



City of Richmond

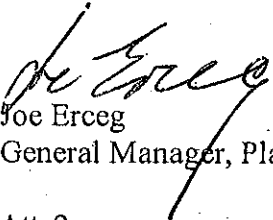
Report to Committee


To: Public Works & Transportation Committee **Date:** June 2, 2008 *June 18, 2008*
From: Joe Erceg **File:** 10-6045-01
 General Manager, Planning & Development
 Robert Gonzalez
 General Manager, Engineering & Public Works
Re: 2008 – 2031 Richmond Flood Protection Strategy

Staff Recommendation

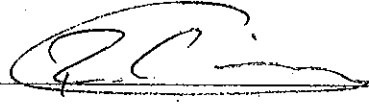
That, as per the report from the General Manager-Planning & Development and the General Manager Engineering & Public Works, dated June 2, 2008, the following recommendations be forwarded to Council:

1. The 2008-2031 Richmond Flood Protection Strategy, and the incorporated implementation program, be adopted; and
2. Staff be directed to forward the report from the General Manager, Planning & Development and the General Manager, Engineering & Public Works, dated June 2, 2008, and the accompanying 2008-2031 Richmond Flood Protection Strategy to the Provincial Minister for the Ministry of Environment and to the Provincial Diking Authority for their review and endorsement as appropriate.


 Joe Erceg
 General Manager, Planning & Development


 Robert Gonzalez,
 General Manager, Engineering & Public Works

Att. 2

FOR ORIGINATING DEPARTMENT USE ONLY			
ROUTED TO:	CONCURRENCE	CONCURRENCE OF GENERAL MANAGER	
Environmental Programs	Y <input checked="" type="checkbox"/> N <input type="checkbox"/>		
Transportation	Y <input checked="" type="checkbox"/> N <input type="checkbox"/>		
Development Applications	Y <input checked="" type="checkbox"/> N <input type="checkbox"/>		
Parks Design, Construction & Programs	Y <input checked="" type="checkbox"/> N <input type="checkbox"/>		
Sewerage and Drainage	Y <input checked="" type="checkbox"/> N <input type="checkbox"/>		
Emergency Programs	Y <input checked="" type="checkbox"/> N <input type="checkbox"/>		
REVIEWED BY TAG	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>	REVIEWED BY CAO (Acting)	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>

Staff Report

Origin

This report proposes the adoption of a 2008 – 2031 Flood Protection Strategy for Richmond.

Work on the Flood Protection Strategy was directed by Council in 2002 with subsequent additional direction from the General Purposes Committee in July 4, 2006 in response to research results and legislative changes at the Provincial level which effectively placed a greater burden of responsibility for flood protection upon local government.

Technical background work previously presented through the General Purposes Committee and Council is not repeated in either this report or the strategy. Instead the overall context for the strategy, the underlying principles and the broad objectives are presented. Embedded within the strategy is an initial implementation program. It is intended that this implementation program be periodically reviewed and updated over time to show progress and to maintain flexibility and responsiveness to changing conditions.

Development of the Flood Protection Strategy was undertaken in consultation with Provincial Diking Authority staff, the Richmond Agricultural Advisory Committee (RAAC), a technical research and advisory team of consultants, and an interdepartmental core staff team.

The proposed 2008-2031 Richmond Flood Protection Strategy is provided in **Attachment 1**.

Why a Flood Protection Strategy For Richmond?

Richmond's geographical location at the mouth of the Fraser River and adjacent to the Pacific Ocean make flood protection an obvious and critical element for this community. The proposed Flood Protection Strategy for Richmond is intended to do the following:

- Provide a framework for addressing and improving the City's flood protection measures.
- Improve life safety and property protection through proactive measures through infrastructure improvements and policy amendments.
- Provide a means for responding to Provincial Legislation changes and the increased responsibilities placed upon Richmond as the local government authority.
- Address, to the extent possible, Provincial Flood Hazard Management Guidelines.
- Respond, in part, to the GVRD (now Metro Vancouver) -Richmond Memorandum of Understanding regarding the Livable Region Strategic Plan that Richmond and the Province agree on a mutually acceptable implementation plan for flood and seismic protection.
- Provide a stronger case for access to new Federal and Provincial grant funding sources.
- Replace the 1989 Flood Plain Management Implementation Policy with a more efficient, integrated approach to flood protection and management for the City.
- Begin to address climate change implications as it relates to flood protection
- Provide the basis for developing appropriate adaptation responses.
- Provide the basis for future research and partnerships aimed at improving flood protection for Richmond.

Strategy Overview

The Flood Protection Strategy document is organized into three parts.

Part One provides the Strategy and its context. This section includes the following:

- Purpose of the strategy and the orientation toward an integrated approach to flood protection and management.
- A description of the twelve guiding principles considered in developing the strategy.
- The legislative basis for flood protection and management in BC as well as the roles and responsibilities for each of the levels of government – Federal, Provincial, Regional and Local.
- An outline of the strategic direction for the City in terms of priority, dike and land use management over time, emergency management. The ‘system of defence’ and various plans and mechanisms (e.g., the Flood Plain Bylaw) are described.
- Establishes the foundation for partnerships with other levels of Government and agencies to work cooperatively to address issues such as sea level rise and climate change.

Part Two of the document contains the cross-departmental implementation program. A table of key tasks, approximate completion dates, status of projects, cost elements and City Division/department responsibilities are identified.

Part Three provides background information on the original study mandate, factors influencing the strategy development, descriptions of the technical reports prepared for the study and key study findings and recommendations.

Next Steps

1. Council approves the 2008 – 2031 Flood Protection Strategy and the incorporated Implementation Program.
2. Council directs staff to forward the 2008 – 2031 Flood Protection Strategy and implementation program to the Minister for the BC Ministry of Environment (MOE) and the Provincial Diking Authority for review and endorsement. Based upon discussions with Provincial Diking Authority staff, the legislative and mandate changes for the MOE suggest that the Ministry will selectively approve certain portions of the City’s 2008 – 2031 Flood Protection Strategy and only provide comments and make suggestions on the balance of the document.
3. Once the Provincial response is received and accepted, staff will prepare a separate report to Council to advise Metro Vancouver that the City has met the a requirement of the 1996 GVRD – City Memorandum of Understanding (see **Attachment 2**).
4. Staff deliver the work program outlined in the strategy. As new information becomes available through best practises and studies, staff will update Council accordingly and recommend adjustments of design standards, targets and the work program in general.

Financial Impact

- None through this report.
- Implementation will occur through annual work programs and capital budgets submitted for Council consideration and approval.
- Individual projects will also be reviewed and approved by Council.
- Full implementation of the 2008 – 2031 Flood Protection Strategy requires senior government cost sharing and cooperation.

Conclusion

The 2008-2031 Flood Protection Strategy for the City of Richmond is presented for Council's consideration and adoption. Program implementation will occur through subsequent Council approvals as required.

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April 1, 2008

**2008 – 2031
Flood Protection Strategy
City of Richmond**

Prepared by:
The City of Richmond

Table of Contents

Part 1: 2008 – 2031 The Flood Protection Strategy 1

 1. Purpose of Strategy 1

 2. Extent of Application 1

 3. Principles 1

 4. Legislative Framework, Roles and Responsibilities 3

 5. City of Richmond’s Role 8

Part 2: The Implementation Program 15

Part 3: Background 21

 1. Introduction 21

 2. Purpose 21

 3. Context 21

 4. Study Area 21

 5. Hay Report (1989) 21

 6. Key Factors Influencing the Strategy 22

 7. Study Process 23

 8. Project Context 24

 9. Issues and Challenges 25

 10. Flood Minimization Analysis 33

 11. Land Use and Environmental Issues 37

Part 1: 2008 – 2031 The Flood Protection Strategy

1. Purpose of Strategy

The purpose of the 2008 – 2031 Flood Protection Management Strategy (Strategy) is to:

- enable Richmond to be a safe place to live, work and play,
- complement the Corporate Strategic Vision (Appealing, Livable and Well Managed),
- establish an integrated, sustainable Strategy which better:
 - enhances the City’s ability to reduce flood risk, prevent flooding, increase flood protection, minimize flood damage, improve floodproofing and enhance responses to floods,
 - co-ordinates and manages dike integrity, land use, infrastructure (e.g., drainage), emergency response and sustainability,
 - defines partnerships, roles, responsibilities and cost sharing, and
 - begin to address climate change implications specific to Richmond

2. Extent of Application

This Strategy applies to those areas within Richmond’s municipal boundaries where the City has the legislative mandate and primary responsibility to address flood protection.

In certain locations where the City does not have the jurisdictional authority, such as the Vancouver Fraser Port Authority (i.e., the former Fraser River Port Authority and North Fraser Port Authority lands in Richmond), lands held or controlled by either the Federal or Provincial Governments (e.g., most of Sea Island), the City’s Strategy encourages interagency cooperation to address mutual flood protection interests and benefits.

3. Principles

The Flood Protection Strategy is based on the following principles:

Principle	Emphasis
1. Safety	As Richmond is in a floodplain system, its population, development and infrastructure are to be safeguarded from flood hazards, by a range of methods including an appropriate: <ul style="list-style-type: none"> - level of flood protection, flood proofing, preparedness, - emergency response, and - flood recovery plans and programs.
2. Proactive Prevention	The City will proactively continue its efforts to research, plan, maintain and enhance the City’s flood protection system, and prevent flood damage, rather than waiting to react to events.
3. Risk Avoidance	The City will strive to minimize the risks and potential damage associated with flooding.

Principle	Emphasis
4. Sustainability	Flood prevention approaches are to be: <ul style="list-style-type: none"> - socially, economically, environmentally sound and sustainable, and - able to achieve the City's long term planning, growth and development objectives.
5. Coordinated Partnerships	The City will coordinate its Strategy in partnership with senior governments, regional agencies, other municipalities, NGOs, emergency service agencies and the private sector.
6. Research	The City will continue its flood protection research with others to: <ul style="list-style-type: none"> - take advantage of the latest science, best practices, technology, solutions, cost sharing, - improve its understanding of flood risks and management, - identify innovative, tailored options, decision making criteria and solutions.
7. Integrated Flood Planning	The City will prepare and enhance a range of flood protection documents including this Flood Protection Strategy, a Floodplain Bylaw, flood infrastructure plans, flood preparedness plans, emergency response plans, flood recovery plans and other plans, as necessary.
8. Standards	The City will establish and follow a variety of flood protection standards including: <p>Provincial Standards:</p> <ul style="list-style-type: none"> - The new Provincial dike crest elevation standard (as defined by the Jan. 24, 2007, Fraser Basin Council (FBC) Study profile, plus 0.6m freeboard), - Provincial Dike Design Standards, - The Provincial Flood Hazard Area Land Use Management Guidelines, - Other, as necessary. <p>City Standards:</p> <ul style="list-style-type: none"> - Strategically raising land levels, - New flood construction level (FCL) standards for buildings and structures, - Flood proofing standards, - Alternate requirements for authorized exemptions to basic standards, - Other, as necessary.

Principle	Emphasis
<p>9. A System of Defence</p>	<p>The City recognizes and will enhance and provide an integrated physical flood protection "System of Defence" which includes:</p> <ul style="list-style-type: none"> - A Perimeter Dike, - A proposed Mid Island Barrier, - Raising Land Levels strategically and economically, - Requiring Flood Construction Levels (FCLs) for new construction, - Floodproofing buildings and structures, - Infrastructure (e.g., drainage system and pumping stations), - Maintenance Programs – cleaning of infrastructure, - Stormwater Retention/Detention – best practises and implementation, - Dredging (This is a federal Vancouver Fraser Port Authority responsibility), - Other, as necessary.
<p>10. Incremental Solutions</p>	<p>The City will implement the Strategy incrementally, as technical and effective solutions are identified.</p>
<p>11. Cost Effectiveness</p>	<p>The City:</p> <ul style="list-style-type: none"> - will implement the Strategy in a cost effective manner, appropriate to existing and planned growth and development, and - recognizes that such costs are part of growth and development.
<p>12. Cost Sharing</p>	<p>The City will actively solicit partnerships with other levels of government, NGOs and the private sector, to share the benefits and costs of implementing the Strategy.</p>

4. Legislative Framework, Roles and Responsibilities

A. Federal

1. General

The federal role has primarily been related to issues of national significance or to situations where the capacity or authority of a provincial government to deal with the situation is exceeded. Federal legislation such as the Emergencies Act enables the Federal government to act in such situations. Over the past decade, much of the responsibility for flood protection has been turned over to the provinces with the Federal government providing assistance through enabling funding and research.

2. Focus

The focus of Public Safety Canada (PSC) includes:

- Critical Infrastructure Protection
- Emergency Preparedness
- Disaster Mitigation.

Programs under these topics are still evolving particularly with regard to critical infrastructure protection. One of the evolving federal projects is the development of a National Disaster Mitigation Strategy.

3. Establishing Flood Protection Standards

1. The federal government does not currently establish flood standards; however, CMHC funding for urban development, or post disaster recovery funding may be limited in designated floodplain areas, unless adequate floodproofing measures have been taken.
2. The City intends to establish adequate flood protection measure through this Strategy and a range of implementation measures.

4. Research

1. The Federal government provides research assistance (e.g., climate change).
2. Ongoing Federal research is encouraged.

5. Funding

1. The federal government may assist in funding studies, capital dike improvements preparedness and recovery programs. Periodically, the federal government co-funds with the Provincial governments programs for flood protection, for example:
 - in 2006, the Federal government provided funds toward the 2006 Lower Fraser Hydraulic Modeling study which was completed by the Fraser Basin Council (FBC).
 - in 2007, \$33 million dollars for flood mitigation initiatives to address concerns related to anticipated spring freshette water levels),
2. Ongoing Federal funding is encouraged.

6. Dredging

1. The federally created Vancouver Fraser Port Authority is responsible for the dredging of the Fraser River.
2. Richmond supports this activity as it is an essential element of an effective flood protection System of Defence, as the capacity of the Fraser River to convey water must be maintained to prevent flooding, and avoid unnecessarily increasing dike height and incurring unnecessary costs. Dredging activities should be carried out in a manner which does not affect the integrity of the City's dike system.

7. Summary

The City will co-operate with the Federal government and encourages ongoing Federal flood protection programs, research, funding assistance and dredging.

B. Provincial Role

1. General

In 2004, the Provincial role with regard to flood protection and management was significantly altered with legislative changes made to a number of statutes - notably to the Land Title Act, Local Government Act, the Flood Hazard Statutes Amendment Act, 2003 and the Miscellaneous Statutes Amendment Act (No. 2), 2004.

2. BC Ministry of Environment (MOE) Approvals Regarding Dikes

- MOE continues to regulate dikes, provincial flood response (BC Flood Plan).
- The Provincial Inspector of Dikes can require reports, inspect records, audit diking authorities, make regulations and prescribe trusts.
- Approval from the Provincial Inspector of Dikes is required for:
 - *The construction of a new dikes and flood barriers (Dike Maintenance Act Approvals: MOE 2007),*
 - *Changes or alterations to the cross section or crest elevation of a dike,*
 - *The installation of culverts, pipes, flood-boxes, utility lines, pump stations, or any structure through, on or over a dike,*
 - *The construction of any works on or over a dike right of way, including structures, excavations and placement of fill or other materials;*
 - *The alteration of the foreshore or stream channel where the works could increase flood levels or impact the integrity of a dike such as dredging, and*
 - *Construction of erosion protection works, bridges and other in-stream works.*

3. BC Ministry of Environment (MOE) Guidelines

The BC MOE provides guidelines for development in flood hazard areas, guidance and technical information.

4. Subdivision Approval

- Provincial approval for subdivision is no longer required, unless the lots are in proximity to a Provincial highway.
- In those cases, the BC Ministry of Transportation (MOT) Approving Officers can now consider flooding and erosion potential.

5. Approval of Municipal Floodplain Bylaws

Provincial approval of municipal floodplain bylaws is no longer required.

6. BC Ministry of Environment (MOE) Flood Protection Standards

- General
 - MOE establishes standards for municipal dike design, construction, operation and maintenance plans.
 - MOE reviews and approves these.

- For Freshette, Summer, Winter and Tidal Flood Threats
 - Based upon the 2006 Fraser River Hydraulic Model Study, which emphasized freshette, summer, winter and tidal flood threats, the Province has adopted a new dike crest elevation standard defined by the 2006 Study Model profile, plus 0.6m freeboard.
 - This new standard establishes flood design standards, for freshette, summer, winter and tidal flood threats, to safely convey the largest historical flood of record which occurred in 1894.
 - For Richmond, the new profile varies from approximately 2.9m GSC near Steveston to 3.3m GSC near Queensborough.
- For Sea Level Rise Threats
 - Sea level rise flood threats have yet to be fully studied and addressed in the above flood protection standards:
 - The most recent studies suggest that sea level is rising approximately 3 to 5 cm per decade.
 - Additional research is needed to refine these values given global warming expectations.
- For Subsidence Flood Threats
 - Subsidence flood threats have yet to be fully studied and addressed in the above flood protection standards.
 - The most recent studies suggest that subsidence in Richmond is approximately 2 to 5 cm per decade.
 - Additional research is needed to refine these values given global warming expectations.
- Summary
 Richmond is prepared to participate in such studies with other stakeholders and consider next steps as per this Strategy.

7. Research

- The Province conducts research with others (e.g., the Fraser River Hydraulic Modelling study).
- Ongoing Provincial research is encouraged.

8. Funding

- The Province funds flood protection in a variety of ways.
- In October 2007, the Province announced new flood protection funding for BC of \$10 million per year for 10 years.
- Matching funding will be sought from the Federal government to increase this to \$20 million each year.
- Ongoing Provincial funding is encouraged.

9. BC Provincial Emergency Program (PEP) Emergency Preparedness and Recovery

- The Province operates a BC Provincial Emergency Program (PEP) which coordinates aspects such as:
 - Emergency preparedness training and funding;
 - Disaster response including military assistance;
 - Recovery funding and assistance.
- PEP will respond to emergency calls from local governments and emergency personnel.
- Ongoing PEP assistance is encouraged.

10. Provincial [MOE] Approval Of The City's Strategy

- *Provincial Jurisdiction:* The Province has jurisdiction to approve those portions of the City's Strategy that are directly related to the dike system (e.g., any proposed modifications or additions).
- *No Provincial Jurisdiction:* For the remainder of the City's Strategy, the Province is likely to provide only comments or advice.

11. Summary

The City will co-operate with the Provincial government and encourages ongoing Provincial flood protection programs, research, funding assistance and dredging.

C. Regional Role

1. Some Regional Flood Protection Issues:

At this time, some regional flood protection issues to be addressed include:

- river profiles,
- possible dike settling and implications,
- seismic risks and implications,
- risk analysis and implications,
- sea level rise and implications, and
- other.

2. Metro Vancouver: Currently, there is no regional flood protection management strategy.

3. Fraser Basin Council (FBC)

- Although it lacks a mandate or authority to oversee flood protection works or emergency services, the Fraser Basin Council has been working with 36 federal, provincial, local government agencies and organizations to address flood risks through the Joint Program Committee (JPC) for Integrated Flood Hazard Management. This program has coordinated recent flood plain mapping exercises

in the Lower Fraser. The JPC led the recent study to update the Fraser Flood Profile.

- The City has been an active participant and funding partner in the Fraser Basin Council's JPC and is committed to the management of growth both within an overall regional context and in terms of its Official Community Plan (OCP).

4. Summary

Richmond intends to continue participating in the Fraser Basin Council and with other stakeholders to better address flood prevention and protection.

D. City's Role

Generally, a city:

- is responsible for local flood protection and management including the ongoing operation and maintenance of the dike and drainage infrastructure;
- has a legislated duty to respond first to emergency situations within its jurisdiction and to have an emergency plan in place;
- has the authority to designate a flood plain by bylaw and to set construction requirements for development, subject to regard for Provincial policies and standards (e.g., the Provincial Flood Hazard Area Land Use Management Guidelines);
- *For Discretionary Development Applications* (i.e., Rezoning, Development Permits), the City has the authority to set conditions and to require the registration of restrictive covenants for development on land which may be subject to flooding for all discretionary development applications.
- *For Non-Discretionary Applications* (e.g., building permit approvals), the City will gain the authority, upon adoption of a Floodplain Bylaw (pending), to set conditions and to require registration of restrictive covenants for non-discretionary applications, when exemptions to the provisions of the Floodplain Bylaw are given.

5. City of Richmond's Role

A. Strategy Emphasis and Limitations:

1. As a community within the floodplain, the City acknowledges that an element of flood risk will always exist.
2. This Strategy provides an integrated flood protection framework which emphasizes:
 - preventing flooding, and
 - minimizing the impacts of a flood event, should such an event occur.
3. The integrated flood protection Strategy elements identified below, addresses dike safety, land use management and emergency management.

B. Sustainable Approaches

As the City is committed to improving sustainability, where practical and cost effective, sustainable approaches will be undertaken when implementing the Flood Protection Strategy. Flood prevention approaches are to be socially, economically, environmentally sound and sustainable, and able to achieve the City's long term planning, growth and development objectives.

C. System of Defence

The City's integrated physical flood protection "System of Defence" includes:

1. A Perimeter Dike,
2. A proposed Mid Island Barrier,
3. Raising Land Levels strategically and economically,
4. Requiring Flood Construction Levels (FCLs) for new construction,
5. Floodproofing buildings and structures,
6. Infrastructure (drainage system and pumping stations),
7. Maintenance Programs – cleaning of infrastructure,
8. Stormwater Retention/Detention – best practises & implementation,
9. Dredging (This is a federal Vancouver Fraser Port Authority responsibility),
10. Other, as necessary.

D. Dike Integrity and Management

1. General
 - Richmond's Flood Protection Strategy recognizes both sea surge and river flood threats.
 - Richmond's dike system is its primary flood protection defence.
2. New Dike Crest Elevation Standard
 - The City is committed to meeting or exceeding the Province's new dike crest elevation standard defined by the 2006 study profile plus 0.6m freeboard.
 - This standard is designed to accommodate the largest historical flood of record which occurred in 1894.
 - The City will continue to work with the Provincial, Federal and regional agencies to secure funding for research and construction to meet or exceed the Provincial dike standards.
3. Perimeter Dike Improvement Program

In conjunction with Provincial Diking Authorities, the City will prepare and implement a comprehensive perimeter dike improvement program which includes researching, strengthening and widening dikes to reduce the level of risk.

4. Proposed Mid Island Barrier

- An element of the System of Defence is the proposed a “mid-Island dike barrier”.
- The barrier is to be a secondary flood defence mechanism to reduce flood impacts in the urban areas of Lulu Island from a Fraser River dike failure or overtopping.
- The barrier will be along the along the Highway 99 / Knight Street corridor.
- The City is conducting studies with the BC Ministry Of Transportation to determine the alignment, technical requirements, costs, phasing and funding sources.
- It is anticipated that the barrier will be built in phases, once partner cost sharing is secured.
- The Provincial Diking Authority has indicated their strong support for the mid island barrier.

E. Managing For Sea Level Rise

1. Standards to address sea level rise have not yet been established.
2. The City will participate in research studies, in partnership with others, to ensure that these standards are established in a timely manner.

F. Managing For Subsidence

1. Standards to address subsidence have not yet been established.
2. The City will participate in research studies, in partnership with others, to ensure that these standards are established in a timely manner.

G. Flood Construction Levels (FCL):

1. The new Bylaw and associated policies will, in consideration of Provincial guidelines, define certain classes of use and/or geographic areas within which construction elevations will not be required to meet the established flood levels.
2. Examples of exemptions (e.g., to raising the land, to building to FCLs, may include:
 - agricultural buildings and structures (except residential dwellings and accessory buildings),
 - The Steveston Village Heritage Area where the introduction of grade changes for new construction would detrimentally affect the important heritage character of the area.

H. Raising Land Levels

1. Generally, as an overall long term objective, the City will seek to raise the average grade of land (e.g., to FCL) within the urbanized areas of the City.
2. To achieve this the City, at its discretion, will strategically and incrementally require that ground levels be raised in certain areas, for example where:
 - development opportunities exist (e.g., through rezoning and property redevelopment);
 - site size is sufficiently large to enable it to be achieved effectively,
 - where negative impacts can be reasonably mitigated, and
 - where it makes sense to do so.
3. West Cambie Example: This approach was applied in the West Cambie area, where much of the Alexandra quarter section is to be raised during redevelopment.

I. Not Raising Land Levels

1. The City does not intend to raise all the land in the whole City, as such would be unacceptable and impractical.
2. Generally, farmland and parkland will not be raised. There may be situations where some of these lands will need to be raised to improve flood protection and the dikes.
3. These cases will be identified as the need arises in consultation with those affected.

J. An Incremental Land Raising Approach

1. General
 - An incremental land raising approach is necessary because it will be achieved mostly during:
 - the rezoning and re-development of large private sites, and
 - City and public re-development initiatives where they do not involve excessive costs or negatively affect adjacent properties.
 - The City will determine these areas on a case by case basis, at its discretion.
2. Phasing
 - Where it is not practical to raise land to the desired level all at once, the City may require that the land be raised incrementally, during successive eras (e.g., 40 years each) of redevelopment.

K. Interface Areas

1. Between areas of different required raised land height and FCL construction level requirements, the City may establish land and FCL transition requirements and techniques to manage grade changes with minimal problems.
2. In these situations, the City will determine specific raised land and FCL requirements, on a site by site basis.

L. Monitoring

The City will monitor the latest flood protection and climate change science (e.g., sea level rise, subsidence, river, ocean conditions), best practices, the effectiveness of its flood protection “System of Defence” and the Strategy. Improvements will be made as necessary.

M. Annual Flood Protection System of Defence Improvements

1. Each year the City intends to improve its flood protection “System of Defence”.
2. This will be achieved by preparing a Strategy Implementation Work Program, for Council’s consideration and funding.
3. Individual Projects will be submitted through the annual Capital Program for Council’s consideration.

N. Emergency Management

1. City Emergency Management Office (EMO)

The City has established an Emergency Management Office (EMO) which works with Richmond’s protective service agencies and City departments to prepare response plans and programs that establish and implement mitigation, preparedness, response and recovery measures for emergency events.

2. City Emergency Plan:

Under the EMO’s guidance, the City has established an Emergency Plan that provides overall direction to guide the City’s actions to prepare for, respond to and recover from major disasters. This Plan identifies the key hazards which threaten the community such as flooding, the priority actions to be taken per threat, the roles and responsibilities of staff, and key response agencies responsible for managing the City’s response and recovery from disasters.

3. Flood Response Operational Plan

The City Flood Response Operational Plan outlines the City’s strategies for preparedness, response, and recovery surrounding the seasonal spring freshet, and any flood events that may result from this annual event.

4. City Flood Response Plan:

Through the direction of the EMO, a series of threat specific plans have been, or are in the process of being prepared. With direct reference to flood protection management, a City Flood Response Plan has been prepared and operationalized through the City's Public Works-Roads and Construction Department and a City Flood Evacuation Plan is currently being drafted.

5. Some of the key emergency management elements imbedded within the Strategy Implementation Program include:

- The co-ordination of community planning and emergency facilities to ensure that City refuge/public gathering areas during disasters are located in areas which do not flood,
- The preparation and updating of City evacuation and communication programs,
- Reviewing and implementing plans for refuge areas, emergency routes, and creating public awareness,
- Establishing a protocol for dike restoration (e.g., City procedural response plan),
- Updating the City's existing procedural policy of comprehensive dike maintenance.

O. Funding

Each year, to implement this Strategy, the City intends to:

- budget to implement this Strategy, subject to corporate priorities and funding,
- seek senior government funding.

P. Senior Government and Partner Funding

1. The success of this Strategy requires senior government, partner and private sector funding.
2. The City will seek senior government, partner and private sector funding for a wide range of flood prevention and protection research, monitoring, studies, planning and improvements.

Q. City Drainage Utility Reserve

1. In 2006, the City established a City drainage-utility reserve for the purpose of annually saving money for dike improvements.
2. The City intends to continue this reserve and will be reviewing the purposed of the reserve as well as funding levels in response to programs.

R. Annual City Dike Improvement Funding

1. In 2006, the City established an annual City capital budget (e.g., currently \$600,000 annually), to ensure that each year funds are available to undertake flood protection studies and work.
2. The City intends to continue this annual budget approach.

S. Implementation (see Part 2)

1. The City will implement this Strategy through the accompanying Implementation Program.
2. The Strategy and Implementation Program will guide all City Flood Protection actions and is to be referenced in all relevant City proposals and senior government funding requests.

T. Next Steps

1. General

The City will:

- approve this Strategy,
- rescind the 1989 Floodplain Management Implementation Policy,
- review and update the Flood Protection Strategy and the Implementation Program, as required,
- review and amend other relevant policies, plans, bylaws and programs as required to support this strategy,
- over time, enhance its flood protection techniques (e.g., a new Floodplain Bylaw; Official Community Plan and Zoning Bylaw amendments, covenants), in accordance with the provisions of the Local Government Act.

2. Flood Plain Bylaw

- In 2008, the City intends to adopt a new Floodplain Bylaw,
- When adopted, the new Floodplain Bylaw will enable the City to better:
 - prescribe the means by which flood construction levels (FCL) can be met for a specific location or area (i.e., by structural means, filling of land, flood proofing),
 - establish the flood levels for the City,
 - establish setbacks from certain watercourses and dikes,
 - establish permitted uses within buildings or structures,
 - provide exemption and covenant requirements for these conditions,

Part 2: The Implementation Program

1. The 2008 - 2031 Flood Protection Strategy is intended to be a living document – one which evolves over time as new science, information, concepts, best practices, techniques, programs and cost sharing opportunities arise.
2. The City also recognizes that the Strategy requires:
 - jurisdictional, economic and cost sharing partnerships,
 - the involvement and direction, of senior governments, specifically regarding dike standards,
 - on-going actions to enhance the City's knowledge and ability to prevent flooding and improve flood protection.
3. The 2008 - 2031 Flood Protection Strategy will be reviewed and updated, as required.
4. The 2008 - 2031 Flood Protection Strategy will be implemented through an Implementation Program.
5. The Implementation Program Chart below identifies:
 - some of the key tasks,
 - the approximate completion dates,
 - status of projects,
 - some cost estimates (where available); and
 - City Division responsibilities.
6. Implementation will occur, subject to City corporate priorities and funding.
7. The Implementation Program will be reviewed and updated, as required.
8. Changes to perimeter dike standards are to await other flood studies and cost sharing.
9. Detailed Implementation will be determined by Council annually.
10. The City's Engineering Division will lead the Strategy and Implementation Program in a proactive and collaborative manner with other City divisions including Policy Planning (PPD), Finance, Building Approvals (BAD), Development Applications (DAD), Environmental Programs and the Emergency Management Office (EMO).

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Implementation Program Chart 2008 – 2031 Flood Protection Strategy			
Key Actions	Short Term (2008)	Medium Term (2009)	On-going and Longer Term (2010 – 2031)
Planning	<ol style="list-style-type: none"> 1. Examine and pursue senior government cost sharing to implement the FPMS (Engineering; Public Works; Finance) 2. Collaborate among City Engineering, Building Approvals, Policy Planning [PPD], Development Applications, Facilities Divisions to develop a phased plan for overall land grade increases (Engineering; Planning) 3. Pursue and plan for appropriate grade changes in City area plans (e.g. City Centre Area Plan update) (PPD). 4. Consult at timely intervals with experts (e.g., MoE, Canadian Hydrographic Service, FBC) and monitor the latest long-range ocean/climate change forecasts and science for their implications (Engineering) 	<ol style="list-style-type: none"> 1. Improve the City's ability to obtain data and undertake direct measurements (e.g., monitoring local sea level changes through City operated gauging stations (Engineering; Public Works) 2. Direct staff to update the City's Flood Response Plan as part of the overall Emergency Response Plan (updated on basis of new modeling and technical information) (Engineering; Emergency Programs) 3. Establish a protocol for obtaining dike rights-of-way for Mitchell Island (Engineering + Development Applications) 4. Work with VIAA to clarify jurisdiction, maintenance standards and improvement programs for the Sea Island dikes (Engineering) 5. Encourage the City of New Westminster to harmonize its flood protection levels with Richmond's strategy (Engineering) 6. Work with Department of Fisheries and Oceans [DFO] on a plan for widening the perimeter dikes - inside and outside existing dikes, addressing related mitigation and compensation requirements (Engineering) 	<ol style="list-style-type: none"> 1. Prepare plans and policies (e.g., OCP, area plans, to support increased density adjacent to dikes but require grade increases and contributions to dike improvements. Retain dike rights of ways and access (PPD, real Estate) 2. Remove and relocate or replace toe ditches adjacent to dikes (Engineering) 3. Ensure that emergency facilities and refuge areas are located in areas not subject to flooding (Engineering; Emergency Programs; PPD, Dev Applications) 4. Review implementation plans for refuge areas, emergency routes, and create public awareness (Engineering; Emergency Programs) 5. Review this Strategy approximately every 5 years to ensure that new information is reflected. (All) 6. Develop on-going public evacuation and communication programs (Engineering; Emergency Programs).

Key Actions		Implementation Program Chart	
		2008 – 2031 Flood Protection Strategy	On-going and Longer-Term (2010 – 2031)
	Short Term (2008)	Medium Term (2009)	
Planning (con't)		<p>7. Work with external agencies (such as the Agricultural Land Commission) to develop a protocol that will allow for these changes in use through rezoning, development permits, etc. (PPD)</p>	
Bylaw Related Actions	<ol style="list-style-type: none"> 1. Rescind Floodplain Management Implementation Strategy Policy 7000 (PPD) 2. Prepare a Floodplain Bylaw including the new FCLs and the requirement for covenants/ indemnity (Engineering; PPD; Law) 3. Adopt other mechanisms and techniques [All]. 	<ol style="list-style-type: none"> 1. Other, as necessary. 	<ol style="list-style-type: none"> 1. Ensure issues of flood protection, grade levels, as well as refuge areas are considered in the development of local area plans (PPD; Engineering; Emergency Programs)
Dikes	<ol style="list-style-type: none"> 1. Establish protocol for obtaining dike rights of way for Mitchell Island (Engineering, PPD, Law). 	<ol style="list-style-type: none"> 1. Seek direction from Province on new acceptable probability criteria that will address sea level rise and climate related extremes for the next 100 years <ul style="list-style-type: none"> - (Current city standard is 1:200 for sea level event, and the 1894 discharge of the Fraser River plus freeboard as per provincial standards, versus 1:1250 conditionally recommended by UMA) - (Potential additional sea level/ subsidence study cost estimate - \$5,000) (Engineering); 	<ol style="list-style-type: none"> 1. Review dike maintenance programs at ongoing 3 to 5 year intervals (Engineering; Public Works) 2. Support sustainable funding for a federal [VFPA] river dredging program to maintain river profile (Engineering) 3. Establish in City budget annual amount for land for access rights to waterfront and dike areas (All)

Implementation Program Chart 2008 – 2031 Flood Protection Strategy	
Key Actions	On-going and Longer Term (2010 – 2031)
Short Term (2008)	Medium Term (2009)
<p>Dikes (con't)</p>	<p>2. Prepare and implement a comprehensive perimeter dike improvement program (researching, strengthening and widening dikes to reduce the level of risk) (Engineering)</p> <p>3. Establish a program for phasing/prioritizing perimeter dike improvement (e.g., seismically weak areas first, the mid island barrier, overall perimeter dike improvements) (Engineering)</p> <p>4. Establish and maintain inventory of rights of way and access agreements to diking system (Engineering)</p> <p>5. Update existing procedural policy of comprehensive dike maintenance (Engineering, Public Works).</p>
<p>Proposed Mid Island Dike</p> <p>Work with the BC MoT and others on a program to study, plan and cost share in the building of the Highway 99/Knight Street mid-island barrier (may require a Multiple Account Evaluation of interior barrier options - study cost estimate -\$100,000) (Engineering)</p>	<p>1. Once Mid Island Barrier technical details are finalized:</p> <ul style="list-style-type: none"> - established a phased implementation program - seek senior government cost sharing. <p>Pursue development of the mid island barrier along the Highway 99 / Knight Street Corridor (Construction cost estimate - \$16 million) (Engineering)</p>

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Part 3: Background

1. Introduction

This section was prepared by the City of Richmond with assistance from the Richmond Agricultural Advisory Committee, UMA Engineering Ltd, 3030 Gilmore Diversion, Burnaby, BC, and the BC Ministry of the Environment [MOE].

2. Purpose

The purpose of the 2008 - 2031 Flood Protection Management Strategy is to enhance the City's ability to prevent flooding and minimize the risk and effects of flood damage, by increasing flood protection, flood proofing and responses to floods.

3. Context

The City of Richmond is comprised of islands and is located in the floodplain of the Fraser River.

The three most developed islands are:

- Sea Island on which lies the Vancouver International Airport (YVR) and the community of Burkeville,
- Lulu Island on which lies the developing urban portion (60%) of the City (West Richmond) and a considerable amount of valuable agricultural land (40%) in the provincial Agricultural Land Reserve, and
- Mitchell Island which consists of industrial-related activities.

The City recognizes that with the human investment in both urban development and agriculture, the need for the protection of residents, farming and infrastructure is paramount.

Until recently, flood protection requirements and construction levels were regulated by the Province. These have now become largely the responsibility of the City as the local Diking Authority.

The principal method of protecting life and property on Lulu Island from flooding has been a structural one, primarily diking.

4. Study Area

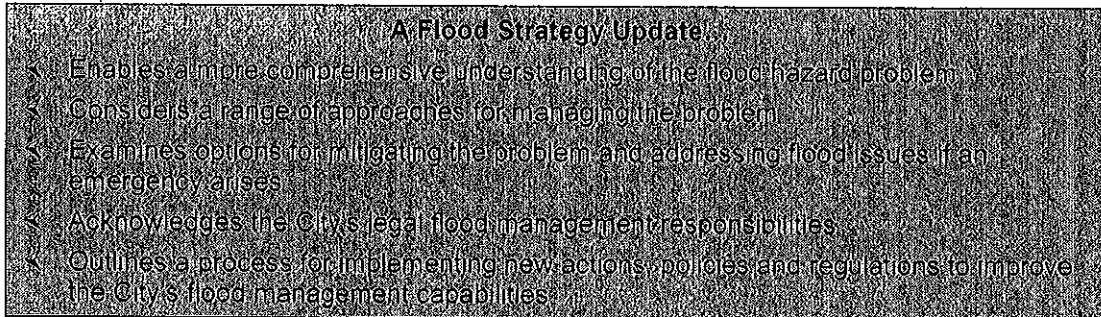
The focus of this study is on Lulu Island, the most inhabited of Richmond's islands and the one where the City has primary responsibility for flood management protection.

5. Hay Report (1989)

A review of flood protection options was last prepared in 1989 resulting in recommendations that led to development and adoption of several Council policies. This included the establishment of Flood Construction Levels (FCL) and areas exempt from flood construction levels. The proposed flood construction levels were defined in a 1989 Hay & Company report and adopted

by Council. However, not all of the flood management recommendations were implemented (e.g., due to funding limitations, agricultural concerns); and Council made a decision to review the earlier strategy and policies with consideration to potential modifications.

The City undertook a review of the issues involved in development of a new strategy by establishing a Technical Advisory Committee working in conjunction with a consulting team.



6. Key Factors Influencing the Strategy

a) Reconsideration of Proposed No. 8 Road Dike

A major impetus to preparing a new strategy was an element in the 1989 strategy which suggested the construction of a new interior dike at the No. 8 Road alignment supplemented with short dikes near the Highway 99 / Steveston exit and under the Knight Street Bridge approach ramp. These construction initiatives were deemed a high priority. However, this proposal was not implemented due to both high costs and concerns expressed by the agricultural community (loss of land and impacts on farm operations and drainage) that would result from the construction of the proposed No. 8 Road dike. These concerns contributed to the City's desire to review the current policy and provide direction for revisions, as necessary.

b) Provincial Legislation Changes

The Flood Hazards Statutes Amendment Act, 2003 repealed section 82 of the Land Title Act which authorizes the Province to designate floodplain areas and to establish subdivision conditions in such areas. The Province, by adopting this Act, transferred responsibility for floodplain regulations to municipalities. The City can enact its own floodplain bylaws and development permit area requirements. The Province still retains regulatory authority for the dikes under the Dike Maintenance Act.

c) Regional Considerations

In 1996, the City and the GVRD agreed that it would establish a flood hazard protection strategy as one step for the City to be considered for inclusion in the GVRD Livable Region Strategic Plan (LRSP) Growth Concentration Area. By being in the LRSP Growth Concentration Area, the City would have a better ability to accommodate residential, commercial and industrial growth, and Light Rapid Transit (i.e., the Canada Line).

d) New Information

The availability of improved information, changes in land use over the years, and the need to examine both structural and non-structural issues related to floodplain management, further advanced the need to re-examine the Hay Report and current City policies.

7. Study Process

a) Committee

A City Technical Advisory Committee was established to coordinate the work and liaise with the consulting team (UMA) throughout the project. This Committee included broad representation of City staff as well as external agencies:

- BC Ministry of Water, Land and Air Protection,
- the City of New Westminster, and
- Richmond Farmers Institute and others.

b) Development Stages of the Study

The work proceeded over a number of stages which are reflected in a series of technical reports including the following:

- Technical Memorandum #1 - #4 (UMA, April 2003). This report provides an overview of the Hay & Co. report, summarizes information gained from technical agencies, reviews the contributing causes to flood events, and summarizes the issues and consequences of flood events. The report also describes the key concepts appropriate to flood strategies and identifies those aspects that would most likely provide the greatest benefit in updating Richmond’s flood management strategy and policies.
- Draft Strategy Presented To Council on July 12, 2006 Council reviewed the draft and made passed the following resolution:

That, (as per Attachment 8 to the report dated June 29, 2006, from the Manager, Policy Planning and the Director, Engineering, entitled: "Richmond 2006-2031 Flood Protection Management Strategy"):

 - (1.) *the proposed "Richmond 2006 - 2031 Flood Protection Management Strategy" be received;*
 - (2.) *The "Richmond 2006 - 2031 Flood Protection Management Strategy" be referred to the appropriate Provincial Ministries (Environment, Transportation) and stakeholders (e.g., City of New Westminster, Fraser River Port Authority, Fraser Basin Council), for comments and approvals;*
 - (3.) *Staff pursue cost sharing for the Strategy Implementation Program with senior governments and stakeholders;*
 - (4.) *Staff begin more detailed discussions with the BC Ministry of Transportation to clarify the scope of work required to construct the proposed mid-island barrier along the Highway 99 / Knight Street Corridor;*

- (5.) *Flood covenants, including indemnity clauses, be required for all discretionary development applications (e.g., subdivision, rezoning, development permits);*
- (6.) *Staff prepare an Interim Floodplain Bylaw and report back to Council in October 2006; and*
- (7.) *Funding of \$10,000, from the 2006 General Contingency Account, be approved for legal services, to prepare an Interim Floodplain Bylaw.*

8. Project Context

a) Threat of Flooding

The City of Richmond is situated on islands surrounded by arms of the Fraser River, and the Strait of Georgia to the west. The entire area is within the floodplain of the Fraser River, and prior to diking was subject to periodic inundation. With most of the population residing on Lulu Island, the safety of the City’s citizens and protection of the built environment is dependent substantially on flood protection measures.

The water bodies surrounding Richmond are influenced by both Fraser River discharges and variations in the water level in Georgia Strait.

Flood threats considered here include the following natural and human actions:

Flood Hazards – Summary

The City faces the following principal flood hazards:

- A dike breach that may occur as a result of water overtopping dikes.
- The liquefaction of soils under the dikes as a consequence of an earthquake, or dike breach.
- Piping through a dike, caused by water under pressure eroding soil particles to cause a tunnel through the dike.
- Human damage to a dike.

The strategy addresses these flood hazards in a comprehensive manner, in particular, those that:

- originate from high tidal ocean levels, and
- are caused by high freshet discharges in the Fraser River.

It is unlikely that both extreme high ocean levels and extreme high river discharges will occur at the same time.

Most of the land surface of Lulu Island that has not been raised by fill placement lie:

- between an elevation of 0.5 m to 2.5 m Geodetic, with the average land level between elevation 1.0 m and 1.5 m, and

- for the Floodplain Exemption Boundary, which includes the more densely populated area in west Richmond, land that is lower than elevation 1.0 m.

b) Contributing Factors

For floodwater to enter the interior of Lulu Island from the river or the sea, it must either overflow the perimeter dikes, or these dikes must be breached in some manner. Given the current design and generally good condition of the existing dikes, an overflow would likely only result from:

- an extreme high water condition in the river or tidal sea;
- from a lowering of the dike crest, and
- an increase in the level of the Fraser River exceeding the dike crest, by extreme freshet discharges in the Fraser River.

When water overflows an earth dike, it may erode the embankment and breach the dike. The possibility of a breach developing from an overflow depends on the magnitude, nature and duration of the flow and the design and surface materials of the dike.

Emergency flood fighting measures can prevent an overflow from developing into a breach, especially when resources are readily available and action is taken quickly.

The other contributing factors that may influence the degree of flood hazard, include:

- The sea level is rising relative to the land level. Global warming causes sea levels to rise due to increased water temperatures and increased volumes of water from ice melt. The deltaic deposits underlying the City of Richmond are still settling, a process that has been occurring since the sand, silt and clay was deposited. The motion of the continental plates near the west coast is responsible for some vertical motion and the land surface is also rising slowly as a result of the retreat of the huge ice sheets of the last ice age. For the purpose of the flood strategy work it was assumed that an average relative sea level rise of 3.5 mm/year will occur over the next century.
- Sediment deposition and changes in peak flood discharges may result from global warming. A significant portion of the sediment load that is transported by the Fraser River surrounding Lulu Island is deposited in these channels, with maximum deposition rates coinciding with the freshet period. This continual build-up of sediment in the South Arm of the Fraser River is partly removed by frequent dredging, which is currently conducted by the Fraser River Port Authority (FRPA) to maintain a navigation channel for deep draft vessels that travel up the River as far as New Westminster.

9. Issues and Challenges

a) Federal

Federal jurisdiction relates to dredging of the Fraser River. Prior to 1998, the Coast Guard reported to Transport Canada and was responsible for dredging. In 1998 the

Coast Guard began reporting to DFO, and through this, were given a revised mandate that does not include dredging (largely due to costs). As a result, dredging has become the responsibility of the Port Authorities. According to FRPA representatives, between 1.2 million to 5 million cubic metres of materials are dredged or removed each year. Dredging can aid in maintaining river channels and avoid flooding as sediments are continuously deposited especially during spring freshet.

b) Provincial

Traditionally, the provincial government regulated construction in the floodplain by requiring approvals for bylaws in flood hazard areas. The Flood Hazards Statutes Amendment Act, 2003 repealed section 82 of the Land Title Act authorized the Province to designate floodplain areas and to establish subdivision conditions in such areas. This is no longer the case and exemptions previously granted by the Ministry are no longer under provincial authority. However, bylaws previously approved by the Ministry and in effect on the date the new section 910 of the Local Government Act came into force, have not been repealed. Currently, the City does not have a flood exemption bylaw but has such a policy.

The Local Government Act now provides local government with approving and regulatory authority through bylaw provisions, upon designation of the land as being a floodplain. Included is the authority to establish setbacks, flood construction levels and provisions to, for example, regulate specific uses within buildings through a bylaw. Provincial guidelines for construction and regulations in the floodplain must, however, be considered in exercising this City authority. The recent legislative changes have left a degree of uncertainty in terms of the role of the Province in sign-offs to plans, dike works and other related aspects. Clarification is likely to occur over a period of time, as specific issues are addressed.

c) Greater Vancouver Regional District (GVRD)

The Local Government Act makes provisions for Regional Districts to adopt a regional growth strategy. Where such a strategy has to be adopted, the affected municipalities are required to prepare a Regional Context Statement – intended to explain the relationship between the community's Official Community Plan and the regional growth strategy. The GVRD's version of the strategy is the Livable Region Strategic Plan (LRSP).

Currently there is no regional flood hazard management policy.

Through a 1996 Memorandum of Understanding (MOU) with the GVRD, Richmond withdrew its objection to the adoption of the original LRSP, in part, subject to agreement that the GVRD Board would support rapid transit to Richmond and that Richmond would seek agreement with the Province on a mutually acceptable implementation plan for flood and seismic protection, plus adopt land use policies and bylaws for achieving future population consistent with the LRSP. While not its sole intent, the proposed Flood Protection Management Strategy and its Implementation Program will, in large measure, respond to the City's commitment to develop a plan to

address the flood related issues identified in the 1996 MOU by outlining the many programs that Richmond has been – and is currently involved in – to improve flood protection for the City.

d) Fraser Basin Council [FBC]

The Fraser Basin Council is a regional organization which works with community groups, business and four orders of government, including First Nations, to ensure that the decisions we make now will protect and advance the Fraser Basin's social, economic and environmental sustainability into the future.

Its role in flood hazard management as noted in the FBC website is to:

- Support government authorities that have responsibility for flood prevention, mitigation and recovery on the Fraser.
- Promote the recognition that floodplain management must be integrated with land use planning and environmental management.
- Support government authorities through the coordination, facilitation and secretariat of the Joint Program Committee (JPC) for Integrated Flood Hazard Management which is a consensus-based committee involving 36 federal, provincial, and local government agencies and organizations to address flood risks.
- Work with the four levels of government on initiatives such as the development of flood hazard management tools and reports on flood protection works and floodplain management.

e) City of Richmond

i) General

City of Richmond Council adopted a Floodplain Management Implementation Policy on September 11, 1989. The strategy established:

- flood construction levels;
- procedures for development occurring within an exempt area (the principal urban portions of Richmond); and
- priority dike construction and improvements.

The concept of Flood Construction Levels (FCL) relies on measures that raise the lowest habitable floor elevations of all buildings above the FCL to protect the integrity of the building during a “design flood event”.

ii) Richmond’s Current Design Flood Event Standards

The current “design flood event” is the 1:200 year flood level for a sea level event, and the 1894 discharge of the Fraser River.

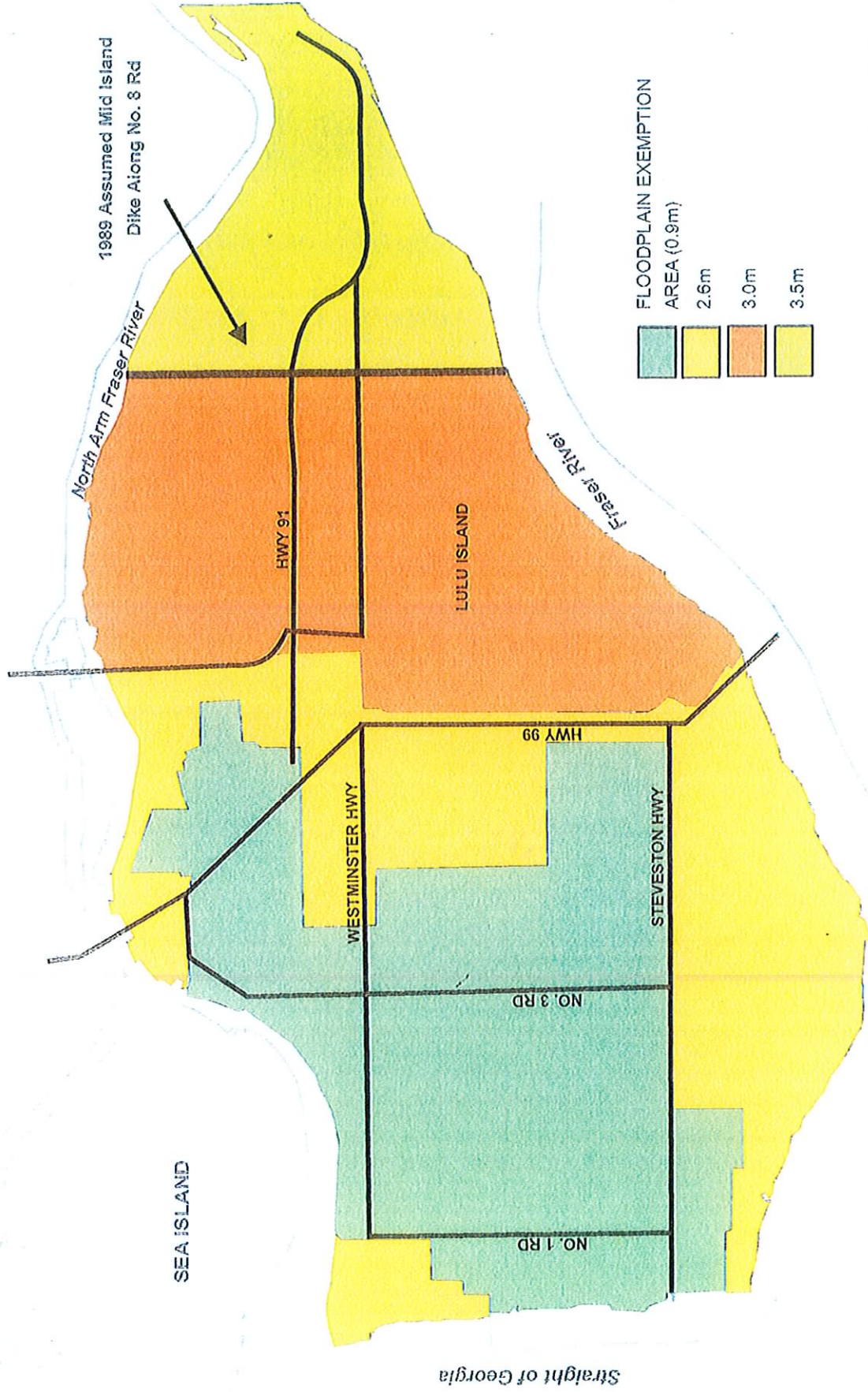
The FCL is typically set above the design flood level by a “freeboard” amount which varies from 0.3m to 0.6 m.

The current flood construction levels for Richmond were defined on the assumption that an interior barrier on the Number 8 Road alignment would be constructed along with other minor dikes identified in the Hay Report. Based on that assumption the FCL was set as follows:

- 3.5 m Geodetic Survey of Canada (GSC) for habitable or commercial building floor elevations east of No. 8 Road.
- 3.0 m GSC for habitable or commercial building floor elevations between No. 8 Road and the Knight Street/Highway 99 Corridor.
- 2.6 m GSC for habitable or commercial building floor elevations in non-exempt lands on Lulu Island west of Knight Street/Highway 99 Corridor, with provision for transition to existing land use adjacent to non-exempt lands.
- in the exempt areas, the FCL is 0.9 m.

Only City standards apply for habitable or commercial floor elevations in flood regulation exempt areas. Current Flood Construction Levels are depicted in Figure 1.

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City of Richmond
Flood Management Strategy

0947-028-01-02
May 2006

Flood Construction Levels

Figure 1

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The City has a number of protective measures in place such as dikes, 39 pump stations, drainage ditches, and flood construction level requirements that have worked well for many years to prevent negative impacts associated with significant flooding upon the community. Conditions have, however, changed since 1989. Notably:

- Provincial legislation has placed a greater responsibility upon local government for flood protection, with no provincially approved urban exempt areas, and municipalities having sole authority to designate by municipal bylaws floodplain areas and floodproofing requirements;
- The level of investment and the number of people living in the community have grown significantly;
- There exists a much stronger understanding of flooding and the changes in the physical environment which affect this community;
- There is better science available on how to improve flood protective measures, and
- There is clear evidence of the long term social and financial impacts after significant flooding through events such as New Orleans, and other flood affected locations.

Such challenges give rise to opportunities to strengthen the preventative and responsive flood management approaches – such as proposed in this Strategy.

f) Legal Considerations

To take full advantage of the regulatory authority provided under the Local Government Act, Richmond will need to prepare a floodplain bylaw pursuant to Section 910 LGA. In addition to allowing the municipality to regulate setbacks, flood construction levels and provisions for use, the Act provides the ability to require a statutory covenant and establish indemnity to the City and the Province for new construction in areas where flooding could occur. The elements contained within such a bylaw will depend upon improved floodplain mapping, what plan is adopted by Council and appropriate documentation that will require preparation by legal counsel.

Without such a bylaw, some provisions do exist allowing covenants to be sought (e.g. through subdivision under Section 86 of the Land Title Act), however, only voluntary covenants can be sought for certain other situations (e.g. typical building permits for single family dwellings). Under the Community Charter where the Building Inspector thinks that a flood hazard exists a geotechnical report can be required but once requested, the Building Inspector must abide by the report without deviation and the building permits can only be issued with a covenant.

While a Section 910 bylaw is seen as the preferred and more flexible option for regulating flood protection measures, uncertainty exists as to how the following section of the Compensation and Disaster Financial Assistance regulation of the Emergency Program Act will be interpreted in the aftermath of a significant flood event:

"If an area is designated under the Municipal Act as a floodplain and a public facility is built or installed in that area after the area has been so designated, no assistance will be provided to repair, rebuild or replace the public facility if it is damaged in a flood unless the structure was determined by the Minister of Environment, Lands and Parks or by Canada Mortgage and Housing Corporation to have been properly flood protected."

The regulation also places similar constraints upon new public facilities.

g) Financial Concerns

As part of any new strategic initiatives, dike improvements, maintenance, as well as construction, requires substantial capital investments. Richmond has recently established a dike utility to begin to address seismic/stability improvements to some of the weaker portions of the perimeter dike system. However the City will not have the resources to undertake such capital improvements on its own. Thus, there is a need to pursue partnerships, senior government assistance as well as to, broaden the use of City Development Cost Charges (DCCs) to include dike improvements, and other initiatives.

10. Flood Minimization Analysis

a) Flood Event Return Period

An assessment was completed to simulate the potential impact of flooding due to a dike breach on Lulu Island. In developing the flood analysis consideration had to be given to the design river flood profile and sea levels that need to be planned at designated breach locations.

For the lower Fraser River, the river flood design profile has been derived based on the largest contemporary flood peak which occurred in 1894. This flood design profile and the extreme sea level recorded at Point Atkinson has been commonly used as the provincial standard for deriving design dike profiles for the Lower Fraser River and flood construction levels in the adjacent floodplains. The peak discharge at Hope for the 1894 event has been estimated at 17,000 m³/s.

During the development of this Richmond Flood Management Strategy, a decision was made to provide a higher standard of flood protection in Richmond by using the 1:1250 year return period Fraser River and Ocean storm surge levels for the modeling. This was based on the following:

- A flood event greater than the current design event could occur;
- To ensure that the substantial increases in Richmond's population, development, and investment, are best protected;
- To maximize "Safety" and "Prevention", which are major City priorities;
- To increase the confidence in the City's flood protection assumptions and planning, and
- The current City's design standard does not address long term sea level rise.

It is noted that other places now use the 1:1250 and greater event for their dike design (e.g., Netherlands 1:5000)

Frequency analysis was performed for both the Fraser River freshet discharges and the ocean storm surge levels. For the river flood, the frequency analysis has shown that the 1894 flood of record appears to have a return period that is most likely between 136 years and 685 years. A reasonable working estimate of the 1894 flood return period suitable for dike design purposes is 200 years. Increasing the 1894 discharge by 25% to 21,250 m³/s brings the Fraser River discharge to be as a 1:1250 year event. In order to simulate a Lulu Island dike breach event, the discharge in the Fraser River at Hope was set to 21,250 m³/s, plus inflows from tributaries downstream of Hope. To model a 1:1250 year, event the discharges corresponding to the modeled hydrograph at Mission were increased by a factor of 1.25.

The impact of using the 1:1250 year return period event has on current dike heights in the municipality is illustrated by Figure 2. The 1.25 factor therefore exceeds the current Provincial and City standards and, if implemented regionally, would likely impact dike heights through to Mission.

The Fraser Basin Council is completing other studies which will increase our knowledge of flood event levels. The City is to consider this information in its on-going monitoring. For deriving the design sea level, a frequency analysis of the annual peak water levels recorded at Point Atkinson was conducted. The 1:1250 year return period still water level of 2.684 m which resulted from this analysis almost exactly matches the current design water level (2.68 m) for the dikes that are governed by the recorded extreme highest sea level. Accounting for long term sea level rise, a design 1:1250 sea level of 2.828 m was used for the modeling.

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Uncertainties

While the type of hazards can be defined, including the probability of certain water levels being realized, current knowledge is insufficient to determine the actual long term risk or probability of a dike breach or failure. Dikes are now designed to be higher than a certain water level, and it is assumed that the defense system will not fail until at least that level is reached.

The City is currently engaged in seismic upgrade studies for selected areas of the perimeter dikes.

c) Options for Minimizing the Potential for Flooding

In addition to diking, there are a number of other approaches available to prevent and mitigate flooding. These include the following:

i) Raise Land Levels

The rationale for raising the level of the land is similar to that which led to the establishment of flood construction levels. It is an attempt to retroactively institute consistent flood construction levels related to design flood levels for all parts of Lulu Island, even those which are currently in the Floodplain Exemption Area.

While it is difficult to implement in built-up areas (there would have to be a consistent fill elevation level over a fairly large area), this strategy provides one of the most secure, effective and long-lasting means of flood protection possible.

The result of raising the land area would be similar to what exists at the Fraser Port Authority lands today. Densely populated areas with many underground utilities could be raised in stages over a long period of time, reaching the ultimate elevation after a few centuries.

If only portions of areas are raised, then refuge areas are created. These refuge areas can serve as places for people to gather in an emergency such as a flood or major earthquake. They would be most functional if they contained critical facilities for emergency response, such as hospitals, fire halls and police stations. Other public buildings such as schools could also be considered for future refuge areas, since they generally occupy relatively large lots and would be more amenable to a fill pad of a few metres in height.

ii) Floodproofing

Floodproofing is achieved by raising habitable space on fill, or on a crawlspace or carport or garage that can survive flooding.

An alternative called wet “floodproofing” allows habitable space below the FCL, but relies on the use of flood resistant building materials and construction methods to mitigate the flood impact.

This approach which Richmond has had in place since 1989 increases public safety and reduces flood damage in the event that the diking system fails. Although used to only a limited degree, it is easily enforced on new construction and major reconstruction through building permits. It can also be applied to each individual building independently. This method is being implemented in parts of Lulu Island.

This concept does however face several major challenges. It is difficult to implement for existing structures, but can be feasible if implemented over a very long time.

iii) **Improving River Channel Conveyance**

The lowering of river flood levels can be achieved with sustained, aggressive and continuous dredging of the river bed. It entails significantly enlarging the channels of the Fraser River that surround Lulu Island. If dredging is used to increase the flow capacity of the channels, then continual maintenance to maintain that flow capacity is also required, since the Fraser River continues to deposit sand into the enlarged channel, especially during freshet periods.

However, this concept can only address flood levels caused by high river discharges. It does not reduce the flood threat posed by extremely high tidal sea levels. It may also affect aquatic habitats in the Fraser Estuary.

11. Land Use and Environmental Issues

a) **Growth**

Most of the residential, commercial and administrative nodes of the city are situated within the 'floodplain exemption area' in West Richmond. Residential growth, as well as commercial expansion, has continued, but is confined largely to the western portions of the city (with the Hamilton area on the New Westminster boundary and Burkeville on Sea Island being notable exceptions). This additional development further emphasizes the need for a re-evaluation of the flood management strategy, since the added population and investment in the area has significantly increased the potential for damage from a flood event. Agriculture predominates in the eastern portions of Lulu Island, with extensive cranberry fields towards No. 8 Road and Nelson Road. This has been a growing sector over the past few years, and now over 850 hectares of the agricultural crop land is devoted to cranberry production (the next largest crop is hay with about 430 hectares). Special drainage canals, ditches and dikes are required for the seasonal harvesting of cranberries.

b) **Land Use Changes**

Land use change has been dramatic since the initial adoption of the 1989 flood management strategy. Notable is the expansion of the residential development in the City Centre and industrial and business park base. Major new activities include the development of the Fraser Port lands which extend along the south arm of the Fraser River at the southern ends of No. 7 Road, No. 8 Road and Nelson Road. Large warehousing and distribution centres characterize this area. The area has been

developed on an extensive volume of fill sand taken from the dredging operations conducted by the Fraser River Port Authority. This fill creates a substantial area of high elevation topography in Richmond with a land surface situated above even the worst case extreme flood levels. The Fraser Port (Richmond lands) will ultimately provide for about 1000 hectares of industrial use in this location, and the elevation of the land here functions as a significant flood barrier.

c) Environment

Over the past decade, the City has placed significant importance on the environment and has successfully protected several natural areas such as foreshore areas, the Richmond Nature Park, the Northeast Bog Forest and the Terra Nova Natural Area. In 1991, the City amended its Official Community Plan to include an inventory of environmentally sensitive areas such as bogs, estuaries, and sloughs as valuable natural habitats. In 2005, parks and protected areas accounted for 9.7% (1248 ha) of the municipality's land base.

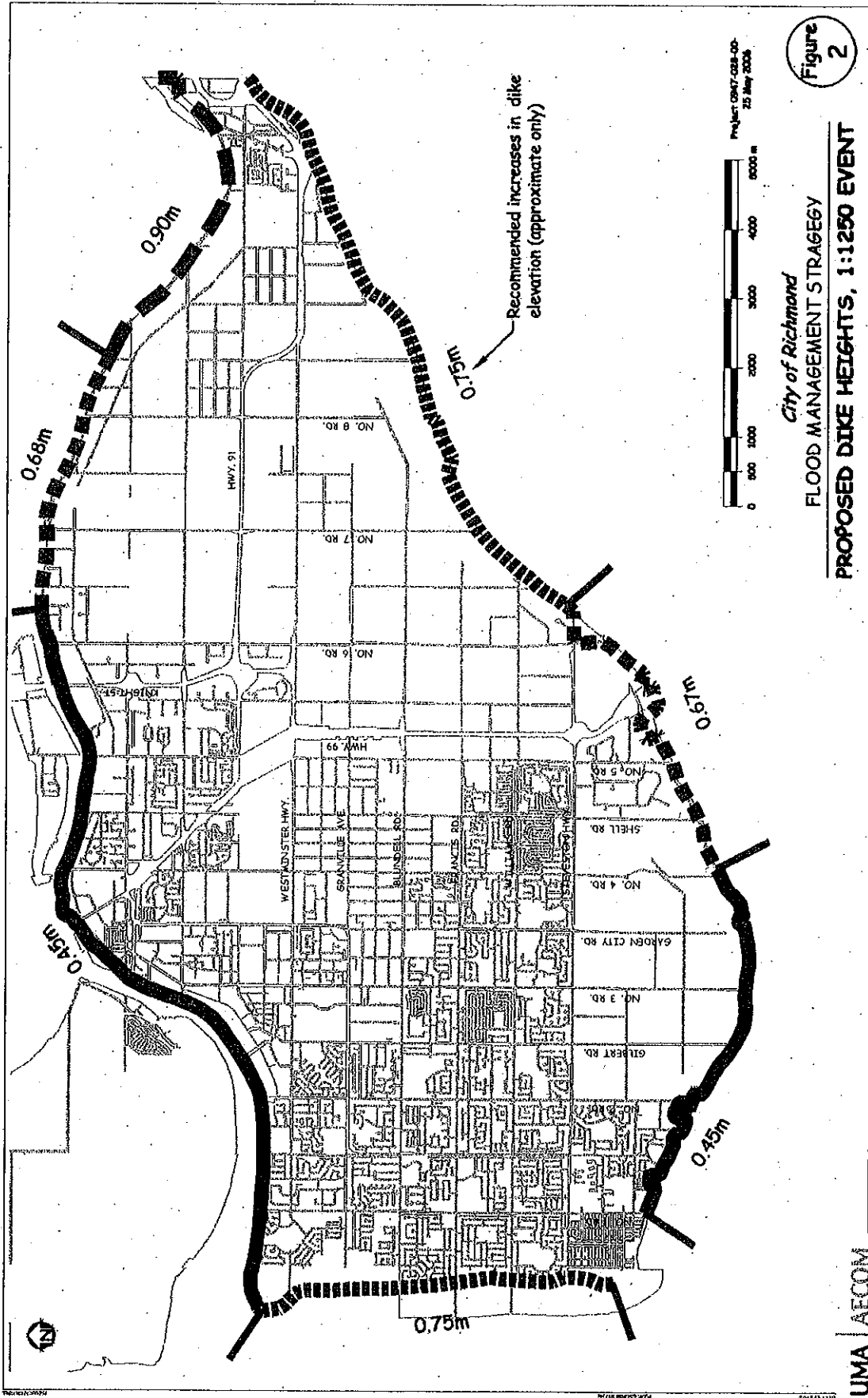
d) City Zoning Authority

The City, under the Local Government Act has the authority to zone land and controls its use and density. Zoning provides an important element in an overall flood management strategy. For example, it provides an opportunity to allow for the gradual widening of the perimeter dike, in agreed to locations, to minimize the probability of such events as piping. This approach is similar to what has occurred at the Fraser Port lands. This would involve the identification of areas where the City wishes to achieve a widened dike on private property. As part of a development agreement and subsequent zoning, owners can be encouraged to fill their lands to an appropriate standard, with rezoning offering an incentive to minimize or mitigate costs to the public and the owner. This strategy, driven by planning considerations, would be considered similar to the filling of land to raise the elevation and offers one of the best possible means of long term flood protection.

This policy, while of broad application, is likely most effective for northeast Lulu Island. A potential area for redevelopment is readily identifiable, using the rail tracks as the southern boundary, with No. 6 Road as the western boundary (up to an established industrial area), and the Hamilton residential district as the boundary to the east. Other areas can also be included, but the interior extent of the potential raised area would require better definition. Land within these areas may be considered for redevelopment from agricultural to industrial, thus providing some incentive to private property owners to fill land and at the same time, fulfilling an industrial strategy to create more water accessible industrial lands.

To further assist the dike widening initiative, this strategy may be combined with a transfer of density rights program. Richmond dikes may be considered an amenity; the dikes are integral to the City's trail system and dike widening provides greater protection from flood hazards. Density rights may be transferred to development on land encroached by dike widening and set backs. Input and approval from the Agricultural Land Commission would also be required.

Figure 2 – Proposed Dike Height Increases



**Memorandum of Understanding Between Richmond and GVRD Regarding
Resolution of Objections to the Livable Regional Strategic Plan**

The Greater Vancouver Regional District and the City of Richmond agree:

- a) that historic growth patterns in Richmond are established and Richmond will continue to grow under the guidance of Official Community Plans, which when modified shall continue to be complementary to regional plans adopted under the Growth Strategies Statutes Amendment Act;
- b) that these historic patterns have already concentrated growth in Richmond and established Richmond as a major centre for residence as well as business in Greater Vancouver, that the conditions for those growth patterns are unique to Richmond (i.e. the location of the international airport within the City, the culturally diverse population, the existing concentration of employment particularly in areas related to international trade, visitor services, and hi-tech activity, the strategic geographic location between downtown Vancouver, the airport, and the U.S. border, and the island amenity and quality of life) and will continue to shape Richmond and benefit the region's well-being; the Richmond should develop as a complete community, balancing job growth with housing opportunities while protecting the Agricultural Land Reserve;
- c) that the "Livable Region Strategic Plan" recognizes that rapid transit to Richmond, which will shape and serve the growth in the Richmond Regional Town Centre, is a fundamental requirement for the success of the plan;
- d) that the Board will continue to press the Province and BC Transit for commitments to construct all three transit lines on the basis that all those lines are necessary for the full realization of the Livable Strategic Plan's objectives;
- e) that West Richmond is a strategic growth area and should Richmond and the Province agree on a mutually acceptable implementation plan for flood and seismic protection, and should Richmond have adopted land use policies and bylaws consistent with the achievement of a future Richmond population comparable to objectives for growth within the Growth Concentration Area, then West Richmond would be considered as an area qualifying for priority in transportation services and facilities, as described in the Livable Region Strategic Plan policy;
- f) that should the condition in (e) be fulfilled, then an amendment to the Livable Region Strategic Plan to include West Richmond in the Growth Concentration Area shall be prepared and brought forward for consideration by the GVRD Board; and,
- g) that the City of Richmond withdraws its objection to the Livable Region Strategic Plan on the basis set out in this agreement.

Approved by Richmond City Council, January 22, 1996
Approved by GVRD Board January 26, 1996