





Investigations in Support of Flood Strategy Development in BC ISSUE B-6: NON-STRUCTURAL FLOOD MANAGEMENT APPROACHES

Final Report

Prepared by: Northwest Hydraulic Consultants Ltd. (NHC)

Dale Muir, P. Eng. Principal <u>dmuir@nhcweb.com</u> Prepared for: Fraser Basin Council

Frances Woo Program Manager, Flood Strategies <u>fwoo@fraserbasin.bc.ca</u>

INVESTIGATIONS IN SUPPORT OF FLOOD STRATEGY DEVELOPMENT IN BRITISH COLUMBIA

ISSUE B-6: NON-STRUCTURAL FLOOD MANAGEMENT APPROACHES

FINAL REPORT

Prepared for:

Fraser Basin Council British Columbia

Prepared by:

Northwest Hydraulic Consultants Ltd. North Vancouver, British Columbia

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Report prepared by:



Dale Muir, M.Eng., P.Eng. Principal Report reviewed by:

Monica Mandrean

Monica Mannerström, M.Eng. P.Eng. Principal

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- Mitchell Hahn, P.Eng.
 Inspector of Dikes / Head Flood Safety Section (BC)
- Sarah Gillett MODUS Planning, Design, & Engagement

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- Dale Muir, M.Eng. P.Eng. Project management
 Dwain Boyer, M.A.Sc. P.Eng. Project engineer
 Julie Van de Valk, EIT Project engineer and risk specialist
- Monica Mannerström, P.Eng.
 Principal review

Arlington Group Planning Inc.

• Graham Farstad, MCIP, RPP Principal planner

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EXECUTIVE SUMMARY

Flood risk is mitigated through a range of measures, often categorized as structural and non-structural measures. Non-structural mitigations include land use policy and public education to reduce the consequence of a flood by reducing the exposure, reducing the vulnerability, and increasing the resiliency to flooding. These measures include establishing limitations, restrictions, and requirements on land use; such as limits on what type of development occurs on flood prone lands, establishing no-build setbacks from a waterbody, and defining minimum elevation for new construction (i.e. flood construction level or FCL). Non-structural flood mitigation measures also include public education, to increase awareness of the local flood risk and the role and value of individual preparations. Non-structural mitigations influence community behaviour and actions. This is in contrast to structural mitigations (e.g. dikes, flood reservoirs, by-pass channels), which are intended to influence the physical flood (i.e. hydrology and/or hydraulics). Non-structural flood management is often the most effective, most broadly applied, and the least costly mitigation to limit or reduce flood risk. It is often required in addition to structural measures to mitigate the risk of failure or exceeding the capacity of structural measures.

In effort to support the *Investigations in Support of Flood Strategy Development in British Columbia*, this report documents investigation into non-structural flood management approaches through the following study questions:

- 1. Investigate past and current approaches to land use and development decisions in floodplains by local and provincial authorities.
- 2. Investigate alternatives to the current approach to managing development in floodplains, including returning regulatory authority for development approvals in municipal floodplains to the Province, and provide an analysis of the benefits and costs/limitations of both local and provincial authority.
- 3. Investigate impediments to and opportunities for implementing available non-structural flood risk reduction actions, including the role of incentives and regulation.
- 4. Investigate the nature of an educational campaign for regional, local, and Indigenous governments to raise awareness of flood risk and possible risk reduction options.

The purpose of this investigation is to identify opportunities to reduce or limit flood risk within BC through improvements in non-structural flood management. Specific objectives of this document are to provide a comparison of past and present approaches in non-structural flood management in BC, identify challenges and limitations with the current approach, and present potential opportunities to improve non-structural flood management within BC.

Prior to the early 2000's the Province of BC had a staff of hydrotechnical experts that actively supported non-structural flood mitigation within the province. The Province set flood standards¹, identified and assessed flood hazards by designating and mapping floodplains across the province, provided review and

¹ Examples of these standards include: 200-year average return period for design flood event, 0.3 and 0.6 m of freeboard (*above daily and instantaneous peak flood level*); and 7.5, 15, and 30 m setback from flood potential water bodies (lake, creeks, and rivers).



approval of local government flood bylaws and official community plans (OCPs), provided review and approval of exemptions, and review of local building permit applications when requested, documented flood covenants, as well as identified suitable property scale mitigation measures, designed the measures, and funded up to 75% of the construction cost for those measures.

Leading up to the start of this century, the Province began to reduce their capacity to provide this support by reducing the size of hydrotechnical staff. In 2003, the Province passed the *Flood Hazard Statutes Amendment Act* which transferred responsibility and authority for non-structural flood management to local governments by modifying sections of the *Land Title Act* and *Local Government Act*. These modifications eliminated the provincial role in designating floodplains, establishing flood construction levels and setbacks, establishing subdivision and development requirements within flood prone lands, setting flood covenants, and providing exemptions for a development or type of development to the established floodplain development conditions. These were replaced with establishing local government's ability to designate floodplains, develop flood bylaws (setbacks, and FCLs), enter into flood covenants, and require flood hazard assessment reports from a qualified professional engineer. Specific provincial standards were not established, but the amendments included a requirement for local governments to consider policies and guidelines with respect to floodplain management. To assist local government, the Province prepared a set of maps identifying the known flood hazards and prepared guidelines on land use in flood hazard areas.

Following the transition in authority there appears to have generally been low levels of engagement within local government and inconsistent understanding of expectations with respect to non-structural flood mitigation. The most engaged communities were those that experienced a recent sizable flood or natural hazard event or had sizable resources. In the past 5 years, Indigenous and local governments have been funded \$40 million in support of non-structural flood mitigations (through NDMP and CEPF). Local governments appear to be increasingly engaged corresponding with this funding. However, the lack of centralized direction and review are expected to have negatively impacted the effectiveness of these efforts by limiting ability to monitor and control quality, consistency, completeness, and effectiveness. Furthermore, where results and guidance are not definitive, local governments are left to interpret findings and provincial guidelines. This can challenge, delay, or halt the final actions in establishing and enforcing land use regulations; particularly where there is conflict with other local government objectives and responsibilities.

Alternative approaches were investigated from other provinces and countries. Within BC Indigenous and local governments are expected to identify and assess flood hazards and establish local land use planning and restrictions with respect to flood hazards. Any technical expertise to support these roles comes from private consultants. In contrast, all of the other jurisdictions investigated had a provincial, regional, or national level assessment and technical support. Interesting features of the approaches from alternative jurisdictions include the following:

 Within all the alternative jurisdictions investigated, technical support is provided to local governments by a national, provincial, or regional level of government. Some locations define the regions based on watershed with technical support and regulation incorporating ecological considerations as well as flood hazard considerations.



- The intent for land use planning in the UK directs development to the lowest risk property(s) followed by the next higher risk property(s), unlike the more standard approach of establishing a hazard or risk threshold that is consistently applied across all properties.
- The UK standardizes measures for wet and dry floodproofing (beyond setbacks and FCL) providing feasible options to flood prone areas already extensively developed.
- In Australia and Alberta, flood hazard information for extreme events beyond the standard design event are presented to communicate residual risk beyond that normally mitigated. This is in contrast to BC that normally does not communicate residual risk (e.g. beyond the 200-year flood event).

Based on review of past and current approaches within BC, review of other jurisdictions, and responses from survey of a sample of local governments, three optional approaches to service delivery are proposed to increase quality, consistency, and effectiveness of land use planning of flood prone lands. These are:

- Option 1: Province to regain a leadership role by providing technical support, review, and approval of floodplain designation and flood bylaws, as well as upon request providing review and approval of challenging development applications and exemptions.
- Option 2: The Province provides technical support to Indigenous and local governments with respect to land use planning of flood prone lands. The Province would provide a supporting role rather than preparing or approving floodplain designation, bylaws, and developments. The technical support could be provided directly by the Province or an intermediary agency.
- Option 3: Indigenous and/or local governments partner to provide non-structural flood management. The partnership provides a larger entity (than a single local level government) to establish a larger technical resource and to ensure consistency across a larger region. The Provincial could facilitate the partnering of the services.

In addition to the alternative service delivery approaches lists of impediments and opportunities were identified. From this review the following recommendations to the Province are made:

- Define the roles and responsibilities for flood risk reduction this includes the purpose, objectives, goals, and expectations on the various levels of government and agencies. In addition, metrics and a plan to routinely monitor and gauge effectiveness of flood management within the province should be defined.
- Review and improve provincial guidelines on land use in flood hazard areas. The existing
 provincial guidelines appear to have had minimal review or updates since 2004, despite changes
 in technology, understanding of climate change, and approaches to address flood hazards. In
 particular, guidance on risk-based approaches, alternative flood proofing techniques, and
 improved link between floodplain designation and land use planning should be considered.
- Implement consistent funding to address projects that span multiple years. This is one of the improvements most frequently requested by local governments through the survey associated with this project.



- Develop technical capacity to support Indigenous and local governments in non-structural flood management to improve quality, consistency, and effectiveness in non-structural flood management and further support Indigenous and local governments through challenging land use regulations and mitigation measures (such as managed retreat).
- Adopt alternative flood proofing measures (beyond setbacks and FCL) for new and existing buildings. Provision and guidance for alternative mitigations could provide an option for areas not able to meet the FCL by elevation (such as for the existing exemption areas) and for existing buildings unable to be elevated above the FCL.
- Review and update existing acts and codes with consideration of flood risk management (e.g. building code, *Tenancy Act*).
- Develop further incentives for land use regulation, this could include technical support, funding, restrictions on disaster relief, restrictions to other funding, or making conditions mandatory (currently local government is required only to consider non-structural flood management guidelines and policies).

A list of recommendations was also developed specific to flood education campaigns. The recommendations are:

- Develop an educational framework to support local level governments in establishing and implementing educational campaigns.
- Provide technical support for Indigenous and local governments in the development and delivery of local flood education campaigns. It is expected that support is most needed for communities with complex flood hazards or contentious mitigation plans (e.g. managed retreat).
- Provide funding for Indigenous and local governments to develop and deliver local flood education campaigns. It is expected that funding is most needed for smaller communities with limited resources and complex flood hazards.

Further details and cost estimates for the proposed recommendations are included in the report. It is recommended that the entire report is read and understood prior to prior to considering any specific measure or approach listed in the executive summary.



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PREAMBLE

Many communities in BC are working to better manage their river and coastal flood risks through a wide range of flood management activities. But current approaches to managing flooding are not always efficient, coordinated, equitable, or cost-effective.

The **Investigations in Support of Flood Strategy Development in British Columbia** is a province-wide initiative aimed at developing a comprehensive understanding of current challenges and opportunities relating to flood management across BC. The focus is primarily on riverine, coastal, and ice jam floods, although other types of flooding are recognized where appropriate. This initiative recognizes that flood management is a multi-faceted, ongoing process requiring the coordination of many organizations, agencies, and orders of government and linked with broader processes, including climate change adaptation and disaster risk reduction, among others.

The BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development retained the Fraser Basin Council to manage and coordinate research and engagement across a broad range of flood management issues relating to governance, hazard and risk management, forecasting, and emergency response and recovery. Consulting teams were retained to undertake research and technical analysis with input from experts, practitioners, and stakeholders from all four orders of government, the private sector, and other organizations. Each investigation produced recommendations to inform flood management program improvements at multiple scales and across many jurisdictions.

Investigations were undertaken across 11 interrelated issues under 4 themes (Table 1.1):

	Theme A – Governance			
A-1	Flood Risk Governance	Review current governance and delivery of flood management activities in BC involving all four orders of government and non-government entities, identify challenges, and recommend changes to improve coordination, collaboration, and overall effectiveness.		

Table 1.1Project investigations.

		Theme B – Flood Hazard and Risk Management
B-1	Impacts of Climate Change	Investigate the state of climate change information and new and existing tools that can support authorities in integrating climate change impacts in flood management.
B-2 Flood Hazard Information Examine the state of flood mapping and dike deficiency information recommend ways to fill current gaps in flood mapping and manages maintain information about flood hazards and dike deficiencies.		Examine the state of flood mapping and dike deficiency information and recommend ways to fill current gaps in flood mapping and manage and maintain information about flood hazards and dike deficiencies.
B-3	Flood Risk Assessment	Explore approaches to completing flood risk assessments at various scales, methods for prioritizing risk reduction actions, and standards- versus risk-based approach to flood management.



Theme B – Flood Hazard and Risk Management		Theme B – Flood Hazard and Risk Management
B-4	Flood Planning	Examine the ability of local authorities to undertake integrated flood management planning and opportunities to improve capacity.
B-5	Structural Flood Management Approaches	Assess the potential for improvements to dike management, improve the capacity of diking authorities, and implement innovative structural flood risk reduction measures.
B-6	Non-Structural Flood Management Approaches	Investigate current and alternative approaches to managing development in floodplains and opportunities for implementing non-structural flood risk reduction actions.

Theme C – Flood Forecasting, Emergency Response, and Recovery		
C-1	Flood Forecasting Services	Identify gaps and opportunities for improvement in the province's flood forecasting services.
C-2	Emergency Response	Investigate roles, plans, and capabilities for flood response and opportunities for improving emergency response.
C-3	Flood Recovery	Examine approaches that would support recovery efforts and help reduce future flood risk.

	Theme D – Resources and Funding		
D-1	Resources and Funding	Investigate resource and funding needs associated with actions to strengthen flood management and evidence in support of proactive flood mitigation.	



1 INTRODUCTION

1.1 **Project Description**

Flood risk is mitigated through a range of measures, often categorized as structural and non-structural measures. Non-structural mitigations include land use policy, public awareness and education, flood forecasting, and planning and preparation for floods. These mitigations are to reduce the consequence of a flood by reducing the exposure and vulnerability and increasing the resiliency. Non-structural mitigations, which are intended to influence the physical flood; that is reducing the probability and magnitude of flood flow (hydrology) or level (hydraulics). Non-structural flood management is often the most effective, most broadly applied, and the least costly mitigation to limit or reduce flood risk (Bruce, J.P., 1976; Stevens and Hanschka, 2014b). Non-structural measures can be applied on their own, but are often applied in conjunction with structural measures to account for events that exceed the design of the structural measures and for potential failure of the structural measures.

This report documents an investigation into non-structural flood management approaches through the following study questions:

- 5. Investigate past and current approaches to land use and development decisions in floodplains by local and provincial authorities.
- 6. Investigate alternatives to the current approach to managing development in floodplains, including returning regulatory authority for development approvals in municipal floodplains to the Province, and provide an analysis of the benefits and costs/limitations of both local and provincial authority.
- 7. Investigate impediments to and opportunities for implementing available non-structural flood risk reduction actions, including the role of incentives and regulation.
- 8. Investigate the nature of an educational campaign for regional, local, and Indigenous governments to raise awareness of flood risk and possible risk reduction options.

The purpose of this investigation is to identify opportunities to reduce or limit flood risk within BC through improvements in non-structural flood management. Specific objectives of this document are to provide a comparison of past and present approaches in non-structural flood management in BC, identify challenges and limitations with the current approach, and present potential opportunities to improve non-structural flood management within BC.

1.2 Context of Flood Mitigation in BC

Due to the widely varying geography of BC, many communities are exposed to a diverse range of flood hazards. Interior communities may be inundated by river and creek floods from snowmelt and intense rainfall, ice jams, debris floods, or outburst floods from debris or ice barriers. In addition, many areas are exposed to geomorphic hazards often associated with high flow such as channel migration, aggradation, or avulsion. Many communities are situated on alluvial and/or debris flow fans and are exposed to the



dangers associated with avulsions and debris inundation. Coastal communities can be inundated by storm surge, extreme tides, swell and wind waves, exposed to forces from waves and coastal debris, or flooded from tsunami flooding (originating from sudden mass movements of the water body, local or distant). Communities along lakes or other large water bodies can also experience many of these hazards (i.e. waves, wind setup, landslide generated tsunami). The variability and complexity of hazards, terrain, climate, and community resilience across this province challenges assessment of risk as well as the approach to mitigate the risks. The following subsections present a brief history of flooding in BC, approaches to mitigate the flood hazards, and legislation relevant to non-structural flood management approaches.

1.2.1 History

Rivers, coasts, and lakes provide sources of waters, food, and transportation, and the surrounding land is often the most habitable. Communities have therefore located on the floodplains near water courses. This has led to a risk of flooding. Indigenous communities have recounted past flooding prior to European contact. An example is presented by FBC (2020a) in which a Great Flood from long ago is recounted when land along the lower Fraser River was flooded except for Golden Ears mountain and Mount Cheam. During the recounted Great Flood, and other high water events, communities would relocate to high ground. Beginning in the mid-1800's the ability for Indigenous communities to temporarily relocate to accommodate floods was lost. Through European settlement, Indigenous communities were forced onto reserves; constraining or preventing movement.

British Columbia joined the Canadian confederation in 1871. The province experienced three large flood events on the Fraser River - its most prominent river² - within its first 100 years as a province, 1894, 1948, and 1972. Each event triggered successive rounds of structural mitigation, such as dike construction, improvements, and repair. Following the 1972 flood, it became apparent that planning and regulatory controls would be required to limit or reduce the risk from flooding (Doughty-Davies, 1976). The provincial strategy from that point forward included planning and regulation of new development on flood prone lands as well as structural solutions. Structural solutions were to only be considered where the extent of existing development and risk of flooding justified their cost. To fulfill the objectives of this strategy, up until 2003, the province of BC participated or led programs in:

- Identification of flood hazard areas
- Approving subdivisions in flood prone areas
- Designating floodplains and associated building requirements through setting flood construction levels (FCLs) and setbacks from the flood source
- Adjudication of applications for site specific floodplain bylaw variances
- Establishing flood covenants on properties within flood prone areas

In 2003, the BC government passed the *Flood Hazard Statutes Amendment Act* which modified the *Land title Act* and *Local Government Act*. This act is often cited as the point of transition when authority and

² The Fraser River conveys the largest water volume and has the longest length of any river wholly within the province's boundaries. Given the dense development and transportation infrastructure along the Lower Fraser, a major flood can directly and indirectly impact a majority of BC's population.

Investigations in Support of Flood Strategy Development in BC B-6 Non-Structural Flood Management Approaches



responsibility of non-structural flood management was transferred from the Province to local government. In reality, the Province had been reducing the number of staff supporting local governments in flood management over a number of years prior to and following this legislation. The legislative changes did however make a number of substantial changes. These include transferring to local governments the authority to designate floodplains, specify flood levels, specify setbacks from a potential source of flooding, require engineering report that certify that a property may be used safely for the use intended, enter-into, modify, or discharge covenants, and approve subdivisions; without provincial approval.

A number of studies have questioned the effectiveness of management of flood prone lands since the 2003 transfer of authority. A paper by Ranade, motivated by the apparent lack of clarity of the statutory framework for flood management in BC, lists the following statements that suggest flood management effectiveness in BC could be improved (Ranade, 2020):

- A survey of flood managers across BC found less than a third of respondents stated that legislation and management tools were sufficient to adequately manage flood hazards (FBC and Arlington Group Inc., 2008)
- Granting of authority to regulate floodplains to local government did not come with corresponding responsibility to do so (Lyle and Mclean, 2008)
- "the current provincial approach to fostering municipal flood risk management in BC ... does not appear to have been successful" (The Arlington Group, 2014)
- "[t]here is lack of clear direction for local governments in the area of flooding" stated by the Auditor General of BC (AGBC, 2018)

Both prior to and following the 2003 transfer of authority, the various levels of government apply their authority through one or more of the following approaches:

- Regulation, such as through an approval process or zoning, to limit or restrict where or how flood prone lands are developed (e.g. District of North Vancouver established Development Permit Areas, requiring specific assessment by qualified professionals prior to issuing permits for subdivision, building, or occupancy)
- Guidelines and standards, which provide recommendations that are to be considered by local governments but are not regulations that must be complied with (*as noted in the Local Government Act, Section 524*). The guidelines and standards, although only need to be considered, in practice are generally followed to limit any perceived liability (e.g. provincial Flood Hazard Area Land Use Management Guidelines)
- Funding, potentially with criteria that encourages appropriate controls or discourages development of flood prone land (e.g. 1975 Flood Damage Reduction Program where the federal government would not fund development on flood prone lands through Canada Mortgage and Housing Corporation (CMHC) nor fund disaster assistance for developments within high floodrisk areas (Bruce, J.P., 1976))
- Information and technical support provided to the different orders of government or the public to guide appropriate development of flood prone lands.



The actual implementation of each of these approaches vary based on level of expertise and capacity within the government. The implementation can be achieved using staff resources, external organizations (e.g. Engineers and Geoscientists of BC (EGBC)), external professionals, professional peer reviews, or a combination. Various exceptions can be applied to provide further flexibility to active regulation (e.g. exemptions and variance).

1.2.2 Flood Mitigation Objectives

For a program to be effective and accountable it requires a defined mission or objective. Based on the provincial integrated flood hazard management website (British Columbia, 2020), the provincial mission is stated as

"to reduce the impacts of flooding on people, communities, and infrastructure in the province"

With the objectives of

Providing i) policies, ii) regulations, iii) guidelines, iv) funding, and v) useful information to manage land use, manage flood protection systems, and to prepare, respond, and recover from flood emergencies.

Different communities, organizations, and levels of government may have varying values when considering the specific objectives or goals of flood mitigation depending on the organization's assets, liabilities, and beliefs. Based on the experience of past flood assessments and flood mitigation projects conducted by NHC and Arlington Group for a range of Indigenous an local governments, the typical objectives of flood mitigation include many of the following, however prioritization does vary:

- Reduce the threat of harm or loss of human life.
- Reduce the hardship to local or regional residents.
- Reduce the extent of property damage.
- Reduce the damage or loss of public or private infrastructure.
- Reduce the magnitude, extent, and duration of disruptions to commerce, transportation, communications, social services, and economy (locally, regionally, provincially, or federally).
- Reduce the potential payout following a flood event (government and/or institutional liability).
- Reduce the damage or loss to environment or habitat.
- Reduce the damage to cultural facilities and valued objects.
- Limit the extent of cascading or cumulative (i.e. including secondary and indirect) impacts from flood damage.
- Increase the resiliency of a community to recover following a flood event.
- Develop opportunities for future shoreline projects that could provide further flood mitigation, habitat improvement, and social or recreational values.
- Limit the current need for costly structural mitigation measures.
- Provide a vision for a long-term planning purposes, including provision for building back better in the event of a flood event, and planned retreat, where applicable.



 Limit flood related restrictions on property use only to the degree needed to meet flood mitigation objectives.

Ideally, flood mitigation strategies are developed to address the specific values of the agency developing the strategies. These objectives may conflict with other objectives when considering a specific location or project.

1.2.3 Approaches to Flood Mitigation

Any approach to flood mitigation will inevitably make use of a range of measures to mitigate flood risk. Flood mitigation measures can be categorized as structural or non-structural mitigation measures as illustrated in **Table 1.2** below. Historically structural flood mitigation measures, particularly dikes, were the primary defence deployed by governments in BC to address flood hazards. Over the past 50 years, non-structural measures have been recognized as potentially effective flood mitigation measures, with increasing acceptance and enthusiasm (Bruce, J.P., 1976; Stevens and Hanschka, 2014b).

Despite the all-encompassing title of this Issue: *"Non-Structural Flood Management Approaches"*, the current study scope is limited to an assessment of land use planning for flood prone lands and public education with respect to flood hazard and risk reduction. Land use planning includes regulations and incentives; with a focus in this study on regulation through zoning, building controls, policy, and guidelines. Land use planning can be used to reduce exposure and vulnerability to flooding through a range of flood mitigation measures, such as use of flood resistant materials, building above a specific flood elevation (i.e. flood construction level, FCL), setback from the "natural boundary" of the source of flooding (e.g. river, steam, sea, lake, pond, etc.), establishing limits or conditions on expansions and redevelopment (restrictions on type or density), and prohibiting certain land uses or new development. Education can be used to gain public support for land use regulations intended to reduce flood risk as well as to reduce the vulnerability to flooding. Flood education can include improving awareness of the flood hazards, responsibilities in preparation, during, and following a flood, measures to prepare for flooding.

As listed in Table 1.2 there are several other non-structural and structural approaches that are covered by related investigations.



Table 1.1	Examples of structural and non-structural flood mitigation approaches
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Non-Structural Reducing Exposure & Vulnerability	Structural Reducing Flood Hazard
 Hazard assessment (B-2) {<i>i.e. current knowledge of hazards</i>} Risk assessment (B-3) {<i>i.e. current knowledge of risk</i>} Integrated flood management planning (B-4) Land use planning (B-6) {<i>i.e. zoning and building controls</i>} Public awareness and education (B-6) {<i>i.e. awareness of hazards, responsibilities, and resources</i>} Emergency routing and safe zone delineation (C-2) 	 Barrier to the hazard (B-5) {<i>i.e. dikes + flood gates</i>} Armouring against hazard (B-5) {<i>i.e. riprap + spurs</i>} Conveyance improvements {<i>i.e. dredging, dike setbacks, pumps, crossing improvements</i>} Reducing Flood flow {<i>i.e. diversions, upstream storage</i>}
 Emergency preparation and planning (C-2) Monitoring and warning systems (C-1) 	

Note: B-2, B-3 etc. indicate the related investigations in support of flood strategy development in BC (*see Appendix A for a full list of parallel investigations*).

1.2.4 Relevant Legislation

A summary of key legislation and provisions (in alphabetical order) is provided below, starting with federal and then provincial. A complete list of relevant legislation, applicable provincial ministry, provisions, and authority for implementation is attached as **Appendix B**.

Federal Government

Canada Water Act [RSC 1985]

- Allows for federal involvement in the management of Canada's water resources; providing a means for federal participation in waterways of significant national interested. The *Canada Water Act* was passed in 1970, superseding the *Canada Water Conservation Assistance Act* (1953), in part to expand participation in flood control from structural works to also include non-structural measures.
- This act allows for collecting data, conducting research, formulating and implementing water management plans, and providing financial assistance to the provinces for programs and projects to manage or reduce flood risk (both structural and non-structural measures).

Provincial

BC Community Charter [SBC 2003]

- Authorizes a building inspector to require a report by a qualified professional engineer or geoscientist that the land may be used safely for the use intended before a building permit is issued.
- Authorizes the expropriation of land by a municipality.



BC Declaration on the Rights of Indigenous Peoples Act [Bill 41 2019]

- States Indigenous peoples' rights to own, use, develop, and control the lands, territories, and resources which they have traditionally owned, occupied or otherwise used or acquired (Article 26).
- States that Indigenous peoples have the right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources (Article 32).

BC Emergency Program Act [RSBC 1996]

 Requirement for local authorities to prepare emergency plans including advance preparation and risk reduction, and emergency measures concerning an imminent threat and post-disaster recovery; provision for cost sharing to deal with emergencies and disasters.

BC Environmental Management Act [SBC 2003]

 Ministerial authorization for environmental management plans with respect to flood control, flood hazard management, and development of land subject to flooding.

BC Expropriation Act [RSBC 1996]

 Authorization to expropriate land by an approving authority (local government, etc.) at fair market value.

BC Land Act [RSBC 1996]

Disposition of Crown land may include flood mitigation requirements.

BC Land Title Act [RSBC 1996]

 Approving Officer may refuse to approve a subdivision subject to flooding; Approving Officer may require a report certified by a professional engineer or geoscientist that the land may be used safely for the use intended as a condition of subdivision approval with registration of a covenant on title.

BC Local Government Act [RSBC 2015]

- Authorizes the expropriation of land by a regional district.
- Authorizes Regional Growth strategies for settlement patterns that minimize the risks associated with natural hazards.
- Authorizes Official Community Plans (OCP), which if adopted, must include statements and map designations respecting restrictions on the use of land subject to hazardous conditions.
- Authorizes a local government to regulate the density, siting, type, and use of buildings and other land uses, minimum and maximum size of subdivision parcels, and other zoning regulations for different uses on land, within zones, and within siting circumstances.
- Provides for the protection of development from hazardous conditions prior to subdivision approval or building construction. If a development permit area is designated in a zoning bylaw or OCP, specified conditions may be established that must be met or exempted for a development permit to be granted. These may include a report from a professional engineer to provide for the safe use of the proposed development. Notice must be issued in the Land Title Office where a development permit has been issued.



 Local government may designate land as a floodplain and adopt a floodplain bylaw that specifies minimum elevation for habitable space, business, or storage of goods (referred to as the flood construction level or FCL) and setbacks from the bodies of water or dike. Floodplain bylaws must consider provincial guidelines and must copy with Provincial regulations and any plan or program the local government has developed under those regulations.

BC Strata Property Act [SBC 1998]

 A strata corporation must obtain and maintain insurance at full replacement value against all major perils.

BC Dike Maintenance Act

- This act regulates the design, construction and maintenance of flood mitigations structures including dikes and debris flow deflection berms and catchment typically used to protect development.
- Provisions in policy require adherence to building setback distances and local authority (e.g. Indigenous or local government) operation and maintenance to help ensure public safety and integration into land use planning

BC Vancouver Charter [SBC 1953]

- Provides for the construction and maintenance of dikes.
- Council may regulate buildings including the authority to withhold a building permit in a designated floodplain area unless the design or elevation reduces or eliminates the risk of flood damage.

Indigenous and Local Government

Indigenous and local governments use a range a variety of land use controls such as floodplain bylaws, development permit areas, zoning, and official community plans to define limits or constraints on development in flood prone areas. This can reduce or control flood risk through limits or requirements on land use, construction levels, setbacks, or site and use specific flood hazard assessments and mitigation.

1.2.5 Excluded Scope

Flooding can occur from a surface water sources such as rivers, lakes, and coastal waters, but can also occur from intense rainfall exceeding the local stormwater capacity. Stormwater derived flooding, often referred to as pluvial flooding, affects many communities across the country, irrespective of proximity to surface water sources. Despite that stormwater flooding can affect every community, it has not been included in the current scope. This is because approaches to manage stormwater are stormwater specific (e.g. design and maintenance of community and lot scale stormwater infrastructure), the approaches have been studied extensively already in BC and abroad, and the impact of stormwater flooding is generally of smaller scale (as suggested by the source of flooding and the lack of notable events in the Canadian disaster database),



Similarly excluded from the study are floods from failure of water storage (i.e. dams) or supply infrastructure (i.e. break in a water main line). Flooding from failure of such infrastructure is generally to be addressed by the owner of the infrastructure (e.g. dam safety review).

1.3 Survey

This document was prepared based on information collected from review of existing literature as well as formal and informal discussions with planning, engineering, and public works staff from Indigenous and local governments, past provincial flood professionals, as well as consultants working on non-structural flood mitigations. As part of this project, surveys were sent to approximately 260 persons in regional districts, municipalities, provincial ministries, consulting firms and Indigenous governments involved in floodplain management. Responses were received from 67 individuals. The survey questions and responses are included in **Appendix C** with summaries presented within relevant sections of the following text. While the responses cannot be considered comprehensive (due to the relatively small sample size), they do reflect a good cross-section of active practitioners in flood management, particularly from local government.

Shortly following the 2003 transition of authority the provincial Ministry of Environment (MOE) with FBC conducted a similar survey and held workshops in 9 cities with local governments and others to discuss the transition and tools to support the transition. The feedback was similar to that received from this survey and resulted in the publishing the provincial guidelines on flood hazard area land use (FLNRORD, 2018) and the flood hazard inventory maps (Ministry of Water, Land and Air Protection, 2004) (*D.Boyer, pers. com.*).

Similar surveys have also been conducted in 2007 (FBC and Arlington Group Inc., 2008) and 1997-1999 (MELP, 1998, 1999).

1.3.1 Survey Participants

Community Representation

A majority of respondents represented local governments, of which 34% were from regional districts and another 30% were from municipalities. The remainder came from consulting firms (4%), provincial ministries or agencies (18%), research or non-profit organizations (4%), and others (10%) including the Vancouver Fraser Port Authority. Respondents were from across BC, including Vancouver Island, the Lower Mainland, Thompson, Kootenay, Cariboo, Skeena, Omineca, Okanagan, and Peace regions. The Lower Mainland and Okanagan regions were most represented, with over 25% of respondents coming from each of those regions. The population of their jurisdictions ranged from >500,000 to <5,000 people. All jurisdictional sizes were represented with those from 5,000 to 50,000 being the most numerous (27% of responses).

Roles and Responsibilities

The current roles of respondents were widely varied. However, planners and engineers were the most numerous by far with each comprising 27% of respondents. Emergency program managers and co-ordinators were also well represented as they comprised 18% of respondents. All other types of role



represented less than 10% of respondents which included provincial and municipal approving officers, environmental officers, chief executive and administrative officers, chief financial officers, lands officers, building inspectors, public works managers, parks and recreation and urban forestry staff.

Hazards

Nearly all community level responses cited riverine hazards as the flood hazard primarily affecting their community. This hazard source was followed, in order of frequency by debris flow or flood, geomorphic hazards, lake flooding, coastal flooding, ice jam and local pluvial flooding.



2 B-6.1 INVESTIGATION OF PAST AND CURRENT APPROACHES TO LAND USE AND DEVELOPMENT DECISIONS IN FLOODPLAINS

This section provides a comparison of the authorities and responsibilities for the development of flood prone lands immediately prior to and following the 2003 change in authority from the Province to local governments (*Flood Hazard Statutes Amendment Act*) and change in support from the Province to local governments. As stated earlier, this report is focused on flooding from riverine, alluvial and debris flow fan areas and coastal sources. The 2003 changes did not substantially affect pluvial flood management responsibilities or authority (i.e. stormwater management).

Following are subsections that present general approaches to land use planning (Section 2.1), a description of the approaches applied immediately prior to 2003 (Section 2.2), following 2003 (Section 2.3) and a summary section that provide a table comparing pre- and post-2003 (Table 2.1) as well as challenges and opportunities (Section 2.4).

2.1 Governmental Approaches for Land Use Planning in Flood Hazard Areas

Land use planning can be used to reduce flood risk though incentives and controls to reduced flood exposure and vulnerability. Land use planning to reduce flood risk can be supported by the various levels of government; federal, provincial, and local level (Indigenous, regional, and municipal) governments. The Associated Programme on Flood Management led by the World Meteorological Organization (i.e. a specialized agency of the United Nations with 193 member states and territories) has published a guide on the role of land use planning in flood management (Associated Programme on Flood Management, 2016). This guide provides a typical breakdown of land use planning responsibilities for different levels of government (**Figure 2.1**).







Each of the levels of government have various tools or mechanisms which can influence flood risk. Tools to control land development and use include official community plans, land use regulation (e.g. zoning bylaws, development permits, subdivision bylaws, floodplain bylaws), easements, covenants, land trusts, and land use acquisition. Tools to influence land use through education and incentives include floodplain mapping, public education campaigns, insurance, taxation, and rebates. Following is a summary of primary non-structural measures that are used to reduce flood risk.

- Review and Approve: Governments (typically local level governments) can require permits or conditions on approval prior to development within flood hazard areas (e.g. development permit areas). Typically, approval conditions can be applied when property use is to be changed, such as requests for change in zoning, development permit, subdivision, building permit, sale or lease of crown land or variance application. The requirements of various agencies can be included in approval conditions, particularly if development triggers other potential changes, such as changes in and about a watercourse or potential to impact adjacent or nearby public or private infrastructure.
- Review and Comment: Governments (provincial) can request an opportunity to be consulted prior to an approval being granted. Typically, this is triggered when another agency is providing an approval.
- Standards: Governments (federal, provincial, or local) can set specific standards for nonstructural flood mitigation. Typically, these include minimum design standards (e.g. probability of flood event / design return period), flood protection and avoidance measures, such as, flood construction levels (FCLs) and setbacks from a water course, specifying no-build areas and elevations above ground on alluvial/debris flow fans but could include other criteria such as requirements for evacuation planning or avoiding transfer of flood risk to other properties. Standards that can be used to assess the hazard and required mitigations for a specific development can be specific to:
 - Location, such as, guiding residential development away from hazardous areas and promoting low density open space and agricultural use of high flood hazard areas.
 - Specified flood protection measures, such as, FCLs and setbacks and not build areas based on local mapping.
 - Hazard event or probability, such as, Fraser River flood of record or 200-year ARI³ or requiring investigation of flood hazards associated with the 500-year as recommended by EGBC and others.
 - Risk, such as variable hazard or probability dependent on potential consequence or proposed land use, or risk rating calculated through analysis of hazard profile, exposure, and consequence.
- Guidelines: Governments (e.g. federal or provincial) can provide guidelines for land use planning in flood hazard areas. The guidelines can pertain to the delineation and assessment of flood hazard areas, limitations on land use within the areas, and potential mitigation measures

³ ARI refers to average recurrence interval, this is the expected average period between events of this magnitude or greater when considering sufficiently long sample of events. Flood events are presented in this document explicitly by their ARI.



for acceptable land uses. Guidelines can include recommended standards and examples of application (e.g. sample land use covenants and bylaws). However, guidelines, by their nature, provide recommendations not requirements.

- Funding: Governments (e.g. federal or provincial) can influence the planning of land within flood hazard areas by attaching requirements to funding (such as no structural flood mitigation measures will be funded without a local flood management plan or limiting eligibility to noninsurable losses or to communities with floodplain land use guidelines). Funding could also include payment by senior levels of government (e.g. federal and provincial) to local level governments for additional mitigation measures, conditions for funding reconstruction of damaged properties, or property buy-outs.
- Information: Government (all levels) can provide information on flood hazards, flood risk, and mitigation options to other government agencies or property owners. Flood hazard information could include:
 - Information to define or assess the hazard, such as flow and climate data, design flood flows or levels, delineation of flood hazard areas and floodplains on flood hazard maps.
 - Information on best management practices for development within flood hazard areas or how to prepare for floods, and
 - Information on forecasting and warning of floods.

Hazard and risk information is foundational for local communities to develop appropriate land use regulations and to effectively review and approve development applications, prioritize flood mitigations efforts and inform emergency response procedures. Adequate information of hazards must be current, and readily available for potential homeowners and builders to make appropriate decisions on what land and buildings they purchase and develop. Governments maybe required to make flood hazard information readily available to the local residents. Similarly, disclosure of such information by current owners may be required for sale of properties or for new land users (e.g. tenants).

Insurance and Taxation: Rates for flood insurance and a requirement for flood insurance can encourage or discourage particular land use practices within floodplains; such as land use, mitigation methods implemented, surveillance and maintenance of mitigation works, or granting of right-of-way for flood protection. Flood insurance can be provided by government (e.g. FEMA in the USA), backstopped by government (e.g. Flood-Re in the UK), or private. Taxes may also be increased or assigned to properties located within a floodplain to guide development away from hazard areas or to cover costs of specific flood protection works.

Within Canada, the federal governments jurisdiction is defined by its legislative powers over fisheries, defence, interprovincial issues, and international issues; the provincial authority is primarily defined by property and civil rights; and local governments powers are limited to matters of a local and private nature particularly on local implementation (Shrubsole, 2001). Lack of accountability can be a criticism of the divided responsibility between the multiple levels of government.



The following sections provide a description of approaches used by the three levels of government, segmented into approaches prior to and following the 2003 transition.

2.2 Prior to 2003

Prior to 2003 land development controls were applied to flood prone lands by MOE and later BC Ministry of Water, Land, and Air Protection (MWLAP). These ministries provided the management and support for the development of flood prone lands. Support was provided through staff (engineers and technicians) located in Victoria and six regional offices. A committee (Floodplain Advisory Committee), co-ordinated activities and interfaced with the senior level of government. The federal government supported floodplain mapping and structural mitigation through funding initiatives. Local governments relied on provincial consent for development of flood prone lands as described further in **Section 2.2.2** below). The following subsections present the level of support provided by each level of government.

2.2.1 Federal Government of Canada

Prior to 2003 the federal government used funding as a mechanism to control, and to a greater extent encourage non-structural flood mitigation. Federal regulations are also important, but primarily in establishing authority to manage water and floods.

Regulation

Water was not specifically stated in the *British North American Act* of 1867 (later known as the *Constitution Act*). However, ownership and control of natural resources, including water, was assigned to the provinces through this act and subsequent court battles, federal-provincial agreements, and the natural resources transfer acts of 1930. The evolution of acts continued with the *Canada Water Conservation Assistance Act* of 1953 and the *Canada Water Act* of 1970. The *Conservation Assistance Act* of 1953 and the *Canada Water Act* of 1970. The *Conservation Assistance Act* of some federal government to financially assist provinces in the construction of works for conservation and control of water The *Canada Water Act* defined a role for the federal government to be able to participate in the conservation, development, and use of water resources. This act expanded priorities to include water resource planning for water quality, conservation, and utilization instead of simply funding of structural measures (Government of Canada, 2013).

Funding

Designated floodplain maps 1984-1998

The federal government supported the production of floodplain maps between 1984 and 1998 through the Flood Damage Reduction Program (FDRP), led by Environment Canada. The FDRP was established in 1975 following the passing of the Canada Water Act (1970). Despite previous funding for disaster assistance and for sizable structural mitigation projects, the FDRP was the first comprehensive federal-provincial flood planning. The FDRP was to include the establishment of agreements between the federal government and each provinces with the following objectives (Bruce, J.P., 1976; FLNRORD, 2018):



- Establish a minimum flood standard (100-year minimum for the program, but the 200-year agreed upon for BC).
- Coordination of provincial and federal flood mitigation programs.
- Development of designated floodplain maps with flood prone lands defined consistently for federal and provincial administration.
- Floodplain maps made available to local governments and the public.
- Preventing provincial and federal support (e.g. no CMHC supported development) for development and limiting development within flood prone areas.
- Appropriate zoning regulations be established by local level governments to restrict development or require flood proofing (e.g. elevating development above the design flood level) for flood prone areas.
- Refuse disaster assistance for any developments within flood prone areas that failed to incorporate suitable flood proofing measures.

The FDRP was terminated in the late 1990's. Past evaluations of the program considered it valuable and a loss that it was terminated (de Loe and Wojtanowski, 2001; Stevens and Hanschka, 2014b; Thistlethwaite and Henstra, 2017). The program was considered efficient (in that the benefits were substantially higher than the cost of the program), successful (developed standardized, high quality, usable, publicly accessible floodplain maps), and did not impose substantial negative influence on property values. The reviews did however concede that the program was not particularly successful in refusing disaster assistance to unmitigated development within flood prone areas and was only partially successful in preventing development within flood prone areas. Some reports attribute a lack of enforcement to limits on the programs success; such as, by the early 1990's only 63% of new homes constructed in designated floodplains across Canada complied with the FCL and setbacks established by the floodplain maps (Shrubsole, 2001). Furthermore, the program was criticized that too large a fraction of program funding went to diking along the lower Fraser River and a handful of other large structural projects, and in general the program was too focused on flood hazards without sufficient consideration for protection or enhancement of environmental values.

2.2.2 Provincial Government of British Columbia

Regulation/Approval

Subdivision approval

Under the *Land Registry Amendment Act*, 1974 and *Land Title Act*, Section 82 the Province had the authority for providing approval for land designated as floodplain and land that is or would likely be subject to flooding. No BC Ministry of Transportation & Infrastructure (MOTI) or municipal approving officer was to approve a subdivision where land was expected to be subject to flooding without consent of the provincial Ministry of Environment Land and Parks (MELP).

Floodplain Bylaws and Official Community Plans

Under the *Municipal Act* (1996) floodplains could be designated by the local government or the Province (Minister of Environment, Lands, and Parks). Land designated as a floodplain could then be regulated to a specific flood level(s) and setback(s) as defined by local bylaw or provincial order.



If a bylaw was developed, approval and sign off by the Province was required before the bylaw could take effect. These approvals were provided by the Floodplain Development Control Program (FDCP) within MOE and later BC Ministry of Water, Land, and Air Protection (MWLAP).

Agricultural Land Reserve

The *Agricultural Land Commission Act* in 1973 established the legislative framework to develop and administer an agricultural land preservation program across BC, referred to as the Agricultural Land Reserve (ALR). The ALR accounts for roughly 5% of the total land base of BC. The ALR is provincial zoning that restricts non-agricultural uses of land. Under the guidance of this objective, development of agricultural floodplain is somewhat constrained. However, the ALR does not explicitly limit development of agricultural activities at risk of flooding on the floodplain, such as construction of livestock, poultry, dairy, or greenhouse operations in flood prone areas. Any local government zoning bylaws or OCPs that apply to land in the ALR required provincial review.

Funding

River Protection Assistance Program

Under the River Protection Assistance Program MOE assisted local governments and private landowners with the funding (25% local; 75% MOE), and technical assistance with the design and construction of flood protection works (MOE engineers and technicians completed site surveys, cost estimates, hired contractors and supervised construction for many of these projects). A required for receiving the support was that the land owner (or local community) was to accept full responsibility for any operation or maintenance of the works.

By the early 1990's this program was amalgamated with two similar provincial cost sharing programs, Flood Protection Assistance Program and Dyking Program, as the Flood Protection Assistance Program. Funding was intermittently available only for local governments and diking authorities under this program, for structural flood mitigation works (constructing and repairing dikes) until the early 2000's.

Supporting Information

Flood hazard assessment

When local government approving officers and building inspectors required technical support to assess local flood hazards or required supporting authority for identifying and assessing flood hazards with respect to a particular development proposal, the provincial Flood Development Control Program (FDCP) would provide the support using provincial staff. This included site inspection, recommendations for mitigation, suggested variance, or determination of no build.

Floodplain Covenants - pre-2003

Floodplain covenants were registered on title as a condition of subdivision approval. The covenants generally defined an FCL and setback from the hazard source and no build areas and include a save harmless/indemnity provision to protect the local government and the province of BC. Technical support in preparation of covenants for lawyers was provided by the provincial FDCP. These covenants remain on title, through change in ownership, unless explicitly modified or revoked. As presented in a more general nature in later sections of this document, modification or discharge of these covenants is



now under the authority of the local government, as per *Flood Hazard Statutes Amendment Act*, item 18.

Official Community Plans and Floodplain and Zoning Bylaws – pre -2003

The Province provided flood hazard information, including flood hazard maps, for inclusion in OCPs and bylaws and to inform the adjudication of applications for site specific bylaw variances. The Province had the authority to exempt a development or type of development from a floodplain bylaw; that is a bylaw that designated a floodplain and /or established flood levels and setbacks.

Designated floodplain maps 1974-2003

Floodplain maps were prepared by or for the provincial floodplain mapping group (within MOE) between 1974 and 2003. The majority of maps were prepared from 1987 to 2003 under the joint federal-provincial floodplain mapping agreement (FDRP). These maps define the 20-year and 200-year clearwater floodplain extent and levels with inclusion of a freeboard. Some maps included polygons delineating the boundaries of some larger alluvial fans. The maps, survey data, and reports were made public and continue to be available through the provincial web portal⁴.

As stated previously (Section 2.2.1) an objective to preparing the floodplain maps was to provide the necessary information to limit the development of flood prone areas. The maps delineate areas of flood hazard (i.e. the designated floodplain) and establishing minimum construction elevations within those areas. The 20-year FCL was to be used for the minimum elevation of septic systems (APEGBC, 2017), whereas the 200-year FCL was to be used as the minimum elevation of new development as a means of floodproofing. These historic maps did not however consistently provide a defined setback, but instead suggest the local government or provincial ministry be contacted (i.e. Ministry of Environment, Lands, and Parks).

2.2.3 Indigenous Governments in BC

Indigenous communities have occupied the lands of BC since time immemorial with a diversity of Indigenous Nations who had and still have systems of land management to mitigate the impacts of flooding. Following Canadian confederation, Indigenous governments were allocated reserves under the *Indian Act*. Reserves were often created along rivers, estuaries, lakes, and the ocean. In the vast majority of the province, these reserves were unilaterally allocated without the consent of the affected Indigenous governments and communities.

Indigenous governments were largely overlooked in flood hazard mitigation planning, except for structural protection, which was often required to protect adjacent freehold land. This was compounded by the fact that Indigenous governments had limited access to financial resources unless provided through the applicable federal department.⁵ For a variety of factors, it is a fair characterization

⁴ Provincial floodplain maps can be found at <u>https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/drought-flooding-dikes-dams/integrated-flood-hazard-management/flood-hazard-land-use-management/floodplain-mapping/floodplain-maps-by-region</u>

⁵ Department of Northern Affairs and National Resources (1953-1966); Department of Indian Affairs and Northern Development (1966-2011); Department of Indian Affairs and Northern Development (DIAND) and under the Federal Identity



to state that the role of Indigenous governments in flood mitigation prior to 2003 was quite limited due to lack of financial resources, limited consultation on land uses within reserves (and none on traditional territories), and lack of acknowledgment of Indigenous rights and existing land governance systems.

The federal department of Indian and Northern Affairs Canada (INAC) provided the lead federal role for emergency preparedness and response management for Indigenous communities, and entered an agreement with Environment Canada in 1985 for floodplain mapping. The 1987 floodplain mapping agreement between the Province and Canada was to reduce unmitigated⁶ development within the floodplain. However, it has a clause that the federal government can fund or construct structures within the floodplain if on "Indian Reserves, special reserves and surrendered lands within the meaning of the Indian Act, or other Crown lands set aside or reserved for the use of Indians".

Floodplain mapping occurred within the FDRP but was spatially limited and inconsistent. Areas would not be designated as floodplain unless requested by the local Indigenous government. Often the floodplain designation was not part of the agreement and subsequent implementation of land use planning was inconsistent or failed to occur. Program success on Indigenous lands was limited by insufficient funds provided for flood management and a lack of awareness of the differences in program requirements due to the differences in community governance, socio-political conditions, and communal ownership (Shrubsole, 2001).

The First Nations' Emergency Services Society of BC (FNESS) is an incorporated society that provides programs for Indigenous governments to support the development of safer and healthier communities. The focus of the society is fire fighting, however it has supported flood hazard assessment and mitigation planning. In the late 1990's FNESS initiated a series of studies that were conducted for Indigenous communities across the province producing a discrete scoping level assessment of each Indian Reservation studied. The studies documented the identified riverine and coastal flood and erosion hazards, items at risk, and potential mitigation options. The assessments were generally based on site inspection, previous local and regional studies, and cursory analysis. The various mitigations options included monitor specific conditions, bank armouring, diking, and floodplain mapping. Cost estimates were included. Some of these assessments initiated further works, but many were used to provide a baseline of the current flood hazard conditions.

Provincial approval for subdivision did not affect Indigenous governments. Provincial approval does not apply to land on Indian Reserves and no modern treaty settlements had taken place prior to 2003. Land on an Indian Reserve cannot be subdivided for public sale. However, under the *First Nation Land Management Act (1999)*, the council of a First Nation has the power to enact laws respecting the development, conservation, protection, management, use and possession of Indigenous land. This included the regulation, control or prohibition of land use and development including zoning and subdivision control. Property rights can be based on i) customary rights, ii) leases, and iii) certificates of

Program, Indigenous and Northern Affairs Canada (INAC) (2011-2017). The current nomenclature of Indigenous Services Canada (ISC) and Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) was announced in 2017 and implemented in 2019.

⁶ Unmitigated floodplain development is referring to development not protected from flood inundation (i.e. through elevating above the FCL or other means) and/or protected from erosion (i.e. through armouring with rock riprap or other means).



possession. The current system that allows for long term leases of up to 99 years on some Indigenous land did not exist prior to 2003.

2.2.4 Local Governments

From the 1974 to 2003, local governments and the Province (i.e. Ministry of Environment) worked closely together to manage floodplain development through planning and approvals (MELP, 1999). With provincial technical support and guidance, funding from the provincial Ministry of Municipal Affairs, local governments developed and adopted OCPs, zoning bylaws, floodplain bylaws, development permit areas, floodplain management policies and other local regulations. The Province reviewed and commented on OCPs and other plans and bylaws (relating to floodplains), and provided approval for floodplain designations, flood bylaws, and floodplain exemptions. The Province had the authority to establish conditions respecting the approval of subdivisions in flood prone areas or block approval of such subdivisions where the conditions were considered unlikely to be met. These Provincial imposed conditions include provincial flood covenants on the subdivided land, setbacks, and FCLs. Provincial staff provided adjudication of applications for site specific flood bylaw variances. Only for specific sites where flood hazards were severe and could not be mitigated, the province withheld consent for subdivision approval. This cooperative approach shared responsibility for both the approval of and potential liability associated with new floodplain development (*N. Peters, pers. com.*).

Local governments in BC refers to regional districts and municipalities (the *Local Government Act* defines local government as the council of a municipality or board of a regional district). Each of these are described, within a BC context in the following subsections.

Regional Districts in BC

Regional districts arose out of a need for greater regional cooperation and equitable cost-sharing between municipal areas and rural areas. Rapid urbanization in the 1950's, including rural areas outside of municipalities, increased the demand for services such as water, sewage and zoning. In 1965, the BC government amended the *Municipal Act* (now *Local Government Act*) to enable the creation of regional districts. Regional districts are composed of municipalities and electoral areas and are governed by a board of directors composed of appointees from the municipalities and elected directors from each electoral area. The regional districts are financed through fees collected for the services provided. Originally, the powers and services of the regional districts were quite limited; however, as regional districts became more established, they were granted more powers by the BC government.

Prior to 2003, regional districts had the authority to adopt regional growth strategies, official community plans, zoning bylaws, and floodplain bylaws, but only with provincial approval (e.g. from the Ministry of Municipal Affairs). As an example, the Greater Vancouver Regional District's Livable Region Strategic Plan was deemed to be a regional growth strategy by the Minister of Municipal Affairs in 1996. Despite this early adoption, other than limited information in some OCPs and policy documents, no other regional growth strategy existed prior to 2003.

Regional districts could issue development permits and development permit variances, provided they did not conflict with floodplain specifications (i.e. previously approved by the province and adopted in a bylaw, OCP, or provincial order). Regional districts lacked authority to approve subdivisions. The



approving authority for the subdivision of land in electoral (non-municipal) areas of regional districts was and remains with the MOTI. Review and approval of subdivision of land is in accordance with the provisions of the *Local Services Act* and subdivision, OCP, zoning, or servicing bylaws adopted by the regional district.

Municipalities in BC

Municipalities include cities, district municipalities, townships, towns, and villages. The distinctions refer to their geographical area and population, but with significant variations. For the purposes of this report, the legislative authority between regional districts and municipalities will be noted but not between different municipal classifications. There are significant differences between municipalities, but they largely apply to their differences in population, available resources, and local priorities.

Prior to 2003, municipal floodplain management though land use planning and development controls was primarily in its infancy. Similar to regional districts, municipalities had the authority to adopt OCPs, zoning, and floodplain bylaws. However, municipalities did not require provincial approval except for bylaws that designate or specify floodplains. The Province had the authority to designate floodplains, specify flood levels (FCL) and setbacks through provincial order or approval of a floodplain related local government bylaw.

Municipalities could approve subdivisions, issue development permits, and issue development permit variances, provided they did not conflict with floodplain specifications (i.e. previously approved by the province and adopted in a bylaw, OCP, or provincial order). For specific historic sites where flood hazards were severe and could not be easily mitigated (through sufficient FCL and setback), the Province supported the creation of floodplain exemption areas, particularly in the Lower Mainland. These included downtown Chilliwack and Abbotsford, and parts of downtown New Westminster, Mission, Squamish, Fort Langley, and South Westminster/Bridgeview in Surrey. These areas allowed for a reduced FCL to address the challenges of retrofitting or infilling new buildings at a substantially higher elevation than the rest of the community.

2.3 Post 2003

Within the 1990's through to 2001, the Province downsized the FDCP reducing the Province's ability to support local governments in the identification, assessment, and mitigation of flood hazards. This was followed in 2003 with the Province transferring much of the remaining non-structural flood management role to local government with the enactment of the *Flood Hazard Statutes Amendment Act* (2003). The exception was MOTI's continued review and approval of subdivision applications in non-municipal areas of regional districts.

Specifically, the *Flood Hazard Statutes Amendment Act* repealed section 82 of the *Land Title Act*. Prior to repeal, section 82 roughly stated the following:

 82 (3) The minister may establish conditions respecting the approval of subdivisions in designated flood plain areas.



- 82 (5) If the approving officer considers that a proposed subdivision would not comply with an applicable condition established under subsection (3), the approving officer must not approve the plan of subdivision without the consent of the minister.
- **82** (6) If the land is not within a designated flood plain area, but is or would likely be subject to flooding, the approving officer must not approve the plan without the consent of the minister.
- 82 (7) The minister may require that the owner of the land being subdivided enter into one or more covenants under section 219.

The ability to establish a covenant was transferred within the e *Flood Hazard Statutes Amendment Act*, by amending section 86 of the *Land Title Act* to allow the local approving officer the authority to require either or both of the following:

- A report by a QP certifying the land may be used safely for the use intended.
- Enter into one or more covenants under section 219.

The *Flood Hazard Statutes Amendment Act* also modified the *Local Government Act*, removing the authority of the minister to designate floodplains and set construction requirements for development on a designated floodplain, while further defining the role of local government.

The following was removed:

- **910** (1) Local government <u>or</u> Minister of Environment, Lands, and Parks may designate the land as a floodplain.
- 910 (3) Designated floodplains and specified flood levels and setbacks have no effect until approved by the Minister of Environment, Lands, and Parks.
- **910** (6) The Minister of Environment, Lands, and Parks may exempt a development or type of development from requirements of this section.

The following was added:

- **910** (1) If a local government considers that flooding may occur on land, they may designate the land as a floodplain.
- **910** (2) The local government may use a bylaw to specify: (a) flood level and (b) setback from a watercourse, waterbody, or dike.
- 910 (3) A local government which applied (1) or (2) must consider any policies, strategies, objectives, standards, guidelines or plans in respect to flood plain management and development or flood control and prevention, prepared under any enactment.

The next subsections of this report present the non-structural flood management roles the various levels of government have adopted following these changes.

2.3.1 Federal Government of Canada

Similar to the province of BC, since 2003, the federal government has, for the most part, provided limited direct involvement or support to non-structural flood management. However, at the time of and



following the performance audit report released in 2016 by the Auditor General of Canada (Auditor General of Canada, 2016), the federal government increased their involvement. This includes;

- Additional funding for non-structural measures (see below).
- Developing and updating standards and guidelines to improve flood resilience (see below).
- Partnered with academic institutions to develop technology and research methods to increase infrastructure resilience to extreme weather, this has included developing guidelines for buildings with buoyant foundations based on research at the University of Waterloo.
- Developing intensity-duration-frequency curves that incorporate global warming scenarios to support hydrologic assessments of flood risk.

Funding

- National Disaster Mitigation Program (NDMP), funding to mitigate flood hazards through structural and non-structural measures. Ends 2023.
- First Nations Adapt (through CIRNAC); funding for Indigenous governments to prepare for and respond to the impacts of climate change. The program works with Indigenous communities to identify region-specific priorities, impacts, and opportunities for climate change projects. The program prioritizes Indigenous communities most impacted by climate change related to *sea level rise, flooding,* forest fires, drought, fisheries, and winter road failures. Coastal vulnerability studies are ongoing or completed to help predict estimated sea level rise, accompanying storm surge and its effects on infrastructure. They include 14 communities (12 studies completed) on the west coast of Vancouver Island, cost shared with the Nuu-Chah-Nulth Tribal Council; 22 communities on the south and east coasts of Vancouver Island, cost shared with the Naut'sa Mawt Tribal Council; and 23 communities (9 studies completed) on the north coast including Haida Gwaii. First Nations Adapt has also provided funding for the creation of a secretariat to facilitate, collaborate and consolidate the coordination of 60 First Nations in the Lower Fraser River Valley with the Fraser Basin Council and the Lower Fraser Floodplain Strategy,
- Indigenous Service Canada (ISC) works with First Nations to support on-reserve structural
 mitigation projects that protect Indigenous communities from climate-related hazards. Projects
 include dikes, sea walls and erosion-control measures, among others. ISC also has a service
 agreement with EMBC (EMBC) to provide emergency management services on reserves
 comparable to those available to other BC communities. During an emergency such as flooding,
 EMBC is the lead in supporting Indigenous communities with their response activities.
- Disaster Financial Assistance Arrangements (DFAA); funding assistance to provincial governments following a large-scale natural disaster. Funding is based on cost sharing formula, with federal funding ranging from 0% to 90% depending on provincial expenditure. DFAA eligibility is limited to non-insurable losses⁷; and therefore, DFAA eligibility criteria may be seen as a non-structural flood mitigation as it provides an incentive for occupants to procure insurance.

⁷ As stated on Public Safety Canada DFAA website: <u>https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/rcvr-dsstrs/dsstr-fnncl-ssstnc-rrngmnts/index-en.aspx</u> (2020 September)

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Other funding sources that at times complement the above sources include:

- Disaster Mitigation and Adaption Fund,
- New Building Canada: Provincial-Territorial Infrastructure Component,
- Federal Gas Tax Fund
- Green Infrastructure Stream of the Investing in Canada Plan

Guidelines, Standards, and Reference Documents

- Natural Resources Canada (NRCan) Federal Flood Mapping Framework (currently in development) is a series of guidelines to support flood hazard delineation, floodplain mapping, and risk assessment. The documents provide general and technical description of the processes to potentially standardize terminology, concepts, and presentation of results, but does not define specific approach or criteria for level of assessment, design, or land use regulation. The series is presented as a guideline but is often required to be followed by proponents to remain eligible for funding and by consultants to be considered for such projects. The guidelines are not completely consistent with existing provincial floodplain mapping guidelines or standard practices in BC. Initial stages to eventually develop standards from the guidelines has started.
- National Building Code 2025 edition is to include provisions for the design of buildings to address natural hazards including flooding.
- Developing revisions to the Canadian Electrical Code to increase resilience to flooding and climate change.
- Developed and updated standards for Wastewater Treatment Plants, stormwater retention, powered backwater valves, and fuel storage tanks to reduced risk of flooding and increase resilience to climate change.
- Developing resource documents to improve flood resilience for new construction (2021) and existing communities (2019)
- Developing guidelines for coastal flood hazard and risk assessments to improve building design.

Sendai Framework for Disaster Risk Reduction

Canada is a signatory to international frameworks for disaster risk reduction since 1995; the most recent being the Sendai Framework for Disaster Risk Reduction. The Sendai framework defines guiding principles for all aspects of disaster risk reduction. This includes understanding the risk, strengthening disaster risk governance effectively through all levels of government, investing is disaster risk reduction, and enhancing disaster risk preparedness. Current federal government flood mitigation work often references this framework.

2.3.2 Provincial Government of British Columbia

During the transition to local governments, the Province released a set of hazard maps and guidelines for land use within flood hazard areas. Since the transition, the Province has provided limited support, guidance, and direction for non-structural flood mitigation. Examples however, include: the River Forecast Centre providing real time information on forecast flood levels, guidelines for coastal floods hazard areas were developed (2011), documents and websites for individual household flood


preparedness were developed, gravel removal maintenance work was conducted along the lower Fraser River, and a limited number of flood modelling and risk assessments were conducted along the lower Fraser River and within the Lower Mainland. In addition, since 2015, funding has been provided to local governments through the NDMP and CEPF programs.

Despite these efforts, the Province has not had a role in providing technical expertise, review, or authorization to municipal or Indigenous governments with respect to flood hazard identification, assessment, or mitigation through land use planning or public education. The exception is MOTI providing review and approval of subdivision approvals in non-municipal areas of regional districts.

The following subsections present additional existing provincial acts that could be used by the Province to expand its influence on non-structural flood mitigation, the existing role the Province has in regulation and approval of land use on flood prone lands, Provincial funding on non-structural measures, and current guidelines to support local level governments in non-structural flood mitigation.

Provincial Statutes

A number of Provincial acts in addition to the *Land Title Act* and *Local Government Act*, have or could have influence on non-structural flood mitigation. These include the *Building Act, Emergency Program Act, Environmental Management Act, Expropriation Act, Flood Relief Act, Land Act, Real Estate Development Marketing Act, Transportation Act, Strata Property Act, and Water Sustainability Act. These provisions typically have limited applicability, provide for very specific flood mitigation measures, or limit the authority of local level governments. For example, the <i>Expropriation Act* is available to local government to adopt a Building Bylaw that varies from the BC Building Code without provincial approval. The *Community Charter* (SBC 2003) provides authority for a building inspector to require a report certified by a qualified professional to provide for the safety of a development prior to the issuance of a building permit.

Ministerial Directive

The *Environmental Management Act* authorizes the Lieutenant Governor in Council (LGC) to make regulations that impose requirements and prohibitions respecting flood hazard management to prevent, mitigate, or reduce potential flood hazards. However, no enactments have been made.

The Province has the authority to direct a local government to undertake specific action or take charge. As documented in Appendix B, these provisions are contained in several statutes. The *Emergency Program Act* authorizes the Minister to order a local emergency plan if a local government has not complied with its obligations.

The *Flood Relief Act* authorizes the LGC to make payments and regulations prescribing the extent and nature of work to be undertaken for the building of works to prevent flood damage. On the recommendation of the Minister, the LGC may designate areas for which a regional growth strategy must be developed and adopted and where a Regional Growth Strategy has been adopted, the Minister may require a local government to adopt an OCP, zoning bylaw or subdivision servicing bylaw of one is not in place. It should be noted that these provisions authorize the Province to require action by a local government, typically if the local government fails to act. These provisions are very rarely acted upon



and if they are, the Province does not undertake the work or specify how the local government should proceed.

Regulation/Approval

As stated earlier, following the 2003 transition, subdivision approval for non-municipal land in all electoral areas of regional districts remains under the authority of MOTI, and is the remaining review or approval role the Province has withheld with respect to land use planning of flood prone lands. This approval process typically involves liaison with regional district staff and can include review of lands subject to flood hazards or within floodplains. The review and approval is generally done by regional MOTI who may or may not be technically proficient in flood hazard assessment and mitigation.

As a further exception, MOTI approval is also required for any subdivision within 800 metres of a controlled access highway. This requirement was established to protect a highway corridor (e.g. access and capacity) but could apply to the subdivision lands subject to flood hazards that are within that 800 metre distance.

Floodplain Covenants Established Prior to 2003

Prior to 2003, floodplain covenants were required by the Ministry of Environment as a condition of subdivision approval. Many of these covenants currently remain on title and will continue to do so until local governments or landowners proposes changes or replacement of the covenants (typically this occurs following application for a building or development permit).

These historic covenants typically included a minimum height above grade or natural boundary or specified FCL for buildings, a setback beyond the natural boundary (15 or 30 metres were commonly used but many properties were assigned setback distances based on erosion hazard assessment), no building areas were designated by metes and bounds or a reference plan, and a save harmless provision to protect the Province and the applicable local government in the event of flooding.

Post 2003, floodplain covenants can be initiated by the local government or approving officer at the time of a subdivision or rezoning application and by the building official at the time of building permit application. Existing floodplain covenants that were previously approved by the province remain in place but may be modified by the local government approving officer (FLNRORD, 2018). Floodplain covenants typically include FCL and setback requirements, and may also include the recommendations of a qualified professional engineer or geoscientist. There is a tendency for the save harmless provision to apply to the local government without reference to the province of BC as it is no longer a party to such covenants.

Funding

Despite much of the funding for floodplain mapping, flood mitigation planning, and disaster relief coming from the federal government, funding often gets distributed through the Province. The Province often is required to contribute a portion of the funding, which rationalizes their role in application review and approval. For example, the NDMP funding was applied for through Emergency Management BC (EMBC). EMBC pre-screened applications and only forwarded the provincially approved applications on to the federal agency. Similar provincial control is provided for other funding applications.



EMBC administers Disaster Financial Assistance (DFA). Since 1995, the DFA operates under the *Emergency Program Act* and the *Compensation and Disaster Financial Assistance Regulation*. Section 8 of the regulation has since then stated that <u>eligible costs are limited to those for which insurances was not reasonably and readily available</u>. In the past 5 years flood damage insurance has become much more readily (and reasonably) available. Due to this eligibility statement, the provincial DFA program indirectly encourages residents to be insured against flood damage. However, communication to date may not be adequate for broad participation in floodplain insurance programs. Section 15 of this regulation states that <u>structures damaged in a flood that were constructed in designated floodplain following the designation, will not be provided assistance</u> to repair, rebuild or replace unless structures is deemed by the province or CMHC to have been properly flood protected.

In addition, the province funds structural flood mitigation, flood risk assessment and mapping, and emergency planning through the Community Emergency Preparedness Fund (CEPF). These funds are available to support improving the resilience of communities to flooding and other disasters. This funding is provided to successful Indigenous and local government applicants administered through the Union of BC Municipalities (UBCM).

The River Protection Assistance Program no longer exists.

Provincial Guidelines and other Supporting Information

The following guidelines and supporting information provide Provincial influence on the identification, assessment, and non-structural mitigation of flood hazards. Other than the Coastal Flood Hazard Land Use guidelines, the information provided by the Province was prepared 15 years ago or earlier.

Flood Hazard Area Land Use Management Guidelines [2004, amended 2011, 2018]

- Presents guidelines for the administration of land use management within flood hazard areas including, official community plans, bylaws, development permits, subdivision approvals, covenants, crown land dispositions, requests for bylaw modifications, and requests for modification of floodplain covenants. In addition, the document provides guidelines for communities to withhold consent where hazard cannot be practically alleviated.
- Provides guidelines for minimum setbacks and minimum elevations or FCL to protect development from flood hazards from the sea, lakes, and rivers (including alluvial fans and debris flows).
- Coastal FCL updated based on the 2011 coastal flood hazard land use guideline to allow use of either the combined or probabilistic method.
- Document defines a 200-year design standard to be applied to habitable land use, defined as residential, commercial, and institutional land uses. Slightly altered standards provided for agricultural and industrial uses.
- Development on high hazard alluvial and/or debris flow fans is discouraged and land should be retained for no-intensive uses, such as, parks, open- space recreation and agriculture.



Guidelines for Management of Coastal Flood Hazard Land Use (2011)

- Guidelines intended for local governments, land use managers, and approving officers to develop and implement land use management plans and make land use approval decisions for lands exposed to coastal flood hazards.
- Presents projections for sea level rise and potential approaches for land use planning within existing and future hazard zones.
- Historically, coastal FCLs were determined based on the location of the *natural boundary*, which is defined by law and can be interpreted *as the visible high-water mark*, where the presence and action of water has left a distinct variation in the bank, soil, and vegetation characteristics of the shore. For present day water levels, the natural boundary can be established by a professional land surveyor. However, it is not possible to survey the future location of the natural boundary due to the effects of sea level rise and other climate change related factors, or estimate the extreme water levels on lakes. This guideline presents the combined method to determine a coastal FCL based on projections of future conditions.
- Accompanying document, *Draft Policy Discussion Paper*, presents risk concepts for flood hazard land use; that is adjusting design event (probability) based on consequence of flooding (i.e. increasing design event to 4,000-year or 10,000-year event, instead of the 200-year event typically applied in BC.

Designated floodplain maps 1974-2003

The designated floodplain maps from the 1970's to early 2000's have remained publicly available despite being prepared nearly 40 years ago. That is, without consideration of channel changes, changes in land cover, additional hydrology data, changes in hydrology, nor projections of changes in climate and land cover.

Flood Hazard Maps – prepared 2004

Regional flood hazard maps and supporting information databases were prepared by the Province and FBC and made available to local governments to pass on flood hazard information that the ministry had accumulated over the 25 years it was involved in the floodplain regulation (Ministry of Water, Land and Air Protection, 2004). Realizing the limitation and sometimes misleading nature of traditional floodplain maps, the maps and databases included the full range of know flood hazards including FCLs and setbacks for streams and lakes, river reaches with floodplain mapping, alluvial fans, debris flow fans, floodways, ice jam, and snow avalanche hazards. They also include the location of known registered and unregistered (orphan) dikes and other flood control works. (Traditional floodplain maps are limited because they only show FCLs and do not show known hazards related to alluvial and debris flow fans and channel shifting or flood control works.) More inclusive flood hazard maps and databases were deemed better suited to support all flood mitigation measures including warning the public of the hazards, regional growth and prioritization of sites for flood hazard mitigation measures (non-structural and structural) and hydrometric stations (see Table 1-1). The databases also provide a listing of engineering reports, records of flood events and other file information that was used to create the maps. Unfortunately, because most of the documents have not been digitized and vetted through the freedom of information legislation, local governments and consultants have had



difficulty accessing the information from provincial archives. Some regional districts have incorporated the maps into their bylaws and the information has been incorporated into recent area wide flood hazard studies (e.g. the RDCK BGC Study, RDEK NHC floodplain mapping).

Flood hazard assessments - Guidance for Selection of Qualified Professionals

 Document on selection of a qualified professional to assess floodplain hazards, but mislabels qualified professionals as being "geotechnical" professional (i.e. focus on ground conditions) instead of qualified professional that could include both geotechnical or hydrotechnical (i.e. focus on water and its interaction with natural and anthropogenic environment).

Stormwater Planning: A Guidebook for British Columbia

Guideline to support development of *liquid water management plans* (LWMP) and *integrated stormwater management plans* (ISMP) for managing stormwater. Requirements are expected to be incorporated into land use planning and future developments through the OCP. Guidelines primarily deals with reducing impacts of frequent flood events, but also provides recommendations for flood conveyance capacity criteria. This criteria is stated as the 100-yr ARI; less than the river and coastal design criteria of 200-yr. (BC Ministry of Water, Land and Air Protection, 2002).

Although the guidelines provide supporting information, local governments are not legally required to incorporate any standards from the guidelines into bylaws (*Local Government Act* Section 910, 1996), nor are local governments legally required to adopt local floodplain management bylaws. Floodplain management through land use planning is voluntary (Stevens and Hanschka, 2014a).

2.3.3 Local Governments

The authority for local governments to manage land use in flood prone areas is authorized by a number of provincial statutes⁸, the most defining of which is the *Local Government Act* (RSBC 2015). This act includes the following key provisions:

- **Regional Growth Strategies** plans by local governments to manage growth on a regional basis. This includes co-ordination between all local governments in a regional district and compliance statements. Ten regional districts in BC have adopted a regional growth strategy which includes over three quarters of the provincial population, including all major growth regions.
- Official Community Plans authority to prepare plans to manage the general direction of development through land use designations, objectives, and policies.
- **Zoning Bylaws** authority to regulate land use through the zoning of land, buildings, and other structures.

Appendix B provides further details on applicable legislation pursuant to non-structural flood management. There the first column identifies the legislation and the responsible provincial ministry. The second column documents the applicable legislative references. The third column provides a description of the legislative provisions. The fourth column identifies the authority for implementation measures (e.g. council bylaw).

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- **Development Permits** authority to require a development permit in a specific area with objectives and guidelines to address flood hazards prior to the approval of a subdivision or building permit.
- Floodplain Bylaws the authority to require FCLs, setbacks from water bodies and other means to protect development from flooding. These requirements may be part of an OCP or zoning bylaw.

Under the *Local Government Act* (Division 13, Other Land Use Regulation Powers) both regional districts and municipalities may by bylaw designate a floodplain, may specific a flood level, and may specify a setback. The local government is to consider Provincial guidelines in such a designation. Despite the apparent option of designating the floodplain or following Provincial guidelines, the local government bylaw must require dwellings and businesses to be above the applicable FCL where one is designated.

OCPs must include statements and map designations for areas covered by the plan that have restrictions based on hazardous conditions (section 473 of *Local Government Act*), such as designated floodplain restrictions. The OCP may designate development permit areas (DPA) for protection of development from hazardous conditions (section 488), specifying areas of land potentially prone to flooding (section 491).

Local governments can issue variances from the conditions of a bylaw if the bylaw imposes undue hardship (section 542). Variances are not to relate to floodplains designation and specifications (FCL and setback). However, exemptions to floodplain requirements can be granted by the local government, provided appropriate terms and conditions apply (section 524.7). These are, i) imposing any conditions stated by a Provincial guideline with relation to an exemption, ii) requiring a QP prepared report that states the land may be used safely for the use intended, and iii) requiring a covenant (*Land Title Act*, section 219). The requirement for a QP to certify "the land may be used safely for the use intended" is challenging for QP's, due to the requirement to certify (which can be considered a warranty and hence nullify their professional liability insurance) and where the proposed exemption is for a building permit that does not alter or make safe the majority of the structure.

Subdivision applications are to be approved by the approving officer as defined in the *Land Title Act*. Within municipalities, the municipal council must appoint an approving officer. In regional districts (and island trusts) the Province may appoint an approving officer as recommended by the regional district or as an alternative default to the MoTI. Despite how appointed, the approving officer may refuse or require conditions for a subdivision application if they consider the land is reasonably expected to be prone to flooding. The conditions are either or both, i) require a QP report that certifies the land may be used safely for the use intended and ii) require a covenant.

As presented in the preceding paragraphs, local government is the governmental agency currently responsible to identify, assess, and mitigate flood hazards through establishing suitable land use restrictions (except in regional districts where approving officers have not been appointed). However, there is no requirement for the local government to act on this responsibility. Furthermore, the specific mitigations that local governments can apply to flood prone lands is limited to applying a setback and elevating structures above the FCL. These restrictions can be exempted by the local government provided the local government requires a QP safe certification report and/or a covenant.



Regional Districts in BC

There are 27 regional districts plus two rural areas in BC. Although there is no legislative requirement to do so, all have adopted Official Community Plans (OCPs). The level of regulation within OCPs varies greatly from one regional district to another. The larger and more heavily populated regional districts typically address flood hazard management in some depth and require development permits where less populated regional districts do not. Ten regional districts have adopted regional growth strategies, all of which address the management of hazards. These include the Lower Mainland, most urban areas on Vancouver Island and the Okanagan.

Zoning bylaws apply in a large majority of electoral areas of regional districts except for some rural electoral areas, typically with a low population or remote. In addition, zoning bylaws have been adopted in some electoral areas but have a limited or negligible regulatory role. Cost and a desire for less government regulation typically apply in both situations.

Building bylaws apply to most regional districts. Exceptions are typically for remote areas where building activity is modest, and the cost/retention of a building inspector is a challenge. Cost sharing between a regional district and local municipality is commonly used to address these challenges.

Municipalities in BC

There are currently 162 municipalities, ranging in population from just over 100 to over 630,000 people. They range in size from 63 hectares to over 8,500,000 hectares. All have the same tools with the notable exception of the City of Vancouver which has its own enabling legislation - the Vancouver Charter. Considering the wide range in population of different municipalities, there should be no surprise that the implementation of these tools varies greatly.

Official Community Plans and zoning bylaws are nearly universal for BC municipalities. Providing a vision, setting community goals, and regulating land use through zoning are seen as basic roles for a local municipality. Both OCPs and zoning bylaws have become increasing complex post-2003 although the level of regulation respecting flood hazard management varies greatly from one municipality to another. While population is a key variable, there are many others including geographical factors, history of flooding, perceived threats, financial resources and local priorities and leadership.

OCPs provide the general direction for managing development in all municipalities. Objectives and policies ranging from general statements indicating a desire to support development and avoid hazards to a strong regulatory approach designating development permit areas and map designations limiting or preventing development subject to known hazards. The designation of development permit areas and the issuance of development permits are key regulatory tools for most urban municipalities. Zoning bylaws and floodplain bylaws are key adaptation tools used by most municipalities to address flood hazards. Where municipal regulation includes FCLs and setbacks, either tool may be used although flood regulation is more commonly addressed in a zoning or OCP bylaw than in a floodplain bylaw. Although the regularity authorization for the mitigation of flood hazards is more precise through a floodplain bylaw than through zoning, there are two main reasons why zoning bylaws are preferred. One advantage is a zoning bylaw can address all forms of land use regulation and avoid the need to adopt a separate bylaw for a limited and more focused regularity role. The second is some municipalities have avoided adopting a floodplain bylaw due to DFA regulations specific to a floodplain bylaw.



A site specific report by a qualified professional engineer or geoscientist (QP) is commonly used by approving officers for the subdivision of land, regardless of existing floodplain designations and specifications are followed. This offers the benefit of requiring a QP to mitigate risk, however it is challenged by the limited number of professionals with the requisite expertise. Furthermore, the registration of a covenant on title specifying the conditions under which the land may be used safely informs all future landowners.

A similar provision for a site specific assessment applies to building officials but for many local governments this is much less commonly used. This is because the issuance of a building permit is the last step in the regulatory process. Where a development is subject to a flood hazard, there are four land use tools which are available and commonly used prior to a building permit application. They are an OCP application, rezoning application, subdivision application and development permit application.

The City of Vancouver is unique in that it is the only local government in BC with its own land use legislation. This gives it authority over development subject to flood hazards. Vancouver is also the only local government with the ability to self-define its building bylaw.

2.3.4 Indigenous Governments in BC

Changes within provincial government legislation and support did not substantially change nonstructural flood risk management for Indigenous governments. The guidelines produced and funding provided by the Province since 2003 have been used for a number of flood risk management projects for Indigenous governments.

Generally, flood mitigation work by or for Indigenous governments follow provincial guidelines and standard practices applied to other communities. However, a number of substantial differences exist; these may include: the various levels of approval within a community to obtain acceptance or guidance for a flood assessment or mitigation plan, consideration of a longer time horizon (i.e. seven generations compared to 50 or 100 years), extensive historical and traditional knowledge of the land and water, impacts with respect to unpopulated areas may have equal or higher value than populated areas, high disaster resilience resulting from tight connections within the community and to the land, retreat rarely an acceptable mitigation option. In addition, the authority over the land may not always be clear (i.e. elected band council overseeing reservation land and hereditary chiefs overseeing traditional territories).

In 2017, INAC was split into two new departments, Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) and Indigenous Services Canada (ISC). According to current annual departmental plans (2019-2020) CIRNAC is to support adaptation for changing environments and flood preparedness through assessing climate change impacts, floodplain mapping, and land use planning, while ISC is to partnership with Indigenous governments to increase community-based preparedness, mitigation, and resilience to flood events as well as ensuring support for response and recovery.

Examples of Indigenous governments having completed (or in the process of) projects reducing flood risk in their communities include, Cowichan First Nation, Nisga'a Lisims Government, Kitsumkalum, Squamish First Nation, Lil'wat Nation, Gitga'at First Nation, and Kingcome Inlet. These communities have or are in the process of developing floodplain mapping, establishing land use restrictions (FCL and setbacks), and



requiring development specific flood hazard assessments. One of these communities considered managed retreat following an extreme flood, but instead chose to elevate existing homes and establish a local flood evacuation warning system.

2.3.5 Survey Results – Land Use Regulations Used by Local Governments

A wide range of tools are used to manage development in a flood hazard area. From the current survey, over 50% of local government respondents reported the use of zoning bylaws (26/40), official community plan policies (26/40), and floodplain mapping (21/40) to manage development of flood prone lands.

Additional tools were also reported as being used in the following order of frequency;

- 9. Subdivisional approval conditions (18/40);
- 10. Development permit area designations (19/40);
- 11. Site-specific engineers or geoscientists report with restrictive covenants on title (16/40);
- 12. Regional growth strategy (8/40);
- 13. Works and services bylaw (4/40);
- 14. Sea level rise planning areas (2/40);
- 15. Crown land disposition conditions (3/40); and
- 16. Others (2/40).

Requirements applied through those tools include in order of frequency:

- 1. Minimum construction elevation (FCL) (30/40);
- 2. Minimum setbacks from flood sources or dikes (29/40);
- 3. Development or site-specific flood hazard assessment (20/40);
- 4. Limits on types of development or specific land uses (23/40);
- 5. Limits on redevelopment, expansion, or change in use (16/40);
- 6. Prohibit any new development in certain areas (18/40);
- 7. Require legal access for future dike widening and upgrading as a condition of development approval (8/40); and
- 8. Wet or dry floodproofing (7/40).

Of interest, is the wide range of tools and requirements stated to be used by the local government respondents.

2.4 Comparison Summary of Past and Current Approaches

The following table provides a summary comparison of non-structural floodplain management prior to and following the 2003 transfer of authority from the province to local government.



Table 2.1Comparison of floodplain management roles and responsibilities in BC prior and post 2003 transfer
of authority.

Approach	Pre 2003	Post 2003
Policy		
Guidelines		Guidelines issued in 2004 ¹ (updated 2017) and 2011 (MFLNRO, 2011) by the Province. EGBC-prepared guidelines on professional practice for flood hazard assessment (2018) and floodplain mapping (2017); standard left up to the Province.
Standards (FCL)	FDRP mapping agreement (BC-Canada) ⁶ : Riverine FCL: 200-yr floodplain designated by Province, allowance for different events if approved by steering committee, but lower limit of 100-yr. Freeboard undefined, but standard at 0.3 m above instantaneous and 0.6 m over daily peak flow. Coastal + Lakes: method based (1.5 m above natural boundary). Tsunami hazard not defined. MoE provided FCLs and setbacks on a site specific basis. Alluvial/debris flow fans : 1.0 m above ground or as prescribed by QP	Riverine FCL ¹ : 200-yr, freeboard not defined Coastal FCL ¹ : 200-yr+ or method based, freeboard defined as 0.3 or 0.6 m. Tsunami (FCL) ¹ : 1964 event or greater (site specific) Lakes FCL ¹ : 200-yr or method based (1.5 or 3.0 m above natural boundary) Alluvial/debris flow fans: 1.0 m above ground or as prescribed by QP (standards based on 2004 guidelines not a regulation or act; requires local government to consider but not conform to)
Standards (Setback)	FDRP mapping agreement (BC-Canada) ⁶ : Riverine + Coastal Setback: 15 and 30 m Lakes: 7.5 and 15 m MoE provided FCLs, setbacks, and no build areas on a site specific basis. Setback from a dike: 7.5 m	Riverine setback ¹ : 15, 30+ m Coastal setback ¹ : greater of 15 m from natural boundary predicted for year 2100 and location where natural ground is of elevation equal to FCL for year 2100. Tsunami (setback) ¹ : 1964 event or greater (site specific) Lakes setback ¹ : 7.5 or 15 m Setback from a dike: 7.5 m (standards based on 2004 guidelines not a regulation or act; requires local government to consider but not conform to)



Approach	Pre 2003	Post 2003	
Standards (land use restrictions)	FDRP agreement (BC-Canada): within any flood hazard area, not to construct, nor financially support, but instead encourage zoning authorities to prohibit construction of, or major addition to, a structure (other than for agriculture, recreation, or transportation) that is vulnerable to flood damage and to be located in the floodway or not floodproofed and to be in the flood fringe; with the exception that Canada could fund or build within flood hazard areas if on Indian Reserves or Crown land set aside or reserved for Indians.	Indigenous and local governments: Subdivisions: may require a flood hazard assessment by an engineer ^{3, 4} Local government OCP's: are to restrict land use where land is subject to hazardous conditions ² Bylaws: may require new buildings in flood hazard areas to be flood protected ²	
Acceptable floodproofing methods	Raising of habitable areas with use of fill, structural means, or combination. ⁶ No guidelines, standards, or regulations to approve wet or dry floodproofing.	Raising of habitable areas with use of fill, structural means, or combination. No guidelines, standards, or regulations to approve wet or dry floodproofing.	
Local / Regional Assessments and Res	strictions		
Floodplain Mapping (to designate the floodplain and required FCL and setbacks for OCP, bylaws, and approvals)	Province led floodplain mapping initiative to determine location of hazard, and have the information accessible to public and planning agencies	Indigenous and local governments are responsible for floodplain maps to support land use controls. Indigenous and local governments have developed their own maps, updated the pre-2003 provincial maps, or relied on the pre-2003 maps; some of which are publicly available others are not). Quality and type of information is not consistent.	
Funding for floodplain mapping and mitigation planning	Federal and provincial sources.	Federal, provincial, and local level government funded.	
Floodplain bylaws, OCP's, and development permit areas	Local government prepared OCPs and floodplain bylaws (with support from the Province). BC MoE provided technical input and approved floodplain management bylaws.	Local government prepares bylaws without support or review from province. Technical support provided from consultants. Provincial Minister can intervene. ^{2,5} Indigenous government councils can enact laws to regulate and control land use through zoning and subdivision control.	



Approach	Pre 2003	Post 2003	
Site Specific Assessments, Approv	vals, Mitigations		
Review and Approval of floodplain component of subdivisions	BC MoE provided approval with conditions, or withheld consent to local governments or MOTI approvals. MoE provided site specific floodproofing conditions for flood prone lands, whether or not area was covered by floodplain mapping.	Subdivision approvals by municipal and Indigenous governments approving officers within their boundaries. Approvals by MOTI outside of municipal and Indigenous government boundaries (i.e. regional districts). Regional districts (i.e. electoral areas) can provide comment to MOTI on subdivision approvals in electoral areas. ^{3,4}	
Site assessment of flood hazards	BC MOE/MWLAP, QPs with FDCP oversight	Consultant QP for the proponent / landowner.	
Determination and design of required mitigations	BC MOE/MWLAP FDCP	Consultant QP for the proponent / landowner with MFLNRORD oversight for structures as defined by the Dike Maintenance Act	
Flood covenants	Prepared by BC MOE/MWLAP FDCP Proponent / landowner prepared with government review.		
Technical Support			
Primary technical expertise for assessment, mitigation, and review of complex hazards.	Province; BC MOE/MWLAP, and FDCP provided a team of flood hazard specialists to support provincial and local governments as well as property owners.	Consultants; Indigenous and local governments retain consultants to assess hazards, prepare floodplain mapping, support the development of floodplain bylaws, and review other consultants reports (flood hazard assessments and mitigation designs).	
Information development and sharing (for flood awareness)	Local government with support from province – River Forecast Centre for flood forecasting and emergency preparedness.	Primarily Indigenous and local government (using multiple platforms; print, websites, social media), with support from Provincial River Forecast Centre for flood forecasting and emergency preparedness	

Notes

1. Based on FLNRORD (2018) and (MoE, 2011b).

2. Local Government Act, 2015

4. Strata Property Act, 1998

5. Community Charter, 2003

3. Land Title Act, 1996

6. Agreement Canada + BC 1987

As a summary, prior to the early 2000's, the province of BC was the technical and administrative lead for identifying, assessing, and mitigating flood hazards within BC. Local governments had authority to control land use, including actions to reduce flood risk, but with extensive support, review, and oversite from the Province. Following legislative changes in 2003, the Province assigned the authority and responsibility for non-structural flood management to local government. The province limited their support to a couple of guidelines and hazard mapping prepared almost exclusively in 2004 or earlier, as well as providing funding to local level governments. This has resulted, in the most part, that



consultants provide the technical expertise. The provincial guidelines, professional practice guideline, and federal guidelines reflect attempts to standardize local governments and the consulting services supporting them. However, such guidelines are challenged by the complexity and variability of hazard assessment and mitigation across BC, the inability or reluctance to set standards (possibly since authority has been relinquished to local government), and lack of oversight to address variability in resource allocation, technical approach, local values, findings, and implementation. Over the past 5 years \$40 million has been proved to local level governments for non-structural flood mitigation⁹. The effectiveness of this funding in meeting the objective to *reduce or limit flood risk within BC* is questionable without monitoring changes in flood risk across the province. This warrants the investigation into alternative approaches to providing non-structural flood mitigation, particularly management the development of flood prone lands.

⁹ NDMP has funded roughly \$36M through 70 flood assessment, mapping, and mitigation projects between 2015 and 2020 (and another \$10M on 12 projects related to structural mitigations or geohazards) CEPF program has funded \$5,6M through 42 flood planning projects across BC between 2017 and May of 2020



3 B-6.2 ALTERNATIVE APPROACHES TO MANAGING DEVELOPMENT OF FLOOD PRONE LAND

This section presents alternatives to the current approach to managing development of flood prone lands. Examples of other jurisdictions are presented along with a comparison to the BC approach. A notable difference between the various jurisdictions presented, and pre- and post-2003 within BC, is the distribution of responsibility. Survey results on preferences with respect to the distribution of responsibility is therefore presented within this section. The section concludes with an evaluation of past, present, and potential future approaches to managing the development of flood prone land in BC.

3.1 Alternatives Used in Other Jurisdictions

Practices from a variety of other jurisdictions are documented for comparison. The jurisdictions and approaches presented in this section have been selected to highlight alternative approaches from that in BC. Jurisdictions for comparison were initially selected based on geographic proximity, innovative approaches, and similarity in government and legal systems.

3.1.1 Alberta, Canada

Alberta recently suffered the costliest disaster in Canadian history, the 2013 flood which impacted much of southwestern Alberta including Calgary. This has brought an acute awareness of flood risk to the government and the people of Alberta. Despite proximity to BC, the approach to non-structural flood mitigation in Alberta is quite different. Most notably, Alberta Environment and Parks (AEP), the provincial ministry to protect and enhance Alberta's natural environment, is tasked with assessing flood hazard throughout the province. The River Engineering and Technical Services Section (RETS), a relatively large sized organization of engineers and water resource scientists (over 20 technical professionals¹⁰) within AEP, provide flood mapping, flow forecasting, river engineering, and other related services. In addition, AEP maintains hydrometric stations and collects data during floods to support future mapping initiatives (i.e. high water marks and flood photos).

AEP has developed detailed standards for floodplain mapping, and subsequently administer and technically review the preparation of floodplain maps by consultants. A recommended minimum flood standard of 100-yr ARI has been adopted by the province. However, floodplain mapping project include 13 flood scenarios, ranging from 2-yr to 1000-yr, which are simulated, mapped and publicly hosted. The floodway is differentiated from the flood fringe based on velocity and depth criteria during the 100-yr event. Indigenous and local governments are provided the AEP maps and tasked with making use of the information. AEP communicates the desired application of the provincial flood maps to local governments as well as RETS providing informal support¹⁰.

Similar to BC, Alberta's *Municipal Government Act* (Municipal Affairs) provides local governments with the authority to manage development in floodways and on other flood hazard lands through restrictions placed by the Subdivision Authority (local government appointed). However, the *Municipal Government*

¹⁰ Pers comm. Bryce Haimila, B.Sc. CFM, Manager, River Engineering and Technical Services, AEP (2021)



Act and Water Act (Environment and Parks) enables the provincial government to control, regulate, or prohibit development in flood prone areas. Within the *Water Act*, the province can establish or approve water management plans and designated flood risk areas (following consultation with the local authority). Within these areas, the province can set limitations on land use, require review and approval for proposed developments, and restrict provision of flood disaster assistance money and services.

In Alberta, structural mitigation (such as dikes) is considered adequate to mitigate the flood hazard. Further mitigation, such as elevating any new habitable areas above the flood level for areas protected by dikes, is not required or recommended in Alberta (unlike it is BC).

An Alberta Community Resilience Program is led by the provincial government and provides multi-year grants that support the "development of long-term resilience to flood and drought events, while supporting integrated planning and healthy, functioning watersheds". The province has invested in a Provincial Flood Damage Assessment Study which includes a computerized model for estimating flood damages. The province has led several studies to apply this tool in communities in Alberta. The results of this tool are used in benefit-cost analysis of various large-scale mitigation measures. For large-scale mitigation projects which overlap multiple local jurisdictions, the province takes a role in options development and evaluation. In addition, the province supports public education and awareness through their Flood Hazard Identification Program website, associated Flood Awareness Map Application (with information on flood hazards across the province), social medial, press releases, and presentations to local level governments (administration and council)¹⁰.

A number of non-structural flood mitigation initiatives and studies have been applied since the 2013 flood; these include: *room for the river*, flood and compensate policies for selected potential flood areas, modifying building codes and zoning bylaws, relocation/retreat from high flood hazard areas, and comprehensive watershed wide plans to include land use restrictions such as wetland protection to manage flood risk.

Summary

The provincial government maintains a relatively large sized group of technical experts (RETS) to collect flow and flood data (for calibration and validation during floodplain mapping), prepare and makes public floodplain maps (with no inclusion of freeboard), and designate the floodway and flood fringe. The province has authority to control, regulate, or prohibit any use or development of land in the floodway.

Local governments have the authority, but are not required, to provide land use regulations to manage flood risk within the floodway and other flood prone areas. Unlike BC, areas protected by dikes are considered outside of the floodplain and hence do not require additional non-structural flood mitigation.

3.1.2 Ontario, Canada

Local Government

Ontario's *Planning Act* provides planning authority and Provincial Policy Statement (PPS) provides provincial policy direction on key land use planning issues that affect communities, such as: managing growth, using and managing natural resources, protecting the environment, and public health and



safety. These are the primary tools that the Ontario government has for directing land use planning within Ontario.

Policy within the PPS is to be incorporated by local governments in their official community plans and zoning bylaws. With respect to natural hazards the PPS requires that site alterations and new development are kept outside of hazardous areas adjacent to shorelines, inland lakes, rivers, and streams and areas that would be inaccessible during floods.

As an exception, 'Special Policy Areas' may be designated to allow floodproofed development within hazard areas, but this requires approval from two provincial ministers. However, development of institutions, emergency services, or hazardous substance facilities is not permitted within hazardous areas. The PPS was updated in 2020, but the natural hazard direction remains largely unchanged from the 2014 version, other than further direction to incorporate projected impacts of climate change with respect to flooding and stormwater management.

Conservation Authorities

Conservation Authorities (CAs) have been part of the Ontario approach for managing the natural resources and flood hazard within watersheds for 75 years. The CAs are watershed-based municipal public sector organizations, governed by representatives appointed from the local government within the CA, and for the most part also funded by those local governments. The CAs are established based on watershed, with 36 covering the more densely populated areas of the province.

The provincial *Conservation Authorities Act* set the CAs as responsible for the management and protection of the water resources of the watershed and regulation of development and activities through permitting in hazard prone areas within the CA's watershed. Their role includes preparation of floodplain mapping and delineating land susceptible to flooding based on the local design event; that is, either the 100-yr ARI, Hurricane Hazel, or Timmins event, depending on location. The CAs are required to review and provide comments on policy documents (official plans and comprehensive zoning by-laws)The CAs review and comment on municipalities' development applications if they fall within a natural hazard area.

Provincial Authority

The Ministry of Natural Resources and Forests (MNRF) is the lead administrative ministry responsible for natural hazard management, policies, and programs. As this authority the MNRF provides technical guides for designation of natural hazards as well as provides review and changes to regulations governing the natural hazard areas.

Currently the MNRF has proposed regulation in an attempt to make development in hazardous areas more consistent, more efficient, and more predictable. This development application processes is to include:

- Authorizing CAs to exempt low risk development activities from requiring a permit,
- Requiring CAs to periodically review and make public, policy that are used to guide permitting decisions, and
- Requiring CAs to make public delineated floodplains (i.e. floodplain maps).



Summary

The primary difference in noted between Ontario and BC, particularly following the updated to regulations currently proposed by MNRF, are:

- Floodplain mapping and land use regulation within the floodplain is under the authority of a single entity (CA) for a particular watershed, as such development in the floodplain is not regulated by municipalities but instead by watershed-based regional entities. Regulations therefore cross municipal boundaries and are expected to be based on a broad perspective with respect to continuity in risk mitigation.
- The CAs are responsible also for protection of water resources including developing business plans, watershed plans, and natural resource management plans, effectively providing the authority to apply an integrated floodplain management approach.

Recent review of Ontario's approach to managing flood risk was conducted following the 2019 flood events (McNeil, 2019). This review notes that the policies in Ontario have been credited at keeping losses associated with flooding less than that experienced in other provinces. Despite this positive remark, this review made 66 recommendations, which include:

- Update provincial technical guides related to flood hazards and floodplain mapping
- With local governments develop a multi-year approach to floodplain mapping and consider establishing a provincial mapping program.
- Consider establishing a provincial custodian for floodplain mapping information
- Support local governments in the conservation and restoration of upstream watersheds during land use planning to encourage water retention and infiltration and reduce runoff to mitigate flood impacts.
- Consider if Province should regulate drainage standards in urban areas (i.e. restrict runoff to predevelopment rates).
- Raise awareness among homeowners about the increasing flood risk.
- Review and potential expand or updated hydrometric and snow-course data network to improve coverage and automation if deemed warranted.
- Improve the disaster recovery assistance program, potentially incorporating build back better instead of replacing as is to improve flood resilience, as well as increase financial limits and tie any reconstruction or repairs to current provincial design standards.
- Try to make flood insurance more available across the province through discussions with Insurance Bureau of Canada.

3.1.3 Washington State, USA

Similar to BC, non-structural measures for flood hazard management in Washington State is influenced by multiple levels of government, this includes the federal, state, and local governments (i.e. county, city, and Indigenous government). The most obvious difference is the role federal agencies take on. The Federal Emergency Management Authority (FEMA) prepares floodplain maps, encourages local



governments to adopt the maps with local land use planning, and subsequently provides flood insurance to all residents who are located within the mapped floodplain.

Federal Emergency Management Authority (FEMA)

This federal agency was established by Executive Order in 1979 with the purpose to coordinate response to a disaster within the USA that overwhelms the local government and state resources. FEMA is currently an agency of the United States Department of Homeland Security. With respect to land use management with respect to non-structural flood mitigation, FEMA has three cornerstones: floodplain mapping, building and land use regulation, and flood insurance. The regulations and flood insurance program are focused on residential properties. FEMA is segregated into 10 regions; Washington State being in Region 10, which includes Washington, Idaho, Oregon, and Alaska.

Floodplain Mapping

FEMA has two types of map products, i) regulatory flood insurance rate maps and ii) non-regulatory flood risk maps. Regulatory maps delineate the 100-yr ARI flood, with one foot (0.3 m) of freeboard, but without consideration of climate change. The maps are to define the required premiums for insurance and support local government land use policy. The risk maps provide additional flood events and other content intended to allow local governments and other users to make better informed decisions with respect to reducing potential loss from a flood.

Flood maps are administered by FEMA and are typically prepared by US Army Corps of Engineers (USACE) or consultants. All maps and reports are publicly available on their website.

Building and Land Use Regulation

The purpose of the floodplain mapping program is to identify the flood hazard to encourage development to stay outside of the floodway and mitigated if within the flood fringe. Local governments are expected to adopt the maps with a local ordinance (i.e. similar to bylaw) requiring development to follow that shown in the regulatory maps; that is construction is to be above the 100-yr plus 1 foot level if in the floodway and avoid the flood fringe. In addition, any waste-water treatment plants are to be above or outside of the 500-year flood extents.

FEMA encourages local governments to adopt the maps, as FEMA will only provide flood insurance to those communities that have adopted the maps. Furthermore, FEMA theoretically reviews to ensure the local government is applying land use restrictions as per the maps, and if not threatens to revoke provision of flood insurance.

FEMA provides some additional flood mitigation programs, which includes providing funding for raising or relocating homes and supporting other flood hazard mitigations. The support follows a cost sharing approach of 75% FEMA, 12.5% Washington State, and 12.5% local government or homeowner. Approval is becoming more flexible, but continues to be based on an economic cost versus benefit analysis.

Flood Insurance

Only within a community that has adopted the FEMA floodplain maps with an ordinance, can one buy flood insurance through the national Flood Insurance Program (NFIP). Homes and businesses within the



high-risk flood areas with mortgages from a government backed lender are required to have flood insurance. Often, the premiums for insurance under NFIP are less than under other insurers, particularly for lower value homes at higher risk of flooding.

Local Level of Government

Local level governments (county, city, or Indigenous government) are responsible for land use planning and permitting including that done to limit the flood risk. FEMA floodplain mapping is limited to 100-yr clear water flood along larger rivers and coastal flooding. Similar in terrain and hydrology to BC, other water courses and flood risks exist across Washington State. The state government provides limited support. USACE and other federal agencies provide technical and financial support when related to structural works.

Washington Special Purpose Districts

Within Washington State a number of special purpose districts exist. Many of them provide a role in flood management. Examples of these are presented in the following subsections.

County Flood Control Zone and Drainage Utility

A number of counties in Washington State have county wide flood control zone and or drainage utilities. Often these organizations work to address flooding issues throughout the county. They are funded, at least partially, outside of the county funds, and are governed by a board of community and government members. Often engineering and planning functions are supported by the county government staff.

Sub-Flood Control Zones

Where a number of properties experience flooding from a single source, sub-flood control zones can be established. The group defines the objectives, acceptable mitigations, and acceptable tax rate. The county adds the self assessed tax to the property tax (for those properties within the sub-flood control zone). The county administers the funds, and provides technical support, to develop and implement the mitigation projects. Examples of this include;

- Self-identified tax zones to fund flood mitigation works.
- Managed by county government (collects tax, manages funds, manages projects).

Diking, Drainage, and Irrigation Districts

Similar to BC, diking districts were established initially to construct and manage systems of dikes, drainage, and irrigation in support of agriculture. As development encroached into these areas, the dikes and drainage protected an increasing number of homes. Although normally focused on structural measures and maintenance of these structures, it is not uncommon for the diking districts to also provide a role in non-structural mitigation. This role can include education and public awareness, emergency planning (often providing sandbags and associated materials), but occasionally also through mitigation planning; such as overtopping dikes sections, establishing floodways, breaching less valued portions of the dikes.



Summary

Washington State is supported by the federal government for floodplain mapping and residents within the designated flood hazard areas are incentivised to obtain flood insurance. However, despite the intent of the insurance to encourage avoidance or mitigation of high risk areas, instead the program has been allowing or even promoting reoccurring subsidized reconstruction of homes in high risk areas; with inadequate incentives to relocate or mitigate the risk (rates not adequately linked to risk). Mapping and insurance imposed by the FEMA program only covers coastal and large rivers within the state. The program does not incorporate the effects of climate change or other hydrotechnical hazards that threaten the floodplains of Washington State.

To address these other hazards and variability across the state, local level governments and a range of special purpose flood districts provide a range of flood mitigation measures. The special purpose districts provide a conjunction of community activism and governmental support, which enables communities to direct and address their concerns, while have the technical support of the local (county) government. This works particularly well where counties are well staffed with water resource engineers and planners, such as Skagit County, King County, Snohomish County. It may be less effective in smaller, less staffed counties.

3.1.4 United Kingdom

In the United Kingdom, management of flood risk is separated between administrations in England, Scotland, Northern Ireland, and Wales. However, there is a national agency to provide national policy on managing river and coastal flood and erosion risks; the Department for Environment, Flood, and Rural Affairs (Defra). This national department develops policies which are delivered by Risk Assessment Management Authorities. These include the Environment Agency as well as lead local flood authorities, district and borough councils, coast protection authorities, water and sewerage companies, internal drainage boards, and highways authorities.

The Environment Agency receives the national policy from Defra and is responsible for strategic overview of flooding and risk management activities on main rivers and the coast. Lead local flood authorities then manage local flood risks and incorporate flood risk into land use plans and strategies. England on its own is estimated to contain 2.4 million properties that are at risk of river or coastal flooding and an additional 3 million properties that are at risk of surface water flooding.

The approach defined by the national policy is referred to as a 'strategic' flood risk management strategy. This approach has been described as minimizing risk through sequentially attempting to direct development to the lowest risk flood zone, and only allowing an increase in risk when no lower risk options are available. This is perceived to be substantially different than other approaches (such as those applied in BC) in which planners instead match development to locations of acceptable level of flood risk or hazard (Department for Communities and Local Government, 2009). The stages of the approach include:

 Assess - Undertake studies to collect data at the appropriate scale and level of detail to understand what the flood risk is.



- Avoidance/prevention Allocate developments to areas of least flood risk and apportion development types vulnerable to the impact of flooding to areas of least risk.
- Substitution Substitute less vulnerable development types for those incompatible with the degree of flood risk
- Control Implement flood risk management measures to reduce the impact of new development on flood frequency and use appropriate design.
- Mitigation Implement measures to mitigate residual risks.

In Scotland, the Scottish Environment Protection Agency has developed detailed guidelines for flood risk and land use vulnerability (Scottish Environment Protection Agency (SEPA), 2018). This system identifies five classifications of vulnerable land uses ranging from most vulnerable uses to land uses that are flood compatible. For each of these classifications, they identify constraints for development suitability based on a range of hazard likelihoods.

Household insurance in the United Kingdom has historically provided flood coverage for coastal or inland overland flooding. A high penetration rate occurred as flood insurance is bundled with general home insurance for buildings and contents. Coverage nevertheless became threatened following persistent flooding in the 1990's, 2000's, 2010's. In 2016, the insurance industry, in cooperation with the UK government, established a joint initiative called Flood Re to support the availability and affordability of flood insurance for homeowners most at risk from flooding. Flood Re is a privately owned organization with public accountability to parliament. Some research identifies that the reliance on insurance appears problematic. Insurance premiums are not effective at incentivising an increase in robustness or resilience to flood events, but instead fund an acceptance of the risk and potential financial consequence (O'Hare et al., 2016).

A wide range of mitigation measures are accepted and applied in the UK. These include dry and wet floodproofing and temporary or emergency barriers, walls, and gates (Barsley, 2019; SEPA, 2018). These approaches are likely needed when adapting historic structures and possibly even when incorporating new structures in areas with a number of adjacent historic structures at potentially a much lower elevation. The British Standards Institute has established a set of specifications to define flood resistance, such as cycling, dynamic impact, and overflow testing. This better aligns customers expectations for floodproofing with product performance.

Summary

Interesting contrasts with BC, is the land use planning based on lowest risk first principal instead of defining land use with a minimum risk or hazard criteria.

The large suite of approaches in flood mitigation measures considered for use in UK may be worth considering in BC, particularly for existing structures and as an alternative to the exemptions to FCL that are present for a number of historic downtown areas in BC. Standardized rating of the various floodproofing techniques helps inform performance expectations.



3.1.5 Australia

Australia provides good comparison for Canada. Australia has a multi-tier government structure similar to that of Canada, particularly with respect to land use and hazard planning. The federal government has little to no role in land use planning, with the state governments responsible for establishing guidelines and objectives for land use and hazard planning and the local governments responsible for implementation. Similar to Canada, flood insurance has only recently been widely adopted, since the mid 2000's (Box et al., 2013).

Australia has experienced multiple natural disasters in the past 10 years; most notably 2009 Black Saturday Bushfires (173 dead, \$3.9 billion), 2011 Queensland floods (33 dead, \$4.8 billion), 2017 Cyclone Debbie (14 dead, \$3.5 billion), and 2019-2020 bushfires (34 dead) (de Vet et al., 2019). This has triggered a number of studies and initiatives to evaluate and improve disaster risk management.

Climate changes considerations are generally within state policy documents, but are not in state legislation, and hence not binding. The adopted projected sea level rise to the year 2100 ranges from 0.8 to 1.0 m, similar to the 1.0 m adopted in BC.

Unique Features

Following are some unique features of flood risk mitigation and lessons learned in Australia (Australian Institute for Disaster Resilience, 2017):

- Floodplain hazard information and flood risk management considers a full range of floods up to and including the probable maximum flood (PMF), to allow assessment of residual risk and to illustrate the floodplain boundary.
- Recognize and communicate the residual risk.
- Incorporate flood warning, flood response, and recovery planning to flood risk reduction strategies.
- Incorporate cultural, environmental, and community issues when assessing flood mitigation measures.
- Within a flood risk plan, provide a clear definition of roles and responsibility for the various government agencies and community as well as the links between structural measures, management measures, flood forecasting, and emergency response.
- Consider community profile, exposure, and vulnerability during flood management decisions.
- Flood risk information is to be readily available and usable to facilitate informed decisions by government, industry, and the community to manage flood risk effectively.
- Support sharing and reuse of information.
- Collect, maintain, and share data from investigations and analysis, floods and post floods to improve understanding and management of the hazards.

Government Structure

The governmental structure of flood management is similar in Australia as it is in Canada. With the states being responsible for flood risk management and each state providing various approaches and



responsibility sharing and coordination with the local governments. Guidance provided by federal publications to the state governments include the following points (Australian Institute for Disaster Resilience, 2017):

- Lead, monitor, and maintain legislative policy and administrative framework for flood risk management, including building controls and building codes.
- Set specific key strategic direction in flood risk management, land use planning, flood emergency management planning, and flood emergency response and recovery.
- Define in a single document the responsibilities of each state and local government entities with
 respect to flood risk management and the coordination between these roles. Include all aspects
 of flood risk management, such as land use planning, flood management, emergency
 preparedness, emergency response, recovery management, and public engagement and
 awareness.
- Provide strategic planning where scale exceeds that of local government (i.e. regional planning).
- Review local government planning for consistency with state strategies.

Many of the Australian risk publications acknowledge and engage both business and residents to take on responsibility in resilience to flood risk (Council of Australian Governments, 2011).

Insurance

Flood insurance was relatively recently widely adopted in Australia. Flood events that have occurred during this adoption have highlighted challenges with its reliance. Following the 2011 floods, a study was conducted of local government, state government, insurance providers, and affected residents. Results from this study and more recently presented concerns are summarized below (Box et al., 2013; de Vet et al., 2019):

- Residents are uncertain on how to prepare for a flood, relying on emergency services and local government to protect them. General expectation is that government should construct dikes or dams to "prevent" floods.
- Flood mitigation requirements are limited to minimum standards. Instead, incentives should be provided for going above the requirements and further reduce the risk.
- Insurance perceived as a "transfer of risk" (to the insurance providers) or as a path to flood resilience and preparedness. In contrast, insurance providers prefer it to be seen as an "indicator of risk".
- Perceptions of insurance allows governments and residents to prioritize disaster response and recovery over risk reduction and mitigation.
- Premiums do not adequately reflect the risk, and hence does not incentivise risk mitigation.
 Instead, some argue that in enables and potentially structurally embeds risky behaviour.
- Insurance was initially expected to engage and share flood risk responsibilities with the residents. Instead, it can enable residents to further discount flood risk due to an expectation that responsibility has been downloaded to their insurance policy.
- Despite not adequately accounting for risk, residents still find the premiums too expensive.



- Residents and governments expect insurance providers to further educate and guide their clients to improved flood mitigation and resilience.
- Governments tend to want to make insurance compulsory in high risk areas. However, insurance companies find these areas the most challenging. This has led to failed initiatives to subsidise premiums and insurance companies to abandon those areas.

Summary

Information or recommendations from this comparison that appears most poignant to BC flood mitigation include:

- Define strategy, roles, responsibilities, and coordination between different roles for all aspects of flood risk management in a single document.
- Consider and display events beyond the design event to illustrate residual risk. In BC, it would be expected that owners of properties outside of the designated floodplain assume they are not a risk of flooding. However, they may be at risk to more extreme events (500-yr, 1000-yr, ...). Illustration of the extreme events may be useful at least for resident preparedness, even if land use policies are not adjusted.
- Graduated incentives on insurance premiums may provide opportunities to further reduce risk versus use of a single minimum standard.
- Insurance may increase resilience to flood events. However, it should not be relied on to incentivise or otherwise encourage less risky land use practices.
- Engagement with public is important to ensure they are able to share in the responsibility of flood mitigation. This includes ensuring information on flood hazard and risk is publicly available and provision of adequate technical resources to discuss risk and mitigation of their community. The provision of technical resources and public education appears to be especially critical where insurance is provided to avoid an over reliance on insurance.

3.2 Comparison of BC to other Jurisdictions

The following table provides a summary of the distribution of roles in land use management of flood prone lands. In BC, prior to 2003, the provincial government had a sizable team of water resource specialists that supported all aspects of land use management with respect to flood hazard areas. Local governments developed bylaws and OCPs and reviewed plans and exemptions, but the Province provided review and technical support. The technical support went as far as conducting flood hazard assessments, developing and constructing mitigation measures, and preparing flood covenants.

Leading up to 2003 *Flood Hazard Statutes Amendment Act*, the province began to reduce staffing levels and subsequently their support. Following the transfer or authority to local government, the Province eliminated much of the internal expertise that previously supported the local governments. The Province continues to review and approve subdivisions within non-municipal areas in regional districts. However, the staff assigned to this work have a broader mandate and expertise, and are not characterized as flood specialists (MOTI geotechnical engineers support when available). Indigenous and local governments retain private consultants to identify and map the flood hazards as well as support



reviews of plans and exemptions. Based on the authors experience, such reviews are often casual phone conversations, but occasionally include retaining the consultant to provide a more thorough review. The contract sizes for such reviews are generally small enough to allow for sole source award, enabling the local level of government to have continuity in the consultant providing the review. Some local governments establish approved consultant lists to simplify award of these small contracts and maintain continuity. Some of the services once provided by the province (prior to 2003) are now provided by the property owner and the consultants they retain. This includes flood hazard assessments, flood mitigation design and construction, and preparation of flood covenants.

Of the jurisdictions considered only BC relies on the local level of government to identify and designate floodplain hazards and only BC lacks a technical resource to either provide or support hazard designations and review of development plan applications.

Interesting elements from other jurisdictions include:

- Ontario's flood hazard technical authority, the CAs, are based on watersheds instead of administrative boundaries. This CAs incorporate both flood hazard and environmental protection mandates, which can be harmonized for some areas (e.g. flood and erosion setbacks along with riparian setbacks) but seen as conflicting objectives in other areas (e.g. vegetation maintenance along river bank dikes often conflicts with riparian objectives).
- Due to the extent of existing development with the floodplain the UK is innovative in its standardization and use of wet and dry floodproofing techniques as well a development sited for areas of least risk instead of areas that meet a minimum threshold.
- Australia incorporates the PMF on their flood maps in to help visualize the residual risk beyond the designated design flood event.



Table 3.1	Comparison of roles within BC and other jurisdictions with respect to flood prone lands.
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Role	BC Pre2003	BC Post2003	Alberta	Ontario	WA	UK	AUS
Policy (set standards & approach to define hazards and manage land use)	Provincial	Provincial guidelines, but local decision ¹	Provincial	Provincial	National	National	National
Local Flood Assessment (Identify, assess, & designate flood hazard areas)	Provincial	Local ¹	Provincial	Watershed based CA ²	National	Regional Authority	State
Local Land Planning (set land use restrictions, such as OCP, zoning, DPA)	Local with Provincial approval	Local ¹	Local with Provincial support/ approval	Watershed based CA ²	Local	Regional Authority	Local
Site Specific (Review + approve development plans)	Local with Provincial support	Local ¹	Local	Watershed based CA ²	Local	Regional Authority	Local
Site Specific (Review + approve exemptions or variances)	Provincial	Local ¹	Provincial	Watershed based CA ²	Local	-	-
Technical Support (available to local authority)	Provincial	Consultants	Provincial	Watershed based CA ²	National	Regional Authority	State

Notes

 MOTI provides review of subdivision approvals when in non-municipal areas of regional districts. However, the review is not provided by flood hazard specialist staff, as was the case prior to 2003 under the FDCP, and where available MOTI will rely on flood hazard assessment, mapping, and recommendations from the regional district or Indigenous government.

2. Indigenous governments may participate in the local Conservation Authority (CA).

3.3 Survey Results – Distribution of Responsibility

During the survey, respondents were asked where they thought responsibility should fall for several activities. The questions asked in the survey were presented to get a response on what local level of government would like to see for a distribution of responsibilities with respect to floodplain assessment and land use planning. Following is a summary of the response; based on 40 local government responses and 12 provincial ministry or agency responses.

Development of Policy and Standards

For setting criteria or standards for planning, policies, or regulations, only 10% of respondents thought that it should be the sole responsibility of local level of government. In contrast, 84% thought that this should be either a provincial responsibility or provincial-local level of government shared responsibility.





Figure 3.1 Survey response – where should the responsibility be for setting criteria and standards for planning policy.

Designating Flood Hazard Areas and Land Use Bylaws

For developing and updating floodplain mapping, only 12% of respondents thought that floodplain mapping should be the sole responsibility of local level of government; the approach currently applied in BC. In comparison 80% thought that responsibility should be provincial or a shared local-provincial responsibility.



Figure 3.2 Survey response – where should the responsibility be for development and update of floodplain mapping.

There was a balanced distribution from respondents with respect to determining the contents of floodplain bylaws and reviewing and approving floodplain bylaws. Roughly a third thought this should be a responsibility of local level of government, a third thought it should the responsibility should be shared between local level and province level of government and roughly 20% thought the responsibility should lie with the Province.





Figure 3.3 Survey response – where should the responsibility be for (a) determining the contents of floodplain bylaws and (b) reviewing floodplain bylaws.

Recently a councillor and planning staff for two local governments expressed challenges in establishing floodplain designations and OCPs that restrict land use, resale, or insurance options for properties owned by their constituents. They expressed the need to avoid appearance that the local government is interpreting the flood hazard, while also expressing an appreciation of the opportunity to provide input in the processes of floodplain designation and setting land use restrictions (*pers. comm. 2021*).

Reviewing and Approve Development Applications and Exemptions

The response of the survey shifts to a more consistent belief that the local level of government should be responsible for review and approval of development applications (i.e. official community plan amendments, rezoning, and development permits) and building permits. For such review and approvals, roughly 80% of respondents believe the responsibility should be with the local level of government.





Figure 3.4 Survey response – where should the responsibility be for (a) review and approval of development permits (i.e. official community plan amendments, rezoning, and development permits) and (b) building permits.

The response of the survey was less definitive when considering the responsibility for review of subdivisions and exemptions. For such review and approvals, the response was somewhat balanced between a belief that the responsibility should be with the local level of government or shared between local level and provincial level of government. This is complicated by the fact that the approving officer for subdivision in regional district electoral areas is the MOTI but a Council appointee for municipalities.



Figure 3.5 Survey response – where should the responsibility be for (a) review and approve subdivision applications and (b) exemptions.

Overall, the preference of survey respondents was to have provincial leadership in setting criteria and standards and updating floodplain mapping; shared responsibility in subdivision applications, the review and approval of floodplain bylaws; and local responsibility for determining the contents of floodplain



bylaws, the review and approval of development applications, building permits and the review and approval of exemptions.

3.4 Comparison of Past, Current, and Future Approaches to Provincial Delivery of Non-Structural Flood Management

The following table provides a summary comparison of past, current, and potential future options for administration of land use management of flood prone lands. Future approaches have been discretized into three options: 1) the Province leading the majority (if not all) aspects of flood management in BC, 2) the Province providing technical support to the local governments, and 3) regional entities providing hazard analysis and planning of flood prone lands. These three options could potentially be partially implemented, either through selecting components of each option or applying different levels of implementation in different regions across the province. However, to simplify comparison, and likely also potential implementation, each option is assumed to be wholistically applied.

The benefits and limitations are estimated based on findings from past and present survey results and previous reviews of the current and present approaches applied in BC (FBC and Arlington Group Inc., 2008; Lyle and Mclean, 2008; MELP, 1998, 1999; Ranade, 2020; Stevens and Hanschka, 2014a; The Arlington Group, 2014).

Option	Benefits	Limitations	
Pre-2003 (Provincial Lead)	Province led the identification, assessment, designation, and mitigation of flood hazards, supporting local governments through review of flood bylaws, subdivision approvals, and challenging development permit, building permit, and exemption requests.		
	 High quality, consistent technical support familiar with both local and regional conditions. 	 Potentially limited local government input on designation of floodplain and hazards High cost due to extensive role taken on by the province (flood hazard assessments, mitigation design and construction, drafting covenants) 	

Table 3.2Comparison of past, current, and future approaches to Provincial delivery of non-structural flood
management.



Option	Benefits	Limitations		
Post-2003 (Local Gov. Lead)	Provincial government has provided guidelines for flood hazard area land use and funding to enable local governments to identify, assess, and designate flood hazards within their region and establish local land use regulations. MOTI provides subdivision approval for Regional Districts. Individual landowners conduct their own flood hazard assessments and mitigation design and implementation.			
	 Encourages engagement of local governments with their flood hazards. Technical expertise only retained when needed (i.e. consultants instead of staff). Places cost of services on the benefactor (i.e. flood hazard assessments, mitigations, and covenants provided by land owner instead of province). 	 Requires technically aware (if not technical specialists) in every local government as well as within the MOTI Variable quality and public distribution of floodplain mapping Reliance on consultants, which is likely to vary over time and across communities and are often retained by lowest cost instead of most familiar with local hazards Potentially conflicting priorities between land use restrictions and other local objectives. Reliance on the flood hazard area land use guidelines and professional practice guidelines. 		
Option 1 Provincial Lead	Revert to the province providing the technical leadership, including review and approval of floodplain designation and floodplain bylaws, and upon request the review and approval of challenging development applications and exemptions. Continue with local government preparation of land use planning and landowner responsibility for flood hazard assessments, mitigation, and covenant preparation.			
	 High quality, consistent technical support, review, and approval, familiar with both local and regional conditions. Consistent approval of flood bylaws Consistent approach crossing administrative boundaries. Potential efficiencies from being centralized. Review and approval of challenging developments and exemptions 	 Potentially limited local government input on designation of floodplain and hazards Potential delays in services and additional cost with additional layer of review and approval. 		
Option 2 Local Gov. with Technical Support	Maintain the existing distribution of responsibilities, except include a technical support team to assist local governments with review of work prepared by their consultants and review of challenging development applications and challenging exemptions. No formal approval.			
	 High quality technical support Ensure minimum level of quality is achieved. Consistency possible across administrative boundaries and the province Provides an entity that can routinely review effectiveness of the program. 	 Potentially conflicting priorities between land use restrictions and other local objectives remains (but potentially reduced) as local government continues to be the approving authority. Additional cost for technical support team. 		



Option	Benefits	Limitations	
Option 3 Partnered Flood and/or Land Use Planning	Smaller local governments could amalgamate floo at threat to natural hazards, or alternatively plann	d hazard expertise, land use planning for all land ing for all lands.	
	 Cost effective with partnered services increasing ability to retain flood hazard specialists. Reduces impact of administrative boundaries. Reduced impact of conflicting priorities between land use restrictions and other local objectives 	 Potential conflicts between various communities. Reduced or loss of local control. Potentially conflicting values for adjacent Indigenous government lands and fee simple lands. Potentially challenging to establish and might not be well received by all local governments or residents. 	

3.4.1 Description of Past, Current, and Proposed Options

As shown in the comparison, prior to 2003, the Province took on an extensive role with respect to nonstructural flood hazard assessment and mitigation. The Province led much of the work and potentially over-extended their role with respect to local land use planning and property scale flood hazard assessment and mitigation design. By taking on such a comprehensive role, and adequately staffing to fulfill the role, the Province was able to ensure consistent, high quality flood assessment and mitigation. However, the cost and responsibility to provide this level of service is high.

The current approach in BC, in which local levels of governments identify, assess, and designate flood hazards within their region with limited (if any) technical flood support from the Province, enables the local governments to apply their knowledge of the local area's hazards and the community values to tailor flood hazard solutions to their region. Costs and responsibility for property development is often placed on the individual landowner as they conduct their own flood hazard assessments and flood mitigation (i.e. through consultants). The current approach is however challenged by the need for each local level government to have sufficient flood expertise to retain help when required. The extensive reliance on consultants has led to inconsistent flood management, which can be further deteriorated when flood risk reduction conflicts with other local objectives.

Three alternative optional approaches were considered.

Option 1 – Provincial Led Flood Hazard Management

The first option is for the Province to regain a leadership role. This would include review and approval of floodplain designations (maps), bylaws, and upon request by the local government, challenging development applications and floodplain exemptions. Unlike, prior to 2003, the province would not do prepare the floodplain designations, bylaws, mitigations, or covenants, nor would they review subdivision approvals. The local government would continue to be responsible for many of these tasks but have the province able to provide technical support, review, and final approval. Maintaining a level of local government in the preparation of the floodplain maps and bylaws allows for flexibility to account for local nuances within a local community and encourages local engagement



throughout the process. The landowner would remain responsible for site specific flood hazard assessments, mitigation, and covenant preparation. This approach should provide high quality, consistent service across the province. The approach would address the following challenges with the existing approach:

- Reduce the variability in depth of study, approach, and quality in flood assessment and nonstructural mitigation across the province.
- Reduce the impact of potential conflict between flood hazard objectives and other local priorities.
- Provide review of challenging flood hazard assessments or flood hazard exemptions submitted to the local government.
- Reduce the level of flood expertise required within every local government.

This approach may lead to additional cost and delay due to the additional review by a single entity.

Option 2 – Local Government Led Flood Hazard Management with Provincial Technical Support

The second option considered is to continue in a similar fashion to the current practice in BC, with the local governments identifying, assessing, and designating flood hazards within their region. Except, the provincial government would establish a flood management group that would provide technical support to the local governments. At a minimum they would establish flood standards, update guidelines, and provide technical review in support of the local governments flood management efforts. The approach would address the following challenges with the existing approach:

- Reduce the level of flood expertise required within every local government.
- Reduce the variability in depth of study, approach, and quality in flood assessment and nonstructural mitigation across the province.
- Provide support for instances when there is conflict between flood hazard objectives and other local priorities.
- Provide review of challenging flood hazard assessments or flood hazard exemptions submitted to the local government.

This approach retains much of the current approach, simplifying implementation, as well as maintaining the benefits of the current approach; that is, flexible to account for local conditions and required an engaged local government. Based on the survey results it is expected that this option would have the widest approval from local government and could be established quicker than the other options.

The provincial technical support could be centralized or regionally distributed. The technical support team could be within the provincial government, a regional entity, or other intermediary agency (potentially something similar to FBC). However, establishing the technical entity within the provincial government may give the impression of greater authority for politically contentious decisions (e.g. managed retreat or other increased land use restrictions) and be more suitable at supporting other government agencies (e.g. MOTI). Use of a regional entity or other intermediary may allow easier collaboration with Indigenous governments than if the technical support is provided by directly by the provincial government.



Option 3 – Regional Partners Flood Hazard Management

Option 3 is to establish regional partners for flood hazard management. The regional entity could be a stand-alone entity, a partnership between neighbouring local governments, or one of the larger local governments within an area providing flood hazard management services to neighbouring local governments or local governments within a common watershed(s). Depending on the location, this entity could provide flood assessment, land use planning of flood prone lands, or potentially all land use planning and permitting functions.

The approach would address the following challenges with the existing approach:

- Reduce the need for flood expertise within every local government.
- Reduce the variability in depth of study, approach, and quality in flood assessment and nonstructural mitigation within a watershed or region.
- Potentially reduce the impact of potential conflict between flood hazard objectives and other local priorities.

The amalgamation of planning services between communities could be voluntary, incentivised, or mandatory. However, any partnering may be received with mixed opinions. Examples of regional groups that provide or could provide combined flood hazard assessment or management services include, the Lower Cowichan/Koksilah Rivers Integrated Flood Management (Cowichan Tribes, City of Duncan, Cowichan Valley Regional District, and District of North Cowichan), the Okanagan Basin Water Board, and Emergency Planning Secretariat (organization of local Indigenous governments in early stage of coordinating flood management from Yale to Tsawwassen to Squamish).

It is expected that this approach may be the lowest cost, and possibly easier to incorporate Indigenous governments than providing technical support directly from the province, but may be more challenging to implement and potentially still require administrative and possibly technical support from the Province.

3.4.2 Summary of Approximate Costs

The following table presents the approximate cost of implementing one of these three options. Option 1, with reinstating Provincial authority through required review and approvals; thus providing the greatest level of control on quality, consistency, and effectiveness, but potential high cost and delays. Option 2 leaves the authority with the local governments, but provides technical support as request by Indigenous and the local governments. The level of control through this option could vary by making Provincial review (or approval) a condition of funding instead of a legislated requirement. Such an approach is probably the most simple to implement and to gain endorsement from Indigenous and local governments. Option 3, doesn't provide the same level of control or assurance on non-structural flood management, and is likely difficult to establish across the province. However, it may be the most cost effective approach to work towards improving quality, consistency, and effectiveness as well as reducing the burden on Indigenous and local governments.

The following table presents a approximation of the level of cost of that support required by the province to institute one of these optional approaches. The presented cost estimates are based on the



dollar value of NDMP and CEPF funded projects over the past 5 years and estimated level of effort in support of a similar scale of annual projects.

Table 3.3	Comparison of additional cost for the proposed approaches for Provincial delivery of non-
	structural flood management.

Option	Additional Resource Requirements	Annual Cost	
Option 1 Provincial Lead	20 to 28 full time employees (\$2-2.8M)Overhead cost (\$2-2.8M)	\$4,000,000 to \$5,600,000	
Option 2 Local Government Led with Provincial Technical Support	 6 to 10 full time employees (\$600-1,000k) Overhead cost (\$600-1,000k) 	\$1,200,000 to \$2,000,000	
Option 3 Regionally Partnered Flood and/or Land Use Planning	2 to 4 full time employees (\$200-400k)Overhead cost (\$200400k)	\$400,000 to \$800,000	



4 B-6.3 NON-STRUCTURAL FLOOD MITIGATION IMPLEMENTATION IMPEDIMENTS AND OPPORTUNITIES

This section presents the impediments to and opportunities for implementing available non-structural flood risk reduction actions, including the role of incentives and regulation. The initial subsection provides a brief introduction of flood risk reduction actions followed by impediments and opportunities.

4.1 Flood Risk Reduction Actions Overview

Non-structural flood mitigation options can be organized as four strategies: *protect, accommodate, retreat,* and *avoid* (sometimes termed PARA). These four strategies are not mutually exclusive with multiple strategies potentially being applied. This categorization, *PARA*, is often used with respect to land use planning, and should be (and generally is) used in conjunction with the other non-structural flood mitigation measures. For example, public awareness and education are essential elements to the success of all flood mitigation strategies.

Protect

Protect strategies refer to defences from flood hazards through isolating development from the flood hazard through structural mitigations (*Issue B-5*,NHC, 2020e). Dikes, riprap, floodgates, floodways, and upstream storage (i.e. flood control dams) are forms of protection. Structural measures are designed to a specific event. A residual risk remains for events greater than the design event, such as a dike overtopping or breaching as a result of geotechnical failure. Often, implementation of flood protection measures leads to increased density of development in the defended area (Haer et al., 2020). The consequence of exceeded structural measures can be greater than if the same event occurred without the structural measure; due to the mechanism of failure and increased development density. Non-structural measures are required in conjunction with structural measures to manage the residual risk.

Accommodate

An accommodate strategy mitigates the risk of flooding without altering the flood. This is done through:

- Restricting land use to reduce vulnerability and exposure,
- Increasing resilience of existing buildings (i.e. elevating critical infrastructure such as main electrical switchgear, adding backflow prevention valves, anchoring propane tanks, etc.), and
- Establishing personal, business, and community preparedness plans.

Most land use planning in BC can be considered as part of an accommodation strategy. Related elements in BC include growth management/regional planning, official community plans, development permit areas, zoning, floodplain bylaws, insurance, and covenants. Taxation¹¹ and rebate programs are

¹¹ Taxation is not directly used for flood accommodation in BC, but taxation reduction through the ALR may discourage development for some flood hazard areas.

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additional incentives that could be used to manage flood risk; other than insurance these two measures are the primary measures to encourage adaptation of existing structures for reducing flood risk.

Restricting Land Use to Reduce Vulnerability and Exposure

Restricting land use is accomplished through the official community plan, zoning, development permit areas, and subdivision approvals. These mechanisms can be used to limit type and density of land use or to add requirements such as, setbacks, construct the FCL, or site specific flood hazard assessment.

Flood hazard assessments are conducted by a qualified professional (engineer, geoscientists, or both). The assessments are to determine, with respect to the flood hazard, if the proposed development increases the flood hazard on other properties (i.e. upstream or adjacent), if the development can safely proceed on the property, and what mitigation measures - if any - are required for the development to be safe. Typically, such assessments are required for residential development permits, building permits, and - for some local governments - occupancy permits. However, based on NHC's experience similar assessments have been applied to commercial and industrials developments, private bridge crossings, chemical storage tanks, aquariums, and lift stations. Flood hazard assessment, although normally applied to new development, have also been requested by local levels of governments for changes in use of existing buildings and by property owners to support premium reductions for flood insurance.

Increasing Resilience of Existing (or new) Buildings

Resilience or recoverability of existing (or new) buildings can be increased through dry or wet floodproofing.

Dry floodproofing is when structures are constructed or retrofitted to keep water out of the structure through use of flood barriers or membranes. This includes backflow prevention valves, external floodwalls to block off flow paths, and sealed walls and openings such as windows and doors. Such barriers can be permanent or temporary. Dry floodproofing is challenged by buoyancy and hydrodynamic loading as well as leakage.

Wet floodproofing is protecting the structure against damage despite the expectation that water will enter the structure. Wet floodproofing is implemented through use of flood resistant building materials, elevation or protection of critical infrastructure (i.e. electrical and mechanical facilities). Wet floodproofing limits the extent of damages from a flood, allowing a faster post-flood recovery.

Where wet or dry floodproofing is used, consideration for human safety and potential environmental impacts must be considered. Wet and dry floodproofing must include safe egress from areas below the FCL and measures must be incorporated to prevent the release of deleterious substances during a flood (typically through elevation and containment). In addition, **knowledge that an enclosed area is below the FCL must be transferred to future users (such as through signage and tenancy agreements) and owners (e.g. covenants)**.

Both wet and dry floodproofing are not extensively used in BC due to a lack of incentives for existing buildings and limited allowance for new construction. The existing provincial flood hazard land use guidelines only considers use of wet or dry floodproofing in new construction for underground parkades and garages. However, as per 2.4.6.4(3) of the BC Plumbing Code (2018) backflow prevention valves are to be added to every fixture located below the adjoining street; a measure of dry floodproofing. The BC



electrical code appears to be less inclusive of mitigations for flood hazards; such as handling of outlets, switches, and other electrical equipment that may be located below the FCL.

Flood Preparedness and Recovery Plans

Preparation for flood hazards and recovery from flood events is a primary mitigation strategy that should be done by all residents, businesses, institutions, and governments potentially affected by a flood event. Flood hazard maps, flood risk maps, awareness campaigns, emergency response plans, and flood forecasting can support flood preparations. The provincial government currently provides resources for individuals and business to prepare for flood events (*flood preparedness plan – before, during, and after the flood*). Additional resources have been prepared by various local and regional entities across the province (e.g. City of Vancouver *business continuity planning*). The recent Covid-19 pandemic has highlighted some of the needs for such preparations (e.g. remote working, remote customers, supply chains, etc.), and is likely to result in further guidance being prepared.

Despite being an approach of non-structural flood mitigation, emergency planning is not presented in this report as it is covered by *Theme C, Flood Forecasting, Emergency Response and Recovery*.

Retreat

Managed retreat (also called planned retreat or stepping back) refers to any strategic decision to withdraw, relocate or abandon private or public assets at risk due to the hazard either current (e.g. frequent flooding or migrated channel) or projected future hazard (e.g. sea level rise). Retreat is an adaptive strategy generally applied when the cost to protect or reconstruct following damage is no longer viable.

Retreat can happen gradually through policies implemented over a period of years or decades. However, retreat can also be used to describe land use change from a more vulnerable land use type to a less vulnerable land use type. This strategy has been modelled and considered as an option in several municipalities in BC (e.g. Ladner in the City of Delta and Crescent Beach in the City of Surrey) and most recently implemented in Grand Forks. Following the May 2018 flood, 120 properties were identified for purchase to re-establish the floodplain and make way for the flood protection works.

Challenges with lack of an established provincial or federal policy for such acquisitions (purchase of property and buildings) added stress to the local government and affected residents. Concerns include cost sharing between federal, provincial, and local government, property valuation (pre or post-flood values), voluntary sale versus expropriation of the properties, timing and delays in communications and actions limited ability for affected residents to make plans to repair, floodproof, or relocate and delayed ability to further increase flood protection for the remaining parts of the town. Removal of up to 120 homes in Grand Forks (final number was closer to 80) was a sizable loss to a community that has less than 4,000 homes (*Statistics Canada, 2016 Census*). This change has the potential to impact the social and economic conditions of Grand Forks; either as increased activity with reconstruction of homes in other parts of Grand Forks, or permanent loss of residents to other communities. Retreat is further challenging for Indigenous governments without award or exchange for additional land.

An ongoing study by Gevity (Managed Retreat to Support Building Long-Term Climate Resilience in Canada) indicated this is a strategy that is attracting more interest in Canada. This approach is likely to



be increasingly in need as global warming elevates sea level by 1 m or more over the next century (MoE, 2011b), and hence policy should be developed to facilitate this approach. The approach is costly and often politically challenging. Implementation tools require long term planning, extensive public consultation, and funding and may include land exchange and expropriation. Typically, such as approach is implement through an integrated flood management plan (see *Issue B-4* for further discussion, KWL, 2020).

Avoid

Avoidance is the strategy to prevent development from occurring where the flood hazard is greater than the acceptable level even with mitigation, or will be with ongoing climate change. Land use planning in BC includes an avoidance strategy with prohibition of land use for high hazard areas (e.g. alluvial fan, setbacks, and identified active channel migration zones). This strategy involves the restriction or prohibition of future development through land use regulation and may involve land acquisition or the transfer of development potential to areas of lower risk. The two key tools to implement an avoidance strategy are flood hazard mapping and designations of no-build areas in the official community plan. Flood hazard covenants placed on land in flood hazard areas during subdivision or building permit application, generally include setbacks from the water body. Despite the defined setbacks, the provincial flood hazard area land use guideline allows for a relaxation where there is severe hardship; that is, no other buildable location on property (FLNRORD, 2018).

4.2 Current Impediments

4.2.1 Survey Results – Current Challenges

A list of potential challenges to the implementation of non-structural measures to reduce flood risk were presented in the survey. These challenges are listed below with the percentage of respondents who acknowledged these as challenges (most frequently noted are highlighted in red, middle frequency in yellow, least frequent in grey). A total of 51 responses were provided from local government (33), provincial government (9), consulting (2), research (2), and other respondents for this question.

Lack of Resources

_	
•	
•	Limited financial resources or access to funding
Сотті	inity and Political Challenges
•	Resistance from property owners or residents
•	Political sensitivities or conflicting priorities
•	Lack of internal or public recognition of the role of land use planning in risk reduction
•	Challenges with other levels of government or neighbouring communities
•	Lack of available land for development25%
Challen	ges with Existing Flood Management Plans
•	Lack of a long-term flood management plan
•	Challenges addressing historic exemptions



Lack of Information or Guidance

•	Gaps in technical information and knowledge (e.g. lack of/outdated maps)	47%	>
•	Lack of tools, standards, guidance, and regional/provincial policy direction	43%)
Other			

•	Challenges related to disaster financial assistance or insurance
•	Challenges working with external organizations (e.g. non-profits, academic, consultants)8%
	Other

The survey indicates that lack of resources (staff and financial), lack of long-term flood management planning and limited support or resistance from public and council are the most common impediments to implementing non-structural flood mitigation measures. Many of these concerns were also identified in previous surveys (FBC and Arlington Group Inc., 2008).

In addition, it was noted that although riverine hazard was the predominant flood hazard affecting surveyed communities, many of the communities were also at risk from debris flows, debris floods, geomorphic hazards, lake flooding, coastal flooding, ice jams, or local pluvial flooding; emphasizing the need for an inclusive consideration of flood related hazards.

4.2.2 Regulatory Deficiencies

1. Voluntary to Regulate Floodplain Hazards

The existing legislative framework is permissive, not mandatory. A small number of local level governments, chiefly in electoral areas of regional districts, have chosen to not adopt basic regulatory mechanisms in three key areas. One is official community plans which have policies concerning flood hazards but no designated development permit areas. This means compliance is voluntary. Second is where there is no floodplain bylaw, zoning bylaw, or the existing zoning bylaw has minimal or no land use setbacks, density limitations or other restrictions. This means there is no regulation of land use of any consequence to mitigate flood hazards. The third is where there is no building bylaw. This means there is no building inspection function and no local level government regulation. Although a builder has an obligation to comply with the BC Building Code, the code does not address flood hazards and without a building official, there is no means of requiring a site-specific flood hazard assessment by a qualified professional. Provincial flood hazard area management guidelines are potentially ignored if there are no regulatory processes to ensure they are met, let alone communicated to landowners and builders.

2. BC Building Code Constraints

The BC Building Code is standardized throughout the province. This may restrict local levels of governments from requiring use of flood resistant building materials for building construction below the FCL as a condition of building permit issuance. Requirements for dry proofing and wet proofing below the FCL could potentially provide an alternative solution for development within historic settlement areas that are substantially below the FCL or for additions to existing structures below the FCL.

The City of Vancouver is the only municipality in BC with the authority to vary the BC Building Code. The province of BC enacted legislation to ensure that other local governments have a standardized set of



building requirements for building construction. This does not prevent floodproofing, but it does mean this cannot be done by modifying the building code to do so. Adding additional building requirements can only be done indirectly through a covenant on title or requesting that the province of BC change the BC Building Code.

4.2.3 Deficiencies in Provincial Guidance

3. Inadequate Technical Guidance to Support Land Use Regulations

Responses from local levels of government reinforced a desire for additional technical support from the Province. From the survey, one third of the comments received from local level government requested increased technical support from Province. The requests included,

- Increased role (similar to pre-2003)
- Support development of floodplain maps
- Guidance on development of flood management plans from floodplain maps
- Provincial policy or standard on risk approach to natural hazards

Floodplain Mapping and Hazard Definition

Floodplain mapping forms the foundation of much of the land use regulations. A couple of concerns are listed below that directly challenge local level of governments when trying to implement land use plans from recently prepared floodplain maps. Additional review of the floodplain mapping program is presented in Issue B-2 of this series (NHC, 2020b).

Inconsistent design flood events provide a wide range of flood levels which can be challenging when there are adjacent jurisdictions. Within BC design flood events include the recommenced minimum 200-year clear water flood, flood events that incorporate debris, sediment, and blockages, and flood events based on historic flow records (flood of record, such as the Fraser River, Elk River, and Okanagan River). Furthermore, approach and extent of climate change projects vary considerably from a 10% (EGBC recommended minimum, APEGBC, 2017) increase in flow to as much as 40% (projected increase in precipitation for some Lower Mainland drainages, GHD, 2018). Depending on the approach for coastal flood levels, design events can be as extreme as the 4000-year event (MoE, 2011c).

There is **limited guidance on establishing setbacks** within BC, and resulting setback defined with floodplain bylaws for adjacent communities can vary widely. Setbacks can be derived from hydraulic conditions, encroachment analysis, detailed geomorphic assessments, or simply taken from the Provincial recommended minimums (FLNRORD, 2018). Example of variations is present along the Fraser River, where there is a setback of 300 m from the river required in the District of Kent (Bylaw 1590), but only 60 m on the opposite side of the river in the City of Chilliwack (Bylaw 4519).

Encroachment of floodplains appears to rarely be evaluated in BC. Successive development or placement of fill within the floodplain can eventually begin to restrict flood flow and result in higher flood levels or higher velocity. Encroachment analysis, generally conducted by modelling a successively narrower floodplain, can be used to identify a limit along the watercourse in which further narrowing will increase the flood level by some set value (such as 0.3 m). Setbacks (no-build buffers) are generally



incorporated in floodplain bylaws, this helps to limit encroachment. However, in BC the setbacks are generally based on provincial standards, hydraulic conditions, or geomorphic hazards.

When preparing a flood hazard assessment, QP's are to consider the potential transfer of risk, such as raising flood levels due to encroachment. However, no acceptable criteria are established in BC, and there is no mechanism to consider the cumulative impacts of multiple projects along a floodplain. Requirements or guidance on encroachment analysis should be considered as part of floodplain mapping standards.

Current floodplain mapping in BC is generally limited to the design flood event. Following the lead shown by Australia and Alberta, **more extreme events should be included to illustrate the residual risk** (e.g. PMF and is Australia or 1000-year event as in Alberta). This will reduce the likelihood of insinuating a false sense that properties outside of the designated floodplain are not at risk of flooding.

4. Quality Control and Technical Standardization

Local governments and Indigenous governments, rely on the provincial flood hazard land use guidelines (FLNRORD, 2018; MoE, 2011b). A number of comments within the survey, received from local levels of governments, praise appreciation for the current guidelines and express a desire for them to be expanded to further cover risk and policy.

Much of the hazard and risk analysis conducted within Indigenous and local government regions is outsourced to consultants. This refers to both the development of underlying studies and mapping for a region¹² as well as the property specific assessments Guidelines prepared by NRCan, the province, and EGBC can strive for consistent approaches in floodplain mapping and flood hazard analysis. However, floodplain hazard analysis, risk analysis, and mitigation are complicated, particularly in BC. The hazards are diverse, as is the terrain, and climate, and available long-term data is often sparse and poorly representative. Data, technology, and techniques evolve. Without review or control of project delivery, there is substantial variability in project comprehensiveness and quality. This is particularly true where low-cost solutions are requested over expertise or quality of data, analysis, and reporting; as is often the case for local government initiated regional studies as well as developer initiated studies to support requests for development permits, building permits, or exemptions.

The extent and effectiveness of floodplain management across BC does not appear to be monitored to ensure targets are being me and identify and remedy shortcomings. Objectives, goals, or measurable metrics of flood risk mitigation appear not to have been established to allow for effective monitoring and review. It takes little effort to find examples recent development that appears to have excessive flood risk. The following photographs provide examples of properties developed or in the process of being developed below the FCL or without adequate consideration of setbacks and flood hazard.

¹² Relied on for development of land use regulations (i.e. maps delineated flood prone lands, FCL, setback referenced in OCPs and floodplain bylaws) and for property specific assessments where required for development permits, building permits, and exemptions.

Investigations in Support of Flood Strategy Development in BC B-6 Non-Structural Flood Management Approaches





Houses constructed (in the late 2000's) behind Pitt River dike with main floor and basement below the dike crest.



House being constructed on the Elk River in threat of flood inundation and erosion (2018).

Figure 4.1 Recently constructed homes below the FCL or on land at risk of flood inundation and erosion.

4.2.4 Resource Deficiency and Challenges within Local Level Governments

As shown by the survey responses, local level governments have stated that lack of staff and financial resources is a leading challenge to implementing non-structural flood measures. As follow comments within the survey, the most frequent requests were for funding and additional technical support.

5. Funding Inconsistencies

Inconsistent and intermittent funding places pressure on recipient communities to maximizing volume of work provided under funding over quality due a fear of lack of future funding. The majority of the funding is for developing the background information that supports the development of floodplain bylaws and OCP's (i.e. floodplain mapping, flood risk analysis, and flood mitigation planning).

Small municipalities and electoral areas of regional districts find funding to be a challenge, not only due to their small population but also the large geographical area they serve and the restricted funding opportunities that apply (limited to fee per service in regional districts), compared to larger local municipalities with larger funding streams.

6. Lack of Technical Resources

With much of the responsibility for governance of land use in flood prone areas resting with Indigenous and local governments, many local level governments have stated that they do not have the necessary staff resources to invest in flood management. This generally relates to the technical expertise to address flood hazards for a local area or specific project or property. There is a large variation in resources available between communities, and the availability of these resources is not necessarily dependent on the level of flood risk. While some funding is available for projects, funding for staff resources specific to flooding is not available. Due to lack in staff, local level governments have difficulties communicating technical information and developing and adjudicating requests for variance from regulations involving complex flood and geomorphic processes. This applies particularly to smaller jurisdictions with a population of under 5,000 and communities with complex or multiple hazards (e.g.



riverine and coastal, or complex geomorphic processes). For such locations, most civic officials have multiple responsibilities and do not have the specialized expertise that is available in more populated jurisdictions to address development or interpretation of land use regulations where flood hazards are complex.

7. Lack of Resources Specific to Integrated Approach to Flood Management

Management of flood risk and subsequently land use in flood prone areas is increasingly in need of an integrated approach; one that accounts for not only the hydraulic, geomorphic, economic, and political aspects but also the ecological, social, and cultural considerations. Some credit the termination of the FDRP in part due to its narrow focus, that is, not sufficiently accounting for other considerations such as ecology (de Loe and Wojtanowski, 2001; Stevens and Hanschka, 2014b). Despite the expressed desire for an integrated approach, the development or evaluation of an integrated flood management approach is challenged by the number of individuals, departments, or organizations required to provide the encompassing expertise.

8. Lack of Resources Specific to Exemptions

Development of land designated within the floodplain can be restricted through local level government zoning and OCPs. Local governments can grant an exemption to the setback and the FCL for a specific parcel, land use, or building providing the exemption is considered advisable by the local government and that the local government receives a certification that the land is safe for the intended use by a professional engineer or geoscientist¹³. The granting of an exemption is to be done in conjunction with establishing a covenant on the property (*Land Title Act, s219*). The covenant provides a means for future property owners to be aware of the flood hazard and the exemption, as well as indemnify and saves harmless the local government from liabilities caused by flooding, erosion, or similar causes.

Prior to 2003, Provincial staff would support the review of exemption requests related to flood hazards. This support provided expertise in flood hazards with the ability to suggest approval, denial, or additional mitigation. In addition, the provincial support provided separation from any potential political influence or local pressures that may exist.

Post 2003, exemptions are provided through local government review of the submitted professional reports. Where expertise is not present within the local government, external consultants are often hired to provide a review. The external consultants rarely (if ever) have knowledge of past exemptions and may not have access to previous hazard assessments or be familiar with the region.

Professional practice guidelines prepared by EGBC on conducting flood hazard assessments, should help to standardize and improve the quality of hazard reports received by local levels of government in support of exemptions (EGBC, 2018). Based on the author's experience of reviewing such reports, there remains substantial discrepancy in the assessment of hazards, recommended mitigations, and level of reporting which is likely to challenge review of exemption requests particularly by staff who may not have the expertise or familiarity with flood hazards. For some communities, the requirement for

¹³ Local Government Act specifies that the qualified professional must be an <u>experienced in geotechnical engineering</u>, which is reasonable for geotechnical hazards, but it should reference <u>experienced in flood hazards similar to those experienced at this</u> <u>location</u> to encompass coastal, riverine, and geomorphic hazards where they may exist.



professional prepared flood hazard assessment is not limited to exemptions, but for all development and building permits in areas designated as potential floodplain.

The survey results suggest only a small portion of respondents (14%) state that exemptions should be reviewed and approved solely by the Province. However, there was a nearly even division between respondents that stated review and approval of exemptions should be done by the local level government (49%) versus done with some level of provincial support (47%).

9. Lack of Resources Specific to Flood Hazard Assessments

Often local governments do not have the expertise to review flood hazard assessments that they receive, and it can be difficult to find a suitable external reviewer. This can be a concern for complicated sites and poorly prepared flood hazard assessments.

As an example, wave effects are often not included or only applied as 50 per cent of the calculated runup value based on misinterpreted text in the existing provincial guidelines (MoE, 2011b). In comparison, other QP's incorporate the full runup height (*guideline references 50 per cent to calculate natural boundary, but often misused to calculate FCL*).

10. Floodproofing or Retrofitting Historic Settlement Areas

There is a legacy of historic exemptions created by the provincial government prior to the 2003 legislative changes. Areas, often the historic downtown areas, were granted exemptions for reduced flood mitigation requirements, typically a reduced FCL. Examples of such areas include key parts of downtown New Westminster, Chilliwack, Mission, Fort Langley, Abbotsford, and Squamish. These areas include roads and buildings that are below the FCL. Roads cannot be elevated if historic buildings are to be retained and new development has a major challenge meeting the accessible requirements of the *BC Building Code* for any habitable space at grade from existing streets. Only the District of Squamish has required floodproofing (i.e. use of flood resistant building materials) for commercial space below the FCL in its downtown.

As risk increase (i.e. with climate change and further development), the difficulty in dealing with or retrofitting such areas are increasing. From the survey, 43% of respondents identified this as a key challenge in developing or implementing non-structural measures to reduce flood risk in their community.

11. Conflicting Priorities

Council/Board and staff may have to balance other local priorities that may conflict with flood risk reduction, such as development pressures to revitalize communities and increase tax base, or existing height restrictions. The cost of floodproofing and restrictions on land use can impact feasibility for development projects. Where all developments must meet the same standards, the playing field is equal. This is not always possible, particularly if an updated flood assessment results in a higher FCL for one community, but not in an adjacent community. Furthermore, often the constituents they were hired or elected to serve are resistant to the restrictions that are to be imposed on flood prone lands; 61% of survey respondents stated this as a key challenge to implementing non-structural flood mitigation measures.



4.3 Opportunities and Recommendations to Improve Non-Structural Flood Mitigation in BC

Following are two lists of potential opportunities recommended for consideration to improve nonstructural flood mitigation across BC. The first list is directed to the Province. These recommendations are to improve the quality, consistency, and extent of implementation of non-structural flood mitigation. Cost estimates are prepared for the provincial recommendations. The second list is directed at Indigenous and local governments. These recommendations are presented to illustrate opportunities that appear effective in non-structural flood management and potentially could be more broadly considered.

4.3.1 Recommendations and Opportunities for the Province

Following are opportunities and recommendations to better support local level governments in the implementation of non-structural flood mitigation. These recommendations are directed to the Province.

1. Define Roles and Responsibilities for Flood Risk Reduction

Clearly define the purpose, objectives, and goals of the Provincial strategy to reduce flood risk. This should include defined roles and responsibilities of the various levels of government, and various departments and ministries within the provincial government. Expectations for each of these entities should be clear to avoid responsibilities from being lost between different orders of government. Ideally, there should be a single lead agency that has the authority and resources to routinely monitor and review provincial flood risk reduction to ensure objectives are being met.

Based on personal communication with local governments over the past 20 years, the lack of understanding of roles and responsibilities has led to delays or inaction with respect to identifying, assessing, and mitigating flood hazards. Increased engagement over the past 5 years has reduced the level of confusion, but a complete understanding of roles and responsibilities is still not clear for many local governments. For example, there is continued confusion on who is responsible for establishing the underlying criteria for determining the setback and FCL (i.e. return period of design event, extent of climate change assessment, and freeboard).

2. Review and Improve Provincial Guidelines on Land Use in Flood Hazard Areas

The Provincial guidelines for land use in flood hazard areas provides minimum standards for local governments (FLNRORD, 2018; MoE, 2011b). Local governments rely heavily on these guidelines during the development and implementation of floodplain bylaws, review of property specific flood hazard assessments, and review of exemptions. The primary flood hazard land use guideline (FLNRORD, 2018) appears to have not been reviewed or updated in any substantial fashion since its inception in 2004. It is recommended that the guidelines be reviewed on a routine basis (for example every 5 years) and updated as necessary.

Potential updates identified in this review include;



- 1. Present risk-based approach,
- 2. Consideration of alternative flood mitigation measures (wet and dry floodproofing),
- 3. Expand on guidance for land use planning (i.e. use of floodplain map and associated analysis to develop floodplain bylaws, development permit areas, and OCPs),
- 4. Consider incorporation of uncertainty assessment and how that relates to freeboard,
- 5. Consider updates based on current understanding of climate change science,
- 6. Consider variable land use or secondary mitigation allowance when protected by dikes, dependent on standardized dike rating system as per *Issue B-5* recommendations (NHC, 2020a),
- 7. Clearly define expectations for professional engineers to assess and certify developments as safe (particularly when applied to changes to existing structures that do not conform to current flood hazard safety standards).

Further details on two of theses items are provided in the following paragraphs.

Expand on Guidance for Land Use Planning

Further guidance for land use planning should be provided to support local governments transition floodplain maps to suitable bylaws, development permit areas, and land use restrictions. As stated earlier, conflicts between land use restrictions for flood hazard and other local priorities, can result in planning staff and council hesitating to adopt new floodplain restrictions unless they are following a clearly defined formula or approach without interpretation.

Guidance should be based on risk; considering both probability and consequence. This could be based on location as a definition of the flood hazard, such as: i) floodway, ii) flood fringe, iii) protected by a dike, iv) protected by super dike (>20 m top width), v) potentially impacted by single geomorphic event, v) potentially impacted following successive geomorphic events; as well as the proposed land use, such as, a) renovation of existing single family home (SFH), b) reconstruction of SFH, c) new SFH, d) subdivision to 3 to 10 SFH lots, e) subdivision to 11-100 SFH lots, f) multi-family home, e) commercial building < 10 occupancy, etc. A matrix of these locations and proposed land use could then be defined as i) no building, ii) build only after approved site specific flood hazards assessment, iii) build with defined mitigations (e.g. FCL), or iv) build without flood restrictions.

Consultants can provide guidance, however existing professional practices guidelines clearly state that the QP is to provide recommendations to the client with respect to design flow and freeboard, with the client making the ultimate decision (APEGBC, 2017). Similarly, the client (local government) is to make the ultimate decision with respect to land use restrictions. The flexibility provided-to/placed-on the local government may be warranted, but can challenge their acceptance of approaches recommended by the consultant.

Adopt a Risk-Based Approach

Guidance should be provided to local level government to help them facilitate use of a risk-based approach. This guidance could be provided through an update or expansion of existing flood hazard land use guidelines (FLNRORD, 2018). Existing guidelines have little guidance to incorporate risk (other than the draft policy discussion paper on coastal hazards, MoE, 2011a). Based on work across the province, even technically sophisticated local governments are reluctant to require increased hazard criteria on



high consequence structures (e.g. personal care residence, schools with on-campus residences). A number of comments received during the survey expressed this as a key challenge.

Land use other than residential should be considered, such as risk of environmental spill or loss of a social or culturally valued asset. The few alternative land uses considered (recreation, industrial, and agricultural) are not adequately developed in the current guidelines (FLNRORD, 2018). For example, campgrounds currently fall within outdoor recreational land use, suitable for floodways. However, the risk can be high if placed in a high hazard zones or developed without consideration of warning, seasons of use, and evacuation. A risk-based approach, instead of simple classifications could potentially address some of these shortcomings. Further information on flood risk is presented in the associated *Issue B-3* document (Ebbwater Consulting, 2021).

3. Implement Consistent Funding

Many of the non-structural flood mitigation projects span multiple years as they progress form identifying hazards, assessing the hazards, modelling the risk, and developing suitable mitigations. Consistent, reliable funding allows local governments to work through the various components and potentially multiple locations of the region. This is particularly important for local governments with diverse or complex flood hazards and limited tax base. Local governments with large populations, more sizable tax base, and established land use planning are generally less reliant on provincial funding. Funding could be provided by need, but this requires an efficient and effective approach at determining need.

For some of the most challenging hazard areas, managed retreat may be required. Opportunities to provide funding for land acquisition should be considered, as well as how to implement. Potential considerations include volunteer sale versus expropriation, pre-disaster purchases versus a component of a post disaster plan, how to address potential changes in property value during implementation period, and final ownership and land use of the property following acquisition.

4. Develop Technical Capacity

Technical support should be provided to local governments. Technical support **provides a means of improving quality, consistency, and effectiveness in non-structural flood management**. Technical support is better at meeting these objectives than can be expected through guidelines and regulation. Flood hazards across BC and approaches for mitigation are complex and not easily directed solely through guidelines and standards; despite attempts by EGBC and Natural Resources Canada (APEGBC, 2017; Natural Resources Canada, 2018)¹⁴. In addition, technical support can provide an incentive to local governments to develop and implement non-structural flood management (recommendation 7 below).

Technical support should include technical oversight, review, and guidance in data collection, floodplain mapping, and preparation of bylaws, development permit areas, and OCPs, where specific to flood and other natural hazards. Review should also be provided when needed for flood hazard assessments and exemptions. Although this is additional cost, it will enable earlier detection and correction of errors in

¹⁴ As an example, AEP has detailed standards for flood mapping in Alberta, yet their professional staff provide extensive review throughout the process of developing floodplain maps.



flood mapping, assessment, and mitigation, which in the long term will save cost in reduced rework or poorly guided development of flood hazard areas.

Over the past 5 years \$40 million has been funded through NDMP and CEPF in support of non-structural flood mitigation in BC. This funded 112 flood assessment, mapping, and planning projects. The funding has local governments more engaged, evaluating the hazards and requiring project specific flood hazard assessments. Despite this, there appears to be a delay in evolving floodplain mapping into floodplain land use restrictions.

Many contemporary floodplain maps have had FCLs increase by 0.5 to 2 m¹⁵ when compared to the historic maps. In addition, setbacks, and delineated hazard areas have changed. Variability in design flood event, vertical datum (CGVD28 versus CGVD2013), and detail of assessment has resulted in substantial variability in mapped FCL for adjacent jurisdictions. Due to concerns on impacts to property owners, planning staff and council are hesitant to appear to be interpreting the maps. A clear path outlined by a provincial guideline (recommendation 2) and external technical authority (recommendation 4) would allow local governments to be less hesitant in the transition from floodplain maps to floodplain bylaws, development permit areas, and OCPs. Technical review provided on the various mapping projects (from initiation to completion) would help avoid variability in results between jurisdictions, allowing faster adoption of floodplain land use restrictions.

Some actions are particularly challenging for a local government to implement without the Province. As an example, managed retreat can be highly politically challenged. Based on the recent survey response, feedback from communities that have attempted to incorporate managed retreat express a need for an engaged technical authority from the Province.

As presented in previous sections, current and previous surveys have consistently received feedback from local governments requesting additional technical support (Section 3.3 and 4.2.1). For comparison, all other jurisdictions reviewed (i.e. Alberta, Ontario, Washington State, UK, and Australia) have technical support provided to the local authorities. It is expected that the province is most likely to provide the increased technical capacity, however, as stated in Section 3.4.1, it could alternatively be provided by an intermediary agency (e.g. Fraser Basin Council) or regional entities that provided technical services for a group of partnered local governments (e.g. Emergency Planning Secretariate).

5. Adopt Alternative Flood Proofing Measures and Incentivise Use for New and Existing Buildings

Adopt flood proofing measures in addition to elevating to the FCL. Current flood hazard mitigations defined the *Local Government Act* and provincial guidelines (FLNRORD, 2018; MoE, 2011b) is limited to elevation, setback, and erosion protection. Federal government of Canada (Government of Canada, 2013) and others present a variety of flood mitigation approaches; including elevation, floodwalls, dry floodproofing (in which water is kept out of a structure), and wet proofing (in which water is allowed to entre the structure (Figure 4.2). Despite their value and use elsewhere in the world, alternative approaches to floodproofing are rarely applied, poorly defined, and not incentivised in BC (Danielson, 2015). Exception in their use within BC are parkades and garages, where wet proofing is allowed and

¹⁵ For example, increases in FCL across the province: Lillooet River by 0.5 to 2 m, Okanagan River/Lake by 0.2 to 1.2 m, Elk River by 0.5 to 2 m, Mission Creek by 1 m, coastal flood levels 1.5 to 2.5 m.



used. Provision and guidance for alternative mitigations could provide an option for areas not able to meet the FCL by elevating the structure (such as for the existing exemption areas), locations constrained by height restrictions, and existing buildings unable to be elevated.



Figure 4.2 Floodproofing techniques (a) elevation, (b) floodwalls, (c) dry floodproofing, (d) wet floodproofing (FEMA, 1986).

Standard Performance Criteria

Similar to what has been done in the UK, flood proofing measures should be standardized through adoption of standard performance metrics and testing. This should likely be done either through the federal government or industry led standards. Consistent metrics of performance would allow comparison of alternative products.

Adoption of alternative approaches may require revision of the *Local Government Act*, which under Section 5.24 (6) requires the floor for dwellings, businesses, and storage be above the flood level specified in a floodplain bylaw. In addition provincial guidelines for flood hazard land use should be updated to reflect the additional techniques (FLNRORD, 2018; MoE, 2011b).

Develop Incentives for Flood Proofing Existing Structures

Following adoption and standardization of flood proofing structures, incentives should be provided to floodproof existing structures. Potential incentives could include guidelines on methods, standardized testing to allow comparison of various methods and manufactures, rebates, tax incentives, and exclusion of post disaster funding to those properties not floodproofed before the flood. Reduced premiums for flood insurance may provide an additional incentive (particularly if standardized tests clearly indicate floodproof performance, similar to the British Standards Institute tests in the UK). Interest of such approaches is often greatest immediately following a large flood event; a period when incentives may not be required. Flood proofing of existing structures could support flood risk reduction for the historic exemption areas; an issue identified by 43% of the survey respondents as a key challenge in flood risk reduction.

It is envisioned that incentives would be provided to building owners and would be contingent that the building is located within a floodplain currently designated by the local government. Such as scheme, would subsequently also encourage local governments to establish current floodplain maps for flood prone land in their region.



6. Review and Update Existing Codes and Acts

A number of codes and acts should be reviewed and potentially updated in support of reducing flood risk. Examples include the BC Building Code and the *Tenancy Act*.

BC building codes should be reviewed and updated where needed to support reducing flood risk. This should be done to confirm no items conflict with flood risk mitigation initiatives as well as to identify actions that would further support flood risk reduction. These actions could include requirements to *build back better* (build with greater flood resilience when reconstructing on the floodplain), incorporate considerations for flood risk and climate change, incorporate floodproofing measures (dry and wet proofing). BC electrical code should be included in this review, and updates such as the main electrical switch gear (i.e. circuit panel) located above the FCL, GFCI (*ground fault circuit interruption*) located above the FCL for any electrical supply below FCL, with allowance of other alternative measures to limit electrical risk during a flood.

The *Tenancy Act* (and possible the *Real Estate Development Marketing Act*) should be reviewed and updated if required to ensure future occupants are informed of flood hazards, adopted mitigations, and residual risk. Land covenants are often sufficient to alert future property buyers, but are unlikely suitable to ensure tenants or other occupants are aware of the flood risk within buildings that they reside.

7. Develop Further Incentives for Land Use Regulation

Increase active participation in local level government regulation of development of lands subject to flood hazards by providing further incentives to the local level of governments. This could include providing active technical guidance and support (as suggested in recommendation 4), increased and consistent funding (including funds to develop floodplain restrictions; recommendation 3), restrictions on eligibility for disaster relief (for local level governments or residents within the local region), restrictions to other funding (such as for structural flood mitigations) or make participation mandatory.

4.3.2 Cost of Recommendations to Improve Non-Structural Flood Mitigation

The following table provides the approximate cost for implementing the opportunities and recommendations directed towards the Province in the previous subsection.

Recommendation	Additional Resource Requirements	One Time Cost	Annual Cost
1. Define Roles and Responsibilities for Flood Risk	 One time project One time project 	\$60,000	- ¢15.000
Reduction	 Ongoing monitoring effectiveness 	-	\$15,000
 Review and Improve Provincial Guidelines on Land Use in Flood Hazard Areas 	 One time project with review of performance and updates every 4 to 5 years.¹ 	\$250,000	\$15,000
3. Implement Consistent Funding	 Establish a long-term plan for consistent funding 	-	\$5,000,000 to \$10,000,000

Table 4.1 Cost comparison for proposed recommendations to improve non-structural flood mitigation in BC.



Recommendation	Additional Resource Requirements	One Time Cost	Annual Cost
4. Develop Technical Capacity	 6 to 10 full time employees plus overhead 	-	\$1,200,000 to \$2,000,000
5. Adopt Alternative Flood Proofing Measures for New and Existing Buildings	 Review and analysis Initiate trial site Standardize performance criteria Ongoing incentives 	\$150,000 \$75,000 \$125,000 <i>varies</i>	- \$35,000 varies
6. Review and Update Existing Acts and Codes	 One time project with updates every 4 to 5 years – building code One time project – <i>Tenancy Act</i> 	\$150,000 \$50,000	\$10,000
7. Develop Further Incentives for Land Use Regulation	Investigate incentive programImplement incentives	\$50,000 <i>varies</i>	- varies

Notes

1. Cost estimate based on \$40M spent funding non-structural flood mitigation projects in BC over the past 5 years by NDMP and CEPF.

4.3.3 Opportunities for Local Levels of Government

The following opportunities and recommendations to improve non-structural flood mitigation are directed towards local governments.

1. Use Flood Hazard Assessments

Flood hazard assessments conducted by a QP for the specific site is valuable in identifying and assessing the hazards with respect to the proposed land use. Survey results indicate that less than half of local level of government respondents use flood hazard assessments.

The authors have worked for proponents (e.g. landowners, developers, architects) preparing flood hazard assessments as well as reviewing assessments conducted by others for local governments. Proponents are generally receptive to the incorporating mitigations identified in the assessment, particularly when assessments are done early in the design process. Local governments (or MOTI for areas with regional districts outside of a municipality) should clearly state the requirement for a flood hazard assessment and request one at the onset of inquiry into requests for subdivision, development permit, or building permits within potential flood hazard areas.

Where hazards have not previously been adequately assessed by the local level government or not made public, substantial data requirements and assessment is required. In such a case the level of work to evaluate the hazard can begin to approach the level required for localized floodplain mapping and require multiple skill sets. Particularly along the coastal mountains this can include survey, GIS, hydrology, hydraulic river modelling, coastal engineering, geoscience, flood risk analysis, as well as an understanding of the building structure, electrical, and mechanical¹⁶. Such extensive skills would suggest

¹⁶ Where there are complex hazards from multiple sources (river, coastal, geomorphic) and limited data, the cost of a flood hazard assessment could become a substantial fraction of the proposed work, particularly if the assessment has been requested for a moderate home addition or change in industrial land use. Furthermore, some sites also require geotechnical review of landslide or rockfall hazard and wildfire hazards.



a moderately sized flood hazard specialist firm, a multi-disciplinary firm, or a team of specialists. However, there is often reluctance to take on these small projects; particularly if a consultant is already working for the local government (to avoid any perceived conflict of interest) as well as concerns with high liability and high project overhead costs with minimal budget. Some local level governments have addressed this issue, by retaining an engineering firm to conduct assessments for multiple development projects with the development proponents reimbursing the local government.

2. Review Options for a Managed Retreat from Flood Hazard Lands

Procurement of land for managed retreat is challenged due to limited funding opportunities (most grants explicitly exclude procurement of land) and restrictions placed on local government restrict their ability for procurement of land. Typically, external funding for land purchase is only available following a disaster; i.e. post disaster recovery, similar to Grand Forks. Delaying until after a flood, results in additional direct and indirect damages being unnecessarily incurred.

An alternative strategy for procuring the land and gradually retreating from the hazard may be possible through incorporating flood risk reduction objectives with park planning and an accompanying park lands procurement fund. Local governments can establish land acquisition funds for areas designated as a regional park or within a regional park plan. Residents can be taxed to support the fund (e.g. is the Cowichan Valley Regional District Parkland Acquisition fund, Bylaw 3163, in which residents are taxed roughly \$20 per year). Many flood prone lands are well suited for park land. Numerous parks are already located or in the process of being procured along flood prone water bodies, such as coastal waterfront property along Ambleside in West Vancouver and Mission Creek Regional Park in Kelowna.

Although the previous recommendations have been presented to support local and Indigenous governments this final recommendation may have limited application for many Indigenous governments. Indigenous governments that have limited development-suitable land may not be able to consider managed retreat unless additional land is available.



5 B-6.4 FLOOD EDUCATION CAMPAIGN

This section of the report presents the nature of educational campaigns for local and Indigenous governments to raise awareness of flood risk and possible risk reduction options.

5.1 Nature of Flood Educational Campaign

The objectives of specific education campaigns for local and Indigenous governments may vary but are likely to include some or all of the following elements:

- Increase public awareness.
 - Motivate flood risk to be incorporated in decision making.
 - Motivate further involvement and learning.
- Information sharing.
 - Provide flood risk information.
 - Provide links or direction to available information and resources.
 - Obtain information from the community on their experiences, success, challenges, and anxieties.
- Foster community support.
 - Foster community support for flood mitigation measures.
 - Foster community support for distributing flood awareness.
 - Foster community support for emergency support services.
- Flood preparedness.
 - Preparation of properties.
 - Preparation of individuals, families, businesses, and institutions.
 - Flood advisory, watch, and warnings.

Often the public under values personal risk, with expectation that government or others are adequately managing flood risk through structural measures or post disaster assistance (Danielson, 2015). Therefore, public awareness of the risk is often a primary goal of an education campaign . Specific goals, approach, and content will vary depending on the target audience of the campaign. Consideration of the audience's current exposure to flood risk, past experiences, resources, responsibilities, strengths, challenges, and potential barriers to communication (such as, language, isolation, accessibility, etc). Campaigns may have portions developed for specific audiences, such as property owners and residents, businesses, and institutions. Further focus may be warranted based on risk, language, age, or culture.

A number of resources exist that provide information in support of educational campaigns targeting flood awareness. Examples of these resources have been added at the end of this section.



5.2 Survey Results – Flood Education Campaigns

Examples of potential formats to share the information include printed materials, in-person presentations, web-based text and photos, web-based multi-media, web-based spatial tools (mapping/GIS), and social media. From the survey results, local governments appear to be using a wide range of formats (Figure 5-1). The majority of the responses for each format suggested that they are *somewhat effective*. Multimedia (videos, art, maps, etc.) was however identified as the most effective and printed resources as the least effective.



Figure 5-1 Local government response to survey on (a) tools used for educational outreach and (b) perceived effectiveness of the tools.

Community Misconception

Survey respondents identified the following challenges in delivering local flood education campaigns based on misconception of the community or subsets of individuals within the community. The most frequently identified shortcoming was the lack of clarity of various roles and responsibilities. This, and other frequently occurring responses, are shown in bold type.

Administrative

- Unclear roles between various agencies and levels of government as well as individual responsibilities.
- Expectation that government will protect and compensate in the event of a flood.
- No one wants to hear about hazards if it is perceived to reduced property value.

Scientific Understanding

- Community has a lack of understanding about rivers and floodplain function.
- Currently coastal and riverine flood risk information is not publicly available.
- Difficult to differentiation between different causes of flooding.
- Representative mapping of various flood levels



Variable Risk Perception

- Owners of high value waterfront homes unaware of flood risk or prefer to enjoy being near the water and accepting the risk.
- Interest in flood risk only present when under imminent threat.
- Community outside of the designated floodplain consider flood risk and responsibility limited to those within the floodplain.
- Lack of understanding and historic compliance of flood hazard setbacks.
- Some community members appear to refuse to acknowledge the flood risk or projected impacts of climate change.
- Perceived ultimate protection provided by dikes.

Local Delivery of Effective Educational Campaigns

Survey respondents identified the following challenges and recommendations in the delivery of effective local level educational campaigns. Bold type was used to indicate most frequently occurring responses.

Challenges in Delivery

- Shortage of staff to translate flood and climate science to the community (Engineers and scientists wrongly assume that they are understood).
- Lack of current and adequate floodplain mapping.
- Educate how flooding affects the entire community.
- Educate on personal responsibilities.

Recommendations

- Increased financial support.
- Staff support in presentation of information to community.
- Province provide communication materials.
 - Standard flood preparedness and emergency response materials
 - Explanation of flood risk
 - Map of all previously flooded communities or extents in the province
 - Role of public insurance
 - Limitations and procedures of disaster financial assistance
 - Comparison of other communities' flood mitigation measures
- Improved accuracy in weather forecasting.
- Clear concise regulation and enforcement.
- Establish a province-wide natural hazard mitigation program.

Similar to the survey responses pertaining to land use planning, additional funding and technical support are the primary requests from local level governments. The requested support ranged from preparation and provision of communication materials to participation in or leading of the education campaign. The request for the Province to provide or lead an education campaign was primarily received from smaller



governments, however larger local governments also expressed a need for external technical authority when presenting contentious land use regulations or managed retreat.

5.3 Campaign Content

Depending on the target audience, objectives, and delivery of the education campaign, the following components may be included.

5.3.1 General Flood Hazard and Risk Information

It is often valuable to start with providing background information on flood hazards and risk. This could include illustrations of the hydrologic cycle, typical flow conditions normally experience by the audience, potential (relevant) drivers for flood conditions (i.e. intense rainfall, atmospheric rivers, and extensive snow pack, or high tide, storm surge, and waves), and response of these events on a typical floodplain. Considerations for climate change should also be presented with specifics on the mechanisms influenced, for example, warming ocean temperatures resulting in increased volume and sea level.

Following development of flooding processes, presentation should include how this is experienced on the floodplain, such as protection from dikes, temporary protection from sandbags, and possibly overflow or breach of existing defences.

5.3.2 Local Details on Hazard and Risk

Mechanism of Flooding

Presentation of flood information should include the mechanism of flooding to provide context on the potential how and when floods are most likely to occur.

- The mechanism of flooding (such as ice jams in the winter, rain-on-snow floods in the spring, coastal storm surge with high tide and waves, avulsions on alluvial and debris flow fans, dam bursts, log jams),
- The timing of flooding (such as what time of year, and how quickly the water level is expected change), and
- Duration of flooding (such as, hours, days, or weeks of potential inundation).

The range of flood hazards within a local region (as illustrated by the survey response) may require multiple materials to present each separate hazard. For an example of hazard specific information, see the debris flow hazard awareness pamphlet prepared for the RDCK titled *"Debris Flow Hazard in the Kootenays"* (<u>https://rdck.ca/assets/Services/Emergency~Management/Documents/2016-02-19-Debris%20Flow%20Hazard%20Brochure_FINAL.pdf</u>).

Floodplain Maps

Floodplain maps are generally initially prepared as a regulatory tool to designate the floodplain and establish FCLs and setbacks. Additional maps that illustrate alternative flood scenarios, such as less



extreme, more extremes, or failures (such as dike breach) or additional data, such as velocity, depth, or risk, are also useful.

When presenting regulatory floodplain maps, items that frequently need to be clearly presented include,

- What the regulatory design event represents (maybe a single event or the maximum flooding from the amalgamation of a number of design events).
- How the freeboard was derived.
- Contribution of climate change or land cover changes (e.g. loss of forest in the watershed)
- Comparison with past flood events and historic floodplain maps.

Flood Risk and Risk Reduction

Illustration of the potential flooding should include the potential consequences, such as areas, roads, and services that become inundated or otherwise unavailable. This can be supplemented with photos, statistics, stories, or individual accounts of past floods and the measures to be applied to mitigate the risk.

There is often some resistance to regulation of lands protected by dikes. Therefore, where dikes or other structural flood mitigation measures exist (or are proposed), it is important to present the residual risk; that is, the potential flooding if dikes are overtopped or fail.

Land Use on the Floodplain

The process for land development of floodplain properties can be presented. This should include any applicable official community plans, development permit areas, and bylaws and the associated requirements and restrictions imposed. Ideally, if there was a recent change (such as new bylaw or updated mapping) then the changes are highlighted to prepare residents or builders of the change in requirements.

Where applicable, the process of retaining a QP, conducting a flood hazard assessment, and example mitigations required, can also be presented.

5.3.3 Flood Emergency

Presentation of flood emergency information should include preparations before a flood, the flood, and post-flood recovery.

Roles and Responsibilities

As indicated by the survey results, a clear presentation on the roles and responsibilities is required. Some residents are unaware of their personal responsibilities. A partial list of roles and responsibilities includes:

- Federal government
 - National strategies
 - Funding of assessments, planning, and mitigation



- Provincial government
 - Legislation (for local governments)
 - Dike safety
 - Floodplain standards
 - Funding
 - River forecasting
 - Emergency planning and response for floods that affect multiple communities
 - Post disaster financial assistance
- Local level of government
 - Flood assessment, mapping, planning.
 - Land use development planning and decisions
 - Dike surveillance and maintenance
 - Emergency preparedness
- Individuals/Business
 - Research flood hazards before making real-estate decisions¹⁷
 - Preparing household or business
 - Floodproofing home or business
 - Procuring flood insurance
 - Evacuate upon being ordered to.

A more complete list is available at <u>www.floodwise.ca</u>.

To avoid false reliance on post disaster financial assistance, it should specifically be noted that disaster financial assistance is only applied to uninsurable disaster-related damages, and that flood insurance has become more widely available.

Flood Preparations

Information on what measure the local level of government has prepared, such as evacuation plans, locations to obtain sandbags or other emergency materials is important. Equally important are the preparations individuals or business should take. A brief summary of preparations includes:

- Ensuring valuable documents are above the flood level.
- Floodproofing own property (dry proofing, wet proofing, fixing propane tanks, installing back flow prevention valves, backup sump pumps, etc.).
- Purchasing flood insurance.
- Emergency planning for rapid response (such as, having emergency food supply of nonperishable goods and water for all family members and pets, have emergency kits with essential

¹⁷ Flood information for home owners and buyers <u>https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/preparedbc/preparedbc-guides/preparedbc flood information for homeowners and home buyers 2018.pdf</u>



items and go bags prepared, have plans to meet family members caught away from home in emergency, plans for any emergency protections such as pumps and sandbags etc.).

Developing a business continuity plan.

The Province has prepared a number of flood and disaster preparation guides¹⁸ which can be referenced or incorporated into an educational campaign.

Flood Forecast

The BC River Forecast Centre presents high streamflow advisory, flood watch, and flood warnings as well as a 5 day and 10 day forecast for dozens of rivers across the province. Flood forecasting provides valuable information for emergency response as well as community members to do "last minute" preparations for a flood event (i.e. sandbags, relocation of valuables, or evacuation). Currently, forecast data is available from the centre's website, reposted on some local community sites, and posted as a Twitter feed. Additional broadcasts of flooding are presented over the radio. Coastal flood alerts are typically published by Environment and Climate Change Canada (ECCC). Some communities have local warning systems, such as the tsunami sirens in Tofino. Location of the flood forecasting information relevant to community should be presented.

Post-flood recovery plans can be presented to assist residents and business to better align their own flood plans and business continuity plans.

5.4 Campaign Delivery

5.4.1 Province

The Province has prepared a range of flood education materials, some of which have been listed in earlier subsections or listed at the end of this section. This information can be used to support a flood education campaign.

Additional resources that should be developed could include:

- Flood educational framework.
- Template presentation slides.
- Common messaging.
- Resources for options on delivery formats.

Common messaging could include:

- General information on floods, floodplains, and climate science.
- Explanation of flood risk.

¹⁸ Flood Preparedness Guide <u>https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/preparedbc-guides/preparedbc_flood_preparedness_guide_fillable.pdf Household preparedness guide <u>https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/preparedbc-guides/preparedbc_household_guide_2019.pdf</u></u>



- Maps or photos of previously flooded communities or extents across the province to illustrate.
 flooding can happen along any provincial waterbody.
- Roles and responsibilities, particularly personal responsibilities.
- Role of public insurance and limitations of disaster financial assistance.
- Examples of past floods and past flood adaptations.
- Impacts of flooding across the entire community (direct and indirect impacts).
- Cost savings to a community from land use planning and adaptation.

5.4.2 Local Government

Local governments typically have the best collection of local information, specifically; knowledge of past flood events, understanding of community values and anxieties, ability to identify and access opportunities for public engagement, and local strengths and vulnerabilities. Typically, the local government should lead the education campaign for their community. Local government campaigns have included websites, radio and television announcements, public open house meetings, paper handouts available at town halls, school sandbag competitions, as well as booths at local fairs, malls, or other public spaces and events. A Provincial provided framework and funding support would allow a more efficient and complete campaign that would be consistent between neighbouring communities.

Incorporating the flood campaign with other local or regional initiatives or consultations, may get broader engagement and more successful delivery. Other potential initiatives could be a new policy, plan, or program; for example, climate adaptation plans.

5.4.3 Indigenous Governments

Similar to local governments, Indigenous governments best know the local hazards, conditions, and people and would still benefit from provincial resources (i.e. framework, template, common messaging, and resources on delivery format). Educational campaigns should be tailored for the local Indigenous government and attempt to address or account for potential factors that may disproportionately affect Indigenous communities, such as the following factors, primarily identified by the National Collaborating Centre for Environmental Health (2019);

- Location of communities, often on remote floodplains, alluvial fans, and estuaries susceptible to flooding and potentially distant or logistically difficult to be supported by outside resources and emergency services.
- Discordance between externally imposed risk assessments and emergency response preparations versus the local knowledge and traditions.
- Variability in local resources to prepare for and respond to flood event (technical, administrative, equipment, and supplies).
- Lack trust of outside agencies and support (*legacy of colonization*).
- Existing social and health inequalities.
- Reliance and connection with local ecosystem for food and resources.



 Existing organizations that can support flood risk management initiatives, for example, *Preparing Our Home* (a community-based organization enabling youth to become emergency preparedness leaders).

The provincial educational framework should incorporate previsions to incorporate the local opportunities and challenges associated with the Indigenous community.

5.4.4 Other Organizations

Other organizations can provide support in educational campaigns. This could include organizations that assess, coordinate, and present flood hazard and risk information for a number of adjacent local level governments, for example the Fraser Basin Council and the Okanagan Basin Water Board. Links to web components of each of their education campaigns are presented at the end of this section.

Community groups, faith groups, schools, and businesses can also provide flood information. FEMA states 75% more participation in flood preparedness when flood education is presented through the workplace than when presented by the local government (FEMA, 2014). However, it is expected the campaign would be established by the local level government and only delivered through the community group, etc. Examples of this is the Masters of Disaster campaign prepared by the Province and delivered by schools.

5.5 Recommendations to Support Flood Education Campaigns

Following is a list of recommendations to further support flood education campaigns. These recommendations are directed towards the Province.

1. Develop an Educational Framework

The Province should develop a framework to support local level governments in establishing and implementing educational campaigns. The framework should provide guidance on content and delivery mechanisms as well as provide material templates to enable local level governments to efficiently and effectively develop and implement local educational campaigns that account for local geography, land use, and flood hazards. The educational framework should incorporate specific previsions to address any potential inequalities between different nearby local level governments, ethnic communities, or social-economic groups. An advisory committee with representatives from a number of Indigenous and local governments could provide review and support during the development of the framework.

2. Provide Technical Support for Indigenous and Local Government Education Campaigns

Smaller local governments do not have adequate resources or the technical expertise to develop and implement an education campaign. For these communities provincial support could provide technical support for both the local risk as well as how the risk and adopted mitigations relate to other areas in the province. Larger local governments have also expressed a need for Provincial support, primarily during education campaigns; primarily for issues that are politically sensitive, for example managed retreat.



3. Provide Funding for Flood Education Campaigns

Local level governments expressed concerns with respect to funding of educational campaigns. A framework and possibly technical support should lead to efficient and effective educational campaigns. Technical support is especially useful when the educational campaign is part of a related initiative; for example, consultation or launch of a new plan, policy, or infrastructure project. In addition to provision of a framework and technical support, smaller local level governments are likely still in need of financial support to prepare and implement a flood education campaign.

5.5.1 Cost of Recommendations to Support Flood Education Campaigns

The following table presents the estimated cost to implement the recommendations. The cost of an educational campaign can vary widely depending on the campaign objectives. Similarly, the estimated costs below can vary substantially. Educational programs are currently funded through Stream 4 of the NDMP. Item 3 in the following table is not necessarily additional cost.

Table 5.1 Estimated cost of proposed recommendations to support local government flood education campaigns.

Recomm	endation	Additional Resource Requirements	One Time Cost	Annual Cost
1. Develop Framewo	an Education ork	 One time project with periodic review and updates (e.g every 4 to 5 years)¹ 	\$300,000	\$15,000
2. Provide T for Local Campaig	echnical Support Education ns	 Two part time staff plus overhead and expenses. 	-	\$125,000
3. Provide F Flood Edu	Funding for Local ucation Campaigns	 Funding for local governments with greatest need of educational funding² 	-	\$300,000 (need dependent on what other support implemented)

Notes

1. Based on scaling of the cost of educational campaigns previously funded through NDMP.

2. Based on 15 to 20 communities per year provided \$5000 to \$30,000 in funding.

5.6 Additional Resources

Information for development of educational campaign, including strategy, content, and delivery formats are provided in detail from various organizations within Canada and abroad. Examples are provided below.

- Partners4Action, an applied research network advancing flood resiliency in Canada, based out of the Faculty of Environment at the University of Waterloo (<u>https://uwaterloo.ca/partners-for-action/</u>). They developed the following guides for effective flood risk communication:
 - Community Guide to Effective Flood Risk Communication, 2018
 - Communicating to Increase Flood Awareness and Incite Personal Action Among Canadians, 2020.



- Raising flood awareness, framework prepared by New Zealand, UK, and Belgium, (<u>http://www.flood-aware.com/topics/final_report_activity_2.pdf</u>)
- A number of frameworks are available also from the USA through FEMA, NOAA, and numerous state and counties such as,
 - FEMA Flood Risk Communication Tookit for Community Officials, 2019
 - https://www.weather.gov/safety/flood-education

Examples of existing national and provincial flood hazard and risk education campaigns are listed below.

- Canada's Flood Ready, provides online resources on general flood information, and making communities and residents flood ready: <u>https://www.canada.ca/en/campaign/flood-ready.html</u>
- Flood Smart Canada, on-line educational campaign for individuals, organizations, and local governments, prepared by Partners4Action: <u>http://floodsmartcanada.ca/</u>
- BC Adapts Coastal Flood Management: <u>https://www2.gov.bc.ca/gov/content/environment/climate-change/adaptation/bc-adapts/bc-adapts-flood</u>
- Prepared BC: <u>https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/preparedbc/know-your-hazards/floods</u>
- BC's Master of Disaster, emergency preparedness classroom program designed for grades 4 to 8: <u>https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/preparedbc/public-education-programs/master-of-disaster</u>
- BC's High Ground Hike, tsunami preparedness education program: <u>https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/preparedbc/public-education-programs/high-ground-hike</u>
- Climate Change BC, provides information on climate change risk assessment and preparedness: <u>https://www2.gov.bc.ca/gov/content/environment/climate-change/adaptation</u>

Examples of local and regional web-based flood education campaigns are presented below.

- FBC BC's Lower Mainland: <u>https://floodwise.ca/</u>
- Okanagan Basin Water Board <u>https://okanagan-basin-flood-portal-rdco.hub.arcgis.com/</u>
- City of Calgary flood story map <u>https://maps.calgary.ca/RiverFlooding/</u>



6 **GLOSSARY**

6.1 Terms and Definitions

The following terms and definitions were provided by FBC for use with the B-theme projects.

Term	Definition
Adaptation	The practice of adjusting or taking actions to limit or reduce vulnerability to changing hazard risk. In the context of climate change impacts on coastal flood hazard risk, specific adaptation actions might include improved coastal zone management, changes to planning, permitting, codes and standards, structural design, and social preparedness.
Assets-At-Risk	Refers to those things that may be harmed by hazard (e.g., people, houses, buildings, cultural assets, or the environment).
Coastal Flood Hazard	A potentially damaging flood event (or multiple events) in coastal regions, which may cause damage to buildings and infrastructure, and/or the loss of life, injury, property damage, social and economic disruption, or environmental degradation.
Coastal Flood Risk	The combination of the probability of a coastal flood hazard event (or multiple events) and the associated negative consequences.
Damages	The financial and non-financial impacts/consequences of a hazard event. For buildings and infrastructure, this may include structural damage or loss of performance, or damages due to loss of serviceability/operability.
Dike (or Dyke)	An embankment designed and constructed to prevent the flooding of land. A dike is supported by related works, such as floodboxes, gates and pumps that serve to hold back floodwaters while continuing to discharge water from behind the dike. <i>To learn more about dikes in the Lower Mainland, see <u>Dikes and</u> <u>Related Works.</u> Reference: <u>https://www2.gov.bc.ca/assets/gov/environment/air- land-water/water/integrated-flood-hazard- mgmt/dike_des_cons_guide_july-2011.pdf</u></i>
Disaster	A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts.
Disaster Risk Management	The application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage



	residual risk, contributing to the strengthening of resilience and reduction of disaster losses.
Disaster Risk Reduction	The concept and practice of reducing disaster risks through systematic efforts to analyze and reduce the causal factors of disasters. Disaster risk reduction includes disciplines like disaster mitigation and preparedness.
Exposure	The presence of people, infrastructure, housing, or other assets-at- risk (or parts thereof) in places that could be adversely affected by hazards.
Flood and Flooding	The presence of water on land that is normally dry. Often used to describe a watercourse or body of water that overtops its natural or artificial confines. See <u>Flood 101</u> for a look at different types of flooding. Reference: <u>https://www.egbc.ca/getmedia/8748e1cf-3a80-458d-8f73-94d6460f310f/APEGBC-Guidelines-for-Flood-Mapping-in-BC.pdf.aspx</u>
Flood Construction Level (FCL)	The minimum height required for a development to protect habitable living space from flood damage.
	Reference: https://www.newwestcity.ca/database/rte/files/Queensborough%20 FCL%20Review%20-%20Final%20Report%20(Jan%2016-13).pdf
Flood Maps	Maps that display information related to a flood, such as the estimated extent of flooding, water depths, water velocities, flood duration or other information.
Flood Risk Assessment	See Flood Maps for more on the types of maps and the information they display. Reference: https://www.egbc.ca/getmedia/8748e1cf-3a80-458d- 8f73-94d6460f310f/APEGBC-Guidelines-for-Flood-Mapping-in- BC.pdf.aspx Evaluation of a flood hazard (including the expected flood extent, depth and direction of flow) together with information about assets and people that are vulnerable to flooding to identify potential economic, social, cultural and environmental losses from flooding. Reference: http://www.ebbwater.ca/wp/services/flood-risk- assessment/
Floodplain	A floodplain is flat or nearly flat land that is susceptible to flooding from a watercourse, lake or other body of water.
	Reference: <u>https://www.sciencedaily.com/terms/floodplain.htm</u> Reference: <u>https://city.langley.bc.ca/sites/default/files/uploads/Bylaws/Floodpl</u> <u>ain%20Elevation%20Bylaw.pdf</u>



Floodplain Management	Floodplain management includes policies and regulations intended to reduce flood risks associated with land use and development in floodplains and flood hazard areas. Reference: <u>https://www.fema.gov/floodplain-management</u>
Floodproofing	In reference to development, actions taken at the site or property level that reduce the vulnerability of buildings and their contents to flood damage.
Floodwall	See: <u>https://www.fema.gov/floodproofing</u> A vertical artificial barrier designed to temporarily contain the waters of a river or other waterway. A floodwall is sometimes constructed instead of a dike in areas where space is restricted. Reference: <u>https://en.wikipedia.org/wiki/Flood_wall</u>
Hazard	A potentially damaging physical event, phenomenon, or human activity that may cause the loss of life, injury, property damage, social and economic disruption, or environmental degradation.
Flood Hazard	A potentially damaging flood event that may cause the loss of life, injury, property damage, social and economic disruption, or environmental degradation.
Flood Mitigation	Steps to reduce flood damage by structural measures (such as dikes), non-structural measures (such as keeping populations and assets away from flood-prone areas or requiring floodproofing), or a combination of these measures. Reference: <u>https://www.ncsl.org/research/environment-and-natural-</u>
	resources/flood-mitigation.aspx
Hazard Assessment	Acquiring knowledge of the nature, extent, intensity, frequency, and probability of a hazard occurring.
Likelihood	A general concept relating to the chance of an event occurring. Likelihood is generally expressed as a probability or a frequency of a hazard of a given magnitude or severity occurring or being exceeded in any given year. It is based on the average frequency estimated, measured, or extrapolated from records over a large number of years, and is usually expressed as the chance of a particular hazard magnitude being exceeded in any one year (i.e., the Annual Exceedance Probability, AEP).
Losses	Equivalent to damages that occur as a result of a flood event, both tangible and intangible.
Natural Hazard	Natural process or phenomenon that may cause loss of life, injury, other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
Peak Flow	The maximum rate of water discharge during a flood at a given location on a river or other watercourse.



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Probability

https://www.oxfordreference.com/view/10.1093/oi/authority.20110
<u>803095824482</u>
In statistics, a measure of the chance of an event or an incident
happening. This is directly related to likelihood.

Residual Risk The risk that remains even when effective risk reduction measures are in place.

Resilience The ability of a system (such as individual or multiple buildings or infrastructure assets), community, or society exposed to hazards to resist, absorb, accommodate, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

Risk The combination of the probability of a hazard event and its negative consequences.

Risk Assessment A method to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed buildings, infrastructure, people, property, services, livelihoods, and the environment on which they depend.

> Risk assessments (and associated risk mapping) include: a review of the technical characteristics of hazards, such as their location, intensity, frequency, and probability; the analysis of exposure and vulnerability, including the physical, social, health, economic, cultural, and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities, with respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process.

Risk Management The systematic approach and practice of managing uncertainty to minimize potential harm and loss.

Susceptibility An asset that could be adversely impacted by exposure to a hazard is susceptible to the hazard. For example, a typical residential building is susceptible to damage from floodwaters. A properly constructed concrete landscaping wall that has some floodwaters around it may not be adversely impacted and is therefore not susceptible to a flood hazard.

Storm SurgeThe increase (or decrease) in still water level at a coastal site due to
meteorological conditions. Storm surge may include wind setup (or
set-down) and barometric setup (or set-down).



Tsunami	A series of waves caused by a rapid, large-scale disturbance of water. Tsunamis can be triggered by earthquakes, landslides, volcanic eruptions, meteor impacts, human activities (e.g., explosions), and meteorological/atmospheric phenomena (meteo-tsunamis).
Vulnerability	The characteristics and circumstances of a community, system, or asset that make it susceptible to the damaging effects of a hazard. For buildings and infrastructure assets, vulnerability is a product of both exposure and susceptibility to damage.
Wave Overtopping	When wave runup exceeds the crest elevation of a beach or coastal structure, water flows over the crest. This is referred to as "green water" overtopping. Another form of wave overtopping can occur when waves break on the seaward face of a structure, causing splash droplets to be carried over the crest by their own momentum or wind.
Wave Runup	The maximum elevation of wave uprush on the shore above the still water level. Wave uprush consists of two components: superelevation of the mean water level due to wave action (wave set-up) and fluctuations about that mean (swash).
Wave Setup	The increase in mean water level near the shoreline, which occurs as a result of a slope in the water level required to balance the onshore flux of wave momentum (radiation stress), usually associated with wave breaking. Wave setup contributes to wave runup.
Wind Setup (Set-Down)	The downwind (or upwind) increase (or decrease) in water level occurring as a result of shear stress exerted by the wind on the water surface.



6.2 Acronyms

AEP	Annual exceedance probability
ARE	Average recurrence interval
BC	British Columbia
CEPF	Community Emergency Preparedness Fund
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
СМНС	Canadian Mortgage and Housing Corporation'
DFA	Disaster Financial Assistance
EMBC	Emergency Management BC
FBC	Fraser Basin Council
FCL	Flood construction level
FDCP	Floodplain Development Control Program
FDRP	Flood Damage Reduction Program
FEMA	Federal Emergency Management Agency
FLNRORD	BC Forests, Lands, Natural Resources Operations, and Rural Development
GFCI	Ground fault circuit interruption
GVRD	Greater Vancouver Regional District
ISC	Indigenous Service Canada
LGC	Lieutenant Governor in Council
MOE	BC Ministry of Environment, replaced by FLNRORD
MOTI	BC Ministry of Transportation and Infrastructure
MWLAP	BC Ministry of Water Land and Air Protection
NDMP	National Disaster Mitigation Program
NHC	Northwest Hydraulic Consultants Ltd.
OCP	Official Community Plan
PMF	Probable maximum flood
QP	Qualified Professional; engineer or geoscientist with expertise in the specific field of study
UK	United Kingdom
USA	United States of America
USACE	US Army Corps of Engineers



7 **REFERENCES**

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APPENDIX A PARALLEL INVESTIGATIONS

Investigations in Support of Flood Strategy Development in BC B-6 Non-Structural Flood Management Approaches



Theme A. Governance

Issue	Investigation
	1. Identify the flood management services provided by each order of government in BC.
	2. Investigate the roles of non-government entities in flood management in BC.
	3. Identify challenges, gaps, and limitations with current service delivery.
A-1 Flood Risk	 Identify opportunities for improving collaboration and coordination within and across authorities and adjusting non-government entities' roles that would address challenges and improve efficiency and effectiveness.
	 Recommend changes to support improved collaboration and coordination in flood management, including an analysis of benefits and costs/limitations for each recommendation.
	 Investigate alternative options for distributing and integrating flood management responsibilities among authorities, including an analysis of benefits and costs/limitations for each option.

Theme B. Flood Hazard and Risk Management

Issue	Investigation
B-1 Impacts of Climate Change	1. Investigate the state of climate change science in relation to BC flood hazards and identify gaps and limitations in provincial legislation, plans, guidelines and guidebooks related to flood hazard management in a changing climate.
	2. Identify current sources of information and models used by experts in the province to predict future climate impacts and investigate opportunities for improved predictive modeling.
	3. Investigate the capacity of responsible authorities and other professionals and practitioners in the province to integrate climate change impacts and scenarios to inform flood planning and management.
	4. Investigate the legislative, policy, and regulatory tools available to responsible authorities in all levels of government for integrating climate change impacts in flood planning and management.
B-2 Flood Hazard Information	1. Investigate the current state of flood mapping in the province, including gaps and limitations. Recommend an approach to improve the spatial coverage, quality, utility and accessibility of flood hazard maps and other flood hazard information.



Issue	Investigation			
	 Investigate the approximate level of effort to prepare flood hazard mapping to address current gaps for existing communities and future areas of development (including floodplain maps ar channel migration assessments). 			
	3. Investigate the current state of knowledge related to dike deficiencies and recommend an approach to improve the quality, consistency, review, utility and accessibility of this information.			
	4. Investigate the status of LiDAR standards for flood mapping and develop recommendations to improve standards if applicable.			
	1. Evaluate and compare the benefits and costs/limitations of taking a risk-based approach to flood management versus a standards-based approach.			
	2. Investigate the effort required to develop and maintain a province-wide asset inventory and/or exposure dataset covering flood prone areas.			
B-3 Flood Risk	 Investigate approaches to completing a province-wide flood risk assessment, addressing effort required, level of detail, types of flood risk, current and future scenarios, scale, and any information required and data gaps. 			
Assessment	 Investigate the level of effort to develop a coarse local-scale flood risk map based on available flood hazard map(s). 			
	5. Determine the effort required to undertake a local-scale comprehensive flood risk assessment for multiple types of flood hazards (e.g. riverine, coastal).and for varying degrees of available data on flood hazard, exposure, vulnerability and risk.			
	6. Investigate methods for valuing the benefits and costs/limitations of flood risk reduction actions in a holistic and consistent manner and develop a framework for project prioritization that could be applied or adapted across the province to reduce flood risk.			
	1. Investigate the ability of responsible authorities in the province to develop adaptation plans and strategies for flood management.			
	2. Investigate opportunities to improve the knowledge and capacity of local authorities with regard to climate change adaptation and the benefits of proactive flood risk reduction.			
B-4 Flood Planning	3. Investigate the potential content of a provincial guideline to support the development of local Integrated Flood Management Plans.			
	 Investigate the level of effort for a local authority to complete an Integrated Flood Management Plan and the possible role of the province in reviewing and/or approving these plans. 			
B-5 Structural Flood Management Approaches	1. Investigate opportunities to incentivize or require diking authorities to maintain flood protection infrastructure and plan for future conditions such as changing flood hazards.			
	 Investigate opportunities to improve the knowledge and capacity of local diking authorities with regard to dike maintenance. 			
	 Investigate opportunities to improve coordination amongst diking authorities under non- emergency conditions. 			



Issue	Investigation		
	4. Investigate impediments to and opportunities for implementing innovative structural flood risk reduction measures, including the role of incentives and regulation.		
	1. Investigate past and current approaches to land use and development decisions in floodplains by local and provincial authorities.		
B-6 Non- Structural Flood Management	2. Investigate alternatives to the current approach to managing development in floodplains, including returning regulatory authority for development approvals in municipal floodplains to the Province, and provide an analysis of the benefits and costs/limitations of both local and provincial authority.		
Approaches	3. Investigate impediments to and opportunities for implementing available non- structural flood risk reduction actions, including the role of incentives and regulation.		
	4. Investigate the nature of an educational campaign for regional, local and First Nations governments to raise awareness of flood risk and possible risk reduction options.		

Theme C. Flood Forecasting, Emergency Response and Recovery

Issue	Investigation		
C-1 Flood	1. Investigate current capacity, coverage, value, and gaps in flood forecasting services.		
Forecasting Services	2. Visualize where flood forecasting gaps exist and estimate costs for improvement to end users.		
	1. Investigate the future direction of the Federal government related to a National Flood Risk Strategy and the future of Disaster Financial Assistance Arrangements		
	2. Investigate the Province's expanding role in providing flood response to First Nations.		
C-2 Emergency Response	3. Investigate the status of local authority flood response plans and recommend an approach to manage, update and improve this information.		
	4. Investigate flood response capabilities considering different flood hazards and different regions of the province.		
	5. Investigate opportunities for improved organizational planning for emergency response in all levels of government.		
C-3 Flood Recovery	 Investigate the current status of coverage of existing overland flood insurance available to home-owners. 		
	2. Investigate the concept of "build back better" and impediments to implementation.		



Theme D. Resources and Funding

Issue	Investigation	
D-1 Resources and Funding	 Investigate resource and funding needs associated with implementing recommendations to strengthen flood management in BC. 	
	2. Investigate evidence in support of investment in proactive flood planning and mitigation activities.	



APPENDIX B RELEVANT LEGISLATION



PROVINCIAL LEGISLATION CONCERNING FLOOD MANAGEMENT

Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
Building Act (Attorney General)	S.2-7, 10	 As of December 2015 (BC Reg 323/2015), the jurisdiction for building activity regulation now lies solely with the Province unless the matter has been prescribed by regulation to be "unrestricted" or a variation has been authorized. Applies to all local governments except the City of Vancouver, which has its own building bylaw. A local authority may make a written request to the Minister for a building regulation (modification or addition). 	Province of BC + City of Vancouver Qualified building officials of local governments may enforce but cannot modify the BC Building Code
Community Charter ((Municipal Affairs & Housing)	S.31-34	A municipality may expropriate land and may construct works through, under or over land adjoining a highway for the protection of the highway from damage by water.	Council
Community Charter (Municipal Affairs & Housing)	S.53	Provides general authority for building regulation by Council for the health, safety or protection of persons or property.	Not specified
Community Charter (Municipal Affairs & Housing)	S. 54, 55, 56	If a bylaw regulating the construction of buildings or other structures is in effect, and a building inspector considers that construction would be on land that is subject to or is likely to be subject to flooding, mud flows, debris flows, debris torrents, erosion, land slip, rockfalls, subsidence or avalanche, the building inspector may require the owner of land to provide the building inspector with a report certified by a qualified professional that the land may be used safely for the use intended. If a qualified professional engineer or geoscientist determines that the land may not be used safely for the use intended, a	Council bylaw to regulate the construction of buildings Building inspector designated by the Council for the municipality This provision not available if building inspection is not undertaken by the municipality



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
		 building inspector must not issue a building permit. A building inspector may issue a building permit if a qualified professional certifies that the land may be used safely for the use intended (i.e. in accordance with the conditions specified in the professional's report). The building permit may only be issued if the owner of the land covenants with the municipality to use the land only in the manner certified by the qualified professional as enabling safe use of the land for the use intended; the covenant contains conditions respecting reimbursement by the owner for any expenses that may be incurred by the municipality as a result of a breach of a covenant; and the covenant is registered under S.219 of the Land Title Act. 	
Community Charter ((Municipal Affairs & Housing)	S.165	A municipality must have a financial plan for a 5 year planning period that is adopted annually before the annual property tax bylaw is adopted. The financial plan must set out the objectives and policies of the municipality for the planning period that includes the funding sources, the proportion of total revenue that is proposed to come from each funding source and the distribution of property value taxes among the property classes. This provides an opportunity to address financial resources needed for short and medium term planning for flood hazard mitigation as well as the local government's strategic priorities.	Council by bylaw annually



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
Emergency Program Act (EPA) (Attorney General)		The EPA concerns several distinct but interrelated elements. They consist of advance preparation or planning to reduce the risk of an event, emergency measures concerning an imminent threat and post- disaster recovery. The central thrust of the EPA is centred around an imminent threat – typically hours or days prior to a substantial event that overwhelms a local government's abilities or requires a coordinated multi- agency approach. Local authorities are at all times responsible for the direction and control of the local authority's emergency response. This includes declaration of a State of Emergency. References to specific sections of the EPA follow.	Minister (or designate)
Emergency Program Act (EPA) (Attorney General)	S.4	 S.4(1) Minister must prepare emergency plans; S.4(2)(a) make surveys and studies to identify and record actual and potential hazards- in practice this is used after the incident has happened; S.4(2)(c) make payments and grants to Local Authorities for assisting in emergency prevention, preparedness, and response; and S.4(2)(d) make payments and grants to persons or organizations for assisting in emergency prevention, preparedness, and response. 	Minister (or designate)
Emergency Program Act (EPA) (Attorney General)	S.5	Minister may require local authorities or persons to prepare, in cooperation with designated ministries, integrated plans and programs to deal with emergencies; establish procedures for the prompt implementation of plans and programs to meet emergencies and disasters	Minister (or designate)
Emergency Program Act (EPA)	S.6	Local authority must prepare local emergency plans and be responsible for its emergency response.	Municipal Council Regional Board



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
(Attorney General)		Local authority may appoint a committee to assist, appoint an emergency program coordinator, and delegate its powers and duties except declare a state of local emergency. Minister may order a local emergency plan	Emergency Program Coordinator
		its obligations.	
Emergency Program Act (EPA) (Attorney General)	S.7, 8	Minister may implement Provincial emergency plan (S.7) – This relates to imminent or existing threat Local authority may implement their local emergency plan (S.8) – This relates to imminent or existing threat Implementation of Provincial plan trumps local emergency plans 8(2).	Minister (or designate) (Director)
Emergency Program Act (EPA) (Attorney General)	S.9, 10	Minister or Lieutenant Governor in Council (LGC) may declare a State of Emergency (S.9), which provides for a broad range of acts (S.10) to respond to the emergency, valid for 14 days. Acts may include the acquisition of land (or property) required to prevent, respond to, or alleviate the effects.	Minister or LGC
Emergency Program Act (EPA) (Attorney General)	S.12, 13	Declaration of local emergency requires bylaw or order by local authority, valid to up to 7 days (S. 2); use special powers to act (S.13); Minister may order LA differently (S.13)	Local Authority or Head of Local Authority
Emergency Program Act (EPA) (Attorney General)	S.20	LGC may make regulation concerning criteria for eligibility for disaster financial assistance and LGC or Minister may provide disaster financial assistance.	LGC by regulation Minister or designate (Director)
Emergency Program Act (EPA) (Attorney General)	S.28	Authorizes the LGC to make regulations for the preparation and implementation of plans or cost sharing to deal with emergencies or disasters.	LGC by regulation



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
Environmental Management Act (FLNRORD)	S.5	Minister may prepare policies, strategies, objectives, guidelines and standards for the protection and management of the environment and to prepare and publish environmental management plan with respect to flood control, flood hazard management and development of land that is subject to flooding.	Minister or designate 2004 Guidelines were issued concerning flood hazard management but no regulation.
Environmental Management Act (FLNRORD)	S.138(3)(e)	LGC may make regulations that impose requirements and prohibitions respecting flood hazard management, including requiring a diking authority or a local authority to develop plans or programs for the purposes of: preventing, mitigating or reducing potential flood hazards; protecting the environment and the public from damage caused by flood waters or potential flooding, and restoring or enhancing the environment or public safety after a flood.	LGC
Expropriation Act (Attorney General)		An approving authority may expropriate land or a partial taking at fair market value.	Approving authority includes LGC, Minister, Local Government
Flood Relief Act (Attorney General)	S.1, 6, 7	LGC may: enter into agreements with any public authority in British Columbia for relief and rehabilitation due to flood conditions or other circumstances attributable to them; contribute or lend to a public authority a proportion of the cost of measures for relief or rehabilitation in flood areas; enter into agreements with Canada for payment of a portion of the cost incurred by British Columbia and by municipal authorities in the Fraser Valley in repairing	LGC Legislation not in active use.



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
		and constructing dikes on the basis that Canada bears 75% of the cost. LGC may make payments and regulations prescribing the extent and nature of work to be undertaken for the building of works to prevent flood damage.	
Land Act (FLNRORD)	S.10-18, 32-36, 39- 40, 48, 51, 55	 Allows for the disposition for Crown land by sale, lease, right of way or easement, or licence of occupation. A right of way or easement over Crown land may be granted for operations and maintenance of the grantee's undertaking including a right to flood (S.40). A Crown grant, free or otherwise, may be issued to a local government or other public authority with the approval by the LGC (S.51). Disposition of Crown land does not include a body of water below the natural boundary (S.18, 55). 	Minister may dispose of Crown land including flood mitigation requirements. Minister may require an applicant for Crown land to undertake feasibility studies and environmental assessments at the applicant's expense.
Land Title Act (MoTI)	S.77.2	Approving officers for the subdivision of land in rural areas (i.e. electoral areas of regional districts) are Ministry of Transportation & Infrastructure employees	Approving officers in rural areas are appointed by Deputy Minister, Transportation & Infrastructure
Land Title Act (MoTI)	S.218	A statutory right of way represents an undertaking in favour of a public body, which, if registered on title, constitutes a charge on the land in favour of the grantee, and confers the right to use the land in accordance with the terms of the legal instrument. A statutory right of way may be issued for any purpose necessary for the operation and maintenance of the grantee's undertaking, including a right to flood.	A person may grant an easement to a municipality and a regional district that is a charge on title that 'runs with the land'.



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
Land Title Act (MoTI)	S.219	 A covenant may make provisions concerning the use of land or the use of a building on or to be erected on land: that land must be built on in accordance with the covenant, that land is not to be built on except in accordance with the covenant, or that land is not to be built on; that land is not to be subdivided except in accordance with the covenant, or that land is not to be subdivided. A covenant may require that land, or a specified amenity in relation to land be protected, preserved, conserved, maintained, enhanced, restored or kept in its natural or existing state in accordance with the covenant. A covenant may include an indemnity agreed upon by the two parties such as a "save harmless" provision in the event of flooding, which is binding on the covenantor and the covenantor's successors in title, if registered. Related to subdivision approval, covenants can be used in conjunction with a report by a qualified professional to establish conditions for the safe use of land subject to flooding or other hazards. 	A covenant may be initiated by the Crown, a Crown Corporation, a municipality, a regional district, or local trust community under the Islands Trust Act. Covenant 'runs with the land' and applies to future owners.
Land Title Act (MoTI)	S.86	 An approving officer may refuse to approve a subdivision plan if the approving officer considers that: the land has inadequate drainage installations, the land is subject, or could reasonably be expected to be subject to specified hazards including flooding, 	Applies to Municipal Approving Officer (S.77 of LTO), Nisga'a Approving Officer (S.77.3 of LTO),



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
		 the anticipated development of the subdivision would adversely affect the natural environment to an unacceptable level, the cost to the Provincial Government of providing public utilities or other works or services would be excessive, the cost to the municipality or regional district of providing public utilities or other works or services would be excessive. If the approving officer considers that the land is, or could reasonably be expected to be, subject to flooding, erosion, land slip or other specified hazards, the approving officer may require, as a condition of subdivision approval, that the subdivider: provide the approving officer with a report certified by a professional engineer or geoscientist experienced in geotechnical engineering that the land may be used safely for the use intended; and/or enter into one or more covenants under S.219 in respect of any of the parcels that are being created by the subdivision. 	Treaty first nation approving officer (S.77.21 of LTO) Crown lands officer under Land Act & Provincial Approving Officer for rural areas of Regional District (S.77.2 of LTO)
Local Government Act (LGA) (Municipal Affairs & Housing)	LGA	The LGA contains numerous provisions concerning BC Flood Policy. They include the authority to expropriate land, prepare and adopt a Regional Growth Strategy, an Official Community Plan, a zoning bylaw, a flood plain bylaw, development approval information areas, and designate development permit areas for the protection of development from hazardous conditions. These are detailed in the following subsections.	Local Government or Regional District by bylaw
Local Government Act (LGA) (Municipal Affairs & Housing)	S.289, 292	A regional district may expropriate real property or works for the purpose of exercising or performing its powers, duties and functions subject to compensation payable to the owners.	Regional District Board



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
Local Government Act (LGA) (Municipal Affairs & Housing)	S.426-454	The purpose of a Regional Growth Strategy is to promote human settlement that is socially, economically, and environmentally healthy. The scope of a Regional Growth Strategy includes working towards settlement patterns that minimize the risks associated with natural hazards (S. 428(2)(k). Regional Growth Strategies are optional but, if adopted, must cover a period of at least 20 years in the future (S.429). Where a Regional Growth Strategy has been adopted, the Minister may require a local government to adopt an OCP, zoning bylaw or subdivision servicing bylaw if one is not in place (S. 454).	Regional District or Minister Regional Growth District Strategies are in place in 10 regional districts, which include a large majority of the population of BC (local initiative for nine regional districts and Ministerial directive in one regional district).
Local Government Act (LGA) (Municipal Affairs & Housing)	S.471-478	 A local government may adopt an Official Community Plan (OCP). If it does, the OCP must include statements and map designations respecting restrictions on the use of land that is subject to hazardous conditions or that is environmentally sensitive to development. The OCP may include policies relating to the preservation, protection, restoration and enhancement of the natural environment, its ecosystems and biological diversity. Before adoption of an OCP, the local government must consider its financial plan in conjunction the OCP. 	Local Government by bylaw
Local Government Act (LGA) (Municipal Affairs & Housing)	S.479	 A local government may create zones and establish boundaries of each zone that; regulate the use of land, buildings and other structures, the density of the use of land, buildings and other structures, the siting, size and dimensions of buildings and uses that are permitted on the 	Local Government by bylaw



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
		 land, and the location of uses on the land and within buildings; regulate the shape, dimensions, and area, including the establishment of minimum and maximum sizes, of all parcels of land that may be created by subdivision. Zoning regulations may be different for different zones, different uses within a zone, different locations within a zone and different siting circumstances. This regulatory power includes the power to prohibit any use or uses in a zone. 	
Local Government Act (LGA) (Municipal Affairs & Housing)	S.488, 490-491, 503	 A development permit area (DPA) may be designated in an OCP bylaw for the protection of development from hazardous conditions and the protection of the natural environment, its ecosystems and biological diversity DPA guidelines can be specified in an OCP or zoning bylaw and must describe the special conditions or objectives that justify the designation and provide guidelines as to how the special conditions or objectives will be addressed. To protect development from hazardous conditions, a report certified by a professional engineer with relevant experience may be required to determine conditions that provide for the safe use of the proposed development. These conditions and protection measure to control drainage, manage erosion and protect banks. A development permit (DP) must not vary a flood plain specification. 	Local Government in OCP bylaw for designation of DPA. Local government in OCP or zoning bylaw for DPA objectives and guidelines. DPA guidelines are far more common in an OCP bylaw than in a zoning bylaw. Local government by resolution for issuance of DP. Note that a DP cannot be filed on Crown land.



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
		Where a DP has been issued, a notice must be filed and registered in the Land Title Office.	
Local Government Act (LGA) (Municipal Affairs & Housing)	S.489	Where a DPA designation occurs, a Development Permit must be issued prior to any subdivision, building construction or alteration of land.	Local Government by resolution
Local Government Act (LGA) (Municipal Affairs & Housing)	S.523	A local government may regulate the maximum percentage of the area of land that can be covered by impermeable material in order to provide for the ongoing disposal of surface runoff and storm water.	Local Government by bylaw
Local Government Act (LGA) (Municipal Affairs & Housing)	S.524	If a local government considers that flooding may occur on land, the local government may adopt a flood plain bylaw and designate the land as a flood plain. The bylaw may specify minimum elevations for habitable space including structural support for floor systems or pads, and landfill as well as business purposes and the storage of goods susceptible to flood damage. These minimum elevations are typically referred to as Flood Construction Levels (FCLs). The bylaw may also specify setback conditions from dikes, watercourses and other bodies of water, the bylaw must consider Provincial guidelines and comply with Provincial regulations under the Environmental Management Act. A flood plain bylaw may also may make different provisions in relation to different areas of a flood plain; different zones; different uses within a zone or an area of a flood plain; different types of geological or hydrological features; different standards of works and services; different sting circumstances; different types of buildings or other structures and different types of machinery, equipment or goods within	Local Government by bylaw Commonly termed a flood plain bylaw Flood plain bylaws were originally developed and enacted by the province with local exemptions in historic areas prior to 2003- 2004 legislative changes.



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
		 them; and different uses within a building or other structure. A local government may exempt a person from the FCL requirements in relation to a specific parcel of land or a use, building or other structure on the parcel of land, if the local government considers that the exemption is consistent with the Provincial guidelines or receives a report that certifies the land may be used safely for the use intended by a professional engineer or geoscientist experienced in geotechnical engineering. A flood plain bylaw must consider Provincial Guidelines enacted under the Environmental Management Act and any applicable Provincial regulations (none currently apply). 	
Local Government Act (LGA) (Municipal Affairs & Housing)	S.527	 A local government may require, set standards for and regulate the provision of screening or landscaping for the following purposes: preserving, protecting, restoring and enhancing the natural environment; and preventing hazardous conditions. 	Local Government by bylaw
Real Estate Development Marketing Act (Ministry of Finance)	S.3, 14	A developer who markets or intends to market a fee simple subdivision lot or bare land strata lot must file and provide a disclosure statement with the Superintendent of Real Estate. A disclosure statement must be in the form and include the content required by the superintendent, and without misrepresentation, plainly disclose all material facts that affect or could affect the value and use of the development.	Superintendent of Real Estate or LGC through Real Estate Development Marketing Regulation
Strata Property Act (Ministry of Finance)	S.149	A strata corporation must obtain and maintain property insurance on the basis of full replacement value against all major	.Strata Corporation



Provincial Legislation (Ministry)	Legislative Reference	Description	Authority for Implementation Measures
		perils as defined in the regulations (see B.C. Reg. 75/78 below).	
Transportation Act (MoTI)	S.2, 7, 8, 10	The Minister may acquire or hold land without consent, including expropriation, for any provincial public undertaking involving a improvement or other work of public utility that relates to transportation (e.g. road relocation where a section is at risk of flooding).	Minister or designate
Transportation Act (MoTI)	S.52	Any zoning bylaw by a local government within 800 metres of a controlled access highway is not in effect unless it receives provincial approval.	Minister or designate
Water Sustainability Act (Environment & Climate Change Strategy)	S.24, 32	 S. 24 provides for the issuance of one or more permits authorizing the flooding of Crown land. S.32 provides for the expropriation of land for a licensee and with the consent of the LGC, the right to expropriate any land that has been flooded by construction of the dam or that would be flooded if the dam were constructed. 	Comptroller of Water Rights or water manager Licensee



PROVINCIAL REGULATIONS CONCERNING FLOOD MANAGEMENT

Regulations + Guidelines	Reference	Description	Authority for Implementation Measures
Vancouver Charter (Municipal Affairs & Housing)	S.154	If the Council passes a resolution that a state of emergency exists in the City, the LGC may confer additional powers with respect to the management and disposal of the property and assets of the City necessary for the period of the emergency.	LGC and Council resolution by two thirds vote
Vancouver Charter (Municipal Affairs & Housing)	S.173	Where the powers conferred on Council are inadequate to deal with an emergency, the Council may declare that an emergency exists and exercise powers necessary to deal effectively with the emergency.	Council bylaw by two thirds vote
Vancouver Charter (Municipal Affairs & Housing)	S.190	Council may acquire and dispose of real property as may be required for the purposes of the City.	Council
Vancouver Charter (Municipal Affairs & Housing)	S.302(o)	Council may provide for the construction and maintenance of dykes or embankments and ancillary facilities to prevent the flooding of land.	Council
Vancouver Charter (Municipal Affairs & Housing)	S.306(1)	Council may regulate the construction of buildings including withholding a building permit for any parcel of land situated in a designated flood plain area until the City Building Inspector is satisfied that the elevation or design will reduce or eliminate the risk of flood damage. This is reinforced by requiring a covenant registered against the land acknowledging the risk of flood damage.	Council by bylaw



Regulations + Guidelines	Reference	Description	Authority for Implementation Measures
Bare Land Strata Regulations (B.C. Reg.75/78 (Municipal Affairs & Housing)	Regulation under Strata Property Act S.3(1)(e)	 The approving officer may refuse to approve a bare land strata plan if he considers: the deposit of the bare land strata plan is against the public interest; the land is subject or could reasonably be expected to be subject to flooding, erosion, land slip or avalanche; and the development would adversely affect the natural environment to an unacceptable level. 	Approving Officer
Compensation and Disaster Financial Assistance (DFA) (B.C. Reg. 124/95 including amendments up to B.C. Reg.211/2015)	Regulation under Emergency Program Act S.14, 29 S.16, 31 S.15, 30	 Regulation provides for two claims for DFA. S.14 states that "If assistance has been provided under this regulation on 2 occasions to repair, rebuild or replace a structure in a disaster prone area, a claimant seeking assistance to repair, rebuild or replace the structure is ineligible to receive that further assistance unless the minister determines that, after the second occasion, all corrective or preventive actions reasonably possible to avoid recurrence of the damage or destruction were taken." Assistance may be denied of the claimant or local government took no or insufficient corrective action to protect the claimant's property or public facility. S.15 and 30 apply to a flood plain bylaw under S.524 of the LGA. S.15 states that "If an area is designated under the <u>Municipal Act</u> [now LGA] as flood plain and a structure 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 structure 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." 	Minister or designate Note: regulation adopted prior to 2003-2004 legislative changes
Strata Property Regulation (B.C. Reg.43/2000)	Regulation under Strata Property Act S.9.1	Required insurance for "major perils" refers to the perils of fire, lightning, smoke, windstorm, hail, explosion, water escape, strikes, riots or civil	Strata Councils



Regulations + Guidelines	Reference	Description	Authority for Implementation Measures
(Ministry of Municipal Affairs & Housing)		commotion, impact by aircraft and vehicles, vandalism, and malicious acts. While major perils do not specifically reference flood hazards, major perils have been broadly interpreted with the result that the vast majority of strata councils provide insurance for flood hazards such as overland flows.	
Flood Hazard Area Land Use Management Guidelines (May 2004 – amended 2011+ 2018)	Guidelines under Environmental Management Act S.5(e)	 The Guidelines make provision for buildings to be set back from the natural boundary of the sea and other water bodies in a variety of situations. They also provide for the structural elevation of buildings and other floodproofing measures. The Guidelines specifically refer to flood plain bylaws adopted under S.524 of the LGA but are intended "to help local governments, land-use managers and approving officers develop and implement land-use management plans and make subdivision approval decisions in for flood hazard areas." The most recent amendment incorporates sea level rise projection of 1.0 metre by 2100 (Ausenco 2011) and provides for calculation of FCLs based on the Probabilistic or Combined Method by a Qualified Professional Engineer. 	Guidance document for Professional Engineers and Geoscientist in preparing site specific reports, building officials, approving officers, & local governments
Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard land Use, Guidelines for management of Coastal Flood Hazard Land Use (2011)	Ministry of Environment	The Guidelines make provision for buildings set and FCL in coastal environments. Guidelines provide both a method for calculating FCL (method specification) as well as standard (design criteria). Incorporates an allowance for sea level rise.	Guidance document for Professional Engineers and Geoscientist in preparing site specific reports, building officials, approving officers, & local governments



APPENDIX C SURVEY RESULTS

Investigations in Support of Flood Strategy Development in BC B-6 Non-Structural Flood Management Approaches



1 SURVEY

A survey was developed by the Fraser Basin Council, assisted by the consulting firms undertaking flood investigations. The purpose of the survey was to learn from the insights and experiences of professionals and practitioners working on flood risk reduction, education, risk assessment, and/or planning. The survey indicated the Fraser Basin Council was managing a project on behalf of the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development titled **Investigations in Support of Flood Strategy Development in BC**. A project backgrounder was provided.

A survey was sent in July 2020 by email to approximately 260 contacts representing local and provincial governments, consulting firms, academia, and federal agencies. There was some duplication in the email invitations; in some cases the email bounced back; in others, it was forwarded to others. Responses were received from 67 persons that answered at least one question beyond the background questions page. The survey preamble provided a commitment that "responses will be treated as your opinions and not necessarily representative of those of your organization (unless you state so). Results will be aggregated and individual comments will remain anonymous."

This Appendix has documented the key aggregate responses, mainly in the form of graphs. The responses cannot be assumed to be representative as the number of responses is limited and not every question was answered by all respondents. Nevertheless, both the number of responses and the amount of interest shown are considered encouraging. Many of those responding indicated a lengthy history in flood hazard management and provided thoughtful comments indicating both their passion, expertise and desire to help provide a proactive direction.

The survey was divided into a number of sections starting with background information provided by the respondents. It was followed by sections titled Flood Management Plans, Flood Management Planning: Challenges and Opportunities, Structural Flood Management Approaches, Non-structural Flood Management Approaches and Education.

The first five graphs consist of background information providing a profile of the respondents. Question A.1 asked what type of organization concerns the respondent represented, A.2 asked in which Ministry of Environment region the respondent worked, A.3 what type of flood hazards affect the primary community in which the respondent worked, A.4 asked the population of the respondent's jurisdiction, and A.5 asked the respondent to indicate their current role.



2 SECTION A: BACKGROUND

Question A.1

What type of organization do you represent?





67 responses

Note: A separate survey was sent to Indigenous governments. Only two Indigenous Government responses were received and they were not quantitatively summarized.



Question A.2



Which Ministry of Environment region is your flood related work primarily based?

67 responses

Note: Percentages total 136% as some indicated they work in more than region and others work in all of BC.

Question A.3

What types of flood hazards affect the primary community in which respondents work?



⁶⁷ responses

Note: Total equals 367% as most indicated the community in which they work has multiple hazards.



Question A.4



What is the approximate population of the respondent's jurisdiction?

63 responses



30% 25% Percent Repsonded 20% 15% 10% 5% Parts and recreation upan forestry. CEOICAOICOIOTHEE administrative. Municipal approvine officer Provincia approvine officer 0% Public wolts manager 1staft Building inspectory officer Engineer or seoscientist Environmental officer other

What is the current role of the respondent?

67 responses

Note: Percentages total 134% as some indicated their current role involves more than one position. Typical examples would be the respondent's role as the Approving Officer and a planner or engineer.



3 SECTION E: NON-STRUCTURAL FLOOD MANAGEMENT APPROACHES

Question E1

Which of the following tools does your organization use to manage development in flood hazard areas (or floodplains), if any?





Question E2



Which requirements or limitations are applied through the above tools (E1)?



Question E3



In your opinion, where should the responsibility for the following activities fall?

50 responses



Set criteria or standards for planning, policies or regulations



Question E3 continued



In your opinion, where should the responsibility for the following activities fall?

50 responses



Determine the contents of floodplain bylaws



Question E3 continued



In your opinion, where should the responsibility for the following activities fall?

49 responses







Question E3 continued



In your opinion, where should the responsibility for the following activities fall?



Question E6

What do you consider to be key challenges for your organization - or communities in general - in developing or implementing non-structural measures to reduce flood risk?





4 SECTION F: EDUCATION

Question F1

What public education and outreach activities does organization provide to communicate about flooding, if any, and how effective would you say they are?



42 responses



Social Media


Question F1 continued

What public education and outreach activities does organization provide to communicate about flooding, if any, and how effective would you say they are?



37 responses



Printed Resources

43 responses



Question F1 continued

What public education and outreach activities does organization provide to communicate about flooding, if any, and how effective would you say they are?



40 responses



As part of my organization's regular operations

43 responses