years, residential developers have voluntarily raised the elevation of development lands to the same elevation as the dike crest (creating a superdike) to ensure that the units on the ground floor will have a view of the water.

3 Considerations

The considerations in this section were used to evaluate potential flood protection adaptations to make the recommendations that comprise the Phase 2 LIDMP. Any flood protection adaptation, whether in compliance with or deviating from the Phase 2 LIDMP, should use the following considerations in evaluating the suitability of a proposed flood protection project for implementation. It is important that any proposed project avoid or mitigate negative impacts, while maximizing the benefits, as a balance of the following considerations. In the event that a dike adaptation project differs from the recommended adaptation for that design area, the project should still take these considerations into account. These considerations outline important factors that should be incorporated into the implementation plans for both structural adaptations that will alter the existing landscape, or policy adaptations that have indirect impacts on the landscape.

3.1 FLOOD PROTECTION CONSIDERATIONS

The City has established a design crest elevation of 4.7 m with consideration to be further raised to 5.5 m in response to climate change and sea level rise predictions. These design crest elevations have been adopted by the City in response to a combination of sea level rise predictions (1.0 m) and land subsidence (0.2 m)⁷, anticipated to materialize by the year 2100.

Increases in dike crest levels (up to 4.7 or future 5.5 m) to address sea level rise and climate change are anticipated to be staged and implemented over the next few decades to respond to rising sea levels. The City will continue to monitor sea level rise and adjust the target dike crest elevations as required. Any flood protection project in the Study Area should, at

⁷ Sea Level Rise Adaptation Primer, Arlington Group et. al, January 2013

a minimum, adhere to these elevations. Additional regional guidelines should also be considered at the design stage of dike improvements.

Adaptations should be compatible with existing dikes and other flood protection measures adjoining the site of proposed works. Connections to existing flood protection works should be designed to ensure there will not be inconsistencies or weak points where an adaptation meets a pre-existing dike.

3.2 ENVIRONMENTAL CONSIDERATIONS

The Study Area is situated along the Georgia Strait and the Fraser River, two important fish and wildlife habitats. There are also riparian areas and intertidal zones that have ecological value. Any diking projects should be well-integrated with the surrounding natural realm, and should be designed to mitigate alterations that compromise the local environment, either aesthetically or ecologically. The Study Area includes substantial open space and parklands, including wetlands and natural areas on the waterfront. The City has an interest in preserving the environment at the waterfront for public uses, in particular the dike trail for cyclists and pedestrians. The aesthetic value of the natural environment along the trails should be considered as well as ecological significance.

The breadth of ecological values comprised within the study area is reflective of estuary habitats as described in *Section 2.3*. The perimeter ring dike in the Study Area is flanked by either riparian or upland ESA habitat to the landside, and high value shoreline & intertidal ESA or WMA habitats on the foreshore. Any proposed dike design and construction projects should undertake an assessment of the adjacent ecological values to determine the most appropriate dike design and footprint using an approach to avoid alterations in high value habitats, and if that is not feasible, then mitigate or compensate with a net gain approach. The Study Area is comprised of large tracts of open space and park lands that contribute significant aesthetic values within the estuary which must be considered in concert with the ecological values.

An overview of the federal and provincial regulatory context is provided above in *Section 2.3*. Detrimental impacts to the environment are to be avoided wherever possible, in accordance with the City's environmental regulations. In addition, sea level rise should be monitored and reviewed in order to determine the impact on existing foreshore wetlands within the Study Area. Additional guidance documents outlining the City's environmental protection and enhancement strategies are listed in *Section 1.3*. Any flood protection project should be prepared by qualified persons having reviewed and understood these documents, as well as any environmental guidance documents or regulations in effect at the time a project is proposed. The design of proposed diking projects should follow the City's approach regarding the priority to avoid habitat impact first. Where that is not feasible, enhancement and mitigation may be pursued with a net gain approach.

3.3 GEOTECHNICAL CONSIDERATIONS

Geotechnical design considerations for dike adaptations include seepage control both under and through the dike, dike slope stability, dike crest settlement, and seismic performance. Furthermore, additional loading from increased dike size over any existing structures, such as building footings or bridge abutments, will need to be verified for confirmation that existing infrastructure will not be negatively impacted. Other types of structural flood protection measures will also need to be verified for impacts to existing infrastructure.

Thurber has reviewed the existing geotechnical conditions in the Study Area. Their comments on the key design considerations are outlined on the following pages.

Seepage

Seepage risk should be assessed and mitigated for any dike adaptation project, whether for dikes or floodwall systems. Seepage becomes problematic where water flow through or under the dike dislocates the fill materials forming the dike, which may weaken the integrity of the dike and increase the risk of failure during high water events. Adaptations should be designed with proper drainage to mitigate seepage risks.

Increasing the height of an existing dike to 4.7 m or 5.5 m may increase the design flood height, defined as the height from the ground at the land side toe of the dike to the height of water against the dike during a high water event. Existing dikes

are between 3.0 m and 4.7 m, and the ground elevation on the landside of the dikes is generally at about 2.0 m. Raising an existing dike may also increase the flood height, unless the lands adjacent to the dike are also raised in conjunction with crest height increases, forming a superdike. Increasing the flood height may increase risks of landside heave of the less permeable surficial silt layer, and piping through the dike or its foundation.

Piping occurs when excessive seepage forces cause the migration of soil particles through the soil matrix resulting in internal erosion and eventually retrogressive failure. Heave can occur when there are excessive hydraulic pressures on the landside of the dike caused by a lower permeability soil layer forming a cap over a more permeable layer near the ground surface. Heave can lift and fracture the cap, causing large localised seepage volumes and internal erosion, which could cause a dike breach.

To provide reliable protection from higher design flood heights, a system of seepage control measures will likely be required for any dike adaptation project. The potential for heave and piping may be mitigated using relief wells, drainage blankets or trenches to drain water from behind the dike face to an outlet such as a sewer or ditch. The receiving system's capacity should be verified to ensure drainage can be accommodated in the system. Relief wells and trenches should be designed with filters, such as a geotextile, to prevent piping and internal erosion. Seepage exits should be similarly protected with filters to minimize risk of fill materials migrating out of the dike.

Where there are ditches at the toe of an existing dike, filling the ditches may be considered within the scope of a proposed dike adaptation project. Ditches at the toe of a dike increase the risk of piping, since these ditches shorten the seepage path length and increase the hydraulic gradient. Filling the ditches may contribute to a comprehensive plan to reduce the risk of seepage.

Seepage potential should be evaluated and mitigated for any structural adaptation, as seepage may cause build-up of pressures behind the structure that may increase risks of failure. Constrained dikes, designed with a retaining wall on one or both sides, may be less susceptible to seepage risk if the dike face is a uniform material, such as a concrete cut-off wall or a floodwall. A dike face constructed with a segmental wall system, such as lock blocks or armour stone, may need to have the joints between segments grouted to prevent seepage at the joints.

Stability

Any dike adaptation project should be designed and constructed to withstand pressures and forces it may be subjected to during a high water event. For dike adaptations, high quality dike fill materials should be used and placed in accordance with accepted engineering practice to maximize stability. The standard dike section is anticipated to be generally stable with increased flood heights, although it will be less stable than the lower height configuration. In areas where stability is a concern, minor modifications to the standard dike section may be required, such as flattening the landside slope, constructing a toe berm or providing a seepage cut-off and filter within the dike. The stability of dikes may be further improved where ditches at the landside toe are infilled.

Settlement

Any dike adaptation project should be designed and constructed with consideration for settlement. Designs that minimize settlement are preferred, though some measure of settlement is anticipated in the long-term in all cases.

Raising existing dikes may induce consolidation settlement of the surficial silt layers. This settlement could be up to about 5% of the increase of the thickness of new dike fill placed. Dikes and surrounding areas may also experience compression settlement due to on-going long-term compression of deeper silt layers. This ongoing settlement is typically in the range of 1 to 2 mm per year for dikes built on soil conditions in Richmond. Settlement could potentially be compensated for by overbuilding the dike to a higher initial crest elevation, anticipating that it will settle to the target dike crest.

Local soil properties should be investigated prior to finalizing the design of any adaptations. Where construction is over peat or highly organic soils, settlement may be higher.

Seismic Performance

The Provincial Seismic Design Guidelines for Dikes⁸ (Seismic Guidelines) published in June 2014 recommends designing high consequence dikes to control seismic deformations within prescribed limits. For a trapezoidal dike to achieve the objectives of the Seismic Guidelines, ground improvement may be required. Ground improvement reduces seismic vulnerability by densifying the foundation of the dike. Compaction of the ground underlying the dike may achieve the targets in the Seismic Guidelines. However, more intensive methods such as deep soil mixing or vibro-replacement to a specified depth may be pursued if compaction alone is found to be insufficient. These ground improvements may be very costly. Dikes that are set back from the waterfront are more resistant to seismic events due to being restrained by earth at both dike toes, as compared to a waterfront dike where the waterside toe is much deeper and may provide less force anchoring the dike in place. Therefore, setback dikes require less intensive methods to meet the Seismic Guidelines. Likewise, widening the dike crest to create a superdike increases resilience to seismic events without typically requiring ground improvements. Superdikes are discussed in greater detail in **Section 4.1.2**.

To further understand the potential seismic risks to dikes within the Study Area, Thurber conducted seismic deformation analyses at three select locations (No. 1 Road Pump Station, No. 4 Road Pump Station, and Bath Slough Pump Station). Results are included in their Seismic Deformation Analysis report⁹ included in **Attachment 5**. Results from the assessment identified that at the three sites selected, horizontal deformations were within the allowances prescribed for the 1:2,475 year event by the Seismic Guidelines. Vertical deformations exceeded the tolerances; however, overbuilding the dike to provide post-earthquake freeboard may be an acceptable alternate to meet the Seismic Guidelines instead of costly ground improvements. The results are largely depended on the underlying soil conditions, slope of the riverbank, and depth of the river bottom. Larger deformations could be expected where the river channel is deeper and steeper. The results discussed in the Seismic Deformation Analysis pertain only to the three sections analyzed; these are generally representative of Lulu Island however the results cannot be assumed to be consistent for any other locations. At the design stage of a proposed dike adaptation project, a site-specific seismic deformation analysis should be conducted to confirm seismic risks, and possible mitigation requirements. A seismic deformation analysis, for example a Plaxis model, may inform whether ground improvements may be required, and what level of ground improvements may be required to meet the Seismic Guidelines.

3.4 INFRASTRUCTURE CONSIDERATIONS

It is advantageous to pursue dike works alongside other infrastructure upgrades in the vicinity of the dike. Where infrastructure works are proposed on the waterfront, local diking needs should be evaluated and included in the scope of proposed work wherever possible. For example, when a road is being raised or resurfaced, the adjacent dike could be upgraded concurrently. Including dike adaptations within the scope of other municipal works may also present a cost savings as compared to pursuing projects independently. The resulting dikes may also be better integrated with the local landscape if they proceed concurrently with neighbouring infrastructure upgrades.

Any impacts to local stormwater drainage patterns should be evaluated to ensure compatibility with the local infrastructure, such as pump stations or roads. Where adaptations will interfere with existing drainage patterns, the capacity of the receiving pump station must be confirmed. If ditches at the toe of the dike are to be filled, the associated loss of stormwater storage and conveyance functions may need to be compensated with underground pipes or alternative systems.

Above ground utilities may be impacted by diking projects. Utility poles may need to be temporarily relocated while dike works are underway, and relocated to a permanent position when works are complete. There may be an opportunity to relocate cables underground when dike works proceed, particularly if roadworks are included. The dike trail and associate park infrastructure, such as park benches and lookouts, may need to be relocated to accommodate dike adaptations.

⁸ Seismic Design Guidelines for Dikes, 2nd ed., Golder, Ministry of Forests Lands and Natural Resources (MFLNRO) Flood Safety Section, Jun 2014

⁹ Lulu Island Dike Master Plan - Phase 2: Seismic Deformation Analysis, Thurber Engineering Ltd., Sep 12, 2016

3.5 SITES WITH UNIQUE CONSTRAINTS

There may be sites with unique features that must be accommodated when adaptations proceed. Dike adaptations may be realigned to avoid special sites, however this may not always be feasible. Where development and infrastructure exists along the waterfront where a dike adaptation project would ideally proceed, a custom design to accommodate that site may be required. Examples include pump stations, bridges, or industrial sites located immediately on the water. There are a number of bridges in the Study Area. Adaptations at bridge sites are discussed further under *Section 4.3*.

The adjoining adaptations on either side of the special site should be well-integrated with that site's custom adaptation design, to ensure there are no vulnerabilities in the flood protection strategy at the boundaries between adaptation types. For example, a section of floodwall within a dike should be protected at the joints to ensure the joints are as robust as both the dike and floodwall. The joints should be as capable of withstanding high water levels as the adaptations on either side.

3.6 SOCIAL CONSIDERATIONS

Dike adaptations should be designed with consideration of the public realm. The City's 2009 Waterfront Strategy presents a vision that promotes community wellness, economic vitality and a healthy environment through initiatives that integrate the waterfront with the urban landscape. The Study Area contains recreation, culture and heritage resources to be preserved wherever feasible, according to the regulatory protections in place for heritage resources. Recreational uses may include walking and cycling on the trail, as well as offshore activities such as sport fishing and boating.

Heritage sites may be treated as sites with unique constraints, as described in *Section 3.5*, that require special accommodations within a diking project. Heritage sites that have been identified as culturally significant should be preserved per the Heritage Procedures Bylaw 8400 as applicable.

Any impacts that restrict use and enjoyment of the waterfront, as well as views of the waterfront, should be mitigated. Impacts on cultural and heritage resources limiting the accessibility of these sites should be mitigated. Sites should remain accessible to all people including those using mobility aids, such as wheelchairs or crutches.

Public access to the waterfront is provided by the perimeter dike trail system. Where waterfront access is constrained, the City's Parks Planning and Design (Parks) department has identified connectivity at the waterfront as preferable to inland trail detours. For example, where the existing dike trail alignment crosses under low bridges, raising the dike may not provide adequate clearance to maintain the trail over the dike. The preference is to keep the trail at the waterfront. A boardwalk at the waterside toe of the dike would be a preferred approach as opposed to directing pedestrians up to the road to circumvent a barrier.

Adaptations should be aesthetically integrated with the surrounding area. For example, in recreational areas or ecological landscapes, adaptations that do not detract from the natural beauty of the local environment are preferable to those adaptations requiring severe hardscaping, such as concrete or retaining walls. The local character of industrial areas is amenable to man-made structures thus floodwalls may be in keeping with the landscape themes in industrial areas.

Adaptations should support, and be integrated with, the habitat functionality and aesthetics of the surrounding environment.

3.7 PROPERTY CONSIDERATIONS

The City must have permanent access to the dike adaptations in the long-term, for both construction and ongoing maintenance operations. Acquiring property may add considerable costs to a diking project. Wherever feasible, adaptations should proceed within the lands that are already under City ownership, or that the City may access through easements or right-of-ways (ROW's).

Much of the City's waterfront was developed prior to the establishment of robust policies for dedicating lands to diking. As a result, older buildings remain directly on the waterfront, or within 30 m from the natural boundary. In cases where no alternative alignment can be implemented, it may be necessary for the City to acquire waterfront lands or obtain easements or ROWs to construct or maintain adaptations.

3.8 ECONOMIC CONSIDERATIONS

For the purposes of the Phase 2 LIDMP, economic considerations encompass impacts to local businesses operating in the vicinity of existing or proposed dikes. The cost of adaptation projects is also an economic consideration, however for the purposes of the Phase 2 LIDMP these will be referred to as “cost considerations,” discussed further under **Section 3.10**.

Flood protection projects provide an overall economic good by preventing damage to assets. However, any changes to existing conditions may trigger negative impacts to the local economy. For example, diking may damage views to the waterfront, or challenge industrial activities by limiting water access.

Where economic impacts cannot be completely avoided, they should be mitigated to the extent feasible. Dike adaptations should consider local economic factors in the overall decision making context.

Lands that were formerly used for economic purposes, such as waterfront shipping facilities, but are no longer being used for economic activities may be suitable lands for dike adaptations. If alternative lands are available that do not have any associated economic uses, those lands should be used rather than compromising lands of economic interest.

3.9 OPERATIONAL CONSIDERATIONS

Dikes in the Study Area provide access to City assets that must be maintained, such as drainage ditches and trails. Adequate clearance must be retained for maintenance vehicles to navigate the dikes where required, and carry out maintenance activities. For example, if a dike is raised in an area where there are drainage ditches at the dike toe, the boom of an excavator on the dike must be able to reach the ditches for cleaning and maintenance.

Raising a dike may complicate access as the slopes must remain suitable for maintenance and emergency access. Additional lands may be required to improve access to the dike.

3.10 COST CONSIDERATIONS

The overall cost of implementing adaptations is driven by a number of factors that include habitat consideration, land acquisition and ground improvements. When evaluating the cost of an adaptation, the costs of all associated works and mitigation plans should be included. A project with relatively higher construction costs may still be the least expensive option if it does not require any habitat compensation, for example.

4 Flood Risk Management Adaptations

Flood Risk Management adaptations have been categorized as either area wide or area specific.

Ultimately the City's goal is to fortify the perimeter ring dike to a design crest elevation of 4.7 m, with consideration to be further raised to 5.5 m in response to climate change and sea level rise predictions. Area wide adaptations are those that facilitate the City's flood protection objectives in tandem with the dikes or alternative protection measures in place at the waterfront. These could be policy adaptations, structural measures, or enhancement of green infrastructure to secure additional benefits to an adaptation that will achieve the 4.7 m crest elevation. Area wide adaptations may not be sufficient to meet the City's target dike crest elevation if implemented in isolation, however they may facilitate achieving the City's flood protection goals. For example, revising City policies to include specific diking requirements would be an area wide adaptation, as this is applicable across the entire Study Area, however, on its own, a revision to City policy would not achieve the target dike crest elevation. Area wide adaptations encompass strategies to facilitate implementing flood protection projects, and seizing opportunities presented by waterfront development to implement flood protection works concurrently. Area wide adaptations are defined and described in further detail in **Section 4.1**.

Area specific adaptations are recommended for each of the thirteen specified design areas. These include all dike and floodwall adaptations that may achieve the 4.7 m design crest, and may be further raised to 5.5 m in future when required. As noted in **Section 2**, the design areas have been delineated using the City's Official Community Plan (OCP) boundaries

as identified in the OCP Areas, OCP Land Use Maps and OCP Sub-Area Plans. OCP Areas have been subdivided where similar waterfront conditions exist for a clearly defined part of an area. Area specific adaptations are defined and described in further detail in **Section 4.2**.

Recommendations from both area wide and area specific categories have been made to create a comprehensive flood protection strategy for the Study Area. A summary of the recommended Flood Risk Management Strategies that apply to either specific design areas, or all of the Study Area is provided in **Table 2**. The contexts for the recommended application of each adaptation are detailed in **Section 4.1** and **Section 4.2**.

Table 2: Recommended Flood Risk Management Strategies

AREA SPECIFIC				AREA WIDE			
DIKES		FLOODWALLS					
Widen Footprint to Land or Water Side	Raise in Place / Constrained Dike	Permanent	Demountable	Superdikes	Flood Proofing	Planning and Development Controls	Breakwaters and Barrier Islands
							Secondary Dikes

Note that other adaptations were reviewed and evaluated for implementation in the Study Area, though only the recommended adaptations are presented in the Phase 2 LIDMP. Adaptations that were eliminated at the evaluation phase include coastal wetlands, emergency preparedness and response, and managed retreated.

Coastal Wetlands: Coastal wetlands, including intertidal habitat such as brackish wetlands, eelgrass beds, mud flats, and sandflats, temper the extremity of storm impacts by attenuating wave energy, similar to breakwaters. There are no candidate sites within the Study Area to create new coastal wetlands for the purposes of flood protection; however, existing coastal wetlands can be maintained and enhanced to improve their flood protection characteristics.

The West Dike runs adjacent to the Sturgeon Bank WMA which is comprised of intertidal brackish marsh, sandflats, mudflats, and open water. The North Dike runs adjacent to pockets of mud flat, salt marsh, and eelgrass habitat. This intertidal habitat currently provides ecosystem services such as erosion and wave attenuation. Where feasible through dike upgrades this intertidal habitat could be enhanced. As part of the LIDMP the City will need to continue to work with inter-jurisdictional partners to monitor the complexity of the surrounding intertidal habitat, evaluate the existing ecosystems services that this habitat provides, and based on monitoring collaborate of efforts and initiatives to maintain and enhance this area.

Emergency Preparedness and Response: This strategy accommodates flood risks by preparing robust mitigation plans, to be carried out in the event of flood emergencies. The City has an existing emergency response plan: the Emergency Operations Centre coordinates with various departments to execute the Emergency Preparedness Flood Management Plan. The plans in place have not been reviewed as part of the Phase 2 LIDMP as this is beyond the scope of this study.

Managed Retreat: Managed retreat involves decommissioning or demolishing existing assets within a specified hazard zone, thereby eliminating flood risk by removing any development where flooding may occur. This strategy is not appropriate for the Study Area. The economic value of retaining existing

assets exceeds the cost of reducing the risk of flood damage by relocating assets. The existence of development on Lulu Island that must be protected from flooding is considered a permanent condition for the purposes of the LIDMP.

4.1 AREA WIDE ADAPTATIONS

In the context of the Phase 2 LIDMP, area wide adaptations are those that facilitate the City's flood protection objectives in tandem with the dikes or alternative protection measures in place at the waterfront, but may not be sufficient to meet the City's target dike crest elevation in isolation. The target dike crest elevation is addressed through the area specific adaptations described in *Section 4.2*.

The recommended area wide adaptations are: superdikes; floodproofing; planning and development controls; breakwaters and barrier islands; and, secondary dikes,. Each recommended adaptation is discussed in the following sections.

4.1.1 SUPERDIKES

As noted in *Section 2.4*, a superdike is formed where the lands behind the dike are filled to the same elevation as the dike crest. Development is then built on a ground elevation equal to the dike crest.

Maximizing the width of raised land adjacent to the river decreases flood and seismic risks by increasing the integrity of the dike. The existing dikes of Lulu Island are built on soft soils that are subject to liquefaction during seismic events. These dikes may require ground improvements to meet the 2014 Seismic Design Guidelines (Seismic Guidelines). Superdikes are an approach to achieve the dual objectives of reducing vulnerability to both high water levels and seismic events. A superdike is more likely to withstand lateral movement and sloughing of the dike face without resulting in a dike breach, as compared to a standard trapezoidal dike alone. By raising lands to a superdike condition, costly ground improvements may not be required, even if they may have been required for a standard trapezoidal dike in the same area.

Any proposed dike adaptation project should comply with the Seismic Guidelines. If a proposed dike adaptation project will not meet the requirements in the Seismic Guidelines, superdikes may be considered as an alternative to ground improvements. At the design stage, a number of strategies should be investigated to determine which will meet the Seismic Guidelines at the lowest cost, on the overall balance of the considerations listed in *Section 3*.

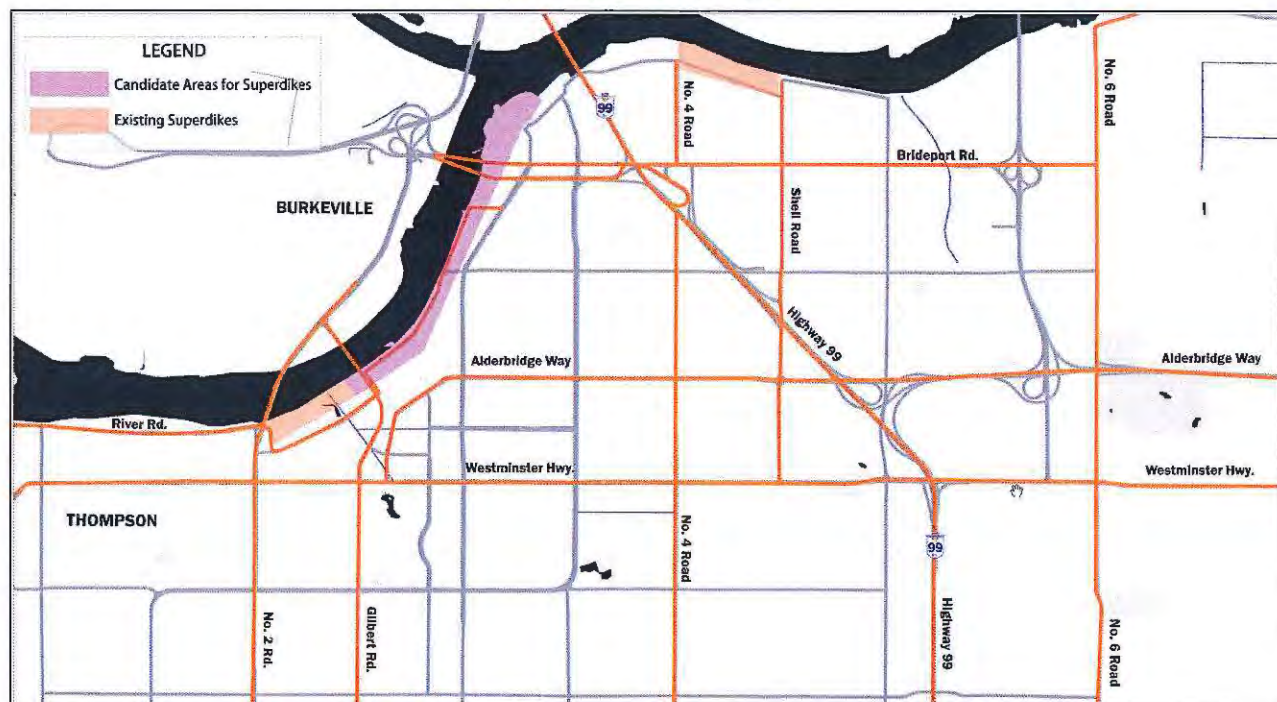
Any redevelopment of waterfront sites presents an opportunity to fortify existing flood protection measures. Although the Study Area is already fully built out, lands will continue to be redeveloped over the long-term future. Opportunities for implementing superdikes are most attainable where existing commercial and industrial sites are leveled in support of developing residential uses. Generally, industrial sites have different waterfront access and aesthetic needs than residential sites, which benefit most from a superdike condition. In recent years, residential developers have voluntarily raised the ground elevation of development sites to the same elevation as the dike crest to ensure that the units on the ground floor will have a view of the water. Within the Study Area, this has been the case at the multi-family residential developments next to the Olympic Oval, and the multi-family residential development under construction on the formerly industrial waterfront sites between No. 4 Road and Shell Road.

Application: Commercial & Residential Lands on the North Dike

The lands of the City Centre area are anticipated to experience extensive intensification and redevelopment in the coming years, further detailed in *Section 4.2.7* and *Section 4.2.8*. This area has been identified as a candidate for superdikes, as shown in *Figure 5*.

Redevelopment of waterfront sites presents opportunities to implement flood protection works concurrently with development. The optimal time for implementing superdikes is when existing assets are demolished and the site is leveled to accommodate new development.

Figure 5: Superdikes in the Study Area



4.1.2 FLOOD PROOFING

Flood proofing is a strategy to minimizing the damage to critical infrastructure in the event of a dike breach. Buildings can be constructed as flood proofed by ensuring habitable space is set at an elevation above the flood risk zone. Damage and losses incurred during flooding are minimal as any valuable or vulnerable assets are located above the possible flood elevation. In these buildings, habitable space and sensitive assets are located above a prescribed ground floor elevation, and lower floors are used only for storage of flood-resistant or low value assets. Another flood proofing strategy is using only impermeable building materials and watertight building equipment below the prescribed flood risk elevation.

The City's influence on where private building operators locate their assets within their buildings is limited, however construction of buildings with habitable space or vital assets below a specified elevation may be prohibited through legislation. By flood proofing buildings located in a specified waterfront or low elevation area, vital assets are prohibited from being located in high risk zones so that flooding will only affect non-vital infrastructure. Generally, flood proofing legislation impacts only the construction of new buildings; existing buildings constructed prior to the legislation's implementation are typically not impacted except through building permit applications for renovations or additions.

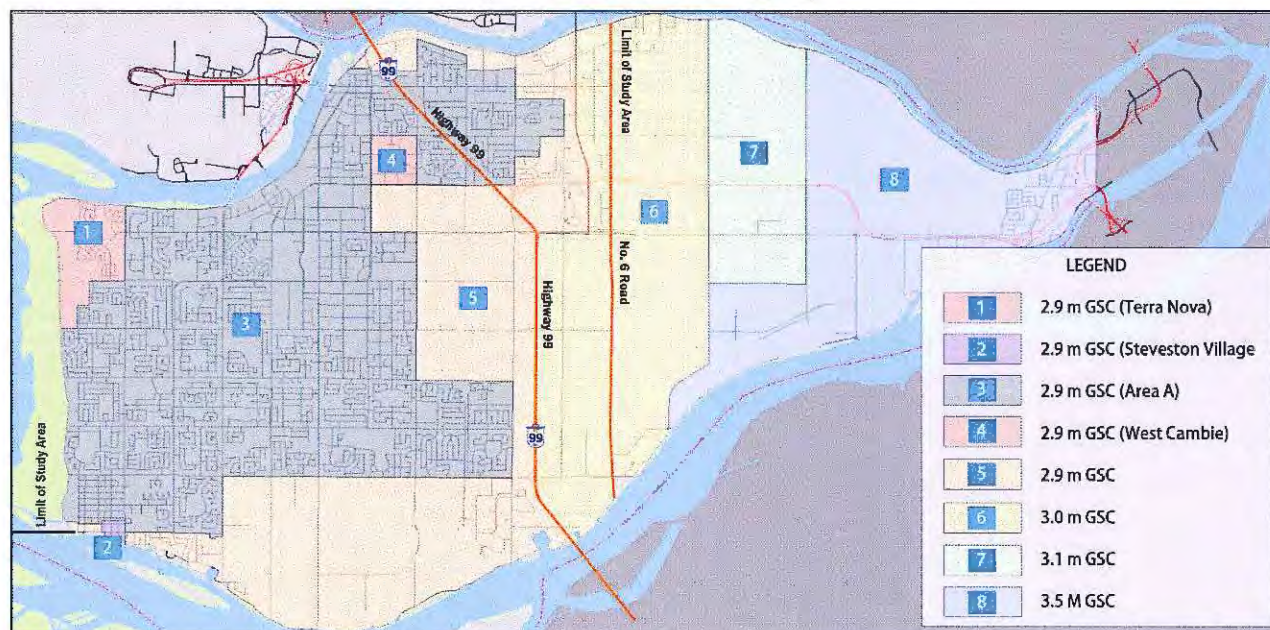
As noted in **Section 2.5**, the City currently enforces flood proofing through the Flood Plain Designation and Protection Bylaw No. 8204. The Bylaw sets minimum Flood Construction Levels (FCL's) throughout the City. The FCL prescribes the minimum elevation where the underside of a floor system can be constructed. Long term raising of land levels has previously been recommended (2008-2031 Flood Protection Strategy); however, is challenging to implement in already built up areas. The bylaw also specifies setbacks from a dike ROW to make land available for diking.

Application: Flood Construction By-law Amendments

Every part of Lulu Island has a designated FCL, not only the waterfront area. The bylaw organizes FCL's by area, as shown in **Figure 6**. Presently, the majority of the Study Area fronting the existing dikes is within 'Area A' of the bylaw. The requirements for 'Area A' are to construct to 2.9 m or at least 0.3 m above the highest elevation of the crown of any road that is adjacent to the parcel. Commercial and industrial buildings are fully exempt if the main entrance is within 3 m of a

road. Developments within the Terra Nova Area are further exempt only requiring the underside of the floor slab to be greater than 2.6 m. There are no exemptions in the north-east portion of the Study Area, where a 2.9 m FCL is required.

Figure 6: Flood Construction Levels (FCL's)



Amendments to Bylaw No. 8204 may be appropriate given the current predictions for sea-level rise. These amendments could include creation of an additional FCL Area adjacent to or within a stipulated distance from the existing dike or waterfront. The area could require an FCL of 4.7 m with exemptions based development size or parcel size. The FCL's would also have to consider overall lot raising and not just habitable space.

Examples of alternate concepts for consideration are provided below:

Single Family Dwellings and Small Lots: The bylaw could be amended to increase the rate at which land is raised concurrently with redevelopment. Presently, this rate is 0.3 m above the road centreline. For smaller lots, this strategy may then present challenges to local grading, producing inconsistent grades across lots and possibly introducing complex drainage patterns. Smaller lots are more likely to be highly constrained by existing grades on neighbouring lots and the road. Where grading is highly constrained, retaining walls may be required to accommodate substantial changes in elevation. Aesthetically, abrupt grade changes are undesirable, especially in neighbourhoods of single family homes. Varied grading between lots can also create issues with differential settlement. Grading designs that are consistent with the surrounding lot fabric and do not use retaining walls are preferred. The sidewalks and road network must also be carefully graded to maintain minimal slopes and safe connections at intersections. Any FCL increase must be implemented strategically to mitigate the potential grading challenges it may introduce.

Zoning bylaws could potentially be modified to provide additional guidance and requirements for lot coverage, setback, building heights, and others to help plan how the greater staggered lot elevations may integrate with each other. This will be challenging to implement but would increase the rate of increasing the land height in residential areas.

Mid-Size Development Lots or Building Permit Value Criteria: The bylaw could be amended to require raising to 4.7 m or 1 m (or alternate) above the road. Challenges may still exist with incorporating grading to adjacent parcels and roads.

Large Development Lots or Building Permit Value Criteria: The bylaw could be amended to require raising to 4.7 m and upgrading the local road network to accommodate access. This is currently done in practice, however, it is not specifically required under the current bylaw.

Additional studies on implementation of modified FCL bylaws should be conducted prior to proceeding with any changes. Input should be provided from architects, planners, engineers, environmental consultants and key stakeholders to obtain a comprehensive understanding of opportunities and factors to be mitigated while achieving flood protection goals.

Flood risk should be evaluated by the City periodically to determine whether increased risk warrants raising the target dike crest elevation. The bylaw can be amended as required to meet evolving City guidelines as they are adjusted per changes to flood risk conditions. For example, if the design crest elevation is raised from 4.7 m to 5.5 m, the FCL bylaw can be amended to reflect the new minimum elevation. In this way, flood proofing can progress over time as required.

4.1.3 PLANNING AND DEVELOPMENT CONTROLS

Planning and development controls may be implemented by enacting legislation to prohibit or restrict development in a defined hazard zone, such as a floodplain. More flexible policies can also be enacted to include conditional development approvals, where projects may be approved on condition that developers commit to implementing flood protection measures such as raising the abutting dike or raising the land elevation to a superdike.

Application: Site Assembly Size in the City Centre

In the Study Area, there are opportunities to pursue flood protection improvements in conjunction with new development, especially in areas expected to be intensified in the coming years. In Richmond, planning and development controls can be implemented through bylaws or amendments to the OCP.

Increasing the ground elevation of a single waterfront site is restricted by the existing elevations of adjacent lands. Where adjacent sites remain low, a redevelopment site can only be minimally raised without introducing challenges to the local road network and drainage patterns. To avoid complications arising from steep grades or retaining walls, the City can encourage developers to assemble multiple adjacent sites until a specified minimum waterfront frontage can be developed concurrently. This strategy permits increasing the dike crest level fully to the current standard elevation, and eases the transition of the waterfront to a superdike.

4.1.4 BREAKWATERS AND BARRIER ISLANDS

Breakwaters may be constructed to dissipate wave energy before waves reach the shore. This reduces the burden on the flood control structures at the waterfront. In combination with a foreshore structure, flood control structures with lower crest elevations may remain adequate to withstand increased wave run-up associated with increased water depths due to climate change and sea level rise.

With appropriate environmental consideration during design and construction, breakwaters and barrier islands can create intertidal habitat, such as sand flats, mud flats, salt marsh and eelgrass beds. These features can assist with erosion and wave attenuation. The intertidal habitat can work in combination with a constructed flood control structures like dikes and floodwalls, to mitigate flood risk.

Sea level rise and upland limitations to natural accretion within the Sturgeon Bank WMA could result in increased offshore depths beyond the West Dike, which could simultaneously increase wave heights reaching the West Dike.

Increased water depths off-shore reduce the wave attenuating properties of Sturgeon Bank. The current predictions and assumptions used in the BC Sea Dike Guidelines¹⁰ for the year 2100 suggest wave run-up may account for up to 2.7 m of the future dike crest elevation. The full extent of future crest height increases will require detailed observation and study of observed sea level rise.

¹⁰ Climate Change Adaption Guidelines for Sea Dikes and Coastal Flood Hazard Land Use Draft Policy Discussion Paper, Ausenco Sandwell, Jan 27 2011

Application: The West Dike Foreshore - Sturgeon Bank

The West Dike runs adjacent to Sturgeon Bank WMA comprised of intertidal brackish marsh, sandflats, mudflats, and open water. Maintenance and enhancement of these areas could provide wave dissipation and erosion protection.

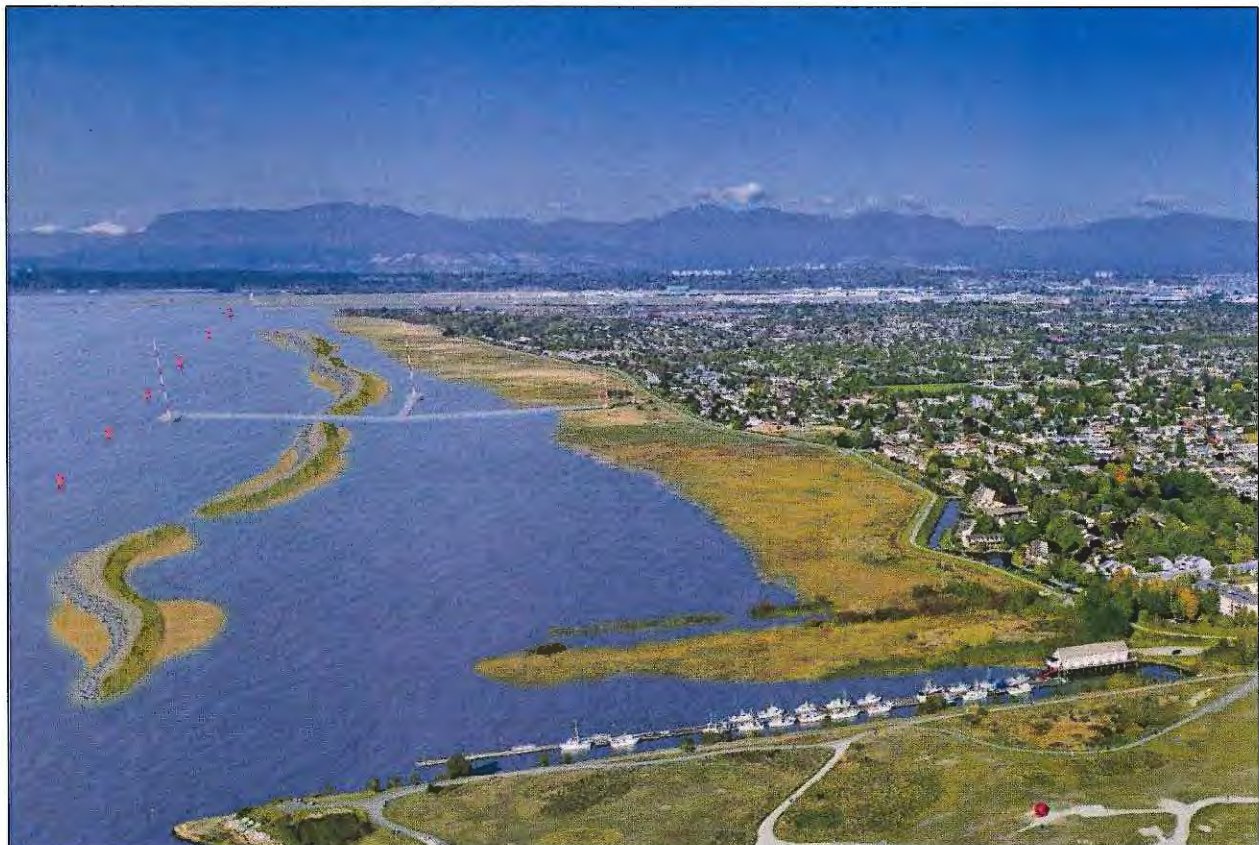
The West Dike is a candidate for barrier islands, as presented in the Phase 1 LIDMP. Presently, the features of Sturgeon Bank dissipate wave energy. With future increased water depths on the Sturgeon Bank, wave heights are expected to increase, reducing the wave dissipate benefits of Sturgeon Bank, putting the West Dike at higher future risk of overtopping. Construction of breakwaters or barrier islands, including the maintenance and enhancement of intertidal habitat, is one approach to offset the potential future loss the existing wave dissipation benefits of Sturgeon Banks.

While breakwaters and barrier islands will not address the immediate crest elevation requirements of 4.7 m, construction of barrier islands may allow for future deferrals of crest height increases. A general concept plan showing possible locations for barrier islands is presented in *Figure 7*.



Photograph: Sturgeon Bank Management Area

Figure 7: Artistic Rendering of Barrier Island Concept for Sturgeon Bank



Breakwaters are most effective when constructed close to the shore, as broken waves grow again behind the breakwater under the influence of wind. The effectiveness depends also on the crest height of the breakwater, with a higher breakwater giving more wave reduction. Preliminary calculations from the Phase 1 LIDMP indicated that wave reduction with a breakwater or barrier islands constructed to +3.0 m geodetic would reduce wave height by 70% if constructed 200 m offshore, 60% at 500 m offshore, and 45% at 2000 m offshore.

Intertidal ecosystems are driven by interdependent components including rates of accretion, stream velocity, salinity, water quality, sea level, temperature, vegetation productivity, adjacent land use etc. that are complex to measure and model. Understanding the complexity of current conditions to better prepare for predictable increases in sea level rise will help direct strategies to maintain and enhance intertidal ecosystems. To this end, the City continues to work on inter-jurisdictional efforts to better understand the influencing factors that affect the Sturgeon Bank WMA, and intertidal habitat throughout the Fraser River Estuary.

4.1.5 SECONDARY DIKES

Secondary dikes work in conjunction with primary dikes to reduce the impact of a flood in the event that a primary dike is breached or overtopped. A secondary dike protects assets behind the secondary dike alignment while the lands between the primary and secondary dikes may flood intermittently. Secondary dikes are appropriate for implementation where the lands between the primary and secondary dike require a different measure of protection than lands behind the secondary dike. Eligible areas may include parking lots, parks or natural areas that can withstand intermittent flooding with minimal damage or losses incurred.

As secondary dikes are built inland, they can be less costly to build and less susceptible to damage during seismic events as compared to adaptations directly on the waterfront. The advantage is that an equivalent measure of protection can be extended to important inland assets, at a lower cost and lower seismic risk, than raising the primary dike at the waterfront. In the Study Area, secondary dikes are recommended for consideration where no critical assets are located on waterfront lands and there are assets further inland that require protection.

Application: Terra Nova

In future, the City may consider exploring establishing an alternative dike alignment for a part of the Terra Nova area through the park lands, as shown in *Figure 8*.

By setting the alignment inland, the City may avoid costly ground improvement measures that may be required for upgrading the existing alignment on the waterfront. Assets sensitive to flooding, such as private homes and heritage sites, would be protected by the secondary dike. Less sensitive assets, such as the park, trails and open space lands, can withstand occasional flooding with minimal losses incurred and therefore may be adequately protected by a dike with a relatively lower crest elevation.

Figure 8: Secondary Dike Alignment through Terra Nova



4.2 AREA SPECIFIC ADAPTATIONS

For the purposes of the master plan, an area specific adaptation is a structural adaptation that can achieve the target 4.7 m crest height, with consideration for a future increase to 5.5 m. This section outlines the preferred area specific adaptation measures for each of the thirteen design areas.

The recommended approaches to area specific adaptations includes: widen footprint to land or water side; raise in place / constrained dike; permanent floodwall; demountable floodwall.

Widen Footprint to Land or Water Side

Dikes are the most common form of structural flood protection. Lulu Island is currently protected by a perimeter ring dike, with floodwalls or alternative protections at some sites. In the Study Area, improvements to the existing dike should be pursued wherever possible.

As per the typical dike sections presented in *Appendix F*, the typical City dike upgrade cross-section consists of a 2:1 slope on the water side, and a 3:1 slope on the land side¹¹. Raising a dike by 1 m then triggers a 5 m horizontal space requirement (assuming the standard slopes are applied). Land side dike expansions can be challenging where the footprint is constrained by existing buildings, infrastructure, drainage ditches, or RMA's at the toe. Where a dike's land side toe is heavily constrained, a standard dike can be raised by widening its footprint onto the water side.

While shoreline habitat within the Fraser River Estuary will generally have a higher habitat value, and expansion into this area should be avoided, this may not always be the case. Implementation of area specific flood protection strategies will have an environmental impact regardless of the strategy put forth for a given area. Environmental assessments and valuation will be undertaken in the design construction phase, where possible habitat impact will be avoided. Where impact cannot be avoided, efforts will be made to mitigate, and if necessary compensate for impact following a net gain approach.

Raise in Place / Constrained Dike

Where dike expansion is constrained on both the land and water sides, it may be possible to raise a dike within its existing footprint, creating a constrained dike. This may be achieved by introducing a retaining wall on one or both sides. In Richmond, RMA's, development and infrastructure may abut to the landside of the dike, and intertidal habitat or marine infrastructure may be on the water side of the dike, meaning the dike may have constraints on both sides. In the Study Area, raising the dike in place can be pursued to minimize impacts on adjacent lands.

Permanent Floodwall

A floodwall is a constructed barrier designed to hold back flood waters. In the Study Area, floodwalls can be implemented where space is limited and a dike would interfere with other land uses or infrastructure, such as existing buildings. Floodwalls may also be preferable to a dike where access to the water is required for economic activity, such as fishing or shipping. Generally, where feasible, earth fill trapezoidal dikes are preferable as they generally have lower costs, they are easier to maintain, they are more reliable and easier to repair in emergency situations.

Demountable Floodwall

In areas where waterfront access is desired, demountable flood barriers can be constructed so that the barrier is erected only when required, during storm events. Regular access to the waterfront is maintained otherwise. This adaptation may be applied in the Study Area at industrial sites or marinas, where activities require amenities directly on the waterfront that cannot be set back behind a floodwall or dike. Where possible, this form of dike is avoided due to their higher costs, mobilization requirements, and reliability concerns.

Parsons assessed each potential dike adaptation strategy based on the considerations outlined in *Section 3*. A summary of the recommendations for each design area is provided in *Table 3*. Key issues and opportunities to be considered when implementing the recommended adaptations are presented for each design area in *Section 4.2.1* through *Section 4.2.13*.

¹¹ Typical Cross Section River Dike Upgrade, City Drawing Mb-98, Golder Associates, 2008

Table 3: Recommended Area Specific Adaptations

FLOOD PROTECTION SEGMENT	RECOMMENDATION
WEST DIKE	
Seafair	Raise the dike on the existing alignment. Additional studies required to quantify drainage impacts of land side expansion, habitat impacts and costs associated with water side or land side expansion, and long term resiliency of a constrained dike solution.
Terra Nova	Raise the dike on the existing alignment. Additional studies required to quantify drainage impacts of land side expansion, habitat impacts and costs associated with water side or land side expansion, and long term resiliency of a constrained dike solution. Alternatively, consider routing a secondary dike inland through Terra Nova Rural Park, in lieu of raising the primary dike at the waterfront.
NORTH DIKE	
Thompson Terra Nova	Raise the dike on the existing alignment with land side expansion. Plan for the long-term raising of River Road.
Thompson Dover	Raise the dike on the existing alignment with land side expansion. Plan to raise River Road.
Oval	Existing area generally redeveloped as a superdike scenario (elevations from 4.0 to 4.5m). Future raisings to 5.5 m can take place on the existing alignments and integrate into the adjacent landscaping.
City Centre 1	Raise a dike with land side expansion. Consider creation of a set-back dike and inland raising (superdike) in conjunction with the future Middle Arm Waterfront Park construction.
City Centre 2	Raise the dike on the existing alignment with land side expansion in conjunction with redevelopment. Ensure any interim dike upgrades are compatible with the long term strategy of constructing superdikes.
Duck Island River Rock	Implement approved development plans. Plan for temporary dike to protect City assets if required to address sea level rise and climate change prior to implementation of the approved strategy at the Duck Island or River Rock Casino sites.
Industrial	Raise the dike on the existing alignment. Site specific solutions may be required at the Fraser River Terminal site. Plan for temporary dike along the alternate alignment if required to address sea level rise and climate change prior to implementation of a strategy at the Fraser River Terminal site.
Bridgeport Tait	Existing area generally redeveloped as a superdike scenario (elevation 4.7m). Future raisings to 5.5 m can take place on the existing alignments and integrate into the adjacent landscaping.
Industrial North East 1	Raise the dike on the existing alignment. Land acquisition may be required to facilitate construction of a trapezoidal dike (through redevelopment or otherwise). Implementation of a temporary floodwall adjacent to the waterfront lots may be required in advance of a permanent adaptation to address sea level rise and climate change. Consider Bath Slough Revitalization Initiative for future designs.
Industrial North East 2	Raise the dike on the existing alignment. Additional studies required to quantify drainage, habitat impacts, and costs associated with land side expansion of a trapezoidal dike. A constrained land side slope may be required to integrate with the existing drainage infrastructure. Consider Bath Slough Revitalization Initiative for future designs.
Industrial North East 3	Raise the dike on the existing alignment. Additional studies required to quantify drainage, habitat impacts, and costs associated with land side expansion of a trapezoidal dike. A constrained land side slope may be required to integrate with the existing drainage infrastructure.

4.2.1 SEAFAIR

The Seafair design area consists of established residential neighbourhoods of single family homes and townhouse complexes. On the foreshore, lands are undeveloped as is the case for the entirety of Sturgeon Bank. The Quilchena Golf & Country Club makes up the northern third of the plan; it sits entirely on Agricultural Land Reserve (ALR) lands. No major changes to the Seafair waterfront are identified in the OCP.

The preferred adaptation is to raise the dike on its existing alignment. Expansions to either side are constrained by environmental and infrastructure factors. These should be evaluated at the time an adaptation project is proposed to inform a detailed design that will best balance the considerations outlined in *Section 3*.

Barrier islands may be considered to reduce wave run-up and mitigate the need for future dike crest increases, as discussed in *Section 4.1.4*.

If ditches at the toe of the dike are to be filled, the associated loss of stormwater storage and conveyance may need to be compensated with underground pipes or alternative systems. Ditches may be designated as RMA's. Associated restrictions to alterations should be investigated when dike adaptations proceed to design and construction. Revised drainage plans must be compatible with local pump stations.

The Williams Road pump station was upgraded in 2013. The dike crest in the vicinity of the pump station is higher than adjacent lands. The pump station is not anticipated to pose special requirements for raising the dike on adjacent lands, however raising the dike crest over the pump station may increase the loading on this infrastructure. Dike adaptation projects that include raising the dike crest over the pump station should consider the pump station's structural and operational needs, including access.



LOCATION:

Williams Road to Granville Avenue

RECOMMENDATION:

Raise the dike on the existing alignment. Additional studies required to quantify drainage impacts of land side expansion, habitat impacts and costs associated with water side or land side expansion, and long term resiliency of a constrained dike solution.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- West Dike
- Traditional Neighbourhood

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded

RMA Presence

- 5m RMA Presence

PHOTOGRAPH:

West Dike, facing north at Williams Road Pump Station

4.2.2 TERRA NOVA

The Terra Nova area is primarily recreational and agricultural including small, low density areas of single family homes. Recreational and natural areas include the Quilchena Golf & Country Club and Terra Nova Rural Park. The park has extensive natural areas with trails and observation decks at the slough and wetland areas. A large children's play structure, the Adventure Play Environment, opened in 2014 at the northwest corner of the park. No major changes to the waterfront or parklands are identified in the OCP for this design area. The entire park is identified as conservation lands within the OCP.

The open space provides a unique setting within the Study Area to consider both waterfront adaptations at the existing primary dike, or a secondary dike alignment through the park. For more information on the secondary dike option, refer to **Section 4.1.5**. Barrier islands may be considered for implementation on Sturgeon Bank to reduce wave run-up and avoid the need for future dike crest increases, as discussed in **Section 4.1.4**. Opportunities to create intertidal habitat areas in the park may be pursued when dike adaptations proceed.

The historic Terra Nova Cannery site is present on the north side of the park, in front of the private homes on River Road within the park. There are no visible remains of the cannery, except the shoreline recedes inwards around the former cannery's boundaries. Heritage status and associated restrictions to local alterations should be investigated when dike upgrades at the waterfront are proposed. Sheet pile may need to be considered for the segment adjacent to the Cannery site to minimize impacts.



LOCATION:

Granville Avenue to Terra Nova Rural Park

RECOMMENDATION:

Raise the dike on the existing alignment. Additional studies required to quantify drainage impacts of land side expansion, habitat impacts and costs associated with water side or land side expansion, and long term resiliency of a constrained dike solution.

Alternatively, consider routing a secondary dike inland through Terra Nova Rural Park, in lieu of raising the primary dike at the waterfront.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- West Dike

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded

RMA Presence

- 5 m & 15m RMA Presence

PHOTOGRAPH:

West Dike, facing north at Terra Nova Rural Park

4.2.3 THOMPSON TERRA NOVA

The Thompson Terra Nova design area is residential, with recreational uses between River Road and the waterfront in the form of the dike trail and surrounding open space. The residential areas consist primarily of single family homes. No major changes to the Thompson Terra Nova design area are identified in the OCP.

The existing dike is situated between the Middle Arm of the Fraser River and River Road. Future expansions in some areas will be challenging due to the lack of space. Raising River Road will help with future dike crest elevation increases; however, will be challenging to implement.

Single family homes have driveway access from River Road throughout the design area. Individual lots are anticipated to be incrementally raised as they are redeveloped, however, this will take numerous decades to occur.



LOCATION:

Terra Nova Rural Park to
McCallan Road

RECOMMENDATION:

Raise the dike on the existing alignment with land side expansion. Plan for the long-term raising of River Road.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- Traditional Neighbourhood

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded

RMA Presence

- None

PHOTOGRAPH:

North Dike, facing east near
Terra Nova Rural Park
entrance

4.2.4 THOMPSON DOVER

The Thompson Dover design area includes a City works yard and recycling facility, as well as mid-rise multi-family residential complexes. Recreational uses exist between River Road and the waterfront in the form of the dike trail and surrounding open space. Within the Thompson Dover design area, only the City works yard has driveway access to River Road. No major changes to the Thompson Dover design area are identified in the OCP. It is anticipated that the City works yard will be redeveloped to residential uses consistent with the surrounding neighbourhood at some point in the future.

It would be advantageous to raise River Road and assist in future land and dike crest increases in the long term. The multi-family residential lands were raised much higher than River Road when these sites were developed. Raising River Road at this location would not have the same access challenges as the Thompson Terra Nova area as there is no driveway access and the buildings are already on high land. River Road may be raised to the dike crest elevation on this section at any time. It would be advantageous to do a longer segment of River Road together, thus raising the road here should proceed concurrently with raising River Road in the Thompson Terra Nova design area to the west. Raising River Road along the City works yard may be considered concurrently with redevelopment of the site in the event that this site is redeveloped.

Issues and opportunities with raising River Road are further discussed in *Section 4.3.2*.



LOCATION:

McCallan Road to No. 2 Road Bridge

RECOMMENDATION:

Raise the dike on the existing alignment with land side expansion. Plan for the long-term raising of River Road.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- City Centre

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded

RMA Presence

- None

PHOTOGRAPH:

North Dike, facing east at Lynas Lane

4.2.5 OVAL

Within the Oval design area, the River Road alignment has been relocated south of development to the former rail corridor. The dike trail is part of a wide landscaped area abutting high rise condos. Redevelopment of the Oval design area began in advance of the 2010 Vancouver Winter Olympics, for which the Richmond Olympic Oval skating and fitness centre was built. The adjacent sites have since been redeveloped as well. The majority of these lands were filled to the dike crest elevation when the dike was raised in conjunction with site redevelopment. This design area is considered complete for the time being as the dike crest elevations vary from 4.0 m to 4.5 m, which is within range of the current 4.7 m target dike crest elevation.

There is one existing building directly west of the Dinsmore Bridge, forming the one remaining section of this design area to be raised. As this building has been set back from the waterfront, there is land available to raise the dike by widening the footprint to the land side at this site. This option may be pursued when this segment of River Road is decommissioned and relocated to the former rail corridor inland.



LOCATION:

No. 2 Road Bridge to
Dinsmore Bridge

RECOMMENDATION:

Existing area generally redeveloped as a superdike scenario (elevations from 4.0 to 4.5m). Future raisings to 5.5m can take place on the existing alignments and integrate into the adjacent landscaping.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- City Centre

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded

RMA Presence

- 5 m & 15 m RMA
Presence

PHOTOGRAPH:

North Dike, facing east at the
Richmond Oval

4.2.6 CITY CENTRE 1

The City Centre 1 design area is presently long-established office industrial sites with sizeable parking lots. All sites have access from River Road, which runs along the waterfront in this design area. Marinas exist along the waterfront. The existing Middle Arm Waterfront Park is a linear park along the waterfront constructed concurrently with the Olympic Oval in 2009. The park's amenities include the dike trail, playgrounds, and piers. Outdoor seating and stages for public events have been inset on the water side dike face. The OCP identifies major changes, including commercial intensification and creation of a large park.

A new park, Middle Arm Park, is proposed in the OCP adjacent to the existing Middle Arm Waterfront Park, as shown on the City Centre Area Plan presented in **Appendix A**. The existing River Road is planned to be realigned to the former rail corridor, and all lands between the rail corridor (the future River Road) and the waterfront are proposed to become the parklands forming Middle Arm Park. A concept sketch¹² is presented in **Figure 9**.

Plans for the new park have not yet been formalized; however, based on consultation with City staff, there is support for establishing the future dike alignment inland to improve public connectivity with the waterfront, and facilitate creation of intertidal habitat within the park. A set-back dike combined with inland raising to create a superdike would provide the most resilient solution for this area. Dike plans should be prepared concurrently with plans for the proposed park.

In the event that the City wishes to fortify the existing dike in advance of the development of Middle Arm Park, the City may consider raising a temporary flood protection adaptation in the interim until the proposed park's plans are finalized and implemented.



Figure 9: 2006 Concept Plan for the Proposed Middle Arm Park



LOCATION:

Dinsmore Bridge to Cambie Road

RECOMMENDATION:

Raise dike with land side expansion. Consider creation of a set-back dike and inland raising (superdike) in conjunction with the future Middle Arm Waterfront Park construction.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- City Centre

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Yellow-coded
- Green-coded

RMA Presence

- None

PHOTOGRAPH:

North Dike at Gilbert Road, facing east

¹² Middle Arm Open Space Master Plan Concept, PFS Studio, December 2006

4.2.7 CITY CENTRE 2

Marinas are present throughout the City Centre 2 design area. The dike trail ends approximately 200 m north of Cambie Road, where the dike becomes marina parking lots. The proposed Middle Arm Park ends where the dike trail becomes parking lots. These parking lots are directly adjacent to the trafficable road; there is no shoulder between the road and the parking lots. Parking lots are raised from River Road with either steep slopes or retaining walls. This section of River Road will ultimately be realigned to the former rail corridor. Lands are planned to be redeveloped into high density commercial and mixed use buildings. Redevelopment of this area has begun.

While the optimal time to implement flood protection adaptations is concurrently with redevelopment of adjacent sites, the parcels of land in this area have narrow frontages, and smaller lot depths. This lot geometry can create challenges in implementing flood protection upgrades alongside redevelopment. These issues can be addressed through site assemblies, as detailed above in *Section 4.1.3*. The approach to flood protection in this area should generally mimic the recent improvements in the Oval area, with redevelopment raising the waterfront and the development site to establish a superdike.

The adaptations along this design area may include sites with floodwalls in order to maintain access and usage of the existing marinas. Any interim dike upgrades planned in this area should be designed with consideration for future adaptations to establish a superdike, the long-term goal in this area.



LOCATION:

Cambie Road to Moray Bridge

RECOMMENDATION:

Raise the dike on the existing alignment with land side expansion in conjunction with redevelopment. Ensure any interim dike upgrades are compatible with the long term strategy of constructing superdikes.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- City Centre

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Yellow-coded
- Green-coded

RMA Presence

- None

PHOTOGRAPH

Float homes off North Dike at Capstan Way

4.2.8 DUCK ISLAND

The Duck Island design area consists of former industrial lands, substantial parking lots and the River Rock Casino, which includes a marina and a wetland. The River Road alignment is inland from Duck Island. The former industrial area, now vacant, hosts the Richmond Night Market in the summer. The landowners of this area are currently seeking development approval to develop the site for commercial uses, consistent with the land uses identified in the OCP.

The existing waterfront lands in the Duck Island design area are entirely privately-owned. The landowners are currently developing private flood protection plans, to be reviewed and approved by the City. The plans are expected to be implemented in the near future, upon approval by the City.

In the event that a suitable strategy is not developed for the private waterfront lands in this area, or if an interim adaptation measure is required, there are inland alternative alignments available to the City to maintain protection for Lulu Island. The alternate alignment would follow River Road or the CN Rail Corridor through this design area. This approach is not preferred; however, details on the alignment and approach are outlined in TM#2 (*Attachment 2*).



LOCATION:

Moray Bridge to Oak Street

RECOMMENDATION:

As per approved development plans. Plan for temporary dike to protect City assets if required to address sea level rise and climate change prior to implementation of the approved strategy at the Duck Island or River Rock Casino sites.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- City Centre

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded
- Yellow-coded
- Green-coded

RMA Presence

- None

PHOTOGRAPH:

Marina at River Rock Casino

4.2.9 INDUSTRIAL

The Industrial design area includes industrial areas and parking lots. The Fraser River Terminal and a BC Hydro power station are located here. River Drive is aligned south of these sites, set back from the waterfront. These lands are anticipated to be industrial uses for the foreseeable future, as noted in the OCP.

The North Arm Bridge carrying the Canada Line and a bikeway was constructed in this design area in 2009 with ample clearance for dike works beneath the bridge deck. At the detailed design stage, dike works would need to be verified for confirmation that the footings can withstand additional loading without risk of settling, or any other risks that may compromise the bridge structure.

Adaptations in this area are constrained by existing waterfront development and uses. This industrial area includes the Fraser River Terminal - a shipping port and ship repair centre - as well as the BC Hydro Kidd #2 Substation. This area is anticipated to be industrial for the foreseeable future. Because waterfront lands are constrained by private industrial uses, the City may consider pursuing a temporary adaptation in the interim until the industrial sites are redeveloped. A temporary structure along the River Drive alignment may be considered. This approach is not preferred; however, details on the alignment and approach are outlined in TM#2 (*Attachment 2*).



LOCATION:

Oak Street Bridge to No. 4 Road

RECOMMENDATION:

Raise the dike on the existing alignment. Site specific solutions may be required at the Fraser River Terminal site. Plan for temporary dike along the alternate alignment if required to address sea level rise and climate change prior to implementation of a strategy at the Fraser River Terminal site.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- City Centre

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded
- Green-coded

RMA Presence

- None

PHOTOGRAPH:

North Dike, west of Fraser River Terminal

4.2.10 BRIDGEPORT TAIT

The Bridgeport Tait design area was formerly entirely industrial. An auto repair facility remains at its eastern edge. The remainder of these lands were recently developed to high-rise multi-family residential, with ongoing development of associated residential and commercial uses.

During site development, the dike crest elevation was raised to 4.7 m and the development lands were filled to a superdike condition. This area is considered complete for the time being. A wide landscaped area exists between the waterfront and the buildings, providing a trail through the neighbourhood at the waterfront. Future dike crest height increases can be accommodated in this area, and integrated with the local landscaping and waterfront trail.



LOCATION:

No. 4 Road to Shell Road

RECOMMENDATION:

Existing area generally redeveloped as a superdike scenario (elevation 4.7m). Future raisings to 5.5 m can take place on the existing alignments and integrate into the adjacent landscaping.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- City Centre

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded
- Yellow-coded

RMA Presence

- None

PHOTOGRAPH:

North Dike, facing west at the Park Riviera Development

4.2.11 INDUSTRIAL NORTH EAST 1

The Industrial NE 1 design area is entirely industrial, and no major changes are outlined in the OCP. Limited space is available in this design area as River Road is either directly on the waterfront or confined by developed lots. Where River Road is adjacent to the waterfront, it will need to be raised concurrently with dike works to meet the target dike crest elevation with a standard trapezoidal cross-section. This may impact driveway access to the lots south of River Road. An interim constrained land side dike toe may be required to mitigate impacts to adjacent lots in the interim until redevelopment and land raising occurs.

A number of small businesses operate on a narrow strip of land between River Road and the waterfront. These lands, approximately 2 ha, are privately owned. The City may consider acquiring these lands to implement diking in this area. The acquisition of approximately 2 ha of private lands north of Simpson Road may add significant costs to diking in this area.

A floodwall may be considered for this section of the design area as an interim solution in advance of the City implementing a permanent trapezoidal dike adaptation. Any interim solutions will require cooperation with the existing landowners. Outside this section, there are lands available from the River Road ROW to the shore to raise the existing dike. At the detailed design stage, if lands are too highly constrained to expand the dike footprint, the City may also consider acquiring additional lands from the parking lots on the south side of River Road.

The Industrial North East 1 LIDMP Study Area is bounded by Bath Slough. Through the Bath Slough Revitalization Initiative, adopted in 2014, the City has conducted a number of innovative ecological initiatives along Bath Slough including water quality improvements, riparian enhancement and native pollinator pasture initiatives. The Bath Slough Revitalization Initiative should be considered in the design and construction phase of diking in this area.



LOCATION:

Shell Road to Bath Slough

RECOMMENDATION:

Raise the dike on the existing alignment. Land acquisition may be required to facilitate construction of a trapezoidal dike (through redevelopment or otherwise). Implementation of a temporary floodwall adjacent to the waterfront lots may be required in advance of a permanent adaptation to address sea level rise and climate change. Consider Bath Slough Revitalization Initiative for future designs.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- Industrial

ESA Habitat Type

- Intertidal
- Shoreline
- Freshwater Wetland

FREMP Data

- Yellow-coded
- Green-coded

RMA Presence

- 15m RMA Presence

PHOTOGRAPH:

North Dike, facing west at No. 5 Road

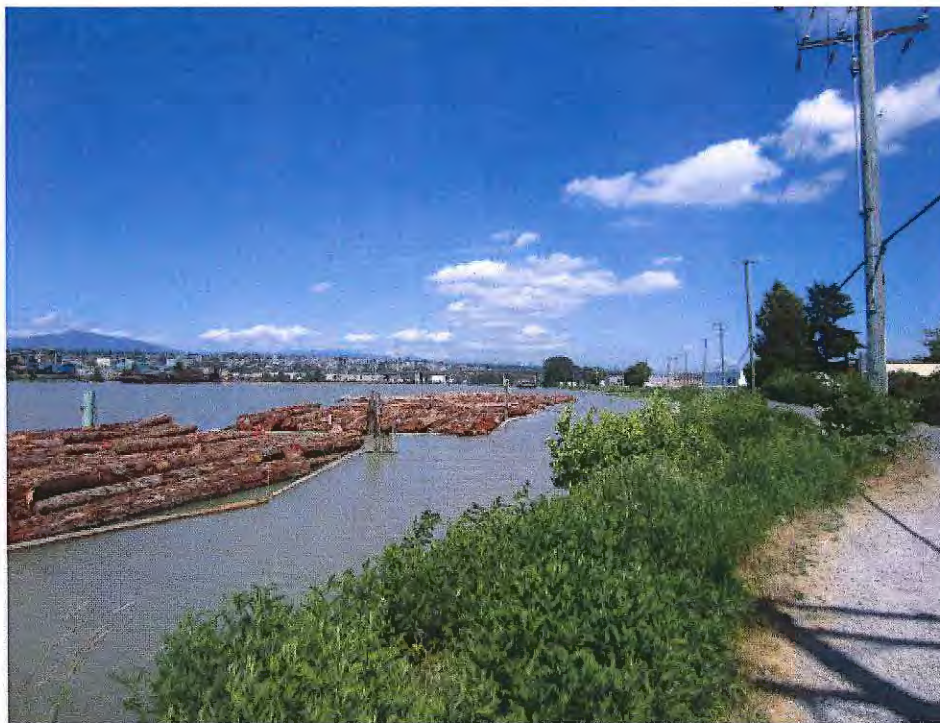
4.2.12 INDUSTRIAL NORTH EAST 2

The Industrial NE 2 design area is entirely industrial. River Road abuts the waterfront. Port Metro Vancouver owns a vacant lot west of the Knight Street Bridge. There are large ditches along the south side of River Road. No major changes to this area are presented in the OCP.

River Road is currently the dike in this design area. There are insufficient lands available north of the road to raise the dike, although the elevation of the entire River Road may be raised. No businesses within this area access the waterfront directly from their lots, therefore maintaining waterfront access for these businesses is not required. Existing drainage on the land side may need to be modified as large ditches are present along River Road.

Public access to the waterfront may be improved by the addition of a trail adjacent to the raised River Road, in compliance with the City's long term vision of a connected trail system at the waterfront of the entire island.

The Industrial North East 2 LIDMP Study Area is bounded by the Bath Slough. Through the Bath Slough Revitalization Initiative, adopted in 2014 the City has conducted a number of innovative ecological initiatives along Bath Slough including water quality improvements; riparian enhancement and native pollinator pasture initiatives. The Bath Slough Revitalization Initiative should be considered in the design construction phase of dike upgrades in this area.



LOCATION:

Bath Slough to Knight Street Bridge

RECOMMENDATION:

Raise the dike on the existing alignment. Additional studies required to quantify drainage, habitat impacts, and costs associated with land side expansion of a trapezoidal dike. A constrained land side slope may be required to integrate with the existing drainage infrastructure. Consider Bath Slough Revitalization Initiative for future designs.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- Industrial

ESA Habitat Type

- Intertidal
- Shoreline
- Freshwater Wetland

FREMP Data

- Red-coded
- Yellow-coded
- Green-coded

RMA Presence

- 15m RMA Presence

PHOTOGRAPH:

North Dike, facing east at Bath Slough Pump Station

4.2.13 INDUSTRIAL NORTH EAST 3

The Industrial NE 3 design area is entirely industrial. River Road abuts the waterfront and provides access to substantial parking lots for associated industrial sites and businesses. There are large ditches along the south side of River Road. No major changes to this area are presented in the OCP.

River Road is currently the dike in this design area. Large natural areas along the waterfront host mature trees, primarily on the north side of the dike. There is also smaller, less established vegetation along the south side of River Road. It is anticipated that the entire road must be raised to implement dike crest increases.

A lumber yard occupies a substantial part of this design area. The City has a ROW through the site over the River Road alignment, however access is blocked off with gates at either end of the lumber yard site. The waterfront trail is also currently blocked off through this area. If ever this site is redeveloped, dike adaptations may be pursued concurrently. However, no major changes to this industrial area are anticipated in the near future.



LOCATION:

Knight Street Bridge to No. 6 Road

RECOMMENDATION:

Raise the dike on the existing alignment. Additional studies required to quantify drainage, habitat impacts, and costs associated with land side expansion of a trapezoidal dike. A constrained land side slope may be required to integrate with the existing drainage infrastructure.

ENVIRONMENTAL CONSIDERATIONS:

ENMS Strategy Area

- Fraser River
- Industrial

ESA Habitat Type

- Intertidal
- Shoreline

FREMP Data

- Red-coded
- Green-coded

RMA Presence

- 15m RMA Presence

PHOTOGRAPH:

Conveyor belt over North Dike at No. 6 Road.

4.3 SITE SPECIFIC ADAPTATIONS

Where existing infrastructure conflicts with the recommended flood protection adaptation, a custom design for that site may be required, or the existing infrastructure may be retrofitted to accommodate diking. Infrastructure including but not limited to pump stations, road or railways, bridges or industrial infrastructure may present site-specific constraints that preclude the implementation of the recommended adaptation for the rest of that design area.

Ideally, dike adaptations are pursued when the adjacent lands are redeveloped. Flood protection measures can then be included in the scope of the proposed works. However, existing infrastructure may be suitable for a design life extending far into the future, farther than the City wishes to defer dike adaptations. In these cases, interim adaptations may be pursued.

Site-specific adaptation designs, whether permanent or temporary, should take into account all the considerations listed in *Section 3*.

4.3.1 BRIDGES

Bridges have unique constraints within a design area. The recommended adaptation for a design area may not be feasible at a bridge site, in which case a site-specific adaptation may be designed to be integrated with the standard adaptation on either side of the bridge.

A list of bridges and the particular constraints that may guide a site-specific adaptation is presented in *Table 4* below. Note that the recommended adaptation strategies in the table are recommended based on adaptations proceeding in advance of any bridge upgrades or replacement. If any bridges are to be upgraded or replaced, flood protection measures at the bridge site should be included within the scope of work.

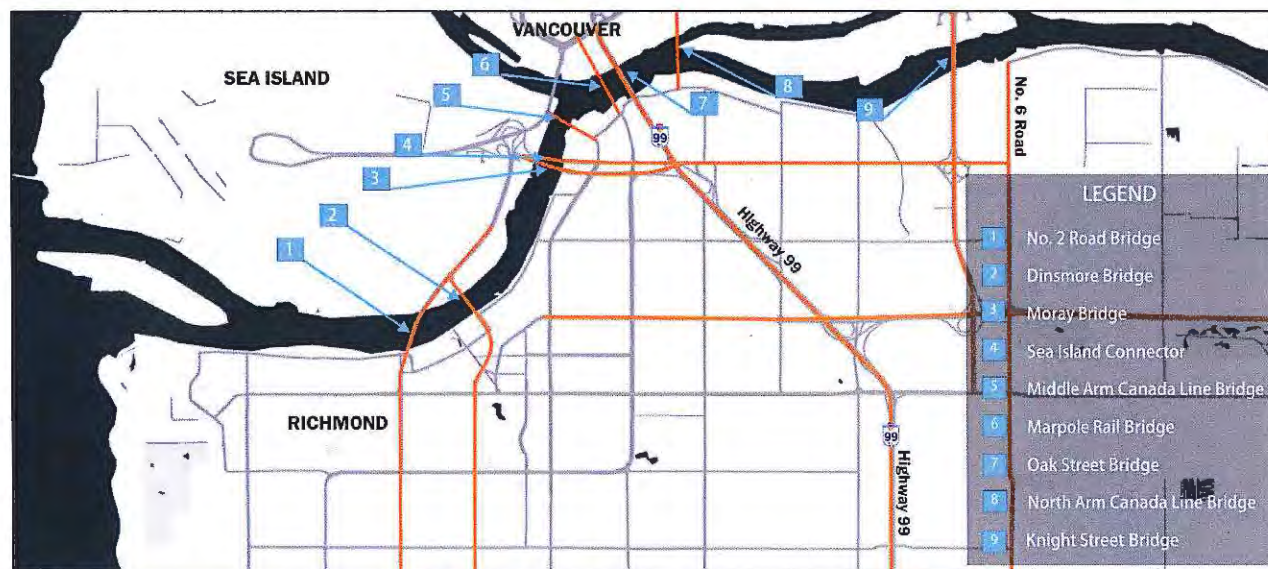
Table 4: Bridge Constraints and Recommended Adaptations

BRIDGE NAME (OWNERSHIP, BRIDGE TYPE)		
AREA	CONSTRAINTS AND CONDITIONS	RECOMMENDED ADAPTATION STRATEGY
1) NO. 2 ROAD BRIDGE (CITY OF RICHMOND, ROAD)		
Oval	- Bridge deck is low. - Footings are under the existing dike. - Bridge crosses over River Road. - Bridge crosses over dike trail. - Bike ramp to bridge from dike trail sensitive to grade changes.	Tied to abutments
2) DINSMORE BRIDGE (CITY OF RICHMOND, ROAD)		
Oval	- Bridge deck is low. - Footings are under the existing dike. - Bridge crosses over River Road with 4.3m clearance. - Bridge crosses over dike trail.	Tied to abutments
3) MORAY BRIDGE (CITY OF RICHMOND, ROAD)		
City Centre 1	- Bridge deck is very low. - Existing dike is inland, not under the bridge. - Bridge does not cross any road or trail. - No waterfront trail currently exists under the bridge. - Existing dike is aligned over the bridge.	Tied to abutments
4) SEA ISLAND CONNECTOR (CITY OF RICHMOND, ROAD)		
City Centre 1	- Bridge deck is very low. - Existing dike is inland, not under a bridge. - Bridge does not cross any road or trail. - No waterfront trail currently exists under the bridge. - Existing dike is aligned over the bridge.	Tied to abutments

BRIDGE NAME (OWNERSHIP, BRIDGE TYPE)		
AREA	CONSTRAINTS AND CONDITIONS	RECOMMENDED ADAPTATION STRATEGY
5) MIDDLE ARM CANADA LINE BRIDGE (TRANSLINK, RAIL)		
Duck Island	• None	Under span
6) MARPOLE RAIL BRIDGE (CP RAIL, RAIL)		
Duck Island	• Bridge deck is low. • Timber trestle bridge; minimal space between footings. • Not currently operational. • Repairs required to return bridge to operational conditions. • CP Rail's intentions for future use are unknown.	Tied to abutments
7) OAK STREET BRIDGE (BC MINISTRY OF TRANSPORTATION, ROAD)		
Duck Island	• None	Under span
8) NORTH ARM CANADA LINE BRIDGE (TRANSLINK, RAIL)		
Industrial	• None	Under span
9) KNIGHT STREET BRIDGE (TRANSLINK, ROAD)		
Industrial NE2	• None	Under span
10) PROPOSED BURKEVILLE PEDESTRIAN BRIDGE (CITY OF RICHMOND, PEDESTRIAN)		
City Centre 1	• Proposed bridge design has not yet been prepared. • Diking to be incorporated when design proceeds.	N/A

The locations of all bridges listed in Table 3 are shown in *Figure 10*.

Figure 10: Bridges in the Study Area



4.3.2 RAISE RIVER ROAD

In the Thompson Terra Nova and Thompson Dover areas, River Road is immediately adjacent to the existing dyke; however, is constructed at a lower elevation to match the existing developed area. It is anticipated that land-side expansion of the existing dike will encroach on River Road. As such, the City should consider raising the grade of River Road from Cornwall Drive to No. 2 Road. The area identified for this strategy is show in *Figure 11*.

Figure 11: Raising River Road in the Thompson Neighbourhood



The benefits to long-term flood protection associated with raising River Road include:

- Improves dike stability and seepage performance;
- Reduce requirement for water-side expansion and impacts to environmental habitat;
- Promotes the long-term increase in site grades for redevelopment of the Thompson Residential Area; and,
- Facilitates future dike crest increases or overbuilding of the existing dike height to accommodate settlement during a seismic event.

Challenges to raising River Road will include:

- Maintaining driveway access and for the single family residential developments;
- Tying the raised River Road into adjacent streets;
- Addressing settlement concerns with underground utilities;
- Planning to cost-effectively stage incrementally raising of River Road; and,
- Addressing potential impacts to RMA's and ESA's.

Raising River Road is then a very long-term strategy to assist with achieving higher waterfront land elevations, and minimize future waterside works to achieve higher crest elevations.

5 Timing of Adaptation Projects

Implementation of adaptations is best pursued alongside adjacent works. For example, when adjacent lands are being developed, dike adaptations can be included in the scope of site redevelopment. If there are substantial works to an area that are upcoming, the City may choose to implement an interim adaptation until those adjoining works proceed.

5.1 REDEVELOPMENT OF SMALL LOTS

Small lots with narrow frontages are highly constrained by grading. There must be adequate lands available to raise a dike immediately to the target crest elevation. In areas where lot sizes are too small to implement adaptations that may immediately achieve the dike crest elevation, lands can be incrementally raised by raising the lots in small intervals each time it is redeveloped. Similarly, the frontage road can be raised by a practical interval whenever substantial road rehabilitation works proceed. This is a very long-term strategy.

The ground elevation of individual lots may be raised as they are redeveloped, however the grading will be constrained by matching neighbouring ground elevations, as well maintaining driveway access to the road. If the road is also raised, then individual lots can be raised higher, however existing lots at relatively low elevations must still have driveway access to the road. This limits the overall height that the frontage road can be raised. Over time, the frontage road and adjoining lots are raised at different times. In this way, the road and surrounding lots are raised in steps. In the very long term, the overall land elevation can be raised to the target dike crest elevation using this strategy. The City may pursue interim adaptations if a greater level of flood protection is deemed to be required before the lands can be raised to the specified elevation.

Where flood protection will be integrated with redevelopment, lot consolidation is preferred to minimize impacts associated with tying in to neighbouring properties.

5.2 LAND ACQUISITIONS & LEGAL ACCESS

The City may need to acquire property where development is immediately adjacent to the waterfront, and bound on the land side by roads, buildings or other assets. Obtaining a sufficient ROW from some properties for diking may effectively sterilize the lot, leaving insufficient space available for development. In those instances, the City may need to acquire the entire property in order to implement dike adaptations. The riverfront lots between Shell Road and No. 5 Road may be candidates for acquisition when dike upgrades proceed in that area, depending on land requirements to implement dike upgrades.

The City should acquire easements where dikes are being constructed on private property. All adaptations on private lands depend on the City being able to secure legal access to the property in order to maintain them.

5.3 RAISING THE TARGET DIKE CREST ELEVATION

The City should monitor sea level rise to pursue flood protection adaptations when higher dike crest elevations become necessary. Presently, all adaptations will be designed to meet the 4.7 m target crest elevation, with consideration for an increase to 5.5 m. Depending on whether sea level rise predictions materialize, the City may wish to raise the target dike crest elevation.

5.4 INTERIM ADAPTATIONS

Temporary adaptations, such as a demountable floodwall, may be necessary where existing conditions are constrained by existing infrastructure (such as bridges, roads, ditches, or buildings) that cannot be impacted or modified to make way for diking. Temporary adaptations may also be pursued in instances where the City cannot yet secure adequate lands or capital to implement the ultimate adaptation.

The timeline until the ultimate adaptation can be implemented should be considered when allocating resources to temporary works. For example, if the interim adaptation will only be in place for a period of a few months, it is likely not worth investing substantial resources into it. Interim adaptations may be considered if necessitated by sea level rise or any other increase in flood risk.

Compatibility with the ultimate adaptation should be considered in the design of any interim adaptation. An interim adaptation should be easily decommissioned, or able to remain in place indefinitely without interfering with the ultimate

adaptation or any other land use. The ultimate adaptations are anticipated to be implemented alongside concurrent waterfront works, as noted in *Table 5*.

Table 5: Triggers to Implementation of Adaptations

AREA	EXISTING	SUMMARY OF RECOMMENDED ADAPTATION	TRIGGER TO IMPLEMENTATION OF RECOMMENDED ADAPTATION
Steveston	Earthfill Dike	Raise Dike on Existing Alignment & Consider Construction of Barrier Islands	City Initiative
Seafair	Earthfill Dike	Raise Dike on Existing Alignment & Consider Construction of Barrier Islands	City Initiative
Terra Nova	Earthfill Dike	Raise Dike on Existing Alignment & Consider Construction of Barrier Islands	City Initiative
Thompson Terra Nova	Earthfill Dike	Raise Dike on Existing Alignment & Plan for Long-term Raising of River Road	River Road is Reconstructed
Thompson Dover	Earthfill Dike	Raise Dike on Existing Alignment & Plan for Long-term Raising of River Road	River Road is Reconstructed
Oval	Superdike	Complete	N/A
City Centre 1	Earthfill Dike	Raise Dike at Waterfront or Set Back & Fill Adjoining Lots to Superdikes	Development of Middle Arm Park
City Centre 2	Earthfill Dike	Raise Dike on Existing Alignment & Fill Adjoining Lots to Superdikes	Redevelopment
Duck Island	Varies	Implement Recommendations of Approved Developer's Plan	Approval of Developer's Plan
Industrial	Varies	Raise Dike on Existing Alignment	Redevelopment of Fraser River Terminal
Bridgeport Tait	Superdike	Complete	N/A
Industrial North East 1	Earthfill Dike	Raise Dike on Existing Alignment	Assembly of Sufficient Lands to Implement Dike Upgrades
Industrial North East 2	Earthfill Dike	Raise Dike on Existing Alignment	Rehabilitation of River Road or Redevelopment of Industrial Sites
Industrial North East 3	Earthfill Dike	Raise Dike on Existing Alignment	Rehabilitation of River Road or Redevelopment of Industrial Sites

6 Implementation Opportunities

Dike upgrades are best undertaken alongside alterations to adjacent lands and infrastructure. In addition to the examples of concurrent infrastructure development noted in the sections above, dike adaptations may present opportunities to implement projects strategically to accomplish other City goals.

6.1 WATERFRONT TRAIL SYSTEM

The City's Parks Planning and Design (Parks) department has identified a goal to improve public access to the waterfront. Recreational trails and linear parks should be considered wherever dikes are modified. Even where waterfront trails are

already present, there may be an opportunity to increase waterfront access by improving trails with ramps or paved surfaces. Dike trails should remain accessible to people using mobility aids, such as wheelchairs or strollers.

The Parks department's preference is to have a trail directly adjacent to the water, without any rerouting inland, even if this means trails are sometimes flooded.

6.2 INTERTIDAL ZONES

Dike adaptations that proceed alongside the development of waterfront parks may be suited to the concurrent development of intertidal zones, to create additional habitat. The local ecosystem's productivity may be increased by providing a rich riparian environment. These intertidal zones may be integrated with the typical foreshore rip rap or other erosion protection by inseting habitat at lower elevations to be closer to the daily water level, and flooded during high water events. Projects incorporating the development of intertidal habitat may be designated as compensation sites for alterations required in environmentally sensitive areas.

6.3 HABITAT BANKING

As the Study Area lies within intertidal, shoreline and upland riparian habitat, environmental impact may be unavoidable. Environmental assessments and valuation will be undertaken in the design construction phase, where possible habitat impact will be avoided. Where impact cannot be avoided, efforts will be made to mitigate, and if necessary compensate for impact following a net gain approach. To achieve a net gain approach to compensation the City may consider establishing a formal habitat banking program. Habitat banking guidelines should articulate appropriate compensation ratios by habitat type, monitoring periods and success measures for created or enhanced habitat. Additionally a hierarchy of compensation options may be considered that replaces habitat types in order of priority as follows:

- Create or increase productive capacity of like for like habitat within the same ecological unit;
- Create or increase the productive capacity of unlike habitat in the same ecological unit; and
- Create or increase the projective capacity of habitat in a different ecological unit.

Habitat credits could be applied to multiple projects, or stored for future dike works. A formal habitat banking program may assist with the implementation of long term flood protection infrastructure upgrade programs.

7 Recommendations

Key recommendations for the Phase 2 LIDMP Study Area are outlined as follows:

1. Plan to raise the existing dike on its existing alignment.

The existing dike alignment along the waterfront is established and well defined. There is limited basis to support any major changes to the alignment of the existing dike, thus the recommendations are generally in keeping with traditional dike crest increases, with consideration for area specific constraints and opportunities.

2. Prepare conceptual level designs for the West Dike upgrades and conduct drainage and environmental studies on the alternatives.

Future crest height increases to the West Dike will required landside or waterside expansion. Both will have impacts to either intertidal, or upland riparian habitat. Environmental impacts should be quantified, and an approach of avoid, mitigate, and compensate following a net gain approach should be used to in evaluating the preferred strategy.

Landside expansion will impact drainage infrastructure. Impacts should be quantified to identify potential internal drainage network upgrades required if landside expansion is the preferred alignment.

3. Continue to monitor sea level rise.

Design crest height elevations are selected with consideration for climate change and sea level rise predictions. The City should continue to monitor sea level rise and adjust crest height targets and City flood protection police as required to address any changes in predicitions.

4. Plan to establish a habitat banking program for dike improvement projects.

Where impact to habitat cannot be avoided, efforts will be made to mitigate, and if necessary compensate for impacts following a net gain approach. To achieve a net gain approach to compensation, the City may consider establishing a formal habitat banking program. Habitat banking guidelines should outline appropriate compensation ratios by habitat type, monitoring periods, and success measures.

5. Plan for implementation of offshore protection along the West Dike as a response to climate change and sea level rise.

Sea level rise and upland limitations to natural accretion within the Sturgeon Bank WMA could result in increased offshore depths beyond the West Dike, which could simultaneously increase wave heights reaching the West Dike. Offshore barrier islands are one option to consider to dissipate wave energy prior to reaching the west dike, thereby minimizing future dike crest increases.

With appropriate environmental consideration during design and construction, breakwaters and barrier islands can create intertidal habitat, such as sand flats, mud flats, salt marsh and eelgrass beds. These features can assist with erosion and wave attenuation. The intertidal habitat can work in combination with a constructed flood control structures like dikes and floodwalls, to mitigate flood risk.

The City should continue to coordinate with relevant agencies including (Port of Vancouver, Fisheries and Oceans Canada, and others) to research and identify opportunities to improve flood protection and enhance intertidal habitats in the Sturgeon Bank WMA and throughout the Fraser River Estuary.

6. Plan to raise River Road in the Thompson neighborhood.

The existing dike in the Thompson Neighborhood is confined by the Fraser River and River Road. Increasing the grade of River Road will improve dike stability and resilience; and minimize requirement to expand the dike into the Fraser River. The City should plan to incrementally raise River Road.

7. Consider acquiring land to accommodate future dike construction between Shell Road and No. 5 Road.

Land acquisition may be required to accommodate construction of a future trapezoidal dike between Shell Road and No. 5 Road. It is anticipated that acquisition will primarily be achieved through redevelopment, however, where redevelopment does not occur; the City may consider opportunistic land purchase to accommodate future dike crest height increases in the area. Plan to complete a conceptual design of the future dike through the constrained area to verify the future dike footprint.

8. Plan for the long-term raising of lands adjacent to and inland of the existing dikes.

Long term raising of land levels has previously been recommended (2008-2031 Flood Protection Strategy). Maximizing the width of raised land adjacent to the river decreases flood and seismic risks by increasing the integrity of the dike. Plan to raise the ground elevation of waterfront development sites to the prescribed dike crest elevation.

9. Support site assemblies along the waterfront that promote cohesive adaptations for flood protection.

Large developments along the waterfront allow for major improvements to flood protection infrastructure and often result in robust superdike conditions.

10. Consider enhanced floodproofing through amendments to the FCL Bylaw

The City's Flood Construction Level (FCL) Bylaw establishes minimum levels to which land needs to be raised. Amending the FCL bylaw is the recommended area wide strategy to regulate raising ground elevations with redevelopment to improve flood protection throughout the Study Area. Plan to conduct an assessment on the implementation of a modified FCL bylaw.

11. Facilitate public access to the waterfront.

Integrate new trails and trail improvements with diking projects; provide trails and waterfront recreation areas that are accessible to persons using mobility aids; and, route any new trails along the waterfront instead of rerouting the trail inland.

8 Closure & Next Steps

Parsons has characterized the existing conditions and constraints of the Study Area, and has established and recommended preferred area wide and area specific adaptation strategies for the City's consideration.

The recommended next steps to finalize the Phase 2 LIDMP are:

1. Council Review;
2. Key External Stakeholder Review;
3. Public Information Session and Consultation;
4. Revise the Draft Final Master Plan Report per consultation if required; and
5. Council adoption of the Final Master Plan

Regards,

DRAFT

Reviewed By:

DRAFT

Evelyne Russell, EIT
Project Engineer

Todd Bowie, P.Eng
Project Manager



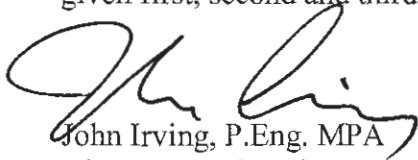
City of Richmond

Report to Committee

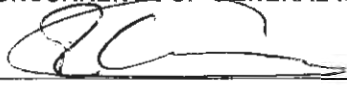
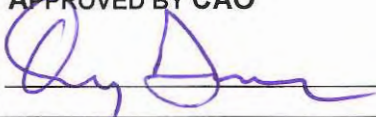
To: Public Works and Transportation Committee **Date:** January 10, 2017
From: John Irving, P.Eng. MPA **File:** 03-1000-08-030/Vol 01
Director, Engineering
Re: DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643

Staff Recommendation

That DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643 be introduced and given first, second and third readings.


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

Att. 1

REPORT CONCURRENCE		
ROUTED TO:	CONCURRENCE	CONCURRENCE OF GENERAL MANAGER
Finance Department	☒	
Law	☒	
Development Applications	☒	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS: DW	APPROVED BY CAO 

Staff Report

Origin

In addition to Development Cost Charges (DCCs) applicable city-wide, local area DCCs are collected for the Alexandra neighbourhood within the West Cambie Area, as per Development Cost Charges Imposition Bylaw No. 8024.

Per West Cambie Area Plan, forming part of the Official Community Plan Bylaw No. 7100, developers are responsible for the construction of local roads along their frontages. Where specified roads are included in the Local Area DCC Program, developers are eligible for DCC rebates via front-end agreements for the cost of land and construction of the specified roads.

The developer for 4000 May Drive has completed the construction and dedication of their road frontages, which are included in the Alexandra Neighbourhood Roads DCC Program, and has requested a front-end agreement to recover a portion of their costs.

This report outlines the proposed DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643, which includes the authorization to execute a DCC front-end agreement with the developer for 4000 May Drive and to release DCC Reserve Funds in respect of their land and construction costs.

This report supports Council's 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.

6.2. Infrastructure is reflective of and keeping pace with community need.

Analysis

Pursuant to section 566(2) of the Local Government Act, money in development cost charge reserve funds, such as the Alexandra Neighbourhood Roads DCC Program, may be used to pay the capital costs of providing and constructing sewage, water, drainage and highway (road) facilities, and to pay a person who incurred such capital costs if the project was completed under an agreement between that person and the City.

Aga Khan Foundation, with the assistance of Larco Investments Ltd. (collectively, "the developer"), has completed frontage road construction as per their servicing agreement with the City and transferred ownership of the dedicated road areas to the City. The fronting roads are included in the Alexandra Neighbourhood Roads DCC Program, as identified by sections C7 and L1 in the proposed agreement (Attachment 1, Schedule A).

The allocated values for these fronting roads under the Alexandra Neighbourhood Roads DCC Program are as follows:

- Road segment C7 (May Drive from Cambie Road to McKim Way)
 - Land \$1,627,503.26
 - Construction \$251,117.97
- Road segment L1 (May Drive from McKim Way to Odlin Road)
 - Land \$1,424,065.35
 - Construction \$175,940.70

Pursuant to section 566(3) of the Local Government Act, the authority to make payments from the Alexandra Neighbourhood Roads DCC Program reserve fund must be authorized by bylaw. As such, staff recommend that DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643, which authorizes the execution of the DCC front-end agreement by the Chief Administrative Officer and the General Manager, Engineering and Public Works, on the terms detailed below, and authorizes the release of DCC reserve funds as set out below and in further detail in the proposed agreement (Attachment 1), be introduced and given first, second and third readings.

The following are the key terms and conditions of the proposed DCC front-end agreement with Aga Khan Foundation and Larco Investments Ltd.:

- The developer contributed 43.1% of the land and 50% of the construction value for road segment C7.
- The developer contributed 57.6% of the land and 20% of the construction value for road segment L1.
- DCC rebates pertaining to land dedication are payable to Aga Khan Foundation, the property owner.
- DCC rebates pertaining to construction are payable to Larco Investments Ltd., which provided funding for the road construction.
- The maximum compensation payable to the developer is \$1,682,463 (\$1,521,716 to Aga Khan and \$160,747 to Larco Investments Ltd.)
- The agreement is in effect until the earlier of:
 - i. 15 years from the completion date of road construction – January 21, 2031; or
 - ii. the City has collected and remitted all applicable payments to Aga Khan and Larco, as described in the agreement, whichever comes earlier.
- Initial payment to the developer is based on DCC amounts collected to date for the neighbourhood.
- Subsequent payments will occur annually based on updated DCC amounts collected.

Financial Impact

Upon execution of the agreement, initial payment to the developer will be \$509,849, based on DCC amounts collected to date for the neighbourhood. Subsequent payments will occur annually based on updated DCC amounts collected. The maximum compensation payable to the developer is \$1,682,463, and payments will be made from the West Cambie Roads DCC balance.

Conclusion

The developer for 4000 May Drive has completed the construction and dedication of their road frontages, which are included in the Alexandra Neighbourhood Roads DCC Program, and has requested a front-end agreement to recover a portion of their costs. Staff recommend that DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643 be introduced and given first, second and third readings, to authorize the execution of the DCC front-end agreement by the Chief Administrative Officer and the General Manager, Engineering and Public Works and the release of DCC reserve funds as set out in the attached DCC front-end agreement.



Lloyd Bie, P.Eng.
Manager, Engineering Planning
(4075)



for Jason Ho, P.Eng.
Project Engineer
(1281)

LB:jh

Att. 1: DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643



**City of
Richmond**

Bylaw 9643

DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643

WHEREAS the Council has established a development cost charge reserve fund for road construction in the Alexandra Area (the "DCC Reserve Fund"); and

AND WHEREAS pursuant to sections 566(2) and 566(3) of the *Local Government Act*, Council intends to expend a portion of the monies set aside in the DCC Reserve Fund to reimburse a developer who has built part of the works that form the basis of the calculations for the development cost charges paid into the DCC Reserve Fund;

NOW THEREFORE, The Council of the City of Richmond, enacts as follows:

1. Council authorizes the execution of the DCC Front-End Agreement in substantially similar form to that attached hereto as Schedule "A" by the Chief Administrative Officer and the General Manager, Engineering and Public Works.
2. Council authorizes the expenditure of up to \$1,682,463 (the "expenditure") from the DCC Reserve Fund on account of May Drive land acquisition and road works, in accordance with the terms of the DCC Front-End Agreement attached hereto as Schedule "A".
3. Should any of the above expenditure remain unexpended after the expenditure hereby authorized has been made, any unexpended balance shall be returned to the credit of the DCC Reserve Fund.
4. This Bylaw is cited as "DCC Reserve Fund Expenditure (4000 May Drive) Bylaw No. 9643".

FIRST READING

SECOND READING

THIRD READING

ADOPTED

MAYOR

CORPORATE OFFICER

CITY OF RICHMOND
APPROVED for content by originating dept. <i>UB</i>
APPROVED for legality by Solicitor <i>JH</i>

DEVELOPMENT COST CHARGE FRONT-ENDER AGREEMENT

ALEXANDRA AREA ROADS DCC PROGRAM

THIS AGREEMENT made as of _____, 2016 (the "Commencement Date").

BETWEEN:

CITY OF RICHMOND
6911 No. 3 Road
Richmond, B.C. V6Y 2C1

(the "City")

AND:

AGA KHAN FOUNDATION (CANADA)
Incorporation No. XS-0016100
199 Sussex Dr.
Ottawa, Ontario K1N 1K6

(the "Developer")

AND:

LARCO INVESTMENTS LTD.
Incorporation No. BC0436664
Third Floor, 100 Park Royal
West Vancouver B.C. V7T 1A2

(**"Larco"**)

WHEREAS:

- A. Five (5) legal parcels were consolidated to create Lot A (hereinafter defined) pursuant to a subdivision plan filed September 26, 2013 assigned number EPP32741 (the "**Subdivision Plan**");
- B. The five (5) legal parcels referred to in Recital A of this Agreement are legally described as follows:
 - a) West half of Lot 10 Block A Section 34 Block 5 North Range 6 West NWD Plan 1224;
 - b) East half of Lot 10 Block A Section 34 Block 5 North Range 6 West NWD Plan 1224;

- c) West half of Lot 19 Block A Section 34 Block 5 North Range 6 West NWD Plan 1224;
 - d) East half of Lot 19 Block A Section 34 Block 5 North Range 6 West NWD Plan 1224; and
 - e) East half of Lot 20 Block A Section 34 Block 5 North Range 6 West NWD Plan 1224;
- C. Pursuant to the filing of the Subdivision Plan, certain lands were dedicated as road;
- D. Due to the filing of the Subdivision Plan, the Developer became the registered and beneficial owner of lands legally described as:
- PID: 029-176-263 Lot A, Section 34, Block 5 North, Range 6 West, New Westminster District, Plan EPP32741
- (**"Lot A"**)
- E. Pursuant to a Servicing Agreement dated August 22, 2013 (application SA 10-530663), between the City and the Developer (the **"Servicing Agreement"**), the Developer, has with the assistance of Larco, at the Developer's and Larco's expense, undertaken the construction of certain road works more particularly described in the Servicing Agreement (the **"Road Works"**) and have since transferred ownership of the Road Works, including the dedication of road areas as highway to the City at no cost to the City;
- F. While the Developer alone was defined as the Developer in the Servicing Agreement, only Larco paid the cost of the construction of the Road Works, and only the Developer contributed land through the road dedication
- G. Proposed road works for the Alexandra Area (as described in City of Richmond *Development Cost Charges Imposition Bylaw No. 8024*, as amended from time to time (the **"DCC Bylaw"**)) are contained within the City's Official Community Plan, adopted under Bylaw 7100, for the West Cambie Area;
- H. Section 1.1.1 and Schedule F of the DCC Bylaw provide for supplementary development cost charges in the Alexandra Area in addition to the development cost charges applicable city-wide in Richmond;
- I. The total lands that benefit from the Road Works and are therefore benefiting lands within the Alexandra DCC area, excluding parks, schools and lands owned by the City, are all the lands shown within the dotted outline on Schedule A of this Agreement (the **"Benefiting Lands"**);

- J. The City created the Alexandra Area Road DCC Program which that the owners of the Benefiting Lands shall pay development cost charges to the City when they apply for a subdivision or a building permit to a maximum of \$24,439,792.00 being the total Alexandra Area Road DCC Program value including land and construction for all the north south roads as shown on the attached Schedule A within the dotted line including related signal, turning bays and other related installations;
- K. The City created the Alexandra Area Road DCC Reserve Fund into which it shall deposit the funds received pursuant to the Alexandra Area Road DCC Program;
- L. This Agreement concerns that area labelled "May Drive" on Schedule A attached hereto between Cambie Road and McKim Way (also known as "Road Segment C7") ("**May Drive C7**") and between McKim Way and Odlin Road (also known as "Road Segment L1") ("**May Drive L1**", together with May Drive C7, "**May Drive**").
- M. The allocated value of land acquisition and the Road Works under the Alexandra Area Roads DCC program for May Drive C7 is \$1,878,621.23 (being land value of \$1,627,503.26 and construction value of \$251,117.97) and for May Drive L1 is \$1,600,006.05 (being land value of \$1,424,065.35 and construction value of \$175,940.70);
- N. The City, as of the date of this Agreement, has provided \$0 development cost charge credits to the Developer and to Larco;
- O. The Developer contributed 43.1% of the land value for May Drive C7 by way of Subdivision Plan EPP32741 and 57.6% of the land value for May Drive L1 by way of Subdivision Plan EPP32741;
- P. Larco constructed permanent works associated with half of the ultimate road configuration, amounting to 50% of the road construction value for May Drive C7, and constructed permanent works associated with the east sidewalk, placement of road base material for approximately 35% of the total road width, and temporary road pavement for approximately half of the ultimate road configuration, amounting to 20% of the road construction value for May Drive L1;
- Q. The maximum compensation payable to the Developer and Larco under this Agreement is \$1,682,463.00 (the "**Agreement Value**"), being \$827,013.00 with respect to May Drive C7 and \$855,450.00 with respect to May Drive L1, which Agreement Value is to be divided between the Developer and Larco as follows:
 - 1) \$1,521,716.00 to the Developer (the "**Developer's Agreement Value**"); and
 - 2) \$160,747.00 to Larco (the "**Larco's Agreement Value**"); and

R. Council of the City adopted a bylaw on _____, 2017, authorizing:

- 1) the parties to enter into this Development Cost Charge Front-end Agreement pursuant to sections 933(8) and 935 of the *Local Government Act*, for the provision of the Road Works; and
- 2) the payment to the Developer and Larco of the amounts described in this Agreement from the City's Alexandra Area Roads DCC Reserve Fund, in accordance with this Agreement.

NOW THEREFORE in consideration of the mutual promises contained in this Agreement and for other good and valuable consideration (the receipt and sufficiency of which is hereby acknowledged by the parties), the parties agree as follows:

Term

1. The term of this Agreement begins on the Commencement Date and terminates on the earlier of:
 - (a) January 20, 2031 (being 15 years after the Completion Date (hereinafter defined)); and
 - (b) the date the City has collected and remitted all applicable payments to the Developer as described in this Agreement,
 (the "Term").
2. The Developer acknowledges and agrees that this Agreement and the obligations of the City under this Agreement terminate on January 20, 2031, even if all applicable Development Cost Charges have not been collected in respect of the Benefiting Lands.
3. Despite section 1 of this Agreement, sections 4, 28, 29, 31, 33, and 34 shall survive the expiration or earlier termination of this Agreement

Representations and Warranties

4. The Developer represents and warrants to the City that:
 - (a) the Road Works have been completed in the manner set-out in the Servicing Agreement;
 - (b) the Road Works were completed on January 21, 2016 and the City accepted the condition of the Road Works in writing by issuing a Certificate of Completion (the "Completion Date");

- (c) the Developer is absolutely entitled to any and all Alexandra Road DCCs (defined in section 10 below) payable pursuant to this Agreement;
- (d) the Developer has not assigned any of its right, title or interest in the Alexandra Road DCCs (hereinafter defined), except to Larco with respect to the construction of the Road Works;
- (e) the information set out in Schedule A of this Agreement is true and correct;
- (f) as of the date of this Agreement, the actual cost incurred by the Developer to construct the Road Works, excluding GST, is \$0;
- (g) the allocated value of land acquisition under the Alexandra Area Roads DCC program for May Drive is \$3,051,568.61 (being the land value of \$1,627,503.26 for May Drive C7 and \$1,424,065.35 for May Drive L1);
- (h) the maximum compensation payable to the Developer under this Agreement from the City's Alexandra Area Roads DCC Reserve Fund is the Developer's Agreement Values (defined above), being \$1,521,716 less \$0 being development cost charge credits already provided to the Developer;
- (i) the Developer has not received, claimed, demanded or collected money or any other consideration from any owner of the Benefiting Lands for the provision of, or in expectation of the provision of, the Road Works, other than as contemplated by this Agreement; and
- (j) the Developer has not entered into any agreement or legal obligation with any owner of the Benefiting Lands for consideration in any way related to or connected directly or indirectly with the provision of the Road Works.

5. Larco represents and warrants to the City that:

- (a) the Road Works have been completed in the manner set-out in the Servicing Agreement;
- (b) the Road Works were completed on the Completion Date;
- (c) the Developer has assigned its right, title or interest in the Alexandra Road DCCs with respect to the construction of the Road Works to Larco;
- (d) the information set out in Schedule A of this Agreement is true and correct;
- (e) as of the date of this Agreement, the actual cost incurred by Larco to construct the Road Works, excluding GST, is \$1,037,400;

- (f) the allocated value of the Road Works under the Alexandra Area Roads DCC program for May Drive is \$427,058.67 (being the construction costs of \$251,117.97 for May Drive C7 and \$175,940.70 for May Drive L1);
- (g) the maximum compensation payable to Larco under this Agreement from the City's Alexandra Area Roads DCC Reserve Fund is Larco's Agreement Value (defined above), being \$160,747 less \$0 being development cost charge credits already provided to Larco;
- (h) Larco has not received, claimed, demanded or collected money or any other consideration from any owner of the Benefiting Lands for the provision of, or in expectation of the provision of, the Road Works, other than as contemplated by this Agreement; and
- (i) Larco has not entered into any agreement or legal obligation with any owner of the Benefiting Lands for consideration in any way related to or connected directly or indirectly with the provision of the Road Works.

DCC Front-Ender Works

- 6. The Developer is solely responsible for the design, engineering and construction of the Road Works and for retaining consultants and entering into any contracts required to construct the Road Works, including with Larco, subject to the direction of the City.
- 7. The following tables set out items and amounts paid for with the collected Alexandra Road DCCs (hereinafter defined) and the payments to the Developer and Larco:

Table 1 – Contributions for the Developer

Item	Item Description	Value (\$)
(a)	Total Alexandra Area Road DCC Program value relating to the area outlined in Schedule A, comprising:	24,439,792
	- land and construction costs for all north-south roads (\$19,285,340.00), and	
	- related signals and turning bays required for the entire area, including arterial road improvements (\$5,154,452.00)	
(b)	Gross Alexandra Area Road DCC's collected, as of Dec 31, 2015	7,406,170
ROAD SEGMENT C7 (May Drive between Cambie Road and McKim Way)		
(c-1)	Road Segment C7 – Land acquisition value	1,627,503
(d-1)	% of land acquisition contribution from Developer to Road Segment C7	43.10%

(e-1)	% of Developer contribution to total DCC program = $[(c-1)(d-1)/a]$	2.87%
(f-1)	Agreement Value (max compensation to Developer for Road Segment C7 = $(e-1)*a$	701,454
(g-1)	Portion of DCC collected payable to Developer on Dec 31, 2015 = $(e-1)*b$	212,567
(h-1)	Total DCC credits/Front-End Agreement Payments already provided to Developer	0
(i-1)	The DCC Front-End Agreement Payment Value = $(g-1)-(h-1)$. (If this value is negative no payment will be made at this time)	212,567
(j-1)	As of the Commencement Date, the outstanding value of this Front-End Agreement payable to the Developer for Road Segment C7 = $(f-1)-(h-1)-(i-1)$	488,887
ROAD SEGMENT L1 (May Drive between McKim Way and Odlin Road)		
(c-2)	Road Segment L1 – Land acquisition value	1,424,065
(d-2)	% of land acquisition contribution from Developer to Road Segment L1	57.60%
(e-2)	% of Developer contribution to total DCC program = $[(c-2)(d-2)/a]$	3.36%
(f-2)	Agreement Value (max compensation to Developer for Road Segment L1 = $(e-2)*a$	820,262
(g-2)	Portion of DCC collected payable to Developer on Dec 31, 2015 = $(e-2)*b$	248,570
(h-2)	Total DCC credits/Front-End Agreement Payments already provided to Developer	0
(i-2)	The DCC Front-End Agreement Payment Value = $(g-2)-(h-2)$. (If this value is negative no payment will be made at this time)	248,570
(j-2)	As of the Commencement Date, the outstanding value of this Front-End Agreement payable to the Developer for Road Segment L1 = $(f-2)-(h-2)-(i-2)$	571,692
Total Payments		
(k)	The Total DCC Front-End Agreement Payment Value for payment to the Developer = $(i-1)+(i-2)$	461,137
(l)	As of the Commencement Date, the outstanding value of this Front-End Agreement payable to the Developer = $(j-1)+(j-2)$	1,060,579

Table 2 – Contributions for Larco

Item	Item Description	Value (\$)
(a)	Total Alexandra Area Road DCC Program value relating to the area shown outlined in broken bold on Schedule A, comprising:	24,439,792
	- land and construction costs for all north-south roads (\$19,285,340.00), and	
	- related signals and turning bays required for the entire area, including arterial road improvements (\$5,154,452.00)	
(b)	Gross Alexandra Area Road DCC's collected to Dec 31, 2015	7,406,170
ROAD SEGMENT C7 (May Drive between Cambie Road and McKim Way)		
(c-1)	Road Segment C7 – Roadwork construction value	251,118
(d-1)	% of permanent roadworks construction contribution from Larco to Road Segment C7	50.00%
(e-1)	% of Larco contribution to total DCC program = [(c-1)(d-1)/a]	0.51%
(f-1)	Agreement Value – max compensation to Larco for Road Segment C7 = (e-1)*a	125,559
(g-1)	Portion of DCC collected payable to Larco on Dec 31, 2015 = (e-1)*b	38,049
(h-1)	Total DCC credits/Front-End Agreement Payments already provided to Larco	0
(i-1)	The DCC Front-End Agreement Payment Value = (g-1)-(h-1). If this value is negative no payment will be made	38,049
(j-1)	As of the Commencement Date, the outstanding value of this Front-End Agreement payable to Larco for Road Segment C7 = (f-1)-(h-1)-(i-1)	87,510
ROAD SEGMENT L1 (May Drive between McKim Way and Odlin Road)		
(c-2)	Road Segment L1 – Roadwork construction value	175,941
(d-2)	% of permanent roadworks construction contribution from Larco to Road Segment L1	20.00%
(e-2)	% of Larco contribution to total DCC program = [(d-2)(e-2)/a]	0.14%
(f-2)	Agreement Value – max compensation to Developer for Road Segment L1 = (e-2)*a	35,188
(g-2)	Portion of DCC collected payable to Larco on Dec 31, 2015 = (e-2)*b	10,663
(h-2)	Total DCC credits/Front-End Agreement Payments already provided to Larco	0

(i-2)	The DCC Front-End Agreement Payment Value = (g-2)-(h-2). If this value is negative no payment will be made	10,663
(j-2)	As of the Commencement Date, the outstanding value of this Front-End Agreement payable to Larco for Road Segment L1 = (f-2)-(h-2)-(i-2)	24,525
Total Payments		
(k)	The Total DCC Front-End Agreement Payment Value for payment to Larco = (i-1)-(i-2)	48,712
(l)	As of the Commencement Date, the outstanding value of this Front-End Agreement payable to Larco = (j-1)+(j-2)	112,035

8. The Developer and Larco have facilitated the design, engineering and construction of the Road Works through the provision of funds as set out in this Agreement.
9. The City is not responsible for financing any of the costs of the Road Works.

Calculation and Collection of Alexandra Road DCCs

10. In consideration of the land dedication by the Developer and the completion of the Road Works by Larco to the satisfaction of the City's General Manager of Engineering and Public Works, without incurring any cost to the City, the City agrees to impose and collect from the owners of the Benefiting Lands the road Development Cost Charges payable by them when they seek to subdivide or obtain a building permit (the "Alexandra Road DCCs").
11. The events upon which the City is obliged to impose and collect Alexandra Road DCCs with respect to a parcel within the Benefiting Lands are the earlier of:
 - (a) the approval of a subdivision; and
 - (b) the issuance of a building permit authorizing construction, alteration or extension of a new building or structure,

although, in practice, the City usually collects Development Cost Charges at the time of building permit issuance.
12. The Developer and Larco agree that the City is to calculate all Alexandra Road DCCs, and that the City's determination of such amounts is in each case conclusive and binding on the Developer and Larco.

Payment for DCC Front-End Works

13. The City shall pay to the Developer the sum of the Developer's Agreement Value, excluding GST, as follows:
 - (a) \$509,849.00 initial payment in accordance with item (k) in the Table 1 in Section 7 of this Agreement; and
 - (b) subsequent payments will be calculated based on a review of items (b) through (h) and (l) inclusive of the Table 1 in section 7 of this Agreement and to the extent of the Alexandra Road DCCs collected during the Term from the Benefiting Lands in accordance with sections 10 and 11 of this Agreement.
14. The City shall pay to Larco the sum of Larco's Agreement Value, excluding GST, as follows:
 - (a) \$48,712.00 initial payment in accordance with item (k) in the Table 2 in Section 7 of this Agreement; and
 - (b) subsequent payments will be calculated based on a review of items (b) through (h) and (l) inclusive of the Table 2 in section 7 of this Agreement and to the extent of the Alexandra Road DCCs collected during the Term from the Benefiting Lands in accordance with sections 10 and 11 of this Agreement.
15. Subject to there being sufficient reserves in the City's account designated for this purpose, the City will remit the amounts described in section 13(b) to the Developer and the amounts described in section 14(b) to Larco following the City's financial audit or on or before June 30th of each year of the Term, in accordance with City policies and procedures from time to time.
16. If there are any unpaid payments due to there being insufficient reserves in the City's account designated for this purpose, the City will pay such payments upon being in receipt of sufficient reserves in the City's account designated for this purpose.
17. After the Term has expired, the City shall have no further obligation to the Developer or to Larco to make any payment pursuant to this Agreement.
18. The Developer and Larco acknowledge and agree that no interest is payable by the City on Alexandra Road DCCs for the period between their receipt by the City and their payment to the Developer to the sum of the Developer's Agreement Value and to Larco to the sum of Larco's Agreement Value.
19. The Developer and Larco acknowledge and agree that the City is not obliged to make any payments under this Agreement except to the extent that the owner of a parcel within the Benefiting Lands has actually paid Alexandra Road DCCs to the City.

20. The Developer and Larco acknowledge and agree that once the City has fully paid out the total Alexandra Area Road DCC Program value (\$24,439,792.00), the City may elect in its sole discretion (subject however to compliance with any City bylaw requirements) to discontinue collecting Alexandra Area Roads DCCs.
21. The Developer and Larco acknowledge and agree that it is possible that the City may not ever fully reimburse the Developer and/or Larco for all their costs in providing the land dedicated for Road and in providing the Road Works. Accordingly, the Developer and Larco acknowledge and agree that they will not make a claim against the City or City Personnel for any lack of full reimbursement for all the Developer's costs and Larco's costs in providing the land dedicated for Road and the Road Works.
22. The Developer acknowledges and agrees that the City does not owe the Developer any monies for the cost of the Road Works.
23. The Developer warrants and represents to the City that the Developer did not contribute any monies towards the Road Works.
24. Larco acknowledges and agrees that the City does not owe Larco any monies pursuant to the land dedicated for Road.
25. Larco warrants and represents to the City that Larco did not provide any land dedicated for May Drive.
26. The Developer and Larco shall each provide the City from time to time with a current address(es) to which amounts payable under this Agreement may be sent by ordinary mail, if such address is different from the addresses first set-out above. If the Developer and/or Larco fails to provide such address to the City and amounts sent to the address set out in this Agreement or the most recently provided address are returned to the City, the City may retain such amounts for its own use and is thereafter discharged from any obligation to remit the remaining Alexandra Road DCCs.
27. The Developer and Larco direct that the amounts payable to the Developer and Larco pursuant to this Agreement from the City's Alexandra Area Roads DCC Reserve Fund be paid as follows:
 - a) To the Developer re May Drive C7: 2.87% of whatever amounts the City collects each year of the Term in connection with the Alexandra Area DCC Charges (such amounts collected determined in the City's sole discretion), with the total maximum value to be paid under this agreement being \$701,454;
 - b) To the Developer re May Drive L1: 3.36% of whatever amounts the City collects each year of the Term in connection with the Alexandra Area DCC Charges (such amounts

collected determined in the City's sole discretion), with the total maximum value to be paid under this agreement being \$820,262;

- c) To Larco re May Drive C7: 0.51% of whatever amounts the City collects each year of the Term in connection with the Alexandra Area DCC Charges (such amounts collected determined in the City's sole discretion), with the total maximum value to be paid under this agreement being \$125,559; and
- d) To Larco re May Drive L1: 0.14% of whatever amounts the City collects each year of the Term in connection with the Alexandra Area DCC Charges (such amounts collected determined in the City's sole discretion), with the total maximum value to be paid under this agreement being \$35,188.

Release and Indemnity

- 28. The Developer and Larco hereby jointly and severally release, waive and agree not to commence legal proceedings against the City, or its elected officials, officers, employees, agents, or contractors ("**City Personnel**"), from and in respect of any duty, obligation or liability of any of them in way connected with any error, omission or act relating to this Agreement, including without limitation, failure to pass any resolution, adopt any bylaw, enter into any agreement, or impose, calculate or collect any Alexandra Road DCCs .
- 29. The Developer and Larco hereby jointly and severally release, waive and agree to indemnify and save the City harmless from and against all costs, expenses, damages, claims, demands, actions, suits and liability by whomever brought or made and however arising whether directly or indirectly, from any misrepresentation by the Developer and/or Larco or breach of this Agreement by the Developer and/or Larco.

Assignment

- 30. Neither the Developer nor Larco shall assign or transfer its rights under this Agreement without the City's prior written consent.
- 31. In the event of the assignment or transfer of the rights of the Developer voluntarily, or by operation of law, the City may pay any benefits accruing under this agreement, after notice, to the successor of the Developer as the City, in its sole discretion, deems entitled to such benefits. In the event of conflicting demands being made on the City for benefits accruing under this agreement, the City may at its option commence an action in interpleader joining any party claiming rights under this agreement, or other parties which the City believes to be necessary or proper, and the City shall be discharged from further liability on paying the person or persons whom the court having jurisdiction over such interpleader action shall determine, and in such action the City shall be entitled to recover its reasonable legal fees and costs, which fees and costs shall

constitute a lien upon all funds accrued or accruing pursuant to this agreement and the City shall have a right of set-off in respect of such fees and costs.

32. In the event of the assignment or transfer of the rights of Larco voluntarily, or by operation of law, the City may pay any benefits accruing under this agreement, after notice, to the successor of Larco as the City, in its sole discretion, deems entitled to such benefits. In the event of conflicting demands being made on the City for benefits accruing under this agreement, the City may at its option commence an action in interpleader joining any party claiming rights under this agreement, or other parties which the City believes to be necessary or proper, and the City shall be discharged from further liability on paying the person or persons whom the court having jurisdiction over such interpleader action shall determine, and in such action the City shall be entitled to recover its reasonable legal fees and costs, which fees and costs shall constitute a lien upon all funds accrued or accruing pursuant to this agreement and the City shall have a right of set-off in respect of such fees and costs.
33. The Developer and Larco acknowledge and agree that the City is released from any liability under this Agreement by paying amounts payable to the Developer and/or Larco to the assignee(s), transferee(s) or successor(s) considered by the City, in its sole discretion, to be entitled to receive those payments or by paying the amounts payable to the Developer and/or Larco under this Agreement to the person whom the Supreme Court of British Columbia orders in any interpleader proceedings is entitled to receive those amounts, or as otherwise ordered by the Supreme Court of British Columbia.

General Provisions

34. The Developer represents and warrants to the City that:
 - (a) it has the full and complete power, authority and capacity to enter into, execute and deliver this Agreement;
 - (b) all necessary corporate actions and proceedings have been taken to authorize entry into and performance of this Agreement;
 - (c) this Agreement shall be fully and completely binding upon such party in accordance with the terms hereof;
 - (d) neither the execution and delivery, nor the performance of or covenants in, this Agreement breaches any other agreement or obligation or causes default of any other agreement or obligation on the part of such party; and
 - (e) the foregoing representations and warranties shall have force and effect notwithstanding any knowledge on the part of the City whether actual or

constructive concerning the status of such party or any other matter whatsoever.

35. Larco represents and warrants to the City that:
 - (a) it has the full and complete power, authority and capacity to enter into, execute and deliver this Agreement;
 - (b) all necessary corporate actions and proceedings have been taken to authorize entry into and performance of this Agreement;
 - (c) this Agreement shall be fully and completely binding upon such party in accordance with the terms hereof;
 - (d) neither the execution and delivery, nor the performance of or covenants in, this Agreement breaches any other agreement or obligation or causes default of any other agreement or obligation on the part of such party; and
 - (e) the foregoing representations and warranties shall have force and effect notwithstanding any knowledge on the part of the City whether actual or constructive concerning the status of such party or any other matter whatsoever.
36. Any notice to be given under this Agreement shall be in writing and may be delivered personally or sent by prepaid registered mail. The addresses of the parties for the purpose of notice shall be the addresses set-out in this Agreement. Any party may at any time give notice in writing to another of any change of address.
37. No partnership, joint venture or agency involving the City or the Developer or Larco is created by or under this Agreement and neither the Developer nor Larco will have the authority to commit and will not purport to commit the City to the payment of any money to any person.
38. The parties each agree that this Agreement creates only contractual rights and obligations among them and each party by this section agrees that no tort or other duty, obligation or liability is created by or under this Agreement (including any duty of care or fiduciary duty).
39. This Agreement is the entire agreement among the parties, apart from the Servicing Agreement between the Developer and the City, and supersedes and terminates all previous agreements, promises, representations and warranties respecting the subject matter of this Agreement. The City has made no representations, warranties, guarantees, promises, covenants or agreements to or with the Developer or Larco other than those in this Agreement and the Servicing Agreement. For certainty, the Developer

and Larco each acknowledge and agree that the City has not made or given any representations or warranties to the Developer and/or Larco respecting the subject matter of this Agreement.

40. No amendment to this Agreement is valid unless in writing and executed by the parties.
41. Wherever the singular or masculine is used in this Agreement, the same shall be construed as meaning the plural or the feminine or the body corporate or politic where the context or the parties so require.
42. If any section, or lesser portion of this Agreement is held invalid by a court of competent jurisdiction, the invalid portion shall be severed and the invalidity of such section or portion shall not affect the validity of the remainder.
43. Time is of the essence of this Agreement.
44. This Agreement shall enure to the benefit of and be binding upon the parties, their respective heirs, executors, administrators, successors and permitted assigns.
45. Nothing contained or implied in this Agreement shall fetter in any way the discretion of the City or the Council of the City. Further, nothing contained or implied in this Agreement shall derogate from the obligation of the Developer or Larco under any other agreement with the City or, if the City so elects, prejudice or affect the City's rights, powers, duties or obligation in the exercise of its functions pursuant to the *Community Charter* or the *Local Government Act*, as amended or replaced from time to time, or act to fetter or otherwise affect the City's discretion, and the rights, powers, duties and obligations of the City under all public and private statutes, by-laws, orders and regulations, which may be, if the City so elects, as fully and effectively exercised as if this Agreement had not been executed and delivered by the parties.
46. The laws of British Columbia are to govern its interpretation and enforcement and each of the City and the Developer accepts the jurisdiction of the courts of British Columbia. If a party to this Agreement consists of more than one person, firm, or corporation, the covenants and obligations of such party under this Agreement shall be joint and several.
47. This Agreement may be signed by the parties hereto in counterparts and by facsimile or pdf email transmission, each such counterpart, facsimile or pdf email transmission copy shall constitute an original document and such counterparts, taken together, shall constitute one and the same instrument.

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IN WITNESS WHEREOF the parties have set their hands and seals on the day and year first above written.

CITY OF RICHMOND

by its authorized signatory:

George Duncan
Chief Administrative Officer

Robert Gonzalez
General Manager, Engineering & Public Works

AGA KHAN FOUNDATION (CANADA)

by its authorized signatory:

Print Name:
Print Title:

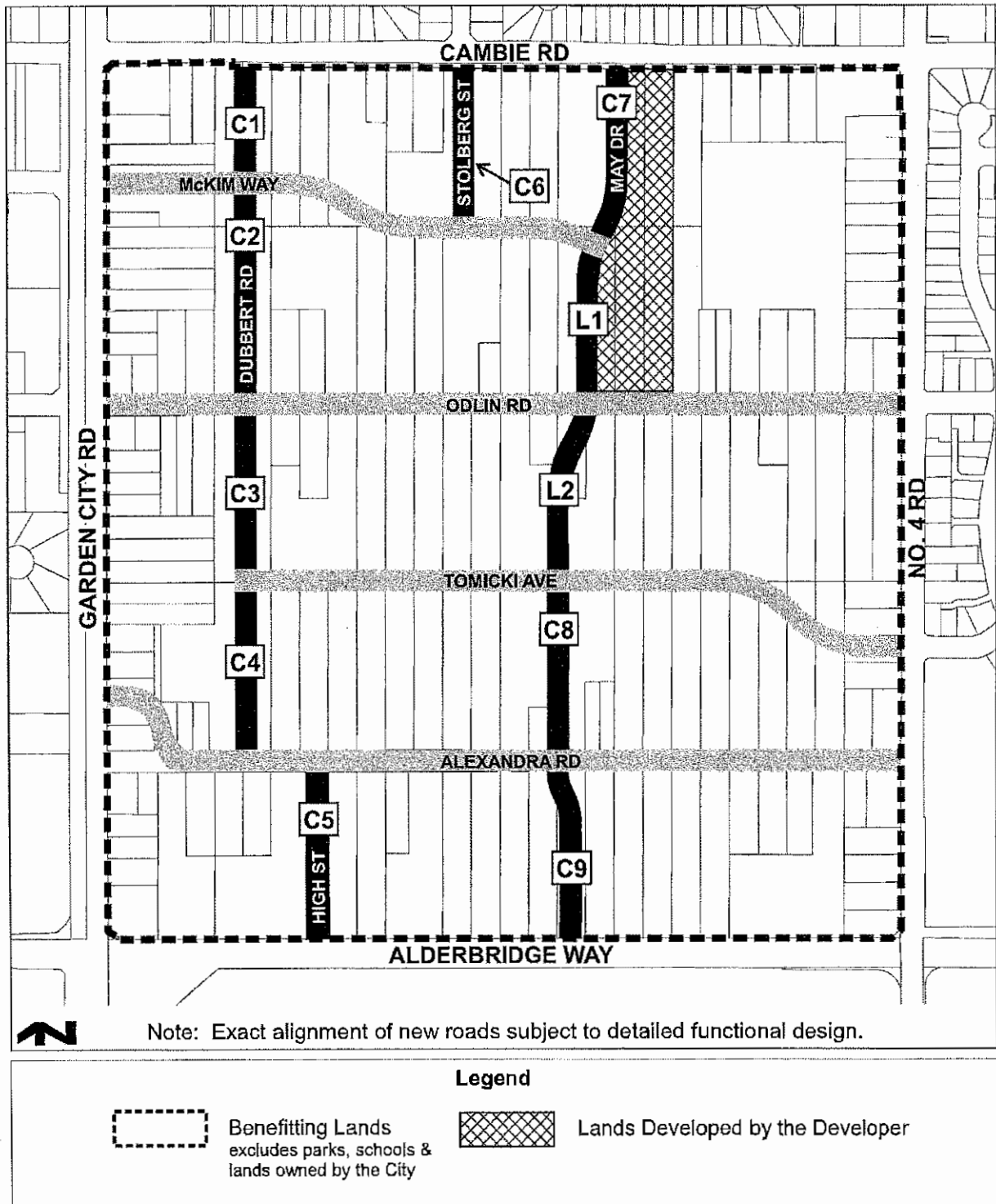
LARCO INVESTMENTS LTD.

by its authorized signatory:

Print Name:
Print Title:

SCHEDULE "A"

Schedule A





City of Richmond

Report to Committee

To: Public Works and Transportation Committee **Date:** January 3, 2017
From: John Irving, P.Eng. MPA **File:** 10-6060-01/2016-Vol
Director, Engineering 01
Re: **Water Shortage Response Plan – Proposed Changes**

Staff Recommendation

That the comments on Metro Vancouver's proposed changes to the Water Shortage Response Plan, as summarized in the staff report titled "Water Shortage Response Plan – Proposed Changes," dated January 3, 2017, from the Director, Engineering be submitted to Metro Vancouver.

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

REPORT CONCURRENCE		
ROUTED TO:	CONCURRENCE	CONCURRENCE OF GENERAL MANAGER
Water Services	☒	
Parks	☒	
Bylaws	☒	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS: DW	APPROVED BY CAO

Staff Report

Origin

The Metro Vancouver Water Shortage Response Plan was prepared by Metro Vancouver and adopted by the City of Richmond as the Water Use Restriction Bylaw No. 7784. The bylaw restricts water use during the summer months and any time during the year in the event of a water shortage, and is intended to manage discretionary uses of water while minimizing impacts on residents and avoiding unnecessary hardships on businesses.

The plan was originally adopted in 2004, with updates adopted in 2011 and 2016. The 2016 update was initiated as a result of the hot and dry summer of 2015 and the resulting activation of incremental stages of the Water Shortage Response Plan. A review process was initiated by Metro Vancouver to address public feedback and challenges experienced. Immediate amendments were implemented the summer of 2016, and a broader review of the plan is being completed in 2016 and 2017.

On December 14, 2016, Metro Vancouver hosted a Local Government Workshop, where proposed updates to the Water Shortage Response Plan were presented to member municipalities. Metro Vancouver has requested municipal feedback on the proposed updates indicating support, support with conditions, or do not support for each of the proposed updates.

Analysis

Proposed Updates to the Water Shortage Response Plan

Stage 1 Activation Period

The annual activation period for Stage 1 is proposed to be extended from the existing period of May 15 to October 15 to the proposed period of May 1 to October 15. This change is intended to improve consistency with other BC jurisdictions and to address increased water consumption earlier in the season that has been observed in recent years.

Staff recommends support of this proposed update. The need for lawn watering in May is generally low as Richmond's average May precipitation is 71.9 mm. In most years, Richmond residents will not need to water their lawns during this time and the earlier activation of Stage 1 will cause little inconvenience. In years of drought, such as 2015, this earlier activation will conserve water in the early season for use later in the summer. Given the low degree of inconvenience and the potential to delay or avoid the activation of advanced stages of the Water Shortage Response Plan in drought years, staff recommends support of this update.

Sprinkling of Lawns

Lawn sprinkling during Stage 1 is proposed to be reduced from three (3) mornings per week to two (2) mornings per week. The proposed plan permits lawn sprinkling for residential properties at the following times:

- Even-number addresses: Wednesdays and Saturdays, 4 am – 9 am
- Odd-number addresses: Thursdays and Sundays, 4 am – 9 am

This change is based on the rationale that lawns only require watering once a week, and is estimated to reduce seasonal water use by 2%.

Staff recommends support of this update as it will reduce the potential for over-watering of lawns and will assist in water conservation with little or no negative impact to the public. The Canadian Mortgage and Housing Corporation recommend lawn watering once per week before 9 am to maintain a healthy lawn. The update provides two opportunities per week for residents to apply this recommended level of irrigation.

Sprinkling of Flowers, Planters, Shrubs and Trees

The sprinkling of flowers, planters, shrubs and trees during Stages 1 and 2 is proposed to be restricted to morning lawn watering hours (4 am – 9 am) on any day.

Staff recommends support of this update. The proposed change in sprinkling hours will reduce the amount of irrigation water lost to evaporation and will continue to provide adequate irrigation for flowers, planters, shrubs and trees. Watering by hand will continue to be unrestricted should residents need to water outside the restricted hours.

Watering of Sports Fields

Watering of school yards, sports and sand-based playing fields, which is currently unrestricted in the 2016 Plan, is proposed to be restricted as follows:

- Stage 1: Restricted to 7:00 pm – 9:00 am, any day
- Stage 2: Restricted to 7:00 pm – 9:00 am, 4 days per week, unless operating under an approved local government water management plan
- Stage 3: Restricted to 7:00 pm – 9:00 am, 3 days per week, unless operating under an approved local government water management plan

The proposed change is intended to promote public sector leadership in water conservation efforts, and to prevent mid-day sprinkling to limit water lost to evaporation.

Staff recommends supporting this update with the condition that the irrigation of sports fields outside of the designated hours be permitted where damage to these fields would otherwise result. Based on Richmond's experience, watering of new or renovated sand-based fields during morning hours only may not be sufficient during hot summer months and may result in damage. If this additional condition is satisfied, staff recommends recommending the proposed change as it shows municipal leadership by following similar sprinkling hours to residential restrictions while allowing enough irrigation to support high traffic sand based playing fields.

Watering of Golf Courses

Fairway watering for golf courses are restricted in Stages 2 and 3 under the existing Plan. The proposed Plan allows the watering of golf courses under an approved local government water management plan. This increases staff administration efforts, but allows more flexibility to golf courses while maintaining water use reduction targets.

Staff recommends supporting this update as it offers golf courses the flexibility of preparing irrigation plans that facilitate reduced water use while minimizing impacts on their commercial viability.

Commercial Car Washing

Commercial car washing is currently unrestricted for all Stages. The revised plan proposes to restrict use under Stage 3 to automatic systems that recirculate at least 50% of water, or high-pressure wand facilities. This is to provide consistency with other aesthetic water use restrictions within Stage 3.

Staff recommends supporting this update as the proposed change encourages the adoption of efficient technologies that will reduce annual water use in car wash facilities.

Filling of Commercial Pool and Hot Tubs

The topping up or filling of hotel, residential strata, and private club pools and hot tubs, is currently prohibited under Stage 3. The revised plan proposes that the topping up and filling of these pools be permitted.

Staff recommends supporting this update as the proposed change will minimize impacts to public pool users and businesses with only marginal increases to Stage 3 water use.

Additional Comments

Water Metering

Water metering is a proven water demand management tool. It reduces water use by offering cost incentives to discouraging wastage of water, as well as helping property owners identify and reduce leaks on private property. Richmond recommends that Metro Vancouver implement universal water metering as a regional water demand management tool. If all municipalities followed the example set by metered communities, there would be significant volumes of water conserved without creating hardships for communities and businesses in the region. This has the potential of deferring or eliminating the need to activate advanced stages of the Water Shortage Response Plan, thereby minimizing impacts to residents and businesses.

Richmond has installed water meters for 100% of ICI properties, 93% of single-family properties, and 40% of multi-family properties. This allows the City to review quarterly water consumptions in order to identify properties with possible leaks and inform homeowners in a timely manner. Such leaks would have been unnoticed and continue to leak indefinitely if water meters had not been installed.

Activation of Advanced Stages

Richmond recommends that measurable triggers, such as reservoir levels, for activating and deactivating stages 2, 3 and 4 of the Water Shortage Response Plan be implemented. This will improve Metro Vancouver's ability to activate and deactivate stages in a consistent, transparent and pragmatic manner. The activation and deactivation of these stages is currently at the discretion of the GVWD Commissioner guided by factors outlined within the Water Shortage Response Plan.

Financial Impact

There is no financial impact anticipated.

Conclusion

The Metro Vancouver Water Shortage Response Plan has been an effective tool for managing water demand during times of shortages or emergencies. The proposed amendments further improve demand management and promote water conservation.

Staff recommends that comments regarding the proposed updates to the Water Shortage Response Plan as summarized in Table 1 be endorsed and submitted to Metro Vancouver.

Table 1 - Water Shortage Response Plan Comments

Activity	Proposed Update	City of Richmond Comment
Stage 1 Activation	Amend activation of Stage 1 from May 15 to May 1.	Support.
Lawn Watering	Reduce from three (3) mornings per week to two (2) mornings per week during Stages 1 and 2.	Support.
Sprinkling of Flowers, Planters, Shrubs and Trees	Restrict to morning hours only during Stages 1 and 2.	Support.
Watering of Sports Fields	Restrict to 7:00 pm – 9:00 am, any day during Stage 1 and four (4) and three (3) days respectively during Stages 2 and 3.	Support with condition – that the irrigation of sports fields outside of the designated hours be permitted where damage to these fields would otherwise result.
Watering of Golf Courses	Allow under an approved local government water management plan during Stages 2 and 3.	Support.
Commercial Car Wash	Restrict to use of automatic systems that recirculate water or high pressure wand facilities only during Stage 2.	Support.

Filling of Commercial Pools and Hot Tubs	Allow during Stage 3.	Support.
Water Metering	N/A	Richmond supports universal water metering across the region.
Activation of Advanced Stages	N/A	Richmond recommends that measurable triggers for activating and deactivating of advanced stages be implemented.

Municipal comments will be incorporated into the final Water Shortage Response Plan which is scheduled to be presented to the Greater Vancouver Water District Board for approval in the spring of 2017 and implemented in November 2017.



Lloyd Bie, P. Eng.
Manager, Engineering Planning
(4075)



Beata Ng, P. Eng.
Project Engineer
(4257)

LB: bn



City of Richmond

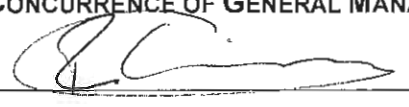
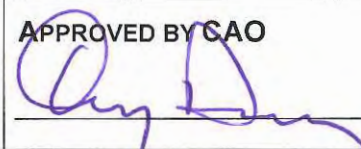
Report to Committee

To: Public Works and Transportation Committee **Date:** December 21, 2016
From: John Irving, P.Eng. MPA **File:** 10-6340-20-
Director, Engineering P.16207/Vol 01
Re: T.5651 - 2016 Paving Program (Lafarge Canada Inc.)
Contract Extension and Change Order for 2017 Paving Program

Staff Recommendation

That Contract T.5651 – 2016 Paving Program with Lafarge Canada Inc. be extended to include the 2017 Paving Program, and that a Change Order be issued to increase the value of this Contract by \$2,700,000.


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

REPORT CONCURRENCE		
ROUTED TO: Finance Department	CONCURRENCE ☒	CONCURRENCE OF GENERAL MANAGER 
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS: DW	APPROVED BY CAO 

Staff Report

Origin

This report supports Council's 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.

Background

The paving program is required to maintain the City's road network to current operating levels as well as reduce the need for costly repairs. As part of the Capital Budget process, Staff develop a prioritized list of locations which are included in the following year's Paving Program. The Contract for the annual Paving Program is based upon unit rates that are valid for one calendar year.

Analysis

As in past years, the 2016 Paving Program was tendered early in the year to realize favourable asphalt pricing. To maximize the benefit of these rates to the City, an extension clause was included in the Contract language that would allow the City and the Contractor, by mutual agreement to extend the contract through 2017.

The tender for the 2016 Paving Program was issued to the market in January 2016 and awarded to Lafarge Canada Inc. Through the remainder of the year, Lafarge successfully completed the list of locations included in the 2016 program, demonstrating their ability to meet the City's performance and delivery expectations.

Lafarge Canada Inc. has indicated that they are willing to extend the 2016 Contract rates into 2017.

The Paving Program unit prices are influenced by a number of factors including oil prices, labour costs, equipment costs, disposal costs, and increasing traffic control requirements. Since 2010, paving costs have increased by an average of 7% annually. Also, bids received in 2016 for paving work outside the scope of the paving program were higher than the paving program rates.

Lafarge Canada Inc. has also indicated that, as part of the proposed Change Order, Lafarge will provide sponsorship or services in kind to Richmond community events in 2017 at no additional cost to the City.

Based on the factors listed above, extending the 2016 Paving Program rates through 2017 presents the best value to the City.

The current value of the 2016 Contract T.5651 is \$2,625,608. The proposed Change Order for the 2017 Paving Program is \$2,700,000, giving a revised contract value of \$5,325,608.

Financial Impact

Funding for the 2017 Paving Program was approved by Council as part of the 2017 Capital Budget.

Table 1 – Estimated Cost for 2017 Paving Program

Approved Budget

CR00042 – Annual Asphalt Re-Paving Program - MRN	\$1,081,000
CR00043 – Annual Asphalt Re-Paving Program – Non-MRN	\$3,200,000
Total Approved 2017 Budget	\$4,281,000

Estimated Costs

• T.5651 Change Order – 2017 Paving Program	\$2,700,000
• Pavement Management Plan Updates	\$400,000
• Ancillary Work (curb and gutter repair, valve adjustments)	\$500,000
• Paving Co-ordinated with Utility Upgrades	\$600,000
Total Estimated Costs	\$4,200,000
Estimated Funds Remaining	\$81,000

Conclusion

Remaining pro-active with the annual paving program is necessary to maintain the current condition of Richmond's road network, and reduce the need for costly repairs in the future. Extending the 2016 Paving Program rates into 2017 presents good value to the City.



Milton Chan, P.Eng
Manager, Engineering Design and Construction
(604-276-4377)

MC:mc