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Investigations in Support of Flood Strategy Development in British Columbia

# Flood Planning (B-4)

Final Report December 2020 KWL Project No. 2038.021

Prepared for:







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# **Executive Summary**

The Fraser Basin Council's (FBC) Investigations in Support of Flood Strategy Development in British Columbia project is a province-wide initiative aimed at developing a comprehensive understanding of current challenges and opportunities relating to flood management across BC. This report summarizes findings from Issue B-4: Flood Planning and recommends actions and resources the Province could develop to support responsible authorities in creating integrated flood management plans.

Flood management plans refer to strategic documents that outline preferred measures for managing flood risk within a jurisdiction. Integrated flood management plans (IFMPs) are a specific type of flood management plan that are integrated with other plans and policies within the organization and use a holistic, systems-based approach to define an optimal combination of structural and non-structural measures.

Four specific investigations are considered as part of Issue B-4, including:

- **B-4.1:** Investigate the ability of responsible authorities in the Province to develop adaptation plans and strategies for flood management.
- **B-4.2**: Investigate opportunities to improve the knowledge and capacity of responsible authorities regarding climate change adaptation and the benefits of proactive flood risk reduction.
- B-4.3: Investigate the potential content of a provincial guideline to support the development of local IFMPs.
- **B-4.4**: Investigate the level of effort for a responsible authority to complete an IFMP and the possible role of the Province in reviewing and/or approving these plans.

These investigations involved a combination of background research, professional judgement, and engagement with responsible authorities across BC to recommend actions the Province could lead to support integrated flood management planning.

### **Background Review**

Background research was completed to understand the existing flood management framework in BC, practices in other jurisdictions, and to identify best practices from the literature.

In BC, flood risk management has been led almost entirely at the local government level since 2003, with the Province playing a reduced role focused on guideline development, grant programs, and regulating dike construction, alteration, and upgrading. Though Provincial guidelines related to sea-level rise, land-use management, and flood mapping have provided an important resource for responsible authorities to draw on, there is a lack of guidelines available to support flood planning and selecting risk management measures.

Review of practices in other Canadian jurisdictions (Ontario and Alberta) explored two very different approaches for flood management planning. This review illustrated the advantages of:

- a centralized role for government in coordinating flood management standards and activities across the province; and
- a securely-funded regional organization with in-house technical capacity acting as a leader within a flood management planning framework that is not vulnerable to shifting political priorities.



## **Engagement Findings**

Engagement with responsible authorities in BC was a key input into the recommendations in this report. Feedback included survey responses from 42 local governments and 4 First Nations as well as detailed input from interviews with six responsible authorities. While the sample of respondents is relatively small and may not represent all flood planning experiences across BC, the perspectives nonetheless provide valuable insights into some of the shared barriers responsible authorities face with flood planning.

Findings from engagement suggest that some leading responsible authorities in BC have prepared flood management plans; however there is no apparent consistency in terms of objective, approach, scope, and outcome. Further, while there is a wide range of capacity across BC, responsible authorities face the following barriers in conducting effective flood management planning activities (in order of perceived severity):

- Limited in-house staff capacity;
- Limited financial resources or access to funding;
- Gaps in technical information and knowledge;
- Lack of tools, standards, guidance, and regional/provincial policy direction;
- Political sensitivities or conflicting priorities;
- Incorporating climate change projections (including sea-level rise and hydrologic changes);
- Challenges working with other levels of government;
- Complex or changing provincial or federal regulations;
- Challenges coordinating with others (e.g., neighbouring communities, utilities);
- Lack of internal stakeholder recognition of non-structural flood risk reduction; and
- Challenges working with external organizations (e.g., non-profits, academics, consultants).

There was strong agreement among responsible authorities who participated in the surveys and case study interviews that the Province of BC should not "take back" full authority over flood management in BC. Rather, respondents felt that the Province could provide support for planning by responsible authorities in five key ways:

- 1. Providing funding;
- 2. Providing technical support, data, and mapping;
- 3. Provincial staff participation and input into local flood planning processes;
- 4. Establishing clear guidelines and standards; and
- 5. Supporting coordination with other government agencies.

These five mechanisms provide the focus of the recommendations outlined in this report, along with professional judgement, and findings from background research.

### **Recommendations**

Recommendations are provided in this report based on feedback from engagement, professional judgement, and findings from background research. Recommendations are accompanied by high-level (unclassified) cost estimates as a starting point for further scoping. While the recommendations are generally directed toward the Province, implementation would significantly expand the capacity, role, and involvement of responsible authorities (municipalities, regional districts, and First Nations) in flood management planning.

The recommendations in this report are described on the following page:



- B-4.2.1 Increase and Support Responsible Authority in-house Staff Capacity for Flood Management Planning (e.g. by funding a designated flood management staff role within each responsible authority, establishing a community of practice, or provincial liaison framework).
- B-4.2.2 Enhance and Participate in Flood Management Planning Funding Programs (e.g. increase funding for flood planning, extend grant timelines and flexibility to allow for multi-year and integrated projects).
- B-4.2.3 Increase Knowledge of Flood Management Planning Among Community Leaders and Administrators (e.g. targeted training or establishing a peer network).
- B-4.3.1 Establish a Guideline and a Roadmap for Developing Integrated Flood Management Plans, including a "how-to" guide, minimum requirements roadmap, and virtual engagement and training to support uptake.

The Roadmap would outline a step-by-step process and minimum quality requirements for developing a flood management plan under three "pathway" options, including a hazard-based approach, risk-informed approach, or risk-based approach.

- B-4.3.2 **Develop Minimum Provincial Flood Risk Tolerance Criteria for use in IFMPs** under each of the three pathways described in the Guideline and Roadmap.
- B-4.4.1 Require and Fund the Development of IFMPs (e.g. through planning grant programs).
- B-4.4.2 Establish a Provincial Structure for Reviewing and Approving IFMPs to confirm that completed IFMPs meet quality standards as a prerequisite for flood mitigation works funding.
- B-4.4.3 Participate in IFMP Development Steering Committees in an advisory or regulatory role.
- B-4.4.4 Introduce Provincially-approved IFMPs as a Requirement for Structural Flood Mitigation Funding.

Together, these recommended actions are estimated to have a cost to the Province of between \$3 million to \$4 million. While the cost range includes some one-time costs to develop guides and standards, the cost is primarily based on estimates of the number of full-time equivalent (FTE) employees the Province would need to employ annually to administer the actions outlined above.

#### Summary

Nearly two decades after the Province delegated responsibility for flood management to responsible authorities, there are significant gaps in the completeness, consistency and comprehensiveness of flood management planning activities occurring in BC. Despite the barriers identified through engagement, responsible authorities indicated a desire to retain leadership of flood management planning with strengthened support and guidance from the Province.

The Province of BC and FBC are taking important steps to build flood management capacity across BC through the **Investigations in Support of Flood Strategy Development in British Columbia** initiative. IFMPs are the current international best management practice approach for managing flood risk and there are great potential and interest among responsible authorities to build their capacity in this area.



# About This Initiative

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 multifaceted, 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, as shown in Table 1

2	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.	
		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 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.	
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.	

#### Table 1: Flood Strategy Research Themes and Issues



	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 ResponseInvestigate 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. Issue B-4: Flood Planning Introduction

Communities in BC are vulnerable to a variety of flood-related hazards, including coastal floods, riverine floods, and mountain creek geohazards. In BC, local governments and First Nations (responsible authorities<sup>1</sup>) are responsible for planning, implementation, and ongoing management of flood hazards within their jurisdictions.

The Fraser Basin Council (FBC) is leading multiple initiatives to understand the flood risk management barriers that responsible authorities in BC face and to identify opportunities to build capacity. The "Investigations in Support of Flood Strategy Development in British Columbia" initiative involves investigations into 12 Issues related to key processes for flood management.

This report summarizes findings from **Issue B-4: Flood Planning** and recommends actions and resources the Province could develop to support responsible authorities in creating integrated flood management plans, which are strategic documents that outline the preferred combination of measures for managing flood risk, including structural and non-structural approaches (WMO, 2017).

Further details on the scope of the overall FBC initiative, and of this investigation specifically are described in the subsections below.

# 1.1 Issue B-4: Flood Planning Project Scope

As stated in**Error! Reference source not found.**, the purpose of Issue B-4 Flood Planning is to "examine the ability of local authorities to undertake integrated flood management planning and opportunities to improve capacity". The study focuses on river and coastal flood hazards and does not consider strategies or planning for pluvial (overland) flooding.

For this study, "flood planning" or "flood management planning" has been defined as the decision-making process to select a set of preferred measures for managing flood hazards and risks. A key tool in the flood management planning process is the development of **integrated flood management plans** (IFMPs), which are strategic policy documents prepared by a flood management organization that outlines the preferred combination of measures for managing flood risk and are integrated with other policies and planning initiatives within the organization. The core concept of an IFMP is the adoption of a holistic, systems-based approach that responds to a community's flood hazard portfolio with an optimal combination of tools (structural, non-structural, emergency response and recovery, etc.) that will reduce risk to an acceptable level without incurring unacceptable economic, societal or environmental costs.

IFMPs are considered to be a specific type of flood management plan, which is one tool used in BC for the process of flood management planning. The relationship between these three terms is shown in Figure 1.

<sup>&</sup>lt;sup>1</sup> This term responsible authorities is used in this report to refer to actors in BC with flood hazards within their jurisdiction. This term is synonymous with "local authorities" but distinct from "diking authorities", which is specific to management of dikes.



#### Figure 1: Flood Planning Components

Four specific investigations are considered as part of this Issue:

- **B-4.1:** Investigate the ability of responsible authorities in the Province to develop adaptation plans and strategies for flood management.
- **B-4.2**: Investigate opportunities to improve the knowledge and capacity of local authorities regarding climate change adaptation and the benefits of proactive flood risk reduction.
- **B-4.3**: Investigate the potential content of a provincial guideline to support the development of local IFMPs.
- **B-4.4**: Investigate the level of effort for a responsible authority to complete an IFMP and the possible role of the Province in reviewing and/or approving these plans.

Key outcomes from this study include:

- A summary of existing practices for flood management planning in BC,
- Recommendations for resources to support flood management planning, with high-level cost estimates,
- Proposed content for an IFMP guideline and preliminary minimum requirements roadmap as a starting point for further refinement, and
- Order-of-magnitude cost estimates for the level of effort to develop IFMPs under the preliminary roadmap.

### **1.2 Report Integration & Organization**

Flood management is an interconnected and iterative process that requires ongoing communication and coordination across departments, neighbouring jurisdictions, and other levels of government. While the scope of Issue B-4 Flood Planning focuses on the planning and decision-making process, there are important intersections with all other B Theme Issues. Figure 2 shows the relationship between this Issue B-4 and the other B Theme Issues

Understanding and enhancing the flood management planning process needs to consider the climate change, hazard, and risk assessment inputs that lead into it, and the structural and non-structural flood protection measures flowing out of it. As such, the Issue B-4 Flood Planning study takes a strong focus on the planning process and references interlinkages with findings and recommendations in the other Issues throughout.





Figure 2: Interlinkages between B Theme Issues

In addition to interlinkages between this and other issues, there are also many interlinkages with other Issues under Theme A (Governance), Theme C (Monitoring & Response), and Theme D (Resources and Funding). As the project methodology is largely based on engagement with responsible authorities in BC, feedback gathered reflects issues and opportunities related to intersections between planning and virtually all other Issues.

There are also strong interlinkages between the individual investigations within the Issue. For example, while investigation B-4.1 is focused on existing practices in BC communities, these existing practices are deeply interlinked with discussions on IFMP level of effort and the role of the Province under investigation B-4.4.

This report is structured to manage interlinkages, reduce redundancy, and improve the report narrative so that each report section and investigation build on earlier content in the report. As shown in Figure 3, background review (Section 2) and findings from investigation B-4.1 (Section 3) provide the foundation for recommendations under the other three investigations (Sections 4, 5, 6).

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#### Figure 3: Report Organization

A summary of key content and outputs in each section of the report is outlined below:

Section 1 - Introduction: Summary of project scope, interlinkages, and methods

**Section 2 - Background:** Summary of the overall flood management planning framework in BC compared with that in Ontario and Alberta. This content informs the development of recommendations in all three investigations.

**Section 3 - Investigation B-4.1:** Summary of existing practices for flood management planning, including scope and content of flood management plans, incorporating climate change, staff capacity, engagement & coordination, implementation, and funding. Content in this section is based on input received through engagement as part of this project and informs recommendations in all other investigations. This investigation does not include recommendations.



**Section 4 – Investigation B-4.2:** Recommendations to address capacity-building priorities identified in investigation B-4.1 (Section 3), with high-level cost estimates.

**Section 5 – Investigation B-4.3:** Summary of literature best practices for IFMP development, proposed IFMP guideline content with preliminary content for a minimum requirements roadmap, and recommendations for how the Province could build on these tools (with high-level cost estimates).

**Section 6 – Investigation B-4.4:** Summary of existing level of effort for IFMP development, high-level cost estimates for IFMP development under the proposed roadmap, and recommendations on the potential role for the Province to support IFMP development (with high-level cost estimates).

**Section 7 – Conclusions:** Key conclusions from this study, including review of flood management planning in BC and other jurisdictions, existing local capacity, and recommendations.

### 1.3 Summary of Methods

Investigating flood management planning capacity in BC used a gap analysis approach that relied on a combination of best practice research and engagement with responsible authorities to identify capacity-building priorities (gaps) as a foundation for recommendations.

Figure 4 shows the three approaches in completing this study. These approaches align with the overall report structure shown in Figure 3.

BACKGROUND RESEARCH	ENGAGEMENT	RECOMMENDATIONS	
<ul> <li>BC Standards</li> <li>Practices in Other Jurisdictions (Ontario, Alberta)</li> <li>Best Practices Literature Review</li> </ul>	<ul> <li>Surveys (2)</li> <li>Case Study Interviews &amp; Summaries (5)</li> </ul>	<ul> <li>Recommended initiatives (w. cost estimates)</li> <li>List of other "opportunities"</li> <li>IFMP Guideline content</li> <li>Preliminary Minimum Requirements Roadmap</li> <li>IFMP Development Cost Estimates</li> </ul>	

Figure 4: Summary of Study Approaches

The methodology for each approach is described in the following sub-sections.



### **Background Research**

Background research was completed to understand the existing flood management framework in BC, practices in other jurisdictions, and to identify best practices from the literature. Ontario and Alberta were selected as the two other Canadian jurisdictions to review for potential insights and other approaches the Province of BC could consider. These two jurisdictions were selected because they are considered leading Canadian jurisdictions in flood management but with very different approaches. Ontario requires watershed-level planning by Conservation Authorities, compared with Alberta, in which the provincial government plays a strong, broad and centralized role.

Findings from this research have been summarized to identify opportunities to inform flood management planning in BC. This jurisdictional review was completed at a high level; there would be value in completing a broader review of Canadian and International flood management planning frameworks under future work.

The literature reviewed for this project was developed from an extensive flood mitigation bibliography provided by Natural Resources Canada (2018) and refined by the KWL team with input from FBC, case study communities, and consultants involved with the other Issues. The long list was narrowed down to a shortlist by a high-level scan to identify the most relevant documents that are specific to the process of flood management planning. Best practices were synthesized from a review of three key sources: World Meteorological Organization (2017), Sayers et al., 2013; and Stevens and Shoubridge, 2015. These best practices informed recommendations in investigation B-4.3 (Section 5).

### **Engagement with Responsible Authorities**

Engagement with responsible authorities was an important part of information gathering, primarily to identify existing practices and flood management planning capacity as well as lessons learned and opportunities for supporting flood management planning by responsible authorities. Engagement was conducted through two online surveys and interviews with case study responsible authorities identified as flood management planning leaders.

#### Surveys

KWL collaborated with FBC and the consultants leading other Issues to develop two surveys for distribution to responsible authorities and other key actors across BC. The first survey was sent out on July 6, 2020, to over 260 contacts representing municipalities, regional districts, provincial and federal government agencies, and academia. The second survey was sent out on August 14, 2020, to over 70 contacts representing First Nation communities, organizations, private sector, and relevant provincial and federal government agencies.

The first survey received 72 responses, including 42 from municipalities and regional districts, and others from senior levels of government and academia. The second survey received five responses, four of which were from First Nation communities or organizations. Individual responses for both surveys were treated as opinions and not necessarily representative of broader organizational opinion (unless otherwise stated in survey responses).

It is important to note that there is the possibility for a self-selection bias with these survey results, as communities who have completed or are completing a flood management plan may be more likely to see flood management as a priority and maybe better equipped and more inclined to complete the survey. Further, survey respondents only represent a small sample of BC local authorities and therefore input and recommendations based on this input should not be considered to represent all flood planning contexts in BC.



#### **Case Studies**

Case study interviews were held with five responsible authorities to build a deeper understanding of flood management approaches, strengths, challenges, and perceived opportunities. Case study responsible authorities were selected based on three key criteria:

- 1. Have completed a flood management plan within the last 10 years;
- 2. Considered by project partners to be practice leaders for flood management in BC; and
- 3. **Represent diverse contexts** (e.g., community type, size, region, relevant hazards, and flood management planning approach).

**Case Study** Region Hazard Approach Type Size **District of Squamish** Municipality Medium Lower Mainland Coast/River Hybrid Village of Lumby Small Interior River Hazard Municipality **Kwantlen First Nation** First Nation Small Lower Mainland River Hazard **Cowichan Valley** Coast/River Region Medium Island Hvbrid **Regional District** Cowichan Tribes First Nation Small Island Coast/River Hybrid

# Table 2: Case Study Selection and Context Summary

The five case studies selected for this study are shown in Table 2.

One-hour telephone interviews with case study representatives were held between July 23, 2020, and August 18, 2020. A discussion guide and project overview were provided in advance of the interview and a copy of the draft summary was provided for feedback and confirmation. Case study responsible authorities also provided background resources about their flood management program to further support case study review. Findings from the review of background documents and interviews have been summarized in case study summary sheets (Appendix C).

**Disclaimer:** Feedback from the two surveys and case study interviews were the primary inputs into our analysis to inform recommendations. However, it is important to note that though strong efforts were made to encourage broad input from municipalities and First Nations across the Province, feedback received should not be considered representative of all viewpoints and experiences. In particular, the low response rate from First Nations communities significantly limited our study's ability to adequately reflect First Nation experiences. Because of this limited sample, our study does not make recommendations may relate within First Nations contexts. While the feedback from all survey respondents and case study communities does provide valuable and relevant information, further input from a more representative sample should be pursued to inform future work on an Integrated Flood Management Planning Guideline.



#### Recommendations

Recommendations are provided throughout the report outlining next step actions that the Province could lead to support flood management planning in BC. While the recommendations are generally directed toward the Province, implementation would significantly expand the capacity, role, and involvement of responsible authorities in flood management planning.

Recommendations are described under investigations B-4.2, B-4.3, and B-4.4, and summarized in a consolidated table in Appendix D. These recommendations have been developed to address the top five capacity-building priorities identified through engagement with responsible authorities. The recommendations have been designed based on professional judgement and drawing on findings from practices in other jurisdictions and literature best practices.

Recommendations include high-level (unclassified) cost estimates that are based on preliminary estimates of the expected level of effort for the Province to implement and manage the recommendations over time. In some cases, the cost estimates represent Provincial staff time (expressed in dollars, based on full-time equivalent (FTE) position estimates) or the cost to hire consultants to develop content. Note that the preliminary cost estimates presented in this report will be compiled, reviewed, and potentially refined together with those from the other projects in this initiative as part of Issue D-1. For more information, refer to the D-1 report.

Survey respondents and case study communities identified a number of other opportunities for additional flood management support. Given the highly interconnected nature of flood management, many of these recommendations are related to flood management planning but more closely related to other Issues being investigated by other consultants. These additional opportunities reflect on-the-ground community experiences and are shared here to capture knowledge for the broader context of the broader initiative. Specific opportunities should be considered by the Province and responsible authorities in addition to the recommendations posed in the body of this report.

# 1.4 Project Team

This study was completed by a multi-disciplinary team of KWL staff, bringing expertise in planning, engineering, geomorphology, and extensive experience in flood management planning and management in BC. The members of the project team are listed below:

- Erica Ellis, M.Sc., P.Geo. Project Manager;
- Mike Currie, P.Eng., Principal-in-charge and Senior Technical Reviewer;
- David Roche, P.Eng., Senior Engineer (integrated flood management planning advisor);
- Robin Hawker, RPP, Environmental Planner (co-author, professional-of-record);
- Amir Taleghani, P.Eng., Water Resources Engineer (co-author);
- Deighen Blakely, P.Eng., CPESC, Water Resources Engineer (Alberta context advisor); and
- Deanna Shrimpton, Water Resources Analyst.

KWL also acknowledges the leadership by the Fraser Basin Council team, including Project Manager, Frances Woo and Senior Lead, Steve Litke, who spent considerable time and effort supporting engagement and encouraging coordination with other consultants and Issues.



# 2. Flood Management Planning in Canada

There are a number of different approaches and frameworks for managing flood risk across Canada. This section provides an overview of the flood management planning context in BC and highlights diverse approaches used in Ontario and Alberta. The purpose of this section is to understand current conditions in BC and identify potential approaches from other jurisdictions that may be applicable to strengthen flood management planning capacity in the BC context.

# 2.1 Flood Management Planning in BC

Flood management planning in BC has undergone a significant transformation over the past few decades. The Province led management and planning from 1974 – 2003, at which time responsibility was formally transferred to local governments. First Nations also play a role in flood management and are decision-makers for flood management on reserve and in collaboration across their traditional territory.

#### Early Ad Hoc Management

Prior to 1974, flood management work was carried out on an ad-hoc basis at the discretion of local governments and private property owners with minimal provincial involvement, guidelines, or standards. However, a series of significant floods over the course of the 20<sup>th</sup> century led the provincial government to establish a more structured approach to flood management under the active leadership of the Province. The primary catalyst for provincial control was the 1972 Oak Hills Disaster, during which dikes along the North Thompson River failed, resulting in serious flooding of a Kamloops neighbourhood.

#### Provincial Floodplain Development Control Program

In 1974, the Province launched the Floodplain Development Control Program, which required provincial approval for subdivision and rezoning on any land subject to flooding. In 1985 the program added a provision enabling local governments to require a report by a professional engineer prior to issuing a building permit in a flood hazard area. During this time, the Province maintained a small staff of floodplain planning experts in Victoria, supplemented by technical staff in the various regional offices. A cooperative referral system was established whereby local approving officers would refer subdivision and other development applications in flood hazard areas to the Province for adjudication.

The program was somewhat successful in guiding development in flood hazard areas but relied on local governments to recognize the presence of such flood hazard areas in order to submit a referral to the Province. In addition to regulating development, the program also involved collaboration with local governments on flood management tools such as designation of flood hazard areas, floodplain and zoning bylaws, and floodproofing measures.

#### **Canada Flood Damage Reduction Program**

In 1975, the federal Flood Damage Reduction Program (FDRP) was initiated, with the focus on preparing floodplain maps in the hope that this would inform better land-use planning. This program had some success until it was terminated in 1996. It is now widely recognizing that the floodplain maps from the FDRP have largely become obsolete, and this limits the ability of the Provinces and local authorities to undertake various flood damage reduction activities.



#### **Current Regime**

In 2003 the Province delegated some flood management responsibilities to municipalities through the *Flood Hazard Statutes Amendment Act (2003)*, which removed the Province from the subdivision and bylaw approval process within municipal areas (though the Ministry of Transportation and Infrastructure has retained subdivision control for electoral areas within regional districts). Flood management responsibilities delegated to local governments under the Act include:

- Ability to voluntarily amalgamate smaller diking authorities with larger diking authorities;
- Authority for both local government and provincial approving officers to determine subdivision requirements for flood hazard areas without ministry approval;
- Authority for local governments to determine requirements for flood hazard area bylaws; and
- Authority for approving officers to remove existing flood covenants.

In the absence of provincial approval, municipalities rely more heavily on qualified professionals to affirm that land-use changes and development were "safe for the intended use".

These changes allow flood management planning that is more specific to the local context. However, they also create a number of challenges, including:

- inconsistent approaches to planning and managing development in floodplains across the Province;
- inconsistent recognition of the role of structural flood protection works (dikes etc.) in floodplain management and development;
- inconsistent and/or limited in-house expertise for flood management in many responsible authorities;
- Challenges implementing land development control in flood hazard areas due to political sensitivity;
- unclear design events for mountain creeks (e.g., debris flows and floods); and
- inconsistent application of non-structural flood management approaches such as floodproofing measures for development.

Historically, the Federal Government and the Province had been very active in floodplain mapping and construction of structural flood protection works (particularly in the Fraser River basin under the Fraser River Flood Control Program). With the termination of the Floodplain Development Control Program, the Province has instead made funding available for local authorities to lead their floodplain mapping updates. However, this has further stretched local capacity.

There are a handful of watershed-level organizations that have taken on an increasingly important role to support flood management planning in BC regions, including the Fraser Basin Council (FBC), Cowichan Valley Water Board, and Okanagan Basin Water Board. The FBC has recently managed initiatives such as the Provincial Orphan Dikes Assessment, hazard and risk assessment in the Lower Mainland and Thompson Region, the Lower Mainland Flood Management Strategy, and the series of province-wide investigations of which this project is a part. These initiatives have continued to build flood management capacity across the Province.

Further details in this section outline the current flood management planning framework in BC, including current legislation, guidelines, and funding programs to guide and support responsible authorities in leading flood management and planning within their jurisdiction. This section sets the stage for the investigations and recommendations posed in this report for Issue B-4 Flood Management Planning.



# **Current Legislation**

As of the writing of this report, responsible authorities are in charge of local flood protection (e.g. structural works), planning, and ongoing maintenance. The Province has established a legislative framework governing local authority responsibilities for flood management through the following provisions:

- Land Title Act (1996, Section 85 and 86) provides for approval of the subdivision of floodplain lands;
- **Community Charter** (2003, Section 55 and 56) provides for the issuance of building permits and allows Building Inspectors to require that landowners provide a report by a qualified professional stating that the land can be used safely for its intended purpose;
- Local Government Act (2015, Section 910) allows local governments to designate floodplains and set development controls and construction requirements in floodplain areas;
- *Emergency Program Act (1996)* establishes local government responsibility as first responders to emergency situations, including flooding, within their jurisdictions;
- **Environmental Management Act** (2003) which clarifies the Province's responsibility for administering the provincial Flood Hazard Area Land-use Management Guidelines. The guidelines are required to be considered by local governments under the *Local Government Act* when making land-use and development decisions in flood hazard areas;
- **Dike Maintenance Act** (1996) which governs the management of dikes across BC and confers oversight powers to the Inspector of Dikes to regulate dikes, diking authorities, and establishing provincial standards for dike design and maintenance under the Dike Safety Program.
- **Drainage, Ditch & Dike Act** (1996) which sets out controls for land-use and taxation for drainage and flood protection infrastructure on public lands, and regulates the Province's few remaining independent Diking Districts.
- **Declaration on the Rights of Indigenous Peoples Act** (2019) which sets out a process to align BC's laws with the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and to introduce better transparency, predictability, and respect in work and partnerships with BC First Nations.
- Flood Hazard Statutes Amendment Act (2003) transferring flood management responsibilities and power from the Province to local authorities, enabling local governments to take control of their floodplain development approval process; and
- *Miscellaneous Statutes Amendment Act (No. 2, 2004)* which clarifies floodplain bylaw authority.

#### **Responsible Authorities**

Under the current regime, local governments in BC have the authority to undertake flood management. Municipalities have a wide range of flood and land-use management powers through the *Community Charter* and *Local Government Act*. Regional districts have a similar role but require approval of the Province (Ministry of Transportation and Infrastructure) for subdivision approval.

First Nations also play a role in managing flood risk on reserve lands. The federal *Indian Act* provides for First Nation Band Councils to pass resolutions regarding land-use and hazard management on reserves. The Government of Canada plays a supporting and funding role for flood and infrastructure management, while the Province provides flood emergency response. Flood hazard management issues on First Nations reserves are often addressed in collaboration with one or more adjacent local



governments. In many cases, First Nation traditional territory extends far beyond reserve lands, leading many First Nations to take an interest in managing watershed health more broadly. The BC *Declaration on the Rights of Indigenous Peoples Act* (2019) recognizes and respects the inherent rights held by First Nations peoples and sets an intention to support meaningful capacity building, self-governance, and self-determination.

#### **Updates Underway**

Recent reports on the 2017 flood and wildfire season (Auditor General, 2018; Abbott and Chapman, 2018) have indicated that the current legislative paradigm is not working as intended, and changes need to be made. Thus, a process is underway to refine provincial legislation around these issues, including changes to the *Emergency Program Act* to reflect guidance in the Sendai Framework for Disaster Risk Reduction (2015). Amendments to the *Emergency Program Act* are expected to be introduced in spring 2021.

Recommendation #36 of the Abbott-Chapman (2018) review is directly related to flood management and was one of the triggers for the BC flood investigations project and the BC flood risk strategy that it will support. A bulletin shared by the Province in October 2019 stated that the BC Government has acted on 99 of the 108 recommendations contained in the Abbott-Chapman independent review. The majority of the recommendations are general in nature and apply to both wildfire and flood emergency planning and response. Approximately 10 of the recommendations are specific to flood management.

### **Guidelines & Standards**

At the provincial level, guidelines have been produced by the BC Ministry of Environment (MoE) and Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD), which set out minimum requirements for flood hazard area land-use management. These guidelines are intended to provide guidance for responsible authorities and include:

- Flood Hazard Area Land-use Management Guidelines (BC MWALP 2003 and BC MFLNRORD, 2018) offers guidance on floodplain management including updated content added in 2018 for the consideration of sea-level rise and wave effects.
- Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land-use (Ausenco Sandwell, 2011a; 2011b; 2011c) outlines provincial guidelines for sea dike design and coastal flood hazard land management to address climate change factors in coastal waters of BC.
- Coastal Floodplain Mapping Guidelines and Coastal Flood Hazard Areas (KWL, 2011) standardized methodology to produce floodplain maps that accounts for sea-level rise for coastal communities.

Examples of other key resources provided by BC organizations to support local governments and qualified professionals in assessing flood hazards, planning, and design of mitigation works include:

- Clean, Resilient Flood Technology Options in Canada (Simon Fraser University Adaptation to Climate Change, 2020) describes a toolkit of structural flood mitigation measures.
- Professional Practice Guidelines Legislated Flood Assessments in a Changing Climate in BC (EGBC, 2018) guides professional practice for flood assessments, to help identify the circumstances when risk assessments are needed and to emphasize the need to consider climate change and land-use changes in such assessments.



- Professional Practice Guidelines Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC (EGBC, 2010) – guides the professional practice of landslide assessments (including debris flows on steep creeks) to support flood assessment and planning.
- Sea-level Rise Adaptation Primer A Toolkit to Build Adaptive Capacity on Canada's South Coasts (Arlington Group et al., 2013) a toolkit for coastal management authorities to help identify, evaluate and compare options for adapting to the impacts of sea-level rise and associated coastal hazards.
- Environmental Protection in Flood Hazard Management: A Guide for Practitioners (Fraser Basin Council, 2010) describes a toolkit of structural and non-structural flood mitigation measures, including flood hazard information and planning, flood protection works, and emergency management.

### Funding

Responsible authorities draw on a range of funding sources for flood management, including federal and provincial government grants, emergency funding, and own-source revenue through taxes and levies. Examples of ongoing and recently-concluded infrastructure grant programs that have supported flood management by local governments and First Nations include:

- Government of Canada National Disaster Mitigation Program (NDMP);
- Adaptation, Resilience, and Disaster Mitigation (ARDM);
- Infrastructure Canada Disaster Mitigation and Adaptation Fund (DMAF);
- Investing in Canada Infrastructure Program (ICIP);
- Federal Gas Tax Fund;
- Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) First Nation Adapt Program, which provide funding for climate adaptation planning;
- Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) Emergency Management Assistance Program;
- Indigenous Services Canada Coastal Vulnerability Assessment Program;
- Provincially funded Union of BC Municipalities (UBCM)'s Community Emergency Preparedness Fund (Flood Risk Assessment, Mapping & Mitigation Planning stream); and
- Federation of Canadian Municipalities (FCM) Municipalities for Climate Innovation Program (MCIP).

Many of these funding programs are administered through the BC Disaster Mitigation Program (BCDMP).

While such funding programs provide critical support for communities, the funding programs typically open and close, and may be replaced by new programs with different priorities, eligibility criteria, and application requirements that make it difficult for communities to rely on funding to be available when they need it. Historically, many grant programs have also focussed on construction-ready infrastructure projects that exclude flood risk management planning activities.



In addition to these funding programs, a variety of financial instruments have been used by different organizations to support flood management, including (FBC, 2010):

- local taxes and levies;
- development cost charges;
- diking and drainage utility fees;
- annual operations and maintenance budgets; and
- collaboration, cost-sharing and in-kind contributions.

#### **Key Findings from BC Practices Review**

- Since 2003, flood risk management has occurred almost entirely at the local government level (municipalities and regional districts) as well as First Nations.
- Since 2003, the Province has also played a reduced role that mainly consists of offering grants, issuing guidelines, and regulating dike systems.
- BC should be considered a leader in Canada for its clear and simple planning-level guidance for SLR (e.g. SLR Primer, 1 m by 2100 policy), however, this guidance is 10 years old and may need to be updated to reflect the most recent IPCC SLR projections.
- While guidelines exist to support flood hazard assessment and mapping, there is a lack of standards and guidelines to support planning and selecting flood risk management measures.

### 2.2 **Practices in Other Jurisdictions**

Provinces and communities across Canada have adopted a range of different approaches for managing flood risk. This section summarizes flood management planning approaches in Ontario and Alberta as a comparison to the current BC framework. Both Ontario and Alberta have unique systems that provide insights into other approaches the Province of BC could consider drawing from to support flood management planning in BC.

### **Province of Ontario**

Flood management in Ontario is a shared responsibility between the Province, municipalities and conservation authorities (CAs). CAs are non-profit groups organized at the watershed scale that have received delegated responsibilities to represent provincial interests for natural hazards. Overarching legislation for flood management in Ontario is led through the *Lakes and Rivers Improvement Act* (1990), *Emergency Management and Civil Protection Act* (1990), and *Planning Act* (1990) (Ontario, 2010).

#### **Conservation Authorities**

There are 36 CAs in Ontario encompassing almost three-quarters of Ontario's 444 communities, 95% of the population, and over 146,000 hectares of land. However, CAs do not cover the total land area of Ontario. They have a mandate to "undertake watershed-based programs to protect people and property from flooding and other natural hazards and to conserve natural resources for economic, social, and environmental benefits" (Conservation Ontario, 2020a).

CAs are represented by the non-profit association Conservation Ontario with powers delegated under the *Conservation Authorities Act* (1946) and *Provincial Policy Statement* (2020). They are involved with protecting and managing impacts on water and related natural resources, including planning for and



managing flood mitigation works and regulating development activities in or near river and stream valleys, Great Lakes and large inland lakes, shorelines, watercourses, hazardous lands and wetlands (Conservation Ontario, 2019). However, as of December 2020, legislated authority for CAs is expected to undergo a radical change brought forward by Bill 229 as part of the Provincial Governments 2020 budget.

CAs deliver over \$300 million in watershed management services each year, with support from 3,600 full-time, part-time, and seasonal staff. They also deliver programs in partnership with local landowners and other environmental agencies and all levels of government. They operate \$3.8 billion (2019 dollars) in flood and erosion control infrastructure (Conservation Ontario, 2019). CA activities are funded through a combination of shared provincial and municipal funding, municipal levy, and self-financing (Ontario, 2010), though provincial funding is generally minimal.

The jurisdiction of flood management planning is shared by Conservation Authorities and municipalities, who together develop floodplain maps and create floodplain management programs. CAs often provide technical advice to municipalities through service agreements, including stormwater management, and often become involved in planning and development processes with adjacent landowners (Conservation Ontario, 2020b). Flood management responsibilities of CAs include:

- Undertaking floodplain mapping, modelling, and monitoring streamflow, rainfall and snowpacks;
- Coordinating flood management planning and flood protection initiatives among municipalities in the watershed;
- Regulating development in flood-prone areas in cooperation with municipalities and the Province;
- Providing planning support and technical advice to municipalities to minimize flood impacts and issue flood warnings;
- Acquiring important floodplain lands and flood-vulnerable structures;
- Operating over 900 dams, dykes, channels and erosion control structures; and
- Informing and educating the public.

While BC uses a 200-year return period (plus 0.6 m freeboard) as the mitigation design standard, the Ontario design flood criteria standard is the greatest of:

- 100-year return-period flood event;
- The flood level during Hurricane Hazel (generally applies to area south of Lake Simcoe),
- The flood level during the 1961 Timmins Storm (generally applies to north of Lake Simcoe and west of Peterborough), or
- The flood of records on a local system.



#### **Flood Management Planning**

CAs work with local governments for flood management planning. They draw on an integrated watershed management approach to protect water resource and manage impacts from environmental change. This approach aims to balance human activities and environmental health to protect the interconnected interests and needs of the environment, economy, and society. Under this model, flood management planning is incorporated as part of CA watershed plans, programs, and services alongside the other watershed initiatives shown in Figure 5.



Figure 5: Conservation Authority Integrated Watershed Management Framework (2020c)

Conservation Ontario refers to the following pillars of emergency planning for flood and erosion management (Figure 6).

	PILLARS C	F EMERGENCY	PLANNING	
PREVENTION Prevent effects of floods	MITIGATION Reduce flooding	PREPAREDNESS Develop capacity to respond	RESPONSE Take action during a flood	RECOVERY Deal with flood aftermath
	EMERGENO	Y MANAGEME	NT ACTIVITY	
Planning and regulation to minimize vulnerabilities	Evaluate risks and implement mitigation programs	Develop plans for emergency preparedness	Implement emergency measures	Help administer relief/recovery programs
(e.g.: regulate floodplain land use, education)	(e.g.: flood control structures, flood proofing, flood forecasting and warning systems)	(e.g.: flood contingency planning, partner training, public education)	(e.g.: monitor storms and stream flows, issue flood warnings)	(e.g.: assess overall damage, post audit of flood response)

Figure 6: Conservation Ontario Flood Emergency Planning & Management Framework (2020d)



### **Key Findings from Ontario Practices Review**

- Flood risk management in developed areas is led at watershed level by CAs;
- CAs have integrated water management responsibilities, and work with municipal partners on a regionally coordinated basis through a combination of advice and regulatory authority; and
- CAs have provided a well-supported and consistent framework for flood risk management for decades.

### **Province of Alberta**

Flood management in Alberta is undertaken jointly by the Province and responsible authorities (municipalities). In Alberta, there is currently no requirement or guidance to support the development of flood management plans at the local level. However, the Province plays a leading role in flood management through a broad range of responsibilities and programs and by providing flood mapping.

#### Flood Management Responsibilities

The Province of Alberta maintains a strong and centralized role in identifying flood hazards, developing tools, constructing and operating infrastructure, and (more recently) completing watershed-level damage assessments and mitigation plans. (e.g. Athabasca Basin Plan, 2014). The Province supports flood management by responsible authorities in a broad range of ways, including:

- Flood Mapping –The Province prepares floodplain mapping studies for communities at risk of flooding through the Alberta Flood Hazard Identification Program (FHIP). These studies divide the flood hazard area into two main zones:
  - a floodway, where hazards are highest and development should be avoided (i.e. in most cases, areas where the water depth is greater than 1 m, and/or the velocity is higher than 1 m/s); and
  - a flood fringe, where hazards are more moderate and raised (or floodproofed) development may be allowed to encroach into the flood hazard area.

These areas are defined as part of every FHIP study and are often incorporated into local development bylaws.

• Floodplain Development Regulation – Hazard areas identified by the FHIP can be officially designated by the Province to limit senior government's exposure to risk in the event of a flood. A 2015 review (KWL, 2015) concluded that less than 50% of completed flood hazard maps had been "designated", in most cases due to a lack of local political support.

Following the 2013 flood, the Province of Alberta passed the *Flood Recovery and Reconstruction Act* to further flood risk mitigation, in part by encouraging the designation of FHIP areas. Details of the *Act* were to be defined through the *Floodway Development Regulation*, which remains under development.

• Water Management - Alberta Environment and Park's Water Management group plays the role of infrastructure owner for a number of water management infrastructure in Alberta including dikes, bank protection works, dams and reservoirs. Water management plans are developed by the Province under the *Water Act (2000)* at the watershed or basin scale and may focus on water supply, floods, or a combination of water management issues.



- Flood Emergency Response Municipalities in Alberta are responsible for being the first line of defence during a flood emergency response and typically develop evacuation plans. If a community's ability to respond to a flood event becomes overwhelmed, they can call upon the Province (Alberta Emergency Response Agency) to step in and manage the flood response.
- **Funding** Funding for structural flood protection measures is provided directly to communities by the Alberta Community Resilience Program (ACRP). Projects supported by ACRP funding typically need to meet or exceed the 1% annual exceedance probability (1:100 year return period) flood design standard set by the Province; however, Alberta does not have an equivalent to BC's detailed dike design guidelines. Separate funding for nature-based solutions is provided by the Watershed Resiliency and Restoration Program (WRRP), which aims to increase flood resilience by restoring watersheds. The ACRP structural mitigation grants were in the order of \$70M of Provincial funding in the first year they were available (2015) and ranged between \$20 and \$40M totals in the subsequent years. In contrast, the total funding available through the WRRP was \$32.5M in the first four years of the program.

Alberta has also established Watershed Planning and Advisory Councils (WPACs). WPACs are nonprofit groups that are typically organized at watershed level (like Ontario's conservation authorities) and act as the "voice of the watershed". They fulfill an advisory role, sharing information and convening forums, and have no regulatory authority. They have limited capacity, with usually one part-time paid staff member with a number of volunteers. They are responsible for producing integrated watershed management plans; however, Alberta's guidelines for preparing watershed management plans (2015) do not address flood management issues. There also participate as stakeholder representatives on broader regional initiatives and lead projects such as stream bank restoration planting or creek crossing replacement projects.

In most cases, floodplain development decisions remain at the municipal government level. Municipalities develop their land-use bylaws around siting and floodproofing of developments. There has historically been no coordinated provincial program of incentives or disincentives to encourage local communities to develop bylaws that buy into the implementation of FHIP floodway / flood fringe recommendations, and relatively few municipalities have formal flood management plans. There are also no known formal guidance documents available in the Province for responsible authorities to develop their flood management plans.

In Alberta, some larger communities own and operate their flood mitigation infrastructure (e.g., City of Calgary dikes), while flood infrastructure in smaller communities is typically owned and operated by the Province (e.g. Drumheller dikes). There are also prominent examples of privately owned dikes (e.g., Calgary river-side condominium corporations, the Calgary Stampede, and Calgary Zoo).

#### **Regional Flood Response & Planning Initiatives**

The Alberta Flood Recovery Task Force is a ministerial group that was established after the 2013 flood in Southern Alberta. It is primarily focused on recovery efforts, but also initiated studies in partnership with at-risk communities to investigate mitigation options. These studies were done at the watershed scale, incorporating input from municipalities as well as local First Nations and stakeholder groups, including watershed interest groups, forestry companies, irrigation districts and the insurance industry. These projects are primarily focused on engineering feasibility studies for major infrastructure while also including some non-structural measures (like emergency response plans and buy-outs of vulnerable property).



Separate watershed-scale planning is also in progress for much of the Province, including the Bow, Elbow, Oldman, Athabasca, Highwood, Sheep, South Saskatchewan, Peace, and Red Deer Rivers. Adhoc working groups were established post-2013 flooding with key stakeholders to examine a range of mitigation options on a basin-wide scale for diverse and interconnected water management issues (including flood, drought, hydropower production and water supply security). These working groups were only active for the life of the projects and included representatives from a range of stakeholders, including municipalities, First Nations, WPACs, irrigation districts, etc.). In the case of the Bow River Water Management Project, watershed level modelling established the effectiveness of flood risk mitigation scenarios while understanding downstream impacts such as irrigation water supply availability. The recommendations from this watershed-level plan were reported to the Province in a 2017 report (Alberta WaterSmart, 2017).

#### Local Flood Management Planning Initiatives

The City of Calgary and The Town of Drumheller are examples of responsible authorities in Alberta who have developed flood management plans, with support from various levels of government. These two responsible authorities represent a range in community sizes, with Drumheller being a town of about 8,000 people, and Calgary being a city of more than 1 million.

Calgary's flood management plan was developed following the 2013 flood and identified actions in six theme areas to be taken in the short-, medium-, and long-term to make Calgary more resilient to flooding. Following community engagement, Calgary's overall Flood Resilience Plan was approved by Council in 2018. Implementation of the Plan is heavily reliant on external funding sources, cooperation from the Provincial Government to implement upstream storage measures and buy-in from local residents and communities for proposed projects.

The Town of Drumheller implemented emergency repair work immediately following the 2013 flood; however, the development of its IFMP process did not begin until 2018 as part of broader planning to build the Town's resilience to climate change. When funding was awarded in 2019, the Town established the Drumheller Resiliency and Flood Mitigation Program, a stand-alone office responsible for implementing their flood management plan, which included buyouts, structural mitigation, municipal planning and land-use bylaw updates, as well as public education.

#### Key Findings for Flood Risk Management in Alberta

- The Province of Alberta plays a strong, hands-on role in flood management decisions, including developing flood hazard maps, designating flood hazard areas, constructing and operating flood control infrastructure (including some dike systems), and completing recent Water Management Plans that evaluate watershed-scale mitigation opportunities.
- Municipal governments are responsible for floodplain development. Historically, many flood hazard areas were not designated due to local political pressures. Provincial regulations to govern development in flood hazard areas have been under development since the 2013 floods.
- There is no formal guidance for developing flood management plans at the municipal level. Some communities (e.g., Calgary, Drumheller) have produced their flood management plans. Many communities do not yet have a formal flood management plan.



# 3. B-4.1: Investigate Existing Capacity in BC

This section focuses on understanding the state of practice for flood management planning in BC. It summarizes feedback provided by local governments and First Nations in the two surveys to BC responsible authorities, case study interviews, and review of IFMPs completed over the last 10 years.

Existing practices, strengths and challenges are summarized under seven themes:

- 1. Flood Management Planning Coverage;
- 2. IFMP Approach & Content;
- 3. Climate Change Consideration;
- 4. Staff Capacity & Knowledge;
- 5. Engagement & Collaboration;
- 6. Implementation; and
- 7. Funding.

These themes reflect key objectives of this project and are aligned with the best practices identified through literature review and described in Section 5. A summary of findings from each case study is provided in Appendix C. This section closes with priorities for capacity-building, based on feedback provided by responsible authorities in the two surveys.

**Disclaimer:** The content in this section is based exclusively on feedback provided by survey respondents or case study communities. As noted previously, a relatively small sample of 42 local governments and four First Nations communities responded to engagement and feedback received should not be considered representative of all experiences with flood planning across BC.

Feedback received has been summarized in the "Strengths & Challenges from Engagement" tables for each theme. In some cases, content summarized in the tables represents input provided by only one community and has been included as an interesting and relevant perspective to consider but may not represent a common experience. In order to support interpretation of these results, content in these tables that reflects sentiments shared by only one survey or case study respondent has been marked with an asterisk (\*).

# 3.1 Flood Management Planning Coverage

Flood management planning by responsible authorities (municipalities, regional districts, and First Nations) varies across BC. Of the 42 regional districts and municipalities who responded to the survey (including case study communities), only 10 jurisdictions (24%) stated having completed a flood management plan. A further 10 of these jurisdictions (24%) are currently developing a flood management plan, and almost half (18 jurisdictions or 43%) do not have a plan. Additionally, of the four First Nation communities who responded, only one reported having a flood management plan.

Overall, community size did not appear to have a strong bearing on whether the responsible authority had completed flood management plans. Six of the 21 completed or in progress plans are from large communities (over 100,000 people) and 15 are from small to medium municipalities or First Nations (below 100,000 people).



Of the 21 responsible authorities who have or are developing a plan, only five reported planning coverage of all flood hazard areas within their jurisdiction. Almost all respondents without a formal flood management plan noted that not having a flood management plan is a significant barrier to developing and implementing non-structural measures for flood management. Of those without a plan, the most common approach for directing flood management decisions was through emergency response planning, land-use planning, community plans, and/or Council, staff, or community committee decisions. Only five respondents without plans intend to develop one within the next five years.

The following sections summarize the practices, strengths and challenges highlighted by the 21 responsible authorities who either have or are currently developing flood management plan(s), based on feedback in the project survey and case study interviews. It is important to reiterate that the 42 responsible authorities who responded to the survey represent only a small portion of communities in BC and their input should not be considered representative of the full range of experiences with flood planning across the Province.

# 3.2 Flood Management Planning Approach

Flood management plans by responsible authorities in BC vary widely in terms of approach and content. Of all 46 local government and First Nation respondents, almost half reported that a lack of tools, standards, and policy direction from the Province is a barrier to flood management planning.

When asked to indicate whether their plans are based on a hazard/standard-based approach or a "riskbased approach", 70% of municipalities and regional districts with a plan indicated that they have taken some form of hybrid that combines elements from both approaches. The survey did not request additional information on how communities defined a hybrid approach or confirm that this is an appropriate reflection of what is being done. A wide range of hybrid approaches are possible given that there are no current standards or guidelines for flood risk assessment in BC. This issue is discussed extensively in Issue B-3 Flood Risk Assessment (Ebbwater, 2020). There are obvious disadvantages with a wide range of hybrid planning approaches from a provincial perspective, but there may also be advantages related to better incorporation of local community context.

The majority of plans consider potential flood impacts on a range of different community sectors, with consequences to critical infrastructure (e.g., disruption to water, wastewater, power grid, and emergency response) and the economy (e.g., lost productivity, building damage) being considered in greatest detail. Only about half of the plans consider flood risk to future growth, social and cultural elements, or environmental health in detail. That said, both of the First Nation case study communities interviewed for this project reported that social and cultural elements (e.g., flood impacts to homes, archaeological sites and cultural sites) were considered in detail in their plans.

Of the 21 survey respondents with completed or developing flood plans, 14 noted that their flood plans recommend both structural and non-structural approaches, which is an important hallmark of an *integrated* flood management plan according to international best practices (WMO, 2017; Sayers et al., 2016).

Flood management planning strengths and challenges reported in the survey and case study interviews are summarized in the table on the following page.



#### Table 3: Flood Management Planning Approach Strengths & Challenges from Engagement

Strengths	Challenges
<ul> <li>Flood risk to critical infrastructure and the economy is considered in detail in most plans</li> <li>Almost all survey respondents noted</li> </ul>	<ul> <li>Lack of tools, guidelines, and policy standards to support consistent planning</li> <li>Lack of definition for what a hybrid approach involves</li> </ul>
<ul> <li>considering risk to some degree</li> <li>Most plans recommend both structural and non-structural measures</li> </ul>	<ul> <li>Lack of consistency in plan format and content generally</li> <li>Flood risk to future growth, social/cultural, and environmental sectors considered only at a high level by many</li> </ul>

### 3.3 Climate Change Consideration

Climate change is expected to cause an increase in flood frequency and magnitude due to sea-level rise and regional effects on precipitation, snowpack, and rates of snowmelt. Many pluvial river systems (watersheds where floods are caused by intense or prolonged rain) are expected to see more frequent and/or more intense rainfall, causing larger and more frequent flood events. Nival river systems (watersheds where floods are caused by rapid melting of a deep snowpack) may see more variable changes due to a reduced snowpack, but faster melting. These realities emphasize the need for flood management planning throughout the province. Content in this section has been considered at a high level as it relates to flood management planning to supplement the focussed analysis of climate change considerations in flood management provided in Issue B-1 Impacts of Climate Change (Associated Engineering, 2020).

Feedback from engagement suggests that 20 of the 21 BC respondents with completed or in-progress flood management plans (95%) have incorporated climate change considerations to some degree, with many considering it in detail. However, 17 respondents (81%) also noted that incorporating climate change projections into flood management planning is a challenge.

While it is expected that the majority of communities in coastal areas draw on the provincial guidance of 1 m by 2100 / 2 m by 2200 sea-level rise (Ausenco, 2011), incorporating climate change into riverine and pluvial flooding is expected to vary more widely. For example, one survey respondent noted that hydrologic analysis as part of a recent floodplain mapping did not reveal a trend in flood magnitude increase under future conditions, and therefore applied a standard projected 10% increase in peak flow to account for climate change. The respondent noted that detailed engineering and sensitivity analysis would consider downscaled projections at the project design stage.

Most respondents reported considering climate change primarily through mapping and modelling, though a number of respondents also mentioned incorporating climate projections to inform setbacks, flood construction levels and development permitting. Only 2 of the 12 respondents who reported being vulnerable to sea-level rise reported having SLR Planning Areas (District of West Vancouver and District of Squamish). Other approaches responsible authorities mentioned having in place include:

- Incorporating climate change into performance criteria for specific flood management structures;
- Incorporating climate considerations into flood mapping, management, and land raising policies; and
- Incorporating climate impacts on flood risk into related plans such as climate adaptation plans or integrated stormwater management plans.



Respondents did not provide details on the degree to which they are considering secondary, cumulative, or cascading impacts, such as the degree to which flood hazards may be exacerbated by wildfire or the degree to which coastal flooding could inundate critical infrastructure causing service disruption beyond the inundation area. KWL recommends that this should be a topic for future investigation.

Climate change strengths and challenges reported in the survey and case study interviews are summarized in the table below.

Table 4.	Climate	Change	Consideration	Strengths &	& Challend	nes from	Engagement
	Cinnate	Change	Consideration	ouenguis		jes nom	Lingagement

Strengths	Challenges
<ul> <li>95% of responsible authorities consider climate change in their plans</li> <li>Some jurisdictions are considering how multiple</li> </ul>	Limited guidance or standardization for considering climate change for non-SLR- related flooding
dimensions of climate change impact multiple elements of their flood management plan	<ul> <li>The analysis behind provincial SLR flood policy is nearly 10 years out of date (recommended update frequency every five years)*</li> <li>Difficulty translating projections into local data to input into flood models</li> </ul>
	Lack of standards to build structures to account for climate change
	<ul> <li>Climate projections do not account for extreme weather*</li> </ul>

### 3.4 Staff Capacity and Knowledge

Limited staff capacity was reported as the single most significant challenge local governments and First Nations face with flood management planning. Of all 46 survey respondents, 31 (67%) highlighted staff capacity as an issue. This was particularly highlighted as a challenge for smaller communities who may have one or two staff responsible for all flood management planning, prevention, and response as just one portion of their responsibilities. For example, flood management may fall under the wide-ranging and complex responsibilities of a sole municipal engineer working within a small community.

Half of all respondents (23 of 46) also mentioned that gaps in technical information and knowledge are a key limiting factor to flood management planning. While case study respondents noted that the necessary data (e.g. flow monitoring) is often available through government websites, in many cases it can be difficult to find especially when moved to different pages.

Case study community Kwantlen First Nation noted that there are a number of ongoing regional initiatives to identify gaps and strengthen community flood management capacity in BC; however, there is considerable overlap and significant time commitment which makes it difficult for communities to be involved in these initiatives in a meaningful way.

The representative from Kwantlen First Nation summarized the challenges that small communities face with capacity and using available information:

"There is no point in sending us any more information on [flood management and planning]. We don't have anyone in-house with the expertise to understand the technical aspects or the time to read it. Small municipalities like ours have a very limited number of staff. We rely on outside expertise and sharing with the regional district."



Survey respondents noted that additional information in the following areas would improve their ability to deliver flood management planning (ranked by number of respondents that cited each issue from high to low):

- 1. Flood hazard assessment and mapping
- 2. Flood risk assessment methods
- 3. Evaluation of risk reduction options
- 4. Flood liability and insurance

- 5. Climate change projections
- 6. Community engagement
- 7. Disaster financial assistance
- 8. Case studies and best practices

Staff capacity and knowledge strengths and challenges reported in the survey and case study interviews are summarized in the table below.

Strengths	Challenges			
Staff Availability	Staff Availability			
<ul> <li>Communities build partnerships with non-profits (e.g., FBC, Emergency Planning Secretariat) and neighbouring communities for knowledge building</li> </ul>	<ul> <li>Smaller communities have small staff teams with less time to support flood management planning, progress monitoring, and flood response alongside their other responsibilities</li> <li>First Nations communities, in particular, have fewer staff but more responsibilities with "all levels of government in one"*</li> </ul>			
Some communities have Council support to build diverse technical expertise in-house	Regulatory agencies expect the same level of effort from small communities as they would for larger, better resourced communities			
Working with staff from across departments, particularly engineering and planning,	<ul> <li>Meeting regulatory reporting requirements for flood response reduces capacity available to support recovery efforts*</li> </ul>			
strengthens outcomes, supports staff knowledge, and streamlines implementation (particularly for policy and land-use changes)	<ul> <li>It is difficult for staff in small communities to find time to meaningfully participate in the multiple, overlapping flood management capacity initiatives in BC*</li> <li>Technical Information and Knowledge</li> </ul>			
Technical Information and	Many communities have limited in house technical fleed			
Knowledge	Many communities have inflied in-house technical houd     expertise, which challenges the use of available			
There is a broad range of	data/information			
resources online which can provide much of the key information needed for flood	<ul> <li>Complex array of data and information that may be difficult to navigate for less experienced staff (particularly when online information is reorganized)</li> </ul>			
<ul> <li>Access to quality data, such as Canadian Hydrographic Service</li> </ul>	<ul> <li>During flood events, Water Survey of Canada stations are often damaged or lost due to high flows and do not report discharge/water levels when most critically needed*</li> </ul>			
available to support modelling and assessment	<ul> <li>Inadequate network of river gauges and weather stations means data may not be available where or when required*</li> <li>Delays in accessing data (e.g., LiDAR) can constrain</li> </ul>			
Where available, LIDAR provided by the Province is critically important for flood mapping to meet provincial standards	<ul> <li>opportunities to apply for funding*</li> <li>In the past, updated flood mapping has not been added to the Province's online database, causing confusion among responsible authority staff and public*</li> <li>More data specific to First Nations is needed, including</li> </ul>			
	archaeological mapping, without making it publicly available*			

#### Table 5: Staff Capacity and Knowledge Strengths & Challenges from Engagement



# 3.5 Engagement and Collaboration

Survey and case study respondents highlighted collaboration and engagement as a strength when successful but also identified that it is challenging to do well. For the purpose of this assessment, collaboration and engagement have been divided into four distinct categories:

- 1. Public communication and engagement;
- 2. Engagement with external groups (e.g., utilities, neighbouring communities);
- 3. Collaboration with external groups (e.g., non-profits, academic, consultants); and
- 4. Collaboration with other levels of government.

Of the 21 local governments and First Nations who have completed or are developing a flood management plan, just over half (n=12, 57%) noted that the plan incorporates input from community engagement. In most cases, this engagement occurred after technical modelling was complete and focused on building community understanding of flood risk and getting input on key concerns and priorities. Feedback from case study communities indicated that though engagement was important, it was often challenging to encourage community members to participate/attend events and to navigate differing priorities (e.g., impacts to land value). In many cases, despite holding a robust engagement process, community members only voiced opposition at the point when land-use changes were being implemented (despite having had the opportunity to provide input earlier on).

A representative from the Village of Lumby noted that:

"You can never communicate enough – even if you think you have, it's difficult to reach everybody.... At some point in the process, you need to collectively move forward with what you feel was adequate."

Engagement with external groups such as utilities and neighbouring communities was, for the most part, highlighted as a rewarding and important process. Case study communities noted that communication with neighbouring municipalities, regional districts, and First Nations significantly increased local flood management planning capacity, providing a forum for knowledge sharing and building shared priorities and vision. Cowichan Tribes and the Cowichan Valley Regional District highlighted the strategic importance and benefits that the region's collaborative watershed governance model provides, and the Village of Lumby noted the important contributions that the Splatsin Yucwmenlúcwu (Caretakers of the Land) provided in the flood management planning process. Kwantlen First Nation highlighted the importance of engaging First Nation communities early in the planning process, a sentiment echoed by another First Nations survey respondent who called for more upfront communication with First Nations in whose territory the mitigation work is being done.

However, 13 of the 46 respondents to the survey overall reported experiencing challenges working with external groups, with comments indicating that most of these challenges relate to working with utilities such as the railway, port, and highways.

Comments also highlighted challenges working with regional districts; however, these seem largely due to differing priorities rather than a lack of commitment to working together. One survey respondent noted that:

"Our priorities are not necessarily the same as the region's, although the [region] is trying hard."



Case study communities noted that collaborating with external groups (e.g., NGOs, academic organizations, consultants) was highlighted as a key strength and opportunity, particularly as a way to fill gaps in staff capacity and expertise. Kwantlen First Nation highlighted the important support role that the Emergency Planning Secretariat (EPS) has played in supporting ongoing flood management planning and assessment work. However, the Nation also highlighted challenges navigating and finding time to be involved in the many interrelated and overlapping regional initiatives for flood management currently underway in the lower mainland.

Most communities that have completed, or are completing, flood management plans hired a consultant to lead technical work and reported a generally positive experience. Some challenges expressed include the fact that consultants can be expensive, have limited in-depth knowledge of community priorities and context (sometimes resulting in the creation of generic plans), and limit opportunities to build in-house expertise and ownership for ongoing implementation. However, despite these challenges, only 4 out of all 46 survey respondents noted challenges working with external groups.

Similarly, working with other levels of government was highlighted by some as a key strength, and by others as a key challenge. Overall, 16 (35%) of the 46 survey respondents identified working with government agencies as a challenge, citing under-resourced provincial departments (e.g., Inspector of Dikes, DFO), poor communication, and complex or changing provincial or federal regulations and departments. Case study communities highlighted the important relationship they have with EMBC, built through ongoing communication around annual freshet flood management planning.

Engagement and collaboration strengths and challenges reported in the survey and case study interviews are summarized in the table below.

Strengths	Challenges		
Community Engagement	Community Engagement		
<ul> <li>Many responsible authorities are making a strong effort to meaningfully engage the public and key stakeholders</li> </ul>	<ul> <li>Difficult to encourage diverse public participation at planning stage (which can lead to opposition at implementation stage)</li> </ul>		
Ongoing engagement around annual flood response can build community awareness and understanding of their responsibilities, and enable more meaningful engagement	<ul> <li>Cases where community priorities or development pressure conflict with staff, Council, or consultant recommendations can be difficult to navigate</li> </ul>		
during planning processes*	Collaboration with External Groups		
<ul> <li>Engagement with First Nation members off-reserve revealed different priorities held by on- and off-reserve members*</li> </ul>	<ul> <li>There are a number of overlapping regional initiatives to support flood management capacity, leading to confusion and stretching limited</li> </ul>		
Engagement with External Groups	community capacity to be involved*		
<ul> <li>Knowledge sharing with neighbouring communities can help build in-house staff expertise for flood management planning</li> </ul>	<ul> <li>Important that consultants tailor flood plans to specific priorities and context of communities they are working with*</li> </ul>		
<ul> <li>Partnerships with neighbouring communities, particularly First Nations,</li> </ul>	<ul> <li>Engagement with utilities (e.g. railways) is a particular challenge</li> </ul>		
strengthens planning outcomes and builds	Collaboration with Government Agencies		
regional approaches	<ul> <li>DFO does not engage in flood management plans, only formal project applications*</li> </ul>		

#### Table 6: Engagement and Collaboration Strengths & Challenges from Engagement



Strengths	Challenges
Collaboration with External Groups	
<ul> <li>Partnerships with non-profit groups (e.g., FBC, EPS) have strongly supported capacity, particularly in smaller communities</li> </ul>	
<b>Collaboration with Government Agencies</b>	
<ul> <li>Involving provincial flood staff in planning where possible can greatly strengthen planning outcomes and efficiency*</li> </ul>	
<ul> <li>Ongoing communication with EMBC as part of annual freshet planning strengthens flood management planning process and outcomes</li> </ul>	

# 3.6 Implementation

Of the 21 survey respondents that have completed, or are developing, flood management plans, 17 (81%) noted that these plans will be used for further planning (e.g., dike master plans) and 15 (71%) are linked with other strategies and documents to support integration across their organization. While some responsible authorities reported establishing stand-alone flood management policies (preferred), others have opted to instead integrate flood management into existing policies and plans. Furthermore, some communities have moved ahead with land acquisition in high-risk areas to reduce consequences and better manage flood risk.

Out of all 46 survey respondents (including those without a flood management plan), half reported having policies in place that limit the type of land-use or development in flood risk areas, 18 (40%) reported prohibiting new development in certain flood hazard areas, and 16 (35%) noted restricting redevelopment in certain flood hazard areas. One First Nation survey respondent noted that, while their community would like to implement these sorts of measures, they lack the in-house capacity to carry out this work. The inclusion of a development planning and approval process is a key component of an *integrated* flood management planning process. Issues, best management practices, and recommendations to the Province on development planning and approvals are provided as part of Issue B-6 Non-Structural Flood Management Approaches (NHC, 2020).

Case study communities highlighted the importance of careful timing for more efficient planning and implementation. For example, the District of Squamish updated its Official Community Plan (OCP) and implemented its Floodplain Management Bylaw soon after their flood plan was completed, meaning that engineering and planning staff, Council and the public already had a strong understanding of flood risks without the need for additional engagement and education campaigns. The Village of Lumby was able to draw on lessons learned from flood events that occurred during the planning process to strengthen analysis and outcomes.

However, despite these approaches to implementation, only nine (43%) of completed or in-progress plans have been or will be, officially adopted by Boards or Councils. While in some cases, this may reflect the fact that plans have led to policies that have been formally adopted, communities without Council approval of flood management planning outcomes may not have the support or momentum needed to move forward with implementation. Further, it is not clear whether the content of a flood plan is considered 'binding' or official policy if the plan document is accepted or adopted by Council.



Additional investigation may be required to better understand the barriers to putting plan content into action and official policy.

Comments from the survey noted that regional districts, in particular, have little authority to approve land-use planning changes under the *Local Government Act* without provincial involvement. Comments from municipalities highlighted the challenges that elected officials face when navigating political sensitivities and priorities, with potential re-election impact providing a disincentive for changes that may negatively affect property values and development potential. Furthermore, comments noted that Councils may be nervous about publicizing flood hazard information out of concern for potential liability. One comment noted:

"This used to be a problem, politicians / senior management were concerned about releasing flood hazard information when we didn't have a plan or all the answers. We managed their anxiety through that. This has been a common response (anxiety) in many other local governments."

Representatives from the District of Squamish and Village of Lumby both noted that there is a need for the Province to provide clearer standards and guidance for land-use requirements in flood hazard areas (e.g. cases where development should be prohibited), which responsible authorities can reference to support changes made for the public good.

A lack of provincial guidelines outlining content required in flood management plans limits consistency and, in some cases, effectiveness of flood management plans. For example, some documents that are referred to as flood management or mitigation plans appear to only focus on technical analysis results from hazard and risk assessment and do not contain much substance on flood risk reduction planning.

Furthermore, very few communities reported formal indicators for measuring successful implementation of flood management plans. Rather, responsible authorities are using informal approaches for tracking success, such as plan approval by Council, observing a reduction in damage during subsequent flood events, or successful receipt of grant funding to support implementation. Respondents noted significant challenges tracking success due to limited staff capacity for reporting on progress amongst their other responsibilities.

Implementation strengths and challenges reported in the survey and case study interviews are summarized in the table on the following page.


Strengths	Challenges
<ul> <li>The majority of plans are linked with existing strategies and will support future planning</li> <li>Sequencing updates to community plans after flood management planning supports efficient integration and implementation for risk mitigation</li> <li>Drawing on lessons learned from past flood events can strengthen planning outcomes</li> <li>Planning supports access to funding for implementation (particularly structural works)</li> <li>Regional/collaborative planning processes build consistency, compatible initiatives, and opportunities for sharing effort for implementation</li> </ul>	<ul> <li>Fewer than half of plans are or will be approved by Council, limiting ongoing implementation</li> <li>Stronger provincial policy direction is needed to direct land-use requirements in flood hazard areas</li> <li>Lack of provincial guidelines for flood management plan content leads to inconsistency</li> <li>Formal indicators are rarely used for implementation performance monitoring (due in large part to limited staff capacity)</li> <li>Regional districts have no authority to approve land-use changes</li> <li>Disconnect between watershed/floodplain boundaries and administrative boundaries</li> <li>Decision-makers have many issues and priorities to focus on which compete with prioritizing flood management*</li> <li>Political sensitivities are a barrier for land-use changes to mitigate flood risk for the community as a whole</li> </ul>

## Table 7: Implementation Strengths & Challenges from Engagement

# 3.7 Funding

Funding was the second most identified barrier to flood management planning (after staff capacity), with 29 out of 46 (63%) survey respondents noting this as a constraint. Survey respondents were asked to indicate which funding sources they have used to support flood management planning and many noted that they use a combination of sources. Of the 21 survey respondents with completed or developing flood management plans, 14 reported drawing on grant funding to develop their plan, with 6 drawing on emergency response funding, 6 using own-source revenue, and 4 reporting different funding sources for different phases of planning. These results highlight the critical reliance communities have on grant programs for flood management planning and implementation. One survey comment noted that:

### "...we are unable to fund flood planning or mitigation without grants."

Input from case study communities highlighted some of the major opportunities and challenges regional authorities may face when accessing funding. The Cowichan Valley Regional District and Cowichan Tribes noted success in accessing grant funding, in large part by leveraging regional collaboration with each other and other local communities to access funding under different grant programs and share the workload for implementing flood management work. However, Cowichan Tribes noted that the Indigenous Services Canada funding model makes it difficult to plan projects in a holistic and integrated way across departments (e.g., funding may be available for a new dike, but not for upgrades to the drainage system to accommodate the new dike, or for future operation and maintenance activities).

Smaller communities, including rural and First Nation communities, are particularly resource-challenged. The Village of Lumby noted that smaller communities have a smaller tax base and less revenue to fund



flood mitigation works. Structural flood mitigation works identified in their Flood Management Plan are expected to cost over \$30 million and will require significant own-source investment in addition to grant funding; however, tax increases generate very little revenue due to their small tax base (e.g., a 1% tax increase in Lumby generates \$8,000, whereas a 1% increase in Kelowna generates over \$1 million).

The Village of Lumby also noted that emergency response funding requires communities to act quickly to install emergency flood works during and immediately after flood events. Smaller communities have limited resources to react quickly, meaning that emergency works will need to be changed or removed after the event if they do not meet regulatory requirements. The additional time and investment to implement and then remove works could be avoided if communities had more proactive funding to put preventative measures in place to build resilience.

These and other funding strengths and challenges raised by survey respondents and case study communities are summarized in the table below.

	Strengths		Challenges
•	Regional collaboration improves access to funding, as different groups are eligible for different funding sources	•	Grant funding is not likely to be available for all flood mitigation works required in each community Small communities, in particular, don't have the necessary own-source revenue to supplement grant
•	There are a number of grant funding programs available to support flood mitigation work and emergency response in BC Flood management plans provide a clear rationale and improve access to	•	funding* Limited funding opportunities for non-structural flood management work or ongoing maintenance Grant applications are time-consuming and it can be difficult for small communities to meet application deadlines
	funding for implementation	•	Some grant funding is regionalized, resulting in "one- off" projects from only parts of the watershed
		•	Grant programs are structured toward siloed projects rather than holistic or integrated measures
		•	Emergency response funding is reactive and requires emergency works to be removed after the event if they do not meet regulations*

## Table 8: Funding Strengths & Challenges from Engagement



# 3.8 Capacity Building Priorities

Findings from engagement with responsible authorities have been used to identify a set of five capacity building priorities to guide recommendations in this report.

Capacity building priorities have been defined based on survey results outlining which barriers responsible authorities face with flood management planning. The full ranked list of barriers from the surveys is shown in Table 9, with the five most frequently-cited capacity-building priorities highlighted. Details on key challenges associated with each barrier are described in earlier sub-sections as indicated in the table below.

Rank	Barrier	# Respondents (out of 46)	Associated Challenges (Report Reference)
1	Limited staff capacity	31	Section 3.4
2	Limited financial resources or access to funding	29	Section 3.7
3	Gaps in technical information and knowledge	21	Section 3.4
4	Lack of tools, standards, guidance, and regional/provincial policy direction	21	Section 3.2
5	Political sensitivities or conflicting priorities	19	Section 3.6
6	Incorporating climate change projections	17	Section 3.3
7	Challenges working with other levels of government	15	Section 3.5
8	Complex or changing provincial or federal regulations	14	Section 3.2
9	Challenges coordinating with others (e.g., neighbouring communities, utilities)	13	Section 3.5
10	Lack of internal stakeholder recognition of non-structural flood risk reduction	6	Section 3.6
11	Challenges working with external organizations (e.g., non-profits, academic, consultants)	4	Section 3.5

## Table 9: Capacity Building Priorities from Survey

These top five capacity-building priorities are the focus of recommendations throughout the remainder of this report. The other lower priority barriers are the subject of other projects in this initiative, including climate change projections (Issue B-1) and challenges working with other levels of government and other groups (Issue A-1).



# 4. B-4.2: Investigate Opportunities to Build Capacity

The purpose of this investigation is to recommend initiatives the Province could consider leading to build capacity for flood management planning among BC local governments and First Nations.

# 4.1 Context

This investigation builds on findings in investigations B-4.1 – Existing Capacity (Section 3), and in particular aims to address the top three capacity-building priorities reported by survey respondents:

- 1. Limited staff capacity
- 2. Limited financial resources or access to funding
- 3. Gaps in technical information and knowledge

Recommendations to build capacity have been developed primarily based on the experience of survey respondents, case study participants, and KWL staff.

Recommendations have been developed in the context of the transition that occurred in the early 2000s from the previous regulatory regime under which the Province held significantly more direct responsibility in flood management planning compared to the current regulatory regime which puts local communities in a direct flood management planning role. The survey and case study results confirm KWL's experience and anecdotal observation that the expertise and capacity for flood management planning were not effectively transferred to responsible authorities when the regulatory regime changed.

A continuum of capacity-building approaches was considered in developing recommendations to increase capacity. At one end of the continuum was the idea of restoring the previous provincially-centralized regulatory regime and increasing the Province's in-house staff capacity. This option was considered but not presented as the recommended approach due to survey and case study feedback favouring capacity building to support continued flood management responsibilities among responsible authorities. Case study interviews also confirmed that responsible authorities want to remain in control of flood planning; this motivation is a foundation for effective flood planning.

Accordingly, the recommendations are based on the premise that it is very important to build flood management planning capacity in responsible authorities. Recommendations focus on providing guiding policies and resources to support responsible authorities as leaders of flood planning and on-the-ground risk reduction measures implementation (where responsible authorities are the primary actors and the Province is in a coordinating and supporting role).

A consolidated list of all recommendations in this report is provided in Appendix D.

# 4.2 Investigation B-4.2 Recommendations

Recommended initiatives that will help the Province and responsible authorities build flood management planning capacity in BC are described below.

#### 1. Increase and Support Responsible Authority In-house Staff Capacity for Flood Management Planning

Many responsible authorities do not have enough staff to participate in meaningful flood management plan development and implementation. Without these local, embedded flood management champions, flood management planning will either not be completed or will be at risk of not being implemented, or even forgotten, over time.



It is recommended that the following actions be considered to increase and support responsible authority in-house staff capacity:

• Provide grant funding to support a designated flood management staff role within each responsible authority.

This investigation has shown that the existence of a flood management champion within a community can make a significant difference in the effectiveness of flood management planning activities. The Province could establish an annual funding grant structure that provides funding to support a flood management role within responsible authorities. To distribute funding effectively and equitably, a funding grant structure should be designed to factor in the size of the community, the overall flood risk rating of the community (linked with a provincial flood risk assessment discussed in Issue B-3 Flood Risk Assessment (Ebbwater, 2020), and potentially other factors.

It is recommended that the Province establish the minimum requirements for the flood management position, but otherwise be flexible to allow the funding to be used to build capacity in the most effective way within the context of each responsible authority. For example, for some responsible authorities, the funding would be best used to support the establishment and maintenance of a 'natural hazards program manager' position whose responsibilities include earthquakes and landslides in addition to flood management. In a different community, the funding would be best used to support the establishment engineer' position whose responsibilities would be best used to support the establishment and maintenance of a 'flood management engineer' position whose responsibilities would include dike management in addition to flood management planning. It should be noted that the funding would not necessarily need to support a new Full-Time Equivalent (FTE) position in every responsible authority.

As part of the supporting role, the flood management champion could be required to prepare and submit to the Province's flood safety section a Council-endorsed bi-annual statement outlining flood management activities as well as highlighting and explaining any local government decisions that vary from the policies adopted through the IFMP. This process would be similar to the annual reporting currently required for dam and dike system operators.

A very rough estimate on the order of \$2M to \$3M per year is suggested as the cost for the Province to cover up to 50% of the salary of a 0.5 FTE 'flood management' position (i.e., funding 50% of 0.5 FTE) for communities that face significant flood hazards. This could be approximated by the ~100 diking authorities that exist in BC, though other communities in BC that are not diking authorities but are exposed to flooding should be eligible for this support.

Other Issues in this initiative have used a range of methods to estimate the number of responsible authorities at risk of flooding, with Issue B-2 Flood Hazard Information (NHC, 2020) identifying 53 communities requiring flood mapping and Issue B-3 Flood Risk Assessment (Ebbwater, 2020) finding 349 communities that could consider flood risk assessments. This wide range suggests that further analysis is needed to determine a more accurate count of the number of communities vulnerable to flooding and eligible for flood management staff funding.

Additional work and engagement with responsible authorities (e.g. survey / interviews) are required to determine the exact amount of funding required to incentivize responsible authorities to incorporate flood management responsibility formally into their staff structure. The Province has extensive experience with designing funding programs that are equitable in their distribution of funds across the many diverse communities of BC. Additional work is required to study the advantages and disadvantages of different distribution approaches. Other contexts to consider in designing the funding distribution model should include the Province's commitments related to the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and historic decisions



and policies that discriminated against First Nations and exposed indigenous peoples to disproportionately higher flood risk.

It should also be noted that the Province could potentially require responsible authorities to have designated flood management positions through legislation/regulation without providing additional funding. However, this would likely not be an effective approach given that responsible authorities already feel that they lack the funding or have other competing investment priorities that limit the development of in-house capacity.

 Develop and implement a provincial support program comprising an annual flood management training program, an on-going community of practice hub, and a provincial liaison program.

This is envisioned as an annual single or multi-week training program that could be delivered virtually by provincial staff, supplemented with provincial liaison on-call support services for responsible authorities and a (virtual) community of practice hub which would connect flood management champions from different responsible authorities for resource sharing and knowledge exchange. It is assumed that existing provincial staff do not have any additional capacity to deliver the training or act as liaisons. Given that there is approximately 13 FTE deputy inspector of dikes positions at this time, it is assumed the addition of 2 FTE dedicated to the support program could serve as a starting point, though the responsibility may be distributed across a number of Flood Safety staff. The cost for this is estimated at approximately \$250,000 per year, including \$100,000 per FTE and an estimated \$50,000 for expenses per year, including developing a community of practice website. An alternative may be to deliver the training and on-call services through a contracted consulting firm; the costs would be expected to be similar. While the costs are similar the provincial staff approach is considered more effective given that it would lead to more relationship building between responsible authority staff and provincial staff.

### 2. Enhance and Participate in Flood Management Planning Funding Programs

Existing flood management planning funding programs (e.g., UBCM CEPF) can be enhanced as follows:

# • Increase recent levels of senior government financial support for flood management planning initiatives.

Implementation of the previous recommendations would significantly expand the capacity of responsible authorities to attempt to access existing funding programs for flood management planning. This recommendation aims to increase the level and flexibility of funding programs to meet the anticipated increased demand for funding associated with the capacity expansion. This is also provided as a major recommendation in Section 6 which focuses on the Province's regulatory role.

#### Extend the typical grant timeline of one year to support multi-year projects.

This change would provide the additional time required for complex assessments, incorporation of new information that emerges during the process, and multiple rounds of community, First Nations, and stakeholder engagement. This change could be accommodated within the funding envelopes that the Province, responsible authorities, and other funding partners provided through the life cycle of various funding programs.



- Increase the flexibility of funding grant programs to allow integration of flood management planning with other related community planning activities (e.g., drainage master planning, watershed planning, and multi-hazard risk reduction planning).
- Assign a provincial deputy inspector of dikes or other qualified flood safety staff to each IFMP project.

The provincial delegate would represent provincial flood safety interests and provide technical expertise. The participation of provincial staff will empower responsible authority staff to better incorporate provincial guidelines and best management practices, particularly when faced with internal, stakeholder, and/or political pressure. It would also allow provincial representatives to guide projects toward consistency across multiple jurisdictions. This would be similar to the approach taken by the Province in its Integrated Watershed Management Plan program in the 1980's.

It is difficult to estimate the cost of this action because provincial staff currently have very little involvement in flood management planning projects. Formalizing this involvement may require increasing the provincial staff by at least 2 FTE. This recommendation is linked with the earlier recommendation to add 2 FTE provincial staff to develop the provincial support program. The \$250,000 cost estimate presented earlier would cover both recommendations, with the same 2 FTEs administering both recommendations.

# • Emphasize the importance of the flood management planning process by making a provincially-accepted IFMP a pre-requisite for funding for structural flood mitigation works.

This is also discussed in Section 6. Other incentives to conduct IFMPs could include making them a pre-requisite for providing Disaster Financial Assistance (DFA) after a flood event. The costs associated with legislating flood management planning is addressed in Recommendation #1 under Section 6.4. No additional cost above that amount is expected for using legislated plans as a pre-requisite for funding.

#### 3. Increase Knowledge of Flood Management Planning Among Community Leaders and Administrators

Responsible authority staff must work within the political and administrative contexts of their community. As discussed earlier, having a flood management champion among staff is a critical need. However, staff cannot implement initiatives without the buy-in of community leaders and administrators. Increasing knowledge of flood management planning and appreciation of its importance can develop flood management champions within the elected and administrative ranks of local or First Nations government. This would further enable a community to develop and implement effective flood management plans.

# • Tri-annual training for political leaders and administrators could be delivered by provincial staff and/or a peer network group of responsible authority staff virtually.

The advantage of including provincial staff is that it allows for a regular interaction between community leaders and provincial staff which is another avenue to continue to keep flood management as a priority within local communities. This could be done on the sidelines of other events such as the annual UBCM convention or perhaps the regional local government associations. No additional cost estimate is provided for this recommendation because it is assumed that the increase to provincial flood safety staff capacity recommended above would provide staff time to deliver this training.



The core content of the training would generally apply to all types of responsible authorities, but some additional content may be required for First Nation communities to focus on the role of the federal government on flood management within Frist Nation communities. This could be used as a reason to hold a separate training for First Nations. However, there are also benefits to hold combined training events related to collaborative action.



# 5. B-4.3: Investigate Content for a Provincial IFMP Guideline

This investigation outlines potential content to include in a provincial IFMP guideline along with recommendations for specific initiatives the Province could take to support guideline development. The guideline would be developed by a provincially-led, inter-jurisdictional working group with strong representation from responsible authorities, and would serve as a resource for responsible authorities in developing community-specific IFMPs.

This investigation builds on findings in investigations B-4.1 – Existing Capacity (Section 3), and in particular, aims to address capacity building priority #4 (Table 9, from engagement): "Lack of tools, standards, guidance, and regional/provincial policy direction". Recommendations for guideline content have been developed based on a combination of best practices from literature review and professional experience in developing BC-based IFMPs.

The purpose of an IFMP guideline would be to enable and empower responsible authorities to develop IFMPs that:

- effectively identify, quantify, and manage flood risk;
- are consistent with other IFMPs across BC; and
- satisfy the Province's minimum expectations for flood management (to be defined).

The guideline must provide flexibility to adapt to local context, encouraging responsible authorities to consider, but not necessarily adopt, the full scope of Integrated Flood Management Planning while prescribing a required scope of core tasks. This vision reflects the wide variety of flood management contexts that exist across BC. The guideline would provide responsible authorities with key flood management planning resources as well as a roadmap of the steps and the minimum requirements for developing an IFMP in BC.

This section provides a summary of literature best practices, a high-level overview of potential guideline content, and a preliminary minimum requirements roadmap that could be included with the guideline. It is recommended that this guideline content and roadmap serve as a starting point for further refinement by the Province.

Section 6 provides discussion and recommendations related to how the Province can support responsible authorities in referring to this guideline to develop and implement their own IFMPs.

# 5.1 Integrated Flood Management Plan and Process

An IFMP is a document prepared by a flood management organization (e.g., a community / level of government) that outlines the preferred combination of measures for managing flood risk. The core concept of an IFMP is the adoption of a holistic, systems-based approach that responds to a community's flood hazard portfolio with an optimal combination of tools (structural, non-structural, emergency response and recovery, etc.) that will reduce risk to an acceptable level without incurring unacceptable economic, societal or environmental costs. The IFMP itself becomes a policy document that is aligned with and also guides other policy documents and planning processes (e.g., land-use planning, infrastructure management, and emergency response planning).



Flood management literature has produced several frameworks that provide guidance on best approaches for integrated flood management planning. These frameworks outline key considerations, step-by-step processes, and an overview of flood management strategies to include in a risk management plan. Of the resources reviewed for this project, three sources in particular outlined recommendations or best practices for taking an integrated approach for flood management planning (WMO, 2017; Sayers et al., 2015; Stevens and Shoubridge, 2015). Based on common themes from these best practices, an IFMP should:

- Identify and respond to a level of flood risk that the community is prepared to accept, recognizing that absolute protection is not possible;
- Consider the full range and scales of flood-related hazards (including interlinkages between coastal/river flood management and drainage) that could affect the community;
- Engage other jurisdictions and stakeholders as necessary to define a holistic response to the relevant flood hazards;
- Assess the economic, social, cultural and environmental impacts of floods and flood mitigation alternatives to promote an equitable, fair and sustainable distribution of costs and benefits;
- Define an optimal balance of structural and non-structural measures that, taken together, can reduce flood risk to the desired level;
- Integrate water management, land-use planning and development decisions;
- Consider conditions over the lifecycle of the measures recommended by the plan (e.g., climate change projections at the redevelopment time scale for land-use decisions and floodproofing requirements);
- Align with other ongoing planning initiatives; and
- Adopt a participatory approach to encourage community buy-in.

An IFMP's approach to risk reduction is comprehensive in that it considers the full spectrum of opportunities to reduce risk. In the context that risk is the product of hazard and consequence, the source-pathway-receptor concept (HR Wallingford, 2005) provides a helpful framework for identifying the full spectrum of risk reduction measures. This is presented visually in Figure 7.



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Flood risk can be reduced at the source level through measures focused upstream of the flood hazard area. These can include policy measures that would vary by context. For a riverine flood management, example measures could include watershed management policies to retain forests and wetlands and slow down flood processes. These can also include structural measures such as upstream reservoirs to regulate flood hydrology.

Flood exposure is the pathway between hazard and consequence. Risk reduction measures at the pathway include measures to reduce flood exposure by focusing on the hazard or by focusing on the elements exposed to the hazard. Measures focusing on the hazard portion of the pathway typically include structural flood mitigation measures (e.g., dikes). Measures focusing on the consequence portion of the pathway typically include land-use planning measures to avoid future development and infrastructure in the floodplain or to retreat/relocate development and infrastructure from the floodplain.

Finally, flood risk can also be reduced by measures focused on the receptors of flood exposure (i.e. people, buildings, infrastructure, habitats, etc.). These can include building and infrastructure floodproofing measures, using flood resilient design, and evacuation planning measures.

As discussed in other investigation reports, flood mapping and risk assessment are important steps towards flood management, but they do not in themselves result in a flood management plan. In most cases, it is likely inappropriate to implement flood risk reduction measures (structural or non-structural) directly from a flood mapping and/or flood risk assessment project. Flood management plans should provide an important first step for further dialogue and planning before moving into design and implementation of risk mitigation projects. The World Meteorological Organization's integrated flood management guideline describes the key approaches that should be considered as part of the portfolio of measures in an integrated flood management planning process (WMO, 2017). These approaches are shown in their planning framework in Figure 8.



Figure 8: Integrated flood risk management framework (WMO, 2017)

Some measures identified by the IFMP may not be feasible or acceptable to a community, but a transparent process must show that the measures were considered and set aside for reasons that



reflect both community values and integrated flood management best practices. This comprehensive and transparent evidence-based approach helps to eliminate bias (both real and perceived) as well as political conflicts of interest from the flood management process. The transparency of an IFMP will also provide an important role for the Province to guide and support effective flood risk management. The Province's role and related recommendations are discussed in Section 6.

An IFMP acknowledges that flood risk generally cannot be eliminated and focuses on managing risk over time such that the residual flood risk (remaining risk after the implementation of the plan) is tolerable to the community. An IFMP may effectively reduce risk without defining a flood risk tolerance goal or target; however, the community and the Province will not know if the community can be considered "safe", or if the outcome is commensurate with the level of risk accepted in other parts of BC.

The result of the IFMP process is a formal plan that defines and sets a path for implementing a preferred combination of flood risk reduction measures. When adopted by a local Council, the IFMP itself becomes a policy document that guides flood-related elements of other policy documents and planning processes (e.g., land-use planning, infrastructure management, and emergency response planning). As such, IFMPs should not only *integrate* different flood risk management approaches, but also be *integrated* with practices and policies across the organization, including land-use and planning, public safety and emergency response, capital planning and asset management, and environmental management.

# 5.2 About the Guideline and Recommended Table of Contents

The recommended IFMP guideline should provide responsible authorities with:

- A clear definition of an IFMP, including purpose, guiding principles, and intended outcomes;
- Minimum requirements reflecting the Province's expectations for flood risk management;
- Identification of different approaches to conduct IFMPs (hazard-based, risk-informed, or risk-based);
- Minimum flood risk tolerance criteria (expressed to enable hazard-based, risk-informed, or riskbased IFMPs);
- Educational resources (e.g., toolkit) on the range of flood risk reduction measures that should be included in an IFMP. Measures could include: structural, non-structural, and land development (e.g. clear direction to deal with land development applications in the flood hazard area, and in particular when approval should be withheld);
- Guidance on how different measures and combinations of measures could be evaluated;
- Information on how to implement/monitor IFMPs and the Province's regulatory role (discussed in Section 6);
- Criteria that should be considered when defining the trigger conditions for updating the IFMP.

It is important to note that the proposed guideline would be supplementary to other existing guidelines. For example, the provincial flood hazard area land-use management guidelines focus on land-use applications which is one component of an IFMP process. Another example is the provincial dike design and construction guide which also focuses on one component of an IFMP process. The proposed guideline would focus on the integration of various individual components.

The following is a suggested table of contents for the guideline, including key appendices. This outline has been developed based on feedback from engagement with responsible authorities, literature best practices, and professional experience developing previous IFMPs in BC.



Section	Description
1	Introduction and Purpose of Guideline
2	Jurisdiction, Relevant Legislation, and Other Guidelines
3	Roles and Responsibilities
4	Integrated Flood Management Plan (IFMP) Definition
5	IFMP Approaches to Flood Assessment (Hazard-Based, Risk-Informed, Or Risk-Based)
6	Considering Climate Change in Flood Planning
7	Minimum Requirements Roadmap
8	Flood Tolerance Criteria
9	Flood Risk Reduction Measures Toolkit (Including Education Resources on the Spectrum of Structural, Non-Structural, and Land Development Measures)
10	Implementation Plan and Monitoring Guidance
11	Risk Reduction Measures Selection
12	IFMP Adoption and Provincial Approval
13	Updating of Policies and By-Laws
14	Regular IFMP Reviews and Updates
Appendices	
A	IFMP Roadmap (Minimum Requirements Template)
В	Links to Sample IFMPs

Further details on the level of effort and process to develop an IFMP guideline are described in Recommendation B-4.3.1.

# 5.3 Preliminary Minimum Requirements Roadmap

A key component of the guideline should be to define a roadmap of what development of an IFMP should involve and what content it should include meeting the goal of defining and enabling a strategy for flood risk management. This section of the guideline (Section 6 in the above suggested table of contents for the guideline) would set a clear framework for the specific steps a responsible authority should go through and the key considerations that must be taken into account in order to meet provincial flood management planning requirements. The development of a Preliminary Minimum Requirements Roadmap is proposed under Recommendation B-4.3.1 in a later subsection of this report. Recommendations for the Province's role in IFMPs are presented in Section 6.

A preliminary draft of the roadmap is shown in Figure 9, with further description of each step in the following sub-sections. The minimum requirements roadmap has been designed to support three alternative approaches to the core analyses that inform an IFMP:

• **Hazard-based** – This approach reflects the conventional approach to flood management in BC over the last several decades. It focuses on identifying and responding to the hazards (inundation depth, velocity, and extent) associated with one or more flood scenarios (typically defined by return period / annual exceedance probability) without attempting to identify the specific consequences that may



result. The hazard-based approach would not directly or quantitatively assess flood risk, but risk would be indirectly considered through an inventory of the amounts and types of receptors (population, development, habitat, critical or cultural sites, etc.) that would be impacted by each scenario. This approach is generally not recommended for most responsible authorities, as it is not in line with international flood risk management best practices. However, this approach may still be reasonable for some communities (e.g. very small communities with limited flood hazard exposure), particularly those with very limited flood exposure and homogenous, lower-density land-uses in the floodplain. Flood risk management measures would still be assessed based on their individual and combined effectiveness in reducing flood risk, but the assessment would be based mostly on judgement in lieu of a thorough risk assessment within the IFMP process. It is reasonable to expect that the suite of flood risk reduction measures resulting from this approach may be more conservative than from a more comprehensive approach. Without fully assessing risks, it is prudent to apply more conservative risk reduction measures that may be necessary if the IFMP is guided by a detailed risk assessment and quantitative or semi-quantitative risk tolerance criteria. For this approach, the risk reduction planning would likely involve an As Low As Reasonably Practicable (ALARP) perspective where risk reduction measures are applied until the cost of additional risk reduction is greatly disproportionate to the incremental benefit of risk reduction. In many cases, responsible authorities will choose to go beyond a hazard-based approach because it will allow them more flexibility and less conservatism in developing their IFMP.

- **Risk-informed** This approach would reflect current best practices in BC and some international • iurisdictions. The IFMP would assess flood risk through quantitative or semi-quantitative methods. Combinations of flood risk management measures would be tested to determine how they reduce flood risk and to estimate the residual flood risk. The risk-informed approach is less complex and comprehensive than the risk-based approach (described below) because it would not use strict quantitative risk tolerance criteria and would not require a detailed fully quantitative risk assessment. Rather, the risk-informed approach would provide flexibility to the responsible authority to insert more judgement into the assessment of flood risk, the effectiveness of flood risk reduction measures, and the acceptability of residual risk. A risk-informed approach would use 'risk' as a lens to select and combine different mitigation measures. It should be noted that the resulting measures would still likely be described in terms of a hazard design/policy standard (e.g. design event return period for dikes or return period for flood construction levels), but the selection of the hazard level would be linked to risk reduction. This could result in stricter than historic design requirements (e.g. higher return periods) for structural mitigation works and floodproofing policies. This approach is expected to be appropriate for the majority of responsible authorities in BC given that it advances beyond the conventional hazard-based approach but is less effort-intensive than the risk-based approach described below.
- Risk-based This approach would reflect the current best practices in leading flood management jurisdictions in the world, including the Netherlands. The IFMP would assess flood risk through a fully quantitative risk assessment that would determine baseline risk in terms of specific risk metrics such as annualized average probability of mortalities and annualized average economic impacts per unit area. Issue B-3 Flood Risk Assessment (Ebbwater, 2020) provides additional discussion of the intricacies of a fully quantitative risk assessment approach. The effectiveness of different combinations of flood risk management measures would be determined quantitatively through the same risk metrics and would be evaluated and compared using quantitative flood risk tolerance criteria. A risk-based approach would use 'risk' as a lens to select and combine different mitigation measures. It should be noted that the resulting measures would still likely be described in terms of a hazard design/policy standard (e.g. design event return period for dikes or return period for flood construction levels), but the selection of the hazard level would be linked to risk reduction. This



could result in stricter than historic design requirements (e.g. higher return periods) for structural mitigation works and floodproofing policies. This approach is the most comprehensive and transparent approach and is best suited to communities with significant current or future people and asset flood exposure and/or highly complex flood risk processes (e.g., river dike breaches interacting with downstream sea dikes). It is also the most suitable to identify an optimal suite of tools that achieves acceptable risk mitigation at minimum cost.

While the overall IFMP development steps will remain the same for each approach, the minimum content requirements will vary, allowing responsible authorities to choose the approach best tailored to their local contexts and capacity. In addition to the roadmap graphic and list of minimum requirements, the Province may wish to use community case studies to show what these different approaches look like in practice. In the end, the Province should consider whether all three of the above approaches should be open for consideration, and clearly define the conditions and context in which a particular approach would be considered appropriate for a particular IFMP. It is also important to note that the selected approach need not be strictly applied across dimensions of the IFMP that go beyond the minimum roadmap. For example, if a responsible authority adopts a risk-based approach to loss of life and economic damages there should be no barrier to it taking a hazards-based or risk-informed approach in a complimentary evaluation of social and/or environmental impacts.

The following sections describe each step in the roadmap process, including the minimum requirements for what should be considered and completed as part of each step.



STEP 1

STEP 2

STEP 3

STEP 4

STEP 5

STEP 6

STEP 7

STEP 8

Updates

Fraser Basin Council Investigations in Support of Flood Strategies in British Columbia Flood Planning (B4) Final Report December 2020

**Risk-**

Based

Based on annualized

linked to life safety

average metric

Map multiple AEP

(quant.)

Quantitative

measures

evaluation of

& climate scenarios

**Risk-**

#### Informed Based Includes a staff project manager, political leader or senior managers Meets at least 5 times during IFMP development Form a Steering Committee Includes necessary expertise to recommend supportable outcomes Confirm IFMP study area, flood hazards, and planning time horizon n G Identify preferred study approach (e.g. risk vs. hazard-based) **Confirm IFMP Scope and** Produce an initial estimate of required resources for completion **Planning Timeline with Climate Scenarios** Based on AEP and Based on max consequence for 2 AEP for one or **Define Flood Risk Tolerance** or more scenarios more scenarios Require LiDAR, topo/bathymetric survey data for all hazard areas Map multiple AEP & Map at least 1 AEP Acquire Technical Data or Preclimate scenarios and minimum GOING COMMUN (semi-qual.) requisite Information climate scenarios Risk reduction measures include structural and non-structural. Qualitative Semi-qualitative **Risk Management Measures** evaluation of evaluation of Identification and Evaluation measures measures Combination of structural and non-structural mitigation measures ٠ Define required timeline, cost, and responsible department for each **Implementation Plan and** • List monitoring metrics with targets to monitor progress of structural **Monitoring Metrics** and non-structural measures Council or Board formal acceptance of IFMP Submit IFMP to Province for review and conditions of approval **Approval and Implementation** Formally acknowledge approval and designate staff to report to Province about ongoing implementation Define IFMP review and update triggers and timelines Complete parallel IFMPs and recommended supporting studies and Framework for Review and data collection prior to the next update

Hazard-

Figure 9: Preliminary Minimum Requirements Roadmap Summary



# Step 1 – Form a Steering Committee

Each IFMP should be led by a steering committee of staff and key representatives from neighbouring or regulatory groups. The purpose of the steering committee will be to guide the IFMP development process and identify and recommend technically and politically supportable outcomes to the responsible authority's decision-making body at key points throughout the process.

It is critical that a steering committee includes (or is advised by) sufficient expert-level personnel to address the wide range of complex issues that will arise. At minimum, each steering committee should include the following members:

- Responsible authority staff project manager for IFMP development (ideally the 'flood management position' discussed in the recommendations provided in Section 4)
- Decision-makers (e.g., councillor) or government administrator(s) (e.g., CAO or band administrator) from each participating responsible authority who will become the champion among decision-makers when presenting the steering committee's results, particularly when decisions have financial or other community implications; and
- A Province of BC flood safety representative (ideally, a deputy inspector of dikes or equivalent staff, as discussed in the recommendations provided in Section 6).

It is also recommended that the steering committee invite representatives from First Nations in whose traditional territory the IFMP will occur, regional districts, and other key groups. Indigenous Services Canada (ISC) representatives should be invited to participate in the Steering Committee for any IFMP that includes First Nation reserve areas.

The committee should also consult or engage managers from relevant departments within the responsible authority such as, but not limited to, public works, engineering, environment, development and planning. For larger communities, there may need to be multiple committees or an internal engagement framework to avoid making the steering committee too large. The steering committee does not necessarily need to be involved in the day-to-day work of developing an IFMP, but should be informed and enabled to make key decisions, such as confirming the preferred combination for flood risk reduction measures for the community.

The steering committee should be established at the start of the IFMP development process. Terms of reference document for the steering committee outlining roles, responsibilities, communication pathways, and processes for addressing decisions and conflicts can be used to support the committee.

### Table 10: IFMP Step 1 (Steering Committee) Minimum Requirements

		/ /	
	Hazard-based Approach	Risk-informed Approach	Risk-based Approach
•	Includes a staff project manager and political leader or senior administrator from each participating responsible authority, and a Province of BC flood safety representative.		
•	Meets at least 5 times during IFMP development, including project scoping, risk tolerance criteria confirmation, evaluation of flood risk reduction measures and combination of measures, and draft IFMP review.		

• Includes expertise and authority required to identify and recommend technically and politically supportable outcomes to each responsible authority's decision-making body.



# Step 2 - Confirm IFMP Scope and Planning Timeline with Climate Scenarios

This step of the minimum process roadmap refers to defining the scope of work that the IFMP will address and the timeline for completion. For convenience, the scoping exercise may be thought of as specifying the technical content that would eventually be incorporated into a funding application, a Report to Council seeking authorization to proceed, and/or a Request for Proposals for consulting services. More specifically, key items in the scoping process include:

- The geographic area(s) that the IFMP will cover
- The range of hazards that the IFMP will consider
- The planning time horizon that the IFMP will assess
- The range of sectors, receptors, and/or consequences that will be incorporated
- The approach to technical analysis (e.g., hazard, risk-informed, or risk-based)
- The approach to community engagement (e.g., as reflected by the IAP2 continuum) and key stakeholders who will require bilateral engagement (e.g., major industry, infrastructure utilities)
- Major sources of critical data that the Steering Committee believes will reasonably be required (e.g., LiDAR and GIS information) and its current availability
- Appropriate mechanisms for project delivery (i.e., which major tasks should be done by consultants versus internal staff, how appropriate consultant(s) will be selected and retained, and how joint decisions will be made where there are multiple responsible authorities); and
- An initial estimate of the required budget and timeline for completion.

The most important of these items are discussed in more detail below.

The IFMP should clearly identify which geographic area the IFMP will cover and what flood hazards and community sectors (e.g., population, buildings, infrastructure, etc.) will be considered in the flood risk assessment phase. Given the IFMP intent to integrate flood management with overall community planning, the IFMP geographic area should cover all flood hazard areas in the responsible authority jurisdictions. In some contexts, there will be multiple responsible authorities involved in a single overlapping flood hazard area, e.g. the Lower Mainland communities along the Lower Fraser River. In these contexts, a regional approach may be more effective. Given that the Lower Mainland is the key example for this context and that the FBC is already facilitating the development of the Lower Mainland Flood Management Strategy, this investigation does not provide specific guidance on regional IFMPs.

The scoping decisions should consider what flood hazards and other related hazards are included in the IFMP. For example, will the IFMP take an all-flood-hazards approach (e.g., tsunami, coastal flood, river flood, debris flow/flood, and landslide) or will different IFMPs be created for different hazards? This question can only be answered with consideration of local context and available resources, and with an understanding of the cross-project coordination that will be required if a multi-study approach is selected. Including a provincial flood safety representative on the IFMP steering committee will allow provincial input and insight into the discussion.



In addition to the geographic scope, the steering committee should define the planning time horizon, which will inform the selection of climate change scenarios to be considered in the technical work that will serve as the foundation for the IFMP (flood hazard analysis and mapping and risk assessment). Current provincial policy related to sea-level rise, coastal hazards, and sea dikes focuses on the Year 2100 and Year 2200 as two planning horizons for consideration. The Year 2100 timeline is linked to development management in the floodplain and structural flood mitigation. The Year 2200 timeline is linked to long-term land-use planning activities. The participation of a provincial representative on the IFMP steering committee will provide an opportunity for the Province to aim for consistency in planning time horizons across all IFMPs in BC, while also allowing for flexibility in the planning horizon to suit different community land-use contexts by considering

questions related to the anticipated timeline for development of greenfield sites and redevelopment of existing developed areas. Once the planning timeline has been determined, the relevant climate change scenarios related to the planning horizon can be specified. Issue B-1 Impacts of Climate Change (Associated Engineering, 2020) provides additional discussion of climate change considerations that may be relevant for consideration in this step of the IFMP process.

## Table 11: IFMP Step 2 (Confirm IFMP Scope and Planning Timeline) Minimum Requirements

	Hazard-based Approach	Risk-informed Approach	Risk-based Approach
•	Determine and confirm IFMP study area.		
•	Confirm which flood hazards (e.	n., floods, debris-flows, debris-floods	s, coastal floods, tsunami.

- Confirm which flood hazards (e.g., floods, debris-flows, debris-floods, coastal floods, tsunami, landslides, etc.) will be included in the IFMP.
- Confirm IFMP planning time horizon (e.g., Year 2100) and identify relevant climate change scenarios (refer to Issue B-1 Impacts of Climate Change).
- Identify preferred study approach (hazard vs risk, consequence considerations, community engagement, project delivery)
- Produce an initial estimate of the required budget and timeline for completion.

# Step 3 – Define Flood Tolerance Criteria

As discussed previously, flood tolerance criteria are a critically important component for the development and implementation of IFMPs. This criteria establishes the ultimate goal that the IFMP process is trying to achieve through risk reduction measures. Without it, the effectiveness of an IFMP process cannot be assessed.

Refer to the Issue B-3 Flood Risk Assessment (Ebbwater, 2020) for a detailed discussion of flood risk tolerance criteria definition approaches and knowledge gaps in Canada and other jurisdictions.

For the purposes of enabling effective IFMPs in BC in the short-term, it is recommended that the IFMP guideline contain <u>minimum provincial flood tolerance criteria</u> for each IFMP approach as follows:

### 1. Hazard-based tolerance criteria

This would specify the minimum return period or maximum annual exceedance probability for flooding of land that is considered tolerable by the Province. While the obvious initial interpretation is the current provincial standard design flood (1894 flood of record along the Fraser River and 200-year return period flood elsewhere), hazard-based tolerance criteria could also be linked to properties of the physical hazard (e.g., depth, velocity, depth x velocity or hazard rating) as well as appropriate land-uses to provide more definition flexibility.



An example would be: "Flood hazards are considered tolerable where the estimated return period for water depths up to 0.1 m depth in residential and commercial land-use is greater than 200 years (or the annual exceedance probability is less than 0.5%)."

The key decision factor for the IFMP would be the physical property itself rather than the inventory of receptors that would be affected by the hazard tolerance event. Using simple tolerance criteria such as the current design flood, the hazard-based approach is able to distinguish between areas of acceptable and unacceptable hazard in different parts of the floodplain. Introducing enhanced tolerance criteria as suggested above would allow the hazard-based approach to also distinguish between different types of development in different parts of the floodplain. During the IFMP, the inventory of receptors affected should be reviewed to confirm that the selection of hazard-based tolerance criteria is appropriate.

More complex consideration would be required when applying these enhanced criteria in dike-protected areas (e.g., by considering conditions resulting from a dike breach at the most critical location under the most likely joint probability of river flood and dike failure).

#### 2. Risk-informed tolerance criteria

This would specify tolerable risk as a combination of flood hazard and potential consequence with linkages to different flood event likelihoods. However, it would not be a formal risk-based criteria (see below). The definition can be linked to flood depths and land-uses to provide more definition flexibility.

This process is differentiated by the consideration of multiple flood hazard scenarios that span a range of probabilities, and by reference to quantitative properties (e.g., the number of receptors affected in each scenario) rather than the physical properties of the hazard or the details of flood consequences (e.g. exposure instead of damage). This provides the IFMP with the critical basis to differentiate between different development densities in different parts of the floodplain, as well as the critical ability to evaluate and respond to cumulative effects across the community.

An example would be: "Flood risk is considered tolerable where the population exposed to 0.1 m of flood depth or more is less than 10 persons per hectare up to the 50-year return period event and is less than 100 persons per hectare up to the 200-year return period event."

#### 3. Risk-based tolerance criteria

This would specify tolerable risk as an annualized average metric linked to population life-safety and/or economic impacts. A quantitative risk assessment approach is implied for these receptors; however, it can (and often will) be complemented by hazard-based or risk-informed assessment of other consequences.

An example would be: "Flood risk is considered tolerable where the average annual risk of mortality due to flooding is less than 1/100,000 and where the average annual risk of direct economic impact due to flooding is less than \$1,000 per hectare." Additional criteria would typically be applied for cumulative risks (e.g., through the use of an F-N curve that displays the probability of having N or more fatalities per year). It is relevant to note that this approach would be a move away from a consistent hazard return period for the design of structural flood mitigation works. The resulting system would be more complex because it would involve different design standards in different areas to achieve consistent tolerable residual risk.

As part of the scoping process, the IFMP steering committee would select the type of risk tolerance criteria and IFMP (hazard-based, risk-informed, or risk-based) that is best suited to the community. The IFMP would also choose whether to use the minimum risk tolerance criteria required by the Province or to develop their own more conservative criteria based on other sources referenced in the guideline.



	Hazard-based Approach		Risk-informed Approach		Risk-based Approach
•	Specify tolerable risk in terms of the minimum return period or maximum annual exceedance probability for physical properties of flooding. The criteria may be limited to only one flood return period or annual exceedance probability.	•	Specify tolerable risk in terms of a combination of flood hazard and potential consequence expressed across multiple flood event return periods or annual exceedance probabilities. Supports IFMP consideration of land-use, density, and cumulative effects.	•	Specify tolerable risk as an annualized average metric linked to population life- safety (e.g., individual mortality probability or group fatality probability (F-N curve) and economic impacts (annualized average direct economic impact per unit area).
•	Province could develop enhanced criteria to differentiate different land- uses.			•	Can be combined with hazard-based or risk- informed consideration of other consequences.
•	Does not allow the IFMP to account for density or cumulative effects.				

## Table 12: IFMP Step 3 (Define Flood Tolerance Criteria) Minimum Requirements

## Step 4 – Acquire Technical Data or Prerequisite Information

Flood hazard mapping and flood risk assessment are critical foundations for an IFMP and should consider climatic, hydrologic, and physical/human geographic (land-use, infrastructure, etc.) and non-stationarity. Preparing some of this data (e.g., LiDAR and bathymetric survey) may involve considerable cost or effort and is typically undertaken as a prerequisite input to the IFMP process. It is recommended that an IFMP guideline would encourage communities to draw on existing flood mapping completed within the past 10 years and provide guidance on how to incorporate or use the results of hazard and risk assessments to inform IFMP development.

Other prerequisite information that should be considered as part of IFMP development includes community land-use and emergency plans and policies (e.g. zoning bylaw, building bylaw, hazard development permit areas, land-use plan, official community plan, emergency plan, etc.).

The reader is referred to other project reports within this initiative, including Issue B-1 Impacts of Climate Change (Associated Engineering, 2020), Issue B-2 Flood Hazard Information (NHC, 2020), and Issue B-3 Flood Risk Assessment (Ebbwater, 2020) for a discussion of these important components and related recommendations.

Depending on the community context, an IFMP may proceed as a single project that encompasses the flood hazard mapping and baseline risk assessment work or may proceed as two (or more) projects that separate the initial baseline assessment from the mitigation analysis. For larger and more complex contexts, it is recommended that the risk reduction planning and associated analysis be conducted separately and after the initial flood hazard mapping and baseline risk assessment have been completed. As discussed further below, such staging allows these projects to fine-tune the scope of the often-iterative assessments needed to assess the effectiveness of different combinations of flood risk reduction measures in achieving the flood risk tolerance criteria. However, the initial baseline components may be treated as critical pre-requisites for accessing grant funding to continue the IFMP, meaning that delays in accessing this data can cause delays or barriers to access funding for developing an IFMP.



	Hazard-based Approach	Risk-informed Approach	Risk-based Approach
•	All approaches require LiDAR information for all hazard area	A / topographic survey data, bathymet as and potential consequences to be	ric survey data, and GIS assessed.
•	Flood inundation analysis and mapping for a minimum of one or more flood return period or annual exceedance probability event(s) that reflect the hazard-based flood tolerance criteria. Consideration of a minimum number of climate change scenarios	<ul> <li>Flood hazard (depth, velocity, depth-velocity product) analysis and mapping for multiple flood scenarios that span an appropriate range of return periods or annual exceedance probabilities.</li> <li>Consideration of a minimum number of climate change scenarios</li> <li>Baseline semi-quantitative flood risk assessment focusing on flood events and consequence variables reflected in the flood risk tolerance criteria.</li> </ul>	<ul> <li>Flood hazard (depth, velocity, depth-velocity product) analysis and mapping for multiple flood scenarios that span an appropriate range of return periods or annual exceedance probabilities</li> <li>Consideration of a minimum number of climate change scenarios</li> <li>Baseline quantitative flood risk assessment focusing on flood events and consequence variables reflected in the flood risk tolerance criteria.</li> </ul>

### Table 13: IFMP Step 4 (Acquire Technical Data) Minimum Requirements

## Step 5 - Risk Management Measures Identification and Evaluation

A key component of an IFMP is the consideration of the full range of structural and non-structural measures. Measures should be identified and discussed in terms of applicability, effectiveness, and advantages and disadvantages in terms of local context (including cost, environmental impact, logistics, and other criteria). This is an important component: the IFMP must demonstrate to the community that it has meaningfully considered a variety of measures, including emerging, innovative measures and those that have been historically ignored in many parts of BC due to lack of political support. Examples of these include land-use restrictions and property buyouts in high-risk areas. The participation of a provincial flood safety representative in the steering committee is expected to promote discussion and consideration of all relevant measures.

Iterative assessments are often required to assess the effectiveness of different combinations of flood risk management measures in achieving the flood tolerance criteria. Different combinations of measures should be tested in terms of their anticipated benefits with the ultimate goal of finding multiple combinations that are capable of producing a residual result that meets the project's flood tolerance criteria. Impact assessments (including costing) may be completed at each step to inform the iteration process or may be deferred until one or more strategies are shown to meet the flood tolerance criteria.

Issue B-3 Flood Risk Assessment (Ebbwater, 2020) provides more detail on approaches and recommendations for risk assessment and evaluation. Issue B-5 Structural Flood Management Approaches (NHC, 2020) and B-6 Non-Structural Flood Management Approaches (NHC, 2020) discuss structural and non-structural flood risk reduction measures and provide related recommendations.



Table 14: IFMP Step 5 (Risk Ma	anagement Identification and	d Evaluation) Minimum Requirements	
Hazard-based Approach	Risk-informed Approach	Risk-based Approach	
<ul> <li>Structured identification and description of flood risk reduction measures within community context including all measures listed in the guideline.</li> <li>All combinations of risk reduction measures under consideration should include some form of non-</li> </ul>			
high-hazard areas).			
<ul> <li>Mapping of residual hazard areas</li> <li>Inventory of potential receptors in residual hazard areas (if any)</li> <li>Qualitative discussion of the effectiveness of the</li> </ul>	<ul> <li>Flood hazard analysis an combinations of flood risk</li> <li>A single combination may feasible measures (i.e., a</li> </ul>	d mapping of the effectiveness of top two c reduction measures y be acceptable if it incorporates all in ALARP approach).	
<ul> <li>flood mitigation value and residual hazard of different combinations of measures in comparison to risk tolerance criteria.</li> <li>Combination of flood management measures</li> </ul>	<ul> <li>Semi-quantitative flood risk assessment to determine two or more combinations of flood risk reduction measures that achieve the flood risk tolerance</li> </ul>	<ul> <li>Quantitative flood risk assessment to determine 2 or more combinations of flood risk reduction measures that achieve the flood risk tolerance criteria.</li> </ul>	

Semi-structured evaluation in terms of non-flood-related decision criteria (e.g., cost, . environmental/social impacts, etc.) for the combinations of flood management measures identified above.

the flood risk tolerance

criteria.

## Step 6 – Implementation Plan and Monitoring Metrics

that satisfies ALARP<sup>2</sup>

criteria

Each IFMP should have a clear, costed implementation plan outlining how and when the preferred suite of flood risk reduction measures will be implemented. This is an important requirement that will provide the Province with an accountability and control mechanism to ensure effective flood risk management action follows the planning work (refer to Recommendations B-4.4.1, B-4.4.2, and B-4.4.4)

The IFMP should also include a set of monitoring metrics to gauge both the implementation and effectiveness of the measures over time. These can include simple checklists for enacting new policies related to non-structural measures, structural measures construction metrics (e.g., km of dike built or upgraded per year), and development-related metrics (e.g., % of floor space below FCL). Metrics could also be defined to track changes in potential consequence, for example, population or number and type of structures within the flood hazard area. Sample metrics, data sources, and collection methods should be outlined in the IFMP guideline and ongoing monitoring of metrics will be supported through

<sup>&</sup>lt;sup>2</sup> ALARP refers to the risk concept of "as low as reasonably possible" and often represents the minimum threshold for acceptable risk.



responsible authority internal staff capacity supports described in Recommendations B-4.2.1, B-4.2.2, and B-4.2.3

#### Table 15: IFMP Step 6 (Implementation Plan and Monitoring Metrics) Minimum Requirements

	Hazard-based Approach	Risk-informed Approach	Risk-based Approach
•	List implementation actions in measures, land-use planning, environmental enhancement, and legislative (e.g., by-law) u	cluding, but not limited to, those rela building and development regulatio emergency response planning, pub odates.	ated to structural mitigation n, infrastructure planning, lic education, funding, and policy
	List required timesline spot (if	unalizzable) and ariment reconcided	a damanting and far again antion

- List required timeline, cost (if applicable), and primary responsible department for each action.
- List one or more metrics for monitoring implementation of actions related to structural mitigation measures (e.g., length of dike constructed per year).
- List one or more metrics for monitoring implementation of actions related to non-structural mitigation measures (e.g., % of new development in the flood hazard area with adequate floodproofing measures).
- List targets for each metric (e.g., 5 km of dike construction in 5 years, 90% of new development in the flood hazard area with adequate floodproofing measures each year)

## Step 7 – Approval and Implementation

Local Councils and leadership are often involved throughout the IFMP process (e.g., approving the project scope, confirming preferred risk management measures, etc.). At a minimum, they must be involved in the formal implementation of the IFMP.

The IFMP is considered completed when the leadership of the responsible authority has adopted it as policy and the Province has approved it with conditions requiring its ongoing implementation and eventual review or update. Recommendations for provincial responsibilities, including IFMP approval, are discussed in Section 6. More detail on review and updating is provided under Step 9 below.

On-going implementation involves the concurrent or subsequent updating of relevant community planning and governance policies and by-laws including official community plans and zoning by-laws.

## Table 16: IFMP Step 7 (Approval and Implementation) Minimum Requirements

	Hazard-based Approach	Risk-informed Approach	Risk-based Approach		
•	<ul> <li>Council or Board formal acceptance of IFMP as a guiding policy document and direction to staff to begin implementation.</li> </ul>				

- Submit IFMP with Council acceptance documentation to the Province for review and conditions of approval.
- Update community planning documents where appropriate and relevant to reflect flood risk findings and mitigation strategies. Relevant documents could include floodplain bylaws, official community plans, development permits, zoning by-laws, land-use plans, and emergency management plans.
- Formally acknowledge provincial approval conditions of IFMP (Council resolution or Board report).
- Designate staff to report to Province on on-going implementation and adherence to conditions on a bi-annual frequency.



## Step 8 – Framework for Review and Updates

The IFMP should include regular review periods and a clear definition of the conditions that would trigger a full update of the IFMP. Examples of conditions that would trigger a full update include new information or changes to assumptions related to flood hazards or underlying forces (e.g., sea-level rise) as well as significant changes to the community planning strategy (e.g., new land-use planning direction).

The updating process should also incorporate the requirement to complete any parallel IFMPs (if the responsible authority's geographic area or flood hazard portfolio were split into multiple studies) as well as supporting studies and data collection efforts identified by the IFMP as necessary to inform the next update.

#### Table 17: IFMP Step 8 (Framework for Review and Updates) Minimum Requirements

	Hazard-based Approach	Risk-informed Approach	Risk-based Approach
•	Define (as part of the IEMP) th	e timelines for review and undates	and triggers for undates before

- Define (as part of the IFMP) the timelines for review and updates, and triggers for updates before scheduled updates.
- Suggested regular review and update intervals: review every 5 years and update at least every 10 years.
- Minimum triggers for updates prior to scheduled updates:
  - Significant changes to climate change projections based on UN IPCC and Province of BC guidance.
  - Population and/or development growth patterns significantly exceeding knowledge and/or assumptions/projections at the time of the IFMP development.
  - Significant flood events (damage or near-miss) that warrant investigation of different flood risk management approach.
- Complete parallel IFMPs as well as recommended supporting studies and data collection initiatives prior to the next update if required.

# **Ongoing Community Engagement**

Meaningful community engagement is essential for effective IFMP development and implementation. Ideally, an IFMP will seek input from the community prior to, during, and after the development of a draft IFMP. Engagement during the planning process should build on engagement from other flood management initiatives, including flood mapping, risk assessment, and ongoing implementation.

The Preliminary Minimum Requirements Roadmap frames engagement as occurring throughout the IFMP development process. Engagement should be founded on discussion of preferred engagement approaches at the project scoping phase (Step 2) and informed through technical analysis completed during each subsequent phase. Feedback from engagement should, in particular, inform the selection of preferred risk reduction measures in Step 5.



Effective measures for engaging key groups and the public should vary by local context, but could include a combination of:

- Raising awareness about the project, flood hazards and risks (e.g., through project websites, earned media, paid media, and social media);
- Design charrettes;
- Structured decision-making workshops;
- Meetings with key groups (e.g., property owners, regulators, neighbouring communities);
- Open houses for the general public; and
- Community engagement initiatives such as surveys, dialogue platforms, social media campaigns, or tours and pop-up events.

Minimum requirements for engagement should involve inviting community input on a combination of risk reduction measures selected through the IFMP's structured evaluation process. The minimum scope should engage regulators and other government jurisdictions (e.g. neighbouring local governments and First Nations), key stakeholders including affected landowners, industry, utilities, and community organizations like business and environmental groups, and the general public.

While gathering input from a broad range of groups can be time-consuming and costly, feedback from responsible authorities involved in this project noted that engagement can strengthen decision outcomes by bringing in new knowledge, priorities, and perspectives. Responsible authorities also noted that initiatives to build awareness, ownership, and buy-in among key stakeholder groups and the public can improve support for the selected measures and reduce opposition and delays at the implementation stage.

#### **Table 18: IFMP Ongoing Engagement Minimum Requirements**

	Hazard-based Approach	Risk-informed Approach	Risk-based Approach
•	At least one in-person or virtual public engagement event to build awareness and get feedback on potential or preferred measures.		
•	At least one meeting with each group with overlapping authority in the study area (e.g., regulators, utilities, neighbouring governments, affected property owners) to inform preferred measures and discuss opportunities for collaboration and reducing potential impacts on neighbouring lands.		

• An interactive cross-departmental meeting with staff, senior administrators, and leaders to consider and prioritize preferred approaches.

# 5.4 Investigation B-4.3 Recommendations

This section recommends initiatives the Province could consider leading to support the development of an Integrated Flood Management Planning Guideline. A consolidated list of all recommendations in this report is provided in Appendix D.

#### 1. Establish a Guideline and a Roadmap for Developing Integrated Flood Management Plans

A 'how-to' guideline is recommended to establish objectives for IFMPs in BC. The IFMP guideline should include a 'minimum-requirements' roadmap to support a consistent minimum standard of integrated flood management planning by responsible authorities. Additional discussion on potential content is provided in Section 5.3.



The estimated cost to develop the provincial guideline (including the minimum requirements roadmap) and to provide province-wide, virtual engagement and training on it is \$360,000. This includes approximately \$200,000 to develop the guide, \$80,000 for engagement to inform guide development and \$80,000 to administer province-wide virtual training on the application of the guide. These cost estimates are high-level and will vary depending on the scope of the project and whether the Province seeks external consulting support to complete the Guideline.

The application of a provincial guideline for developing IFMPs would also require the Province to develop minimum flood risk tolerance criteria. This is framed as a separate recommendation below.

#### 2. Develop Minimum Provincial Flood Tolerance Criteria for use in IFMPs

Issue B-3 Flood Risk Assessment (Ebbwater, 2020) discusses flood risk assessment topics in detail. One topic that is critical to the development and implementation of effective IFMPs is the development of minimum provincial flood risk tolerance criteria. Section 5.3 discusses this topic in additional detail in the context of content for an IFMP guideline and a minimum-requirements roadmap.

To conduct an IFMP, responsible authorities need to define an appropriate goal for managing flood hazards and flood risk. This goal will help authorities determine what combinations of flood management measures are required. The key question in developing the goal is one related to flood risk tolerance: how do we know we have implemented 'sufficient' flood management measures? The answer is: when the overall flood hazard or risk has been reduced to a 'tolerable' level. It is important to note that flood tolerance criteria are important to developing IFMPs regardless of whether the IFMP uses a hazard-based or risk-informed or risk-based approach.

There is currently no formal federal or provincial guidance on risk tolerance for floods. Historically, a hazard-based approach has been used to manage floodplains based on the 1894 Fraser River flood of record, or the 200-year return period (0.5% annual exceedance probability) flood event.

KWL's experience is that while responsible authorities may be interested in defining flood risk tolerance criteria, the lack of senior government guidance on risk tolerance is a barrier. The issue of risk tolerance is a societal one, and minimum acceptable values are best defined at a provincial or national level. In BC, this issue has been getting some attention in the various practice guidelines issued by Engineers and Geoscientists BC, but it would be more appropriate for this issue to be addressed at a governmental level.

Accordingly, it would be appropriate for the Province to define a minimum flood tolerance threshold for hazard, risk-informed, and risk-based flood assessments. If desired, communities could still adopt a stricter (i.e. more conservative) threshold-based that reflects local variations based on demographics and community values.

As discussed above, it is recommended that the Province define minimum flood risk tolerance to support three different IFMP frameworks: hazard-based, risk-informed, and risk-based.

The estimated cost to develop a flood risk tolerance policy with inter-jurisdictional virtual engagement province-wide virtual engagement is \$200,000. This includes approximately \$150,000 for research and works to develop the criteria and \$50,000 for engagement with responsible authorities.



# 6. B-4.4: Investigate IFMP Development Process

The objective of this investigation is to investigate the process and level of effort for developing IFMPs across BC. This investigation builds on findings in investigations B-4.1 – Existing Capacity (Section 3) and aims to address all five capacity building priorities:

- 1. Limited staff capacity;
- 2. Limited financial resources or access to funding;
- 3. Gaps in technical information and knowledge;
- 4. Lack of tools, standards, guidance, and regional/provincial policy direction; and
- 5. Political sensitivities or conflicting priorities.

Sections 6.1 and 6.2, in particular, reflect the findings from priorities #1 and #2, whereas Section 6.3 addresses all five priorities. Cost estimates for future IFMP development are provided for each of the three IFMP development approaches (hazard-based, risk-informed, risk-based) outlined in the preliminary minimum requirements roadmap in Section 5.3.

# 6.1 Existing Flood Management Plan Development

The understanding of what an IFMP is and what its development entails is not consistent among responsible authorities across BC. Accordingly, many or most of the referenced plans likely reflect a subset of the recommended IFMP process. There is no doubt that the scope of the plans varies widely between responsible authorities, as does the level of effort for plan development. This sub-section summarizes the level of detail and scope of flood management plan (FMP) development based on findings from the surveys and case study interviews. Details on staff capacity and the role of external consultants in flood management plan development have been described in Sections 3.4 and 3.5.

# **Typical Level of Effort**

Only 11 of the 46 survey respondents self-identified as having completed a flood management plan with a further 10 noting that a flood management plan is currently being developed. Of the 21 survey respondents with existing or in-progress plans, 17 provided details on costs and scope, including eight with plans (and costs) still underway. Results from the survey are summarized in Table 19, organized by community size.

It is important to note, however, that the tasks included in cost estimates provided varied greatly, with some communities noting costs for plan development, while others included costs for hazard mapping, risk assessment, and structural mitigation works. As such, these cost estimates are not directly comparable but have been presented to illustrate the broad range of existing flood management plan development processes and level of effort. As many or most plans likely reflect a subset of the recommended IFMP process, the values provided may underestimate the cost of a corresponding plan developed through the IFMP process outlined in this report.



	Community Size (pop.)	Estimated Level of Effort	Year Developed	Cost Details
		\$120,000	2021	One plan focused on a specific flood hazard area
		\$120,000	2021	Community-wide plan
		\$237,000	2019	Community-wide plan
	<5,000	\$460,000	2020	Community-wide plan
		\$750,000	2021	Community-wide plan; includes costs for flood hazard mapping and analysis and dike/drainage system planning and engineering.
		\$65,000	2020	One plan focused on several areas of concern
		\$100,000	2018	One plan focused on several areas of concern
	5,000 - 50,000	\$120,000	2019	Regional plan involving input and partnership with neighbouring jurisdictions
		\$145,000	2020	Community-wide plan; includes risk assessment and mitigation planning.
		\$450,000	2022	Community-wide plan; includes risk assessment, flood mapping, and ¾ full- time staff position for a year.
		\$500,000	2017	Community-wide plan; includes 1-D and 2-D modelling, detailed consequence assessment, structural and non-structural measures, and preliminary cost-benefit analysis of preferred structural measures.
		\$400,000 - \$500,000	2021	Community-wide plan
	50,000 - 100,000	\$3,500,000	2020	Community-wide plan; NDMP grant funding stream 1 and 2 (includes hazard, risk, and mitigation work), includes \$100,000 of staff in-kind support.

## Table 19: Level of Effort Summary for Flood Management Plan Development from Engagement



Community Size (pop.)	Estimated Level of Effort	Year Developed	Cost Details
	\$100,000	2016	Regional plan involving input and partnership with neighbouring jurisdictions
100,000 - 500,000	\$2,300,000	2018	Community-wide plan; Cost details not provided but assumed to include implementation of structural measures.
>500,000	\$530,000	2022	Multiple plans, each focused on one or more areas; Includes hazard assessment, public engagement, and definition of values, risk tolerance, and design principles.
	\$1,075,000	2019	Multiple plans (4), each focused on one or more areas; The cost to develop each plan varied by area.

Refer to Section 3.7 for a summary of funding sources used to support flood management planning, as reported by survey respondents.

# Highest Cost Components

Survey respondents and case study interviews identified tasks they found to be the most time- and budget-consuming aspects in IFMP development. This feedback has been summarized below:

- GIS, channel modelling, purchasing LiDAR, and mapping to display information succinctly;
- Determining hazard mapping criteria particularly freeboard levels and how conservative to be when determining flood extents;
- Navigating challenges of the community's remote location;
- Incorporating climate change impacts on expected annual flows;
- Interdepartmental discussion to define risk assessment criteria, including risk tolerances and thresholds;
- Stakeholder engagement to build community understanding, support, and buy-in;
- Grant management, including meeting DMAF grant application timelines during the 2018 flood year;
- Drafting the plan to meet community objectives;
- Consultant fees for hazard modelling and flood mitigation design; and
- Interdepartmental discussion to establish standard operating procedures to support flood management.

Many of these challenges have been addressed through recommendations outlined in Section 4 and Section 5 of this report.



# 6.2 Future IFMP Development

A high-level estimate of the level of effort costs for communities to develop an *integrated* flood management plan according to the steps in the preliminary minimum requirements roadmap (Section 5.3) is shown in Table 20.

Estimates have been developed drawing on actual costs reported in the survey and professional judgement and experience with flood management planning in BC. Estimates are based on the number of Full-time Equivalent (FTE) hours for a contributor assumed to be remunerated at \$100,000/year. These costs reflect the level of effort for an IFMP to be completed either by a responsible authority inhouse or by a consultant (though additional staff time will be required to manage a consultant, which is not included in these estimates).

The level of effort described below is for a responsible authority to complete an IFMP in-house or the cost for consultant to complete the work, but does not include the additional costs for responsible authority staff to lead a consultant. Completing an IFMP through a consultant will likely have a higher cost, but as noted in Section 3, few responsible authorities have the in-house capacity to lead IFMP planning.

All costs should be considered approximate order-of-magnitude estimates as they are likely to vary widely with the scope and context of each IFMP. Cost estimate ranges are based on the community size, flood management planning approach, and desired level of detail to complete an IFMP for a single flood source and a single contiguous flood hazard area. Responsible authorities wishing to complete separate IFMPs for different hazard sources or areas should multiply this estimate, though efficiencies are likely, particularly if IFMPs for different areas are completed simultaneously. It is also assumed that communities will have completed a quality hazard and/or risk assessments to provide the necessary inputs into the planning process. Flood mapping and consequence/risk assessment work is not included as part of the estimates below as it is assumed that this is being investigated as part of other Flood Strategy Issues.

Roadmap Step	Est. Level of Effort	Cost Considerations / Variables
1.Form a Steering Committee	\$5,000 - \$40,000	<ul> <li>Number of people on committee</li> <li>Role of external advisors, neighbouring jurisdictions, or utilities</li> <li>Invitations, engagement, and honoraria for representatives from First Nations communities</li> </ul>
2. Confirm IFMP Scope and Planning Timeline with Climate Scenarios	\$10,000 - \$20,000	<ul> <li>Geographic size of community</li> <li>Community-wide plan or area focused plan</li> <li>All-flood-hazard or select hazard approach</li> <li>Number of people on steering committee</li> <li>Extent of inputs available in hazard or risk assessment previously completed (cost to complete these tasks not defined in this scope)</li> </ul>
3.Define Flood Risk Tolerance	\$5,000 - \$50,000	<ul> <li>Flood planning approach (hazard, risk-informed, risk-based)</li> <li>Community size and number of departments to provide input</li> <li>Availability/applicability of provincial risk criteria standards</li> </ul>

#### Table 20: Estimated Level of Effort for IFMP Development



Roadmap Step	Est. Level of Effort	Cost Considerations / Variables
4. Acquire Technical Data or Pre-requisite Information	\$5,000 - \$15,000	<ul> <li>Availability and quality of mapping and data</li> </ul>
5.Risk Management Measures Identification and Evaluation	\$50,000 - \$150,000	<ul> <li>Steering committee meeting approach and number of members</li> <li>Number of toolkit measures and preferred measures considered</li> <li>Risk evaluation approach (hazard-based, risk-informed, risk-based) (additional risk assessment work may be required as an additional scope)</li> <li>Define number and type of evaluation criteria and available data to support evaluation.</li> <li>Measure prioritization approach (e.g. cost benefit analysis)</li> </ul>
6.Implementation Plan and Monitoring Metrics	\$25,000 - \$100,000	<ul> <li>Length and detail of plan</li> <li>Extent of mapping, graphics, and interactive components</li> <li>Number of people on steering committee</li> </ul>
7.Approval and Implementation	\$10,000 - \$50,000	<ul> <li>Extent of updates to existing policies required to align with IFMP</li> <li>Number of iterations required for Council approval</li> <li>Approach selected for interdepartmental communication</li> </ul>
8.Framework for Review and Updates	\$5,000 – \$10,000	<ul> <li>Level of detail for review process, triggers, and update process.</li> </ul>
9.Community Engagement	\$25,000 - \$100,000	<ul> <li>Community engagement approaches (e.g. software purchased)</li> <li>Extent of graphics and branding</li> <li>Population and number of number of key groups to engage</li> </ul>
TOTAL (Rounded)	\$125,000 - \$535,000	<ul> <li>Excluding LiDAR, survey, &amp; baseline hazard / risk assessment</li> </ul>

# 6.3 Role of the Province

As discussed in Section 2, the Province's role in flood management has changed dramatically over the past few decades. While the Province used to directly lead flood management and planning, since approximately 2003, this role has been formally delegated to local governments.

Under the current flood management regime, the Province does not have a formal role in developing, reviewing, approving, or implementing flood management plans. On a project-by-project basis, the Province may be involved in locally-led IFMPs as a regulatory stakeholder, and in some isolated cases



provincial representatives have been involved as a member of IFMP technical working groups (e.g., District of Squamish).

An overview of feedback from engagement regarding the current and desired role of the Province in flood management planning is described below. A suite of recommendations has been developed based on this feedback outlining how the Province could further refine its role to better support flood management planning by responsible authorities.

# **Feedback from Engagement**

There was strong agreement among responsible authorities who participated in the surveys and case study interviews that the Province of BC should not "take back" full authority over flood management in BC. Of the 32 (of 46) survey respondents who commented on the role of the Provincial Government, only six indicated they were open to the Province returning as the lead authority on flood management and planning. Of these, three respondents noted that the Province should *either* provide adequate funding to support responsible authorities *or* take back the responsibility. Another respondent felt that the Province should play a lead role due to the fact that flooding is linked to factors beyond local government jurisdiction (e.g., climate change, pine beetle, river systems).

The majority of respondents noted that the Province should provide greater support to responsible authorities in 5 key ways (ranked by number of respondents that cited each item):

- 1. Provide funding to support capital projects and ongoing flood response, management, and maintenance;
- 2. Provide technical support, including data, mapping, and technical advice to fill gaps in local expertise;
- 3. Sustain ongoing involvement in flood management planning processes;
- 4. Establish clearer standards and guidelines for flood management planning and land-use change;
- 5. Coordinate and liaise with other federal and provincial government agencies.

### Funding for Planning and Implementation

By far the largest number of survey respondents emphasized that the Province should provide funding to support responsible authorities in flood management and planning. Of the 31 survey respondents who commented on the role of the Province, 10 highlighted funding as important and all five of the case study communities highlighted this as well.

The Cowichan Valley Regional District, Cowichan Tribes, and District of Squamish all highlighted the fundamental importance that funding provided to support flood management planning and implementation. One survey respondent articulated that the Province should "provide consistent and long-range funding for flood risk assessment and reduction planning, including periodic update of maps."

More details on funding capacity needs are described in Section 3.7 of this report and addressed under Recommendation B-4.2.1.

### Provide Technical Support, Mapping and Data

The second greatest area highlighted for provincial involvement was in providing technical data, mapping and other support. The Cowichan Valley Regional District highlighted how critical the Provinceflown LiDAR was for their flood management planning and management work. A survey respondent



echoed that the Province should lead mapping to ensure all maps are consistent and accurate across the Province. Another survey respondent suggested the Province should also support monitoring, data collection and analysis of inter-jurisdictional factors like sea-level rise, storm surge, and flow monitoring.

Another survey respondent noted that their small community doesn't have in-house professionals such as geomorphologists, water resource engineers or hydrologists, and rely on the expertise that provincial staff members hold in these areas This sentiment was echoed by one of the case study communities, who noted the important role that the Province plays in filling gaps in technical skills on small community staff teams

The representative from the Village of Lumby noted that it would be helpful if the Province could support or lead watershed-level studies that reach beyond the jurisdictions of local and regional authorities (e.g., a watershed-level study of land-use and climate impacts on drinking water and flood risk).

#### Involvement in Flood Management Planning Processes

Of the 32 survey respondents who commented on the role of the province, seven noted that the Province should play an active role in flood management planning processes led by responsible authorities. The District of Squamish noted that they involved the Inspector of Dikes in their flood management planning process, which was useful and appreciated. A number of survey respondents noted that the Province should be involved in planning as it has the potential to affect their interests (e.g., subdivision controls in rural areas). Other survey respondents noted that provincial involvement could also help support regional collaboration and help navigate inter-jurisdictional issues (e.g. working with utilities) due to the fact that floodplains often extend beyond local government boundaries.

There was disagreement, however, on whether the Province should be responsible for reviewing and approving flood management plans. Two survey respondents specifically noted that the Province should approve plans as a way to build consistency and ensure plans meet minimum standard requirements, while two others said the Province should *not* approve plans as this could become problematic and contentious.

The representative from Kwantlen First Nation called for each community to have access to a single liaison from the Province to support flood management planning and implementation. This person could also facilitate linkages and communication with other government agencies as needed to limit the need to communities to interact directly with many different representatives from many different government departments.

### **Establishing Clearer Standards**

Six survey respondents and one case study community noted that the Province should play more of a role in establishing standards, guidelines and templates for flood management planning. Survey respondents called on the Province to provide clear, unified standards for the minimum content of flood plans to provide a "standard operating platform" for using the results. Another survey respondent noted that the Province should provide guidelines, tools, and examples for communities to follow.

The representative from the District of Squamish highlighted challenges local governments face in approving contentious land-use changes. They suggested that stronger guidance from the Province on when land-use changes may be required would provide responsible authorities something to point to when communicating potentially contentious policy changes to Council and the public.

Representatives from Cowichan Tribes also noted that the Province should investigate and provide guidance on how to integrate principles from the UN Declaration on the Rights of Indigenous Peoples into flood management and planning to build capacity and support self-governance in Indigenous



communities. The UNDRIP article on free, prior and informed consent should be considered in relation to the development and implementation of IFMPs.'

#### **Coordinate with Other Government Agencies**

One survey respondent and three case study communities highlighted the important role the Province plays in coordinating with other government agencies, including First Nations, federal departments, and provincial ministries.

The Village of Lumby highlighted a need for the Province to establish stronger partnerships with other provincial and federal agencies to streamline regulatory processes and communication pathways to support a more efficient flood response process. For example, they suggested that federal regulators should be more involved in the flood management planning process by joining weekly freshet planning calls to better prepare them to support communities during emergency flood events. The representative said:

"I see this as an opportunity for all of the agencies to partner together to ensure everyone is heard, expectations are discussed and clearly identified, we communicate respectfully, and commit to being on the same page pertaining to funding and the required emergency works."

Both First Nations case studies and one First Nations survey respondent noted the important role the Province should play in supporting, respecting, and upholding First Nation rights and leadership over watershed management "to the extent and in the way they desire is best for their community".

The representative from Kwantlen First Nation suggested this could be further supported by creating a separate, consolidated process for building flood management capacity among First Nations (e.g., through regional meetings with neighbouring Nations). While there are a number of initiatives underway to support flood management capacity in First Nations communities, there is a need for more engagement and tailored tools to support Nations.

# 6.4 Investigation B-4.4 Recommendations

This section recommends specific initiatives the Province could consider to improve IFMP processes. A consolidated list of all recommendations in this report is provided in Appendix D.

### 1. Require and Fund the Development of IFMPs

Based on the outcomes of a province-wide screening flood risk assessment (refer to discussion in Issue B-3 Flood Risk Assessment (Ebbwater, 2020)), it is recommended that the Province implement a mechanism that will require responsible authorities with development in flood hazard areas to develop IFMPs. Realistically, compliance by responsible authorities will also require that the Province provide funding support for IFMPs as recommended in Section 4.

The requirement to complete an IFMP should be phased in to establish a revolving cycle of review and updates that will also help balance annual funding commitments. The outcome of a provincial flood risk assessment should be considered.

No recommendation is provided on how to specifically require or legislate the requirement for IFMPs as provincial staff are best suited to explore the range of options, from policy statements to completely new legislation.



Legislating a requirement for IFMPs from First Nations may not be feasible given the limited jurisdiction of the Province related to First Nation reserve governance. For First Nation communities, the requirement for an IFMP could be more simply linked to accessing flood management funding.

## 2. Establish a Provincial Structure for Reviewing and Approving IFMPs

Expand the duties of the provincial Flood Safety Section to include the review and approval of IFMPs to the satisfaction of the Minister of Forests, Lands, Natural Resources Operations and Rural Development. It is recommended that provincial flood safety staff be empowered to provide 'approval in principle with conditions' letters to responsible authorities that have completed and adopted IFMPs to the satisfaction of the Province, as well as to establish and maintain a database of such approvals. It is envisioned that the conditions would focus on the on-going and timely implementation of the IFMP measures into community planning and governance policies and by-laws.

### 3. Participate in IFMP Development Steering Committees

Dedicate provincial flood safety staff time to participate in IFMP development steering committees in an advisory and regulatory role. As discussed in Section 5, there are several key IFMP development steps that would benefit from the presence of a provincial representative including: defining the geographic scope of the IFMP, defining the planning horizon of the IFMP, identifying appropriate approaches for assessment, and considering and evaluating a range of flood risk reduction measures (structural and non-structural). It would be beneficial to responsible authorities if the same provincial contact was involved in all flood management interactions with the responsible authority. However, the latter may not always be realistic to achieve and maintain in the long term.

#### 4. Introduce Provincially-approved IFMPs as a Requirement for Structural Flood Mitigation Funding

To incentivize the development and implementation of IFMPs, it is recommended that the Province only provide provincial funding to structural flood mitigation projects which are part of an IFMP previously approved by the Province, and to encourage or require funding programs administered by others (e.g., UBCM CEPF) to do the same. In order to give responsible authorities a reasonable opportunity to comply, application of such an incentive would best occur at least one year following formal launch of a provincial IFMP program. Note that support for implementation of non-structural mitigation works (e.g. land-use policy change) would be addressed by building responsible authority in-house staff capacity as described in Section 4 (Recommendation #5.1). This recommendation does not have a direct financial impact as it would only impact the requirements for accessing funding for structural flood mitigation works funding; therefore, a cost estimate is not presented.

Stronger and additional incentives to conduct IFMPs could also be considered by the Province, including making provincially-approved IFMPs a requirement for eligibility to receive Disaster Financial Assistance (DFA) program funding for communities impacted by flooding. An interim period (5-10 years) relaxation of the requirement should be provided to allow time for responsible authorities to develop and begin the implementation of IFMPs.


### 7. Summary

The Fraser Basin Council (FBC) is leading the Investigations in Support of Flood Strategy Development in British Columbia project on behalf of the Province of British Columbia. FBC retained Kerr Wood Leidal Associates Ltd. (KWL) to support Issue B-4 Flood Planning.

Key conclusions from this study on flood management planning in BC are listed below.

- Nearly two decades after the Province delegated responsibility for flood management to responsible authorities, there are significant gaps in the completeness, consistency and comprehensiveness of flood management planning activities occurring in BC. These gaps affect both formal planning documents and development controls for flood hazard areas.
- When the Province led flood management planning and implementation, it was less subject to local development pressures and political influence related to land-use changes and development potential. Local governments, however, are more vulnerable to such political influence and have a harder time implementing policies that may negatively impact a few for the greater community good.
- While there is a wide range of capacity across BC, responsible authorities face the following barriers in conducting effective flood management planning activities (in order of perceived severity):
  - Limited in-house staff capacity;
  - Limited financial resources or access to funding;
  - o Gaps in technical information and knowledge;
  - o Lack of tools, standards, guidance, and regional/provincial policy direction;
  - Political sensitivities or conflicting priorities;
  - o Incorporating climate change projections (including sea-level rise and hydrologic changes);
  - o Challenges working with other levels of government;
  - o Complex or changing provincial or federal regulations;
  - Challenges coordinating with others (e.g., neighbouring communities, utilities);
  - o Lack of internal stakeholder recognition of non-structural flood risk reduction; and
  - Challenges working with external organizations (e.g., non-profits, academics, consultants).
- While some leading responsible authorities in BC have prepared flood management plans, there is no apparent consistency in terms of objective, approach, scope, and outcome.
- Despite the above challenges, responsible authorities indicated a desire to retain leadership of the flood management planning process and indicated a desire for strengthened support and guidance from the Province to do so.
- Review of practices in other Canadian jurisdictions (Ontario and Alberta) further illustrated the advantages of:
  - a centralized role for government in coordinating flood management standards and activities across the province; and
  - a securely-funded regional organization with in-house technical capacity acting as a leader within a flood management planning framework that is not vulnerable to shifting political priorities.



Key themes and directions for the next steps to support flood management planning in BC are listed below.

- Integrated flood management planning and plans (IFMPs) are the current international best management practice approach for managing flood risk in a structured, evidence-based, and transparent way. IFMPs integrate structural and non-structural flood risk reduction measures to reduce risk to a tolerable level through the use of flood hazard and flood risk information.
- There is great potential and interest on the part of responsible authorities for developing and implementing IFMPs that align with international best practice. Some jurisdictions have already begun moving in this direction.
- Several recommendations are provided for the Province to enable responsible authorities to develop and implement IFMPs. Recommendations are presented in Sections 4, 5, and 6 and are also summarized in Appendix D. Recommended provincial focus areas include:
  - o increasing the in-house capacity of responsible authorities;
  - providing guidance for developing IFMPs;
  - o funding, participating in, and approving IFMPs; and
  - requiring provincially approved IFMPs as a condition of funding for future structural mitigation works, and possibly as a condition of providing disaster financial assistance.

In particular, it is recommended that the Province develop an IFMP guideline to support responsible authorities in developing IFMPs. The IFMP guideline should outline minimum content requirements to encourage consistency and quality in IFMPs across BC.



## 8. Report Submission

KERR WOOD LEIDAL ASSOCIATES LTD.

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#### **Statement of Limitations**

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This document represents KWL's best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practising under similar conditions. No warranty, express or implied, is made.

#### **Revision History**

Revision #	Date	Status	Revision Description	Author
0	December 31, 2020	FINAL	Revised Final	RNH/ATAL



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# Glossary

The following definitions have been developed with input from project partners for use across all Issues in this broader flood strategy initiative.

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.
Annual Exceedance Probability	The probability, expressed in percentage, of a flood of a given size being equalled or exceeded in any year. Accordingly, a flood that is estimated to recur once in 100 years (on average) has an AEP of 1/100 or .01 (1% AEP meaning a 1% chance of occurring in any year). A flood estimated to recur once in 500 years on average has an AEP of 1/500 or 0.002 (.2% AEP).
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.
Dike	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.
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.
Flood Risk Assessment	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.
Floodplain	A floodplain is flat or nearly flat land that is susceptible to flooding from a watercourse, lake or other body of water.
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.
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

<u>kw</u>	Fraser Basin Council Investigations in Support of Flood Strategies in British Columbia Flood Planning (B4) Final Report December 2020
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.
Flood Planning and Flood Management Planning	The decision-making process to select a set of preferred measures for managing flood hazards and risks.
Hazard Assessment	Acquiring knowledge of the nature, extent, intensity, frequency, and probability of a hazard occurring.
Integrated Flood Management Plan	A flood management plan that outlines a combination of preferred flood management measures including structural, non-structural, and emergency response and recovery strategies. Integrated Flood Management Plans (IFMPs) are typically developed through a holistic, system-wide planning process and are integrated with other policies and planning initiatives within the organization.
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.



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# Appendix A

# List of all Investigations

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# Investigations in Support of Flood Strategy Development in BC

# List of All Investigations

#### 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 Governance	4. 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.			
	5. Recommend changes to support improved collaboration and coordination in flood management, including an analysis of benefits and costs/limitations for each recommendation.			
	<ol> <li>Investigate alternative options for distributing and integrating flood management responsibilities among authorities, including an analysis of benefits and costs/limitations for each option.</li> </ol>			

### Theme B. Flood Hazard and Risk Management

Issue	Investigation			
	<ol> <li>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.</li> </ol>			
B-1 Impacts of	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.			

Issue	Investigation
	<ol> <li>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.</li> </ol>
B-2 Flood Hazard Information	2. 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 and 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. 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.
	2. 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.
B-3 Flood Risk Assessment	<ol> <li>Investigate the effort required to develop and maintain a province-wide asset inventory and/or exposure dataset covering flood prone areas.</li> </ol>
	<ol> <li>Investigate the level of effort to develop a coarse local-scale flood risk map based on available flood hazard map(s).</li> </ol>
	5. 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.
	6. Evaluate and compare the benefits and costs/limitations of taking a risk-based approach to flood management versus a standards-based approach.
	<ol> <li>Investigate the ability of responsible authorities in the province to develop adaptation plans and strategies for flood management.</li> </ol>
B-4 Flood	<ol> <li>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.</li> </ol>
Planning	<ol> <li>Investigate the potential content of a provincial guideline to support the development of local Integrated Flood Management Plans.</li> </ol>
	<ol> <li>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.</li> </ol>

Issue	Investigation			
	1. Investigate opportunities to incentivize or require diking authorities to maintain flood protection infrastructure and plan for future conditions such as changing flood hazards.			
B-5 Structural Flood	2. Investigate opportunities to improve the knowledge and capacity of local diking authorities with regard to dike maintenance.			
Management Approaches	<ol> <li>Investigate opportunities to improve coordination amongst diking authorities under non-emergency conditions.</li> </ol>			
	<ol> <li>Investigate impediments to and opportunities for implementing innovative structural flood risk reduction measures, including the role of incentives and regulation.</li> </ol>			
	<ol> <li>Investigate past and current approaches to land use and development decisions in floodplains by local and provincial authorities.</li> </ol>			
B-6 Non- Structural	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.			
Management Approaches	3. Investigate impediments to and opportunities for implementing available non- structural flood risk reduction actions, including the role of incentives and regulation.			
	<ol> <li>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.</li> </ol>			

# Theme C. Flood Forecasting, Emergency Response and Recovery

Issue	Investigation
C-1 Flood	<ol> <li>Investigate current capacity, coverage, value, and gaps in flood forecasting services.</li> </ol>
Services	2. Visualize where flood forecasting gaps exist and estimate costs for improvement to end users.
C-2 Emergency	<ol> <li>Investigate the future direction of the Federal government related to a National Flood Risk Strategy and the future of Disaster Financial Assistance Arrangements</li> </ol>
Response	2. Investigate the Province's expanding role in providing flood response to First Nations.
	3. Investigate the status of local authority flood response plans and recommend an approach to manage, update and improve this information.

Issue	Investigation			
	<ol> <li>Investigate flood response capabilities considering different flood hazards and different regions of the province.</li> </ol>			
	<ol> <li>Investigate opportunities for improved organizational planning for emergency response in all levels of government.</li> </ol>			
C-3 Flood	1. Investigate the current status of coverage of existing overland flood insurance available to home-owners.			
Recovery	<ol> <li>Investigate the concept of "build back better" and impediments to implementation.</li> </ol>			

## Theme D. Resources and Funding

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



# Appendix B

# **Annotated Bibliography**

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# Appendix B: Annotated Bibliography

Title	Year	Author	Content		
British Columbia Resources					
Environmental Protection in Flood Hazard Management: A Guide for Practitioners	2010	Fraser Basin Council	This document focuses on how environmental stewardship relates to flood management practices, through outlining past challenges and emerging principles and practices related to flood protection and the environment; and shares lessons learned, case studies and other resource materials to guide practitioners. This provides responsible authorities with examples of alternative flood management approaches that enhance the natural environment, for consideration as mitigative measures as part of their planning process.		
Sea-level Rise Adaptation Primer: A Toolkit to Build Adaptive Capacity on Canada's South Coasts	2013	British Columbia Ministry of Environment (BC MoE)	The Primer is a resource for coastal management authorities (mainly responsible authorities) to help them identify and evaluate options for adapting to the impacts of sea-level rise and associated hazards. It is relevant for southern coastal regions across Canada (including the coast of British Columbia). It uses a PARA approach (protect, accommodate, retreat, avoid; initially defined by the Coastal Zone Management Subgroup of the first IPCC climate change assessment report in 1990), which has been adopted as the standard coastal and flood management planning framework across BC.		
Municipal Hazard Mitigation Planning: A Comparison of Plans in British Columbia and the United States	2015	Mark R. Stevens and Jessica Shoubridge	This academic paper concentrates on evaluating the quality of natural hazard mitigation planning contained within Official Community Plans (OCPs) in BC. It found that OCPs are "generally lacking in hazard related factual information, goals, and policies, and in mechanisms to promote plan implementation". Recommendations are provided to improve the quality of hazard mitigation planning in municipalities. Responsible authorities can look to Table 4 (page 1997) for a list of items that should be included in their final flood plan.		
Flood Mapping in BC: EGBC Professional Practices Guidelines	2017	EGBC	The guidelines assist professionals in developing flood maps in a consistent manner, incorporating best practices (including data requirements, climate change considerations and case studies). A good baseline of knowledge about natural hazard, including accurate flood maps, is important before undergoing extensive flood management planning.		

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# Appendix B: Annotated Bibliography

Title	Year	Author	Content
Legislated Flood Assessment in a Changing Climate in BC	2018	Engineers and Geoscientists British Columbia (EGBC)	These guidelines were written to mandate professional practice for engineers and geoscientists conducting flood assessments in British Columbia. They identify the circumstances when risk assessments are appropriate and emphasize the need to consider climate change and land-use changes in such assessments. The guidelines are primarily aimed at professionals but could also be used by responsible authorities to know what to expect from a flood assessment (the objectives, type of flood assessment to be carried out, level of effort, and terms of reference of an Engineering/Geoscience Professionals' agreement with their Client).
Flood Hazard Area Land-use Management Guidelines	2018	Ministry of Forests, Lands, and Natural Resources Operations, and Rural Development (FLNRORD)	These guidelines are intended to help responsible authorities and land-use managers develop and implement land-use management plans in areas subject to flood hazard. It outlines recommended provincial minimum requirements for land-use management in flood hazard areas, including specifics for flood construction levels and setbacks. Appendix 1 in the guidelines (pages 11 to 13) outlines steps to develop a long term flood protection strategy, focusing on structural measures, which could be used by responsible authorities to map out steps in advance of their planning process.
Clean, Resilient Flood Technology Options in Canada	2020	Simon Fraser University Adaptation to Climate Change Team (SFU ACT)	This report outlines structural measures and policy recommendations for adaptation to flooding using clean technologies, focusing on increasing Canada's low carbon resilience (ensuring that climate mitigation is a consideration in adaptation planning). It has an extensive section listing 'clean technology' criteria to evaluate flood risk mitigation measures, which could be used by responsible authorities to evaluate mitigative measures within a flood management planning context.



# Appendix B: Annotated Bibliography

Title	Year	Author	Content		
International Best Practices					
Flood Risk Management: A Strategic Approach	2013	United Nations Educational, Scientific and Cultural Organisation (UNESCO)	This book on the topic of flood risk management contains a history of flood management, the philosophy and process of flood risk management, the implementation process (including barriers and supports), and supporting tools and techniques. It is very detailed and is useful as a deep dive into flood risk management. Parts B and C are most useful to responsible authorities going through a flood management planning process. Part B outlines the considerations associated with modern flood risk management, and would be useful to read in advance of undertaking a planning process, including Chapter 5 (which discusses taking an adaptive approach to flood management planning, recognizing that future conditions may change and that mitigative measures should be flexible to allow for adjustment). Part C discusses specific parts of a flood plan (i.e. emergency planning and management) which could be read in advance of creating that portion of the plan.		
Strategic flood management: ten 'golden rules' to guide a sound approach	2015	Paul Sayers, Gerry Galloway, Edmund Penning-Rowsell, Li Yuanyuan, Shen Fuxin, Chen Yiwei, Wen Kang, Tom Le Quesne, Lei Wang & Yuhui Guan	This academic paper presents a brief history of flood management, explores what strategic flood management might be, and discusses barriers to implementation. It concludes by suggesting ten golden rules that underlie a sound strategic approach to flood management. These ten golden rules contain important guidance for what responsible authorities should consider before and during development of flood plans.		
Selecting Measures and Designing Strategies for Integrated Flood Management: A Guidance Document	2017	World Meteorological Organization (WMO)	This document is a resource guide and material for flood management practitioners. It contains perspectives on integrated flood management (ke elements, flood hazards and risks and policy development), an overview and assessment of measures to include in an integrated flood plan and describes strategy design and implementation. It is high-level and theoretical bu is a useful introduction to things to consider in advance of the flood management planning process.		

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Appendix C

# **Case Study Summaries (5)**

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## **Case Study: District of Squamish**

The District of Squamish is located at the north end of Howe Sound in the Sea to Sky region between Vancouver and Whistler. The District has a population of over 21,000 people and is exposed to a range of flood hazards, including riverine flooding from the Squamish, Mamquam, Cheakamus and Stawamus Rivers, coastal flooding from Howe Sound, and debris flows or floods from Cheekeye River.

Historic approaches for flood management in the District included structural flood protection (a system of dikes and sediment removals) and policy-based flood protections (covenants and flood construction levels). In 2017, the District initiated a multi-year process to develop an Integrated Flood Hazard Management Plan (IFHMP), establishing the foundation for future policy, land use decisions, and infrastructure management within floodplain areas.

#### Highlights

The District of Squamish has a robust flood management planning program that is strengthened by collaboration in the development and ongoing implementation of the IFHMP. This collaboration includes involvement of staff across District departments (e.g. engineering and planning) and guidance from a Technical Working Group with members including Squamish Nation representatives and the Provincial Inspector of Dikes.

The District considers its flood management program to be a success because it:

- Involved extensive public engagement at the planning stage (after technical assessment), building public understanding of flood risk & mitigation plans;
- Led to the implementation of many of the priority strategies in the IFHMP;
- Has integrated with land use planning through a suite of policies to control development within high-risk areas (e.g. Floodplain Bylaw, Development Permit Area, OCP); and
- Received over \$8 million in grant funding since IFHMP was completed.

This case study outlines the District of Squamish's approach to flood management planning and highlights lessons learned from an interview with David Roulston, P.Eng., Manager of Municipal Infrastructure.

#### Flood Management Planning Approach

The District of Squamish uses the following key documents and policies to guide flood management planning:

- Integrated Flood Hazard Management Plan (IFHMP, October 2017): Comprehensive, risk-based plan outlining over one hundred structural (e.g. preferred dike alignments) and non-structural measures (e.g. land use policies, operational measure, studies) for managing coastal and river flooding. Engagement included three open houses (128 attendees total), four stakeholder meetings, and four online surveys. The documents listed below were all recommended actions (either short term, medium term, or opportunistic) highlighted in the IFHMP.
- Land use planning frameworks: Flood hazards and management guidelines have been integrated into District planning documents to control development in flood risk areas, including the Official



Community Plan (OCP), Regional Growth Strategy, Zoning Bylaw, and subdivision approval conditions.

- **Development Permit Area 2** (2018; Part 5, Chapter 35 of OCP): The DPA 2 controls development in primary and secondary "floodways" to manage risk of flooding, dike breach, or debris flows.
- **Quantitative Risk Assessment** (QRA, April 2019): The QRA assesses economic damages and risk to life for three diking scenarios. It was found that the benefits exceeded the costs for all dike upgrading scenarios.
- Floodplain Management Bylaw (2019): This bylaw designates floodplain areas and regulates new development in these areas, including flood construction levels, floodplain setbacks, exemptions, and penalties.
- Eagle Viewing Area / Siyich'em Reserve Dike Master Plan (2020 draft): Ongoing work to develop a preferred dike alignment for one of the District's highest priority areas for flood protection.

#### Lessons Learned

This section highlights key strengths, challenges, and recommendations shared during the interview to support flood planning across BC.

#### Strengths

- Access to quality data The IFHMP covers a large area, including four river systems and coastal areas, and required significant data inputs. The District and consultants relied heavily on the quality LiDAR and comprehensive Canadian Hydrographic Service Record data available for modelling and assessment.
- **Collaboration across departments** Working with other Squamish departments helped build staff understanding of flood risk and supported integration with other initiatives. Collaboration with the Planning Department, in particular, helped to navigate controversial topics and strengthen land use planning policies for flood management (e.g. limiting density in flood risk areas).
- **Diverse engagement with external groups** Development of the IFHMP was guided by a Technical Working Group including representatives from Squamish Nation and the Provincial Inspector of Dikes. This working group strengthened the final IFHMP, providing an opportunity for key stakeholders and rights holders to provide input throughout the project and build support for the ultimate plan.
- **Planning supported access to funding** The IFHMP provided clear rationale for the District's flood management priorities, supporting a number of successful grant applications receiving over \$8 million to support implementation of the plan.
- Sequencing planning processes supported integration & efficiency The District initiated major updates to their OCP after the IFHMP was completed, integrating flood management guidelines within the District's land use planning framework. The District also adopted its first Floodplain Management Bylaw in 2017, immediately after the IFHMP was complete so that Council, staff, and the public were familiar with flood risk and required less engagement to support the policy.



#### Challenges

- Engagement around land use policy change Some of the adopted land use policies will impact development potential and received public opposition, particularly among affected landowners. This required additional engagement, which delayed the project and had budget impacts but ultimately resulted in a more robust engagement process. Ensuring adequate time and budget to lead engagement with key stakeholders early in the planning process was a key lesson learned.
- Limited funding for implementation Grant funding enabled the development of the IFHMP and the implementation of many of the high priority projects identified in the plan. However, grant funding is not likely to be available for all strategies in the plan (particularly non-structural measures such as land acquisition), requiring the District to find other sources.
- Limited staff capacity for progress monitoring Staff capacity for monitoring IFHMP implementation progress is limited. The only formal progress measure in place relates to the length of dikes upgraded to provincial standards (OCP), though other informal measures include the number of IFHMP strategies implemented and amount of grant funding received.

#### **Opportunities for Further Support**

- **Updates to flood-related climate standards** The provincial sea level rise guidance is almost a decade old. Updates to sea level rise and other climate change guidance would ideally be provided every five years to keep pace with international studies from the IPCC.
- Stronger guidance on flood policy development The current flood hazard area land use guidelines provide high level recommendations but do not provide enough specific direction on where new development should or should not occur. Stronger language (e.g. "should" rather than "may choose to") and clearer direction that local governments can point to would support more consistent planning approaches across the Province.
- More guidance on flood preparedness, emergency response, and insurance In particular, there is currently limited information available on flood insurance options, what role flood insurance could play, and how higher levels of government would respond in a major flood if insurance is not obtained by private landowners.



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# Case Study: Village of Lumby

The Village of Lumby (the Village) is in the north Okanagan region of British Columbia, approximately 25 kilometers east of the City of Vernon. The Village has a population of under 2,000 people and is exposed to riverine flooding due to intense precipitation events and spring freshet along Duteau Creek, Bessette (Harris) Creek, Creighton Creek, and Blue Springs Creek. The complexity of flood risk is also linked with management of reservoir water levels in the Aberdeen Plateau, which is the primary drinking water source for the greater Vernon area.

The Village does not currently have permanent flood protection infrastructure and has relied on a range of emergency measures to respond to recent flood events in 2013 (e.g. quick deploy gabions and sandbags), 2015, 2017 (e.g. berm and riprap bank protection), and 2018. These flood events led to extensive property and infrastructure damage and underscored the importance of flood planning in the Village. In 2016 the Village applied for funding from the National Disaster Mitigation Program to create a flood mitigation plan. The Village of Lumby Flood Mitigation Plan was adopted by Council in March 2019.

#### Highlights

The Village Flood Mitigation Plan (FMP) is an example of robust planning led by a small community. The FMP includes alignments for future flood protection structures and takes an integrated approach, incorporating flood mitigation considerations into existing planning bylaws, rather than creating a separate floodplain bylaw. The Village has been extremely resilient in its efforts to build partnerships, while trying to meet the expectations of the Provincial (FLNRORD and EMBC) and Federal (DFO) governments.

The Village considers its flood management program to-date to be a success because it:

- Outlines a prioritized risk-based approach for flood management to protect key assets;
- Defines "shovel-ready" projects to support grant applications for proactive flood management;
- Has built community and property owner awareness of their role and responsibilities for flood management; and
- Supports knowledge-sharing and partnership with neighbouring communities, including Splatsin, Vernon, Kelowna, and the Regional District of the North Okanagan.

This case study outlines the Village of Lumby's approach to flood management planning, and highlights lessons learned from an interview with Tom Kadla, MBA, AScT, CMC, Chief Administrative Officer.

### Flood Management Planning Approach

The Village uses the following documents and policies to guide flood management planning:

- Flood Mitigation Plan (FMP, March 2019): The plan identified preferred long-term structural flood mitigation options for five strategic areas, outlined recommended floodplain regulations and charted a prioritized implementation plan. Next steps include an environmental assessment, archaeological assessments, obtaining land tenure for structural projects, design and construction of capital projects, and development of an operations & maintenance manual.
- Land use planning frameworks: Flood management policies (including flood construction levels and setbacks) are being integrated into existing Village planning documents (the Official Community Plan and Zoning Bylaw are underway, and the Building Bylaw was completed in 2019) CIATES LTD.



Land acquisition in high-risk areas: The Village recently purchased a piece of land in a high-risk flood area to restrict development and convert to uses that can accommodate flooding (i.e. prioritizing farming and recreation uses, recreational trail expansion, environmental offsetting, or wetland and natural spaces). A potential co-benefit of this strategy is building economic activity through providing a public amenity and recreation space.

"Flooding is going to continue in Lumby... It will take years to implement the Flood Mitigation Plan actions, but in the meantime, let's focus on enhancing the natural spaces in a flood-savvy way."

• Annual freshet planning: The Village works closely with EMBC and other government agencies in the winter and spring each year to track and plan for freshest flood risk. Information about flood risk, resilience, and evacuation notices (if required) are communicated to the public through door-to-door notices and media releases in the local paper. The ongoing communication with regulators supports communication during longer-term planning processes.

#### Lessons Learned

This section highlights key strengths, challenges, and recommendations shared during the interview to support flood planning across BC.

#### **Strengths**

**Ongoing communication with regulators and the public** – Ongoing freshet planning built a strong working relationship with EMBC, which supported the efficient development of the FMP. This supported the role out of emergency works based on known triggers and available forecasts. Annual communication with the public also built community awareness of flood conditions and property owner responsibilities and strategies for flood protection and maintaining business operations. This approach builds community resiliency and strengthens business continuity throughout flood events. The Village also aims to empower residents to build their own resilience by, for example, laying out sandbags for residents to use as needed prior to and during flood season. A lesson learned during the 2015 and 2017 floods, when evacuation notices were issued, was that it is important to be proactive and communicate before an emergency begins and continually during the event.

- Builds on lessons learned from recent flood events The Village drew on lessons learned during the 2015 and 2017 floods to strengthen content and direction in the FMP. The Village also issued policies to control development in high flood risk areas soon after these major flood events. The timing built public and Council understanding of flood risk and enabled broader support for proactive flood management policies.
- Partnership with the Splatsin improved planning success The Village partnered with Splatsin
  resource management company, Yucwmenlúcwu (YUC), for environmental and archaeological input
  into the FMP. YUC also used streamside stewards and fish counts to identify potential impacts and
  manage construction. This partnership helped to reflect Splatsin knowledge and priorities into the
  FMP and built Splatsin support for the Plan.
- Knowledge-sharing across the region to build capacity The Village has a good relationship with neighbouring communities including Vernon, Kelowna, and the Regional District of the North Okanagan, and draws on their knowledge and experience with flood management and response. The Village is always open to opportunities to share their flood management knowledge experience to support other communities.



#### Challenges

• Encouraging active community engagement – The Village has led a number of initiatives to engage the public around flood planning, including print materials, online and social media, and public meetings. Despite these efforts, it's difficult to encourage public attendance and meetings to provide input into planning and policy review periods. Furthermore, in some cases, public opinion differed from professional recommendations, which was difficult to navigate.

"You can never communicate enough – even if you think you have, it's difficult to reach everybody... At some point in the process you need to collectively move forward with what you feel was adequate."

- Limited staff capacity for emergency planning, response, and recovery The Village is a small community with limited staff resources to prepare, respond, and, most importantly, recover from a major flood. It is particularly challenging to meet the extensive Provincial and Federal regulator requirements for documentation and continual communication after flooding occurs. These requirements are the same as they would be for a larger, better resourced community, and are difficult for a small staff team to manage in addition to staff's regular every day to day core duties. The level of effort required to meet regulator expectations further strains the Village's ability to focus on recovery, especially when staff are still responding ton orders from DFO three years after the 2017 flood, while at the same time managing preparation of the community for the 2020 wildfire season after winding down from the 2020 freshet.
- Limited funding for implementation The FMP recommends over \$30 million structural mitigation measures, which will require significant grant funding to supplement the Village's own-source revenue from taxes. As a small rural community, tax revenue is very limited and tax increases generate little revenue (e.g. a 1% tax increase in Lumby generates approximately \$8,000. The same 1% tax increase in Kelowna generates over \$1,000,000). This limited tax base also makes it difficult for the Village to provide the required matching funds to be eligible for major infrastructure grant programs.

#### **Opportunities for Additional Resources**

- **Proactive and coordinated funding for annual flood response** Funding for flood management work is often reactive (e.g. emergency works) and contingent on changes to flood works after-the-fact to meet Provincial and Federal requirements. Smaller communities have limited resources to respond quickly to annual flood events and need more proactive funding to put preventative measures in place and/or respond to an emergency event.
- Establish partnerships with all levels of government to support coordinated flood response Create partnerships and communication pathways between Provincial and Federal regulators to align regulatory requirements and support coordinated and efficient flood response (e.g. avoid local governments being caught in the middle). For example, DFO could be more involved in flood planning and response by joining EMBC weekly freshet planning calls and being on-site to support emergency flood works that more closely meet regulatory requirements.

"I see this as an opportunity for all of the agencies to partner together to ensure everyone is heard, expectations are discussed and clearly identified, we communicate respectfully, and commit to being on the same page pertaining to funding and the required emergency works."

• **Provincial support for watershed-level assessment** – The management (storage and release) of water from the regional district drinking water reservoir and land management are important factors affecting downstream flooding in the creek system surrounding the Village of Lumby and rural Lumby. The Village would like the Province to take a more holistic approach to management of the watershed and lead a modelling study to understand the level of severity for changes in the watershed and the implications on downstream flooding.

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# **Case Study: Cowichan Valley Regional District**

The Cowichan Valley Regional District (CVRD) has a population over 83,000 people and is located on southern Vancouver Island. The Cowichan / Koksilah is the largest watershed in the region, spanning the traditional territories of many First Nations and home to the majority of region's population. The area is exposed to coastal flooding and riverine flooding from the Cowichan and Koksilah Rivers, which is exacerbated by sediment aggradation. There are three floodplains on the Cowichan River system: Cowichan Lake, the Riverbottom Road area, and Lower Cowichan / Koksilah Rivers.

There is a long history of flooding in the Cowichan Valley, with 28 large floods occurring in the period between 1892 to 1982 and some degree of flooding on average every three years over this period (IFMP, 2009). A significant flood occurred in February 2020, and recovery efforts continued until the writing of this case study in August 2020.

In 2009, the CVRD developed an Integrated Flood Management Plan (IFMP). The Plan was developed in partnership with all jurisdictions within the watershed, including the City of Duncan, District of North Cowichan, and Cowichan Tribes. This partnership continues as the Cowichan Flood Management Working Group, which meets twice annually and makes decisions by consensus to coordinate regional flood management and planning efforts.

#### Highlights

The CVRD case study provides an opportunity to look back on a long-standing flood management planning program a decade after the planning process was completed. The IFMP was created through regional collaboration and has laid the foundation for the ongoing regional collaboration which has strengthened flood management effectiveness and supported access to federal and provincial grant funding programs.

The CVRD considers the implementation of its flood management program to-date to be a success because of:

- Measurable flood risk reduction since the IFMP was created, with the recent 2020 flood causing less damage than a comparable flood in the past;
- A continued partnership through the Cowichan Flood Management Working Group to coordinate regional flood planning priorities, funding applications, and work; and
- Led implementation of many of the projects in the IFMP within the planned timeline.

This case study outlines the CVRD's approach to flood management planning, and highlights lessons learned from an interview with Jeff Moore, MRM, Senior Environmental Analyst at CVRD.

#### **Flood Management Planning Approach**

The CVRD uses the following documents and policies to guide flood management planning:

• Integrated Flood Management Plan (IFMP, 2009) – The IFMP encompasses the Lower Cowichan and Koksilah River floodplain, which includes much of the urban core of Duncan and a large proportion of Cowichan Tribes lands. The Plan outlines twenty specific projects ranging from priority structural projects (e.g. sediment removal and selective vegetation removal from dikes), long-term structural projects (e.g. set-back dikes and channel naturalization), land-use planning tools (e.g.

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floodproofing guidelines), and other policy instruments related to public education, flood warning, and emergency response planning.

- Flood Mapping Update (2020, draft) Updated flood and erosion mapping for both the Riverbottom Road area and the Lower Cowichan and Koksilah floodplain is currently being finalized. This mapping will update the hydraulic model of the floodplains based on 2019 LiDAR which meets federal flood mapping guidelines, and will incorporate the effects of climate change of flood construction levels.
- Cowichan Flood Management Service Establishment Bylaw (Bylaw No. 3918, 2015) Defines CVRD authority to construct and maintain flood management works and outlines the tax structure to support this work.
- Cowichan Flood Management Working Group Memorandum of Understanding (2010) Sets a shared vision, goals, and approach for regional collaboration for flood planning and management. The MOU was initiated as an outcome from the IFMP (2009) with all four jurisdictions within the floodplain joining as signatories: CVRD, Cowichan Tribes, City of Duncan, and the District of North Cowichan. The Cowichan Flood Management Working Group was formalized through a Terms of Reference in 2018 to support the MOU.

#### **Lessons Learned**

This section highlights key strengths, challenges, and recommendations shared during the interview to support flood planning across BC.

#### Strengths

- Regional collaboration builds consistency, reduces transfer-of-risk issues, and improves access to funding The Cowichan Flood Management Working Group provides a space for representatives from the four jurisdictions in the floodplain to collaborate and make consensus-based decisions related to watershed-wide issues. The Working Group enabled coordinated funding applications, which are attractive to funders and allow partners access funding sources they may not have been eligible for on their own. Administration of the Working Group is funded through a flood management tax in each partner jurisdiction.
- **Carefully timed public engagement** The CVRD took a phased approach for public engagement, completing a technical flood hazard assessment first, and then leading a public engagement campaign during the planning phase of IFMP development. approach towards public education is to share out with the public after completing the technical analysis. Initiatives to-date to build public awareness of flood risk include distributing "householder" educational fliers, establishing the CVRD Flood Smart website, creating an information panel at Shawnigan Lake (underway), and creating a dynamic flood level photo that can be updated as water levels change over the course of the year.
- **Cross-department collaboration builds internal capacity** The Environmental Services team is a small team of three responsible for flood management. To expand their capacity, they work closely with Public Safety and staff planners, who implement the development and land-use aspects of the plan. The team also holds internal webinars to build capacity in other departments and support integration of flood management practices across the organization.



#### Challenges

- **Disconnect between watershed and administrative boundaries** The boundaries of each jurisdiction do not directly align with floodplain boundaries, including privately-held lands in the Cowichan watershed headwaters. This restricts the actions CVRD and partners can take to manage flood risk in a comprehensive way.
- **Obtaining data in a timely manner** The recent flood mapping work (2020) relied on LiDAR from GeoBC, which is freely available for local governments. However, a 10-month delay receiving the data extended the project timeline and almost affected the District's eligibility for grant funding.

#### **Opportunities for Additional Resources & Support**

- **Provincial repository for updated flood mapping from communities** Despite recent updates by the CVRD to their regulatory flood maps, the Province of BC website still shows outdated maps. This has caused confusion and conflicting information among developers, homeowners, and even CVRD staff who expect Provincial data to be correct and up-to-date. There is an opportunity for the Province to ensure that updated flood mapping information is provided on their website as soon as it is publicly available.
- Maintenance guideline or handbook for non-standard dikes There is an opportunity for more guideline around how communities should assess or maintain non-standard dikes that do not provide full flood protection but have some flood management benefits.
- **Funding with less stringent application timelines** Provincial and Federal grant funding programs for flood mitigation provide a critical resource for local authorities. These grants would be more accessible if the strict application timeline were more lenient.
- **Continue to provide LiDAR** Providing LiDAR data that meets federal standards (including coastal and other areas) enables analysis using accurate topographical data, which eases the burden of data collection for communities.
- **Guidelines for mapping erosion hazards** There is an opportunity for the Province to provide guidelines for how to address erosion hazards as part of flood mapping.



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## **Case Study: Cowichan Tribes**

Cowichan Tribes is one of BC's largest Nations, with reserve lands on southern Vancouver Island, and Traditional Territory reaching across the southern half of Vancouver Island, the Gulf Islands, up the Fraser River, and as far south as Sumas and Nooksak in Washington State. Cowichan Tribes has a population of over 4,900, with around half of members living on reserve.

Cowichan Tribes is committed to sustainable management of the Cowichan and Koksilah rivers, which flow through their lands and are considered part of their constitutionally protected rights and title. Cowichan Tribes' lands are exposed to riverine flooding from the Cowichan and Koksilah Rivers, which is exacerbated by sediment aggradation and coastal flooding. There are three floodplains on the Cowichan River system: Cowichan Lake, the Riverbottom Road area, and Lower Cowichan / Koksilah Rivers.

There is a long history of flooding in the Cowichan Valley, with 28 large floods occurring in the period between 1892 to 1982; some degree of flooding occurred on average every three years over this period (IFMP, 2009). A significant flood occurred in February 2020, and recovery efforts continued until the writing of this case study in August 2020.

In 2009, Cowichan Tribes participated in the CVRD-led project to develop an Integrated Flood Management Plan (IFMP) for the Cowichan Valley. The Plan was developed in partnership with all jurisdictions within the watershed, including the CVRD, City of Duncan, and District of North Cowichan. This partnership continues as the Cowichan Flood Management Working Group, which meets twice annually and makes decisions by consensus to coordinate regional flood management and planning efforts. Cowichan Tribes is involved in a number of ongoing projects identified in the IFMP (2009) and is taking the lead on sediment removal work.

#### Highlights

Cowichan Tribes takes a holistic approach and recognizes flood management as one integrated piece of watershed governance, with linkages to water security management and fish habitat protection. Cowichan Tribes is a committed steward of their lands and waters, with strong internal staff capacity and history of collaboration with regional partners for flood management for over a decade.

Cowichan Tribes considers its flood management program to-date to be a success because of:

- Strong regional partnership and collaboration around watershed governance;
- Increasing in-house staff capacity over the past 10 years to lead flood management work;
- Regional leadership in watershed governance aligned with their cultural values.

This case study outlines Cowichan Tribe's approach to flood management planning, and highlights lessons learned from an interview with Melissa Tokarek (Acting Director, LULUMEXUN - Lands & Governance) and Darryl Tunnicliffe (Environment and Natural Resources Manager and 2020 Flood Recovery Manager) at Cowichan Tribes.

#### **Flood Management Planning Context**

Cowichan Tribes uses the following documents and policies to guide flood management planning:



- Integrated Flood Management Plan (IFMP, 2009) The IFMP encompasses the Lower Cowichan and Koksilah River floodplain, which includes a large proportion of Cowichan Tribes lands. The Plan outlines twenty specific projects ranging from priority structural projects (e.g. sediment removal and selective vegetation removal from dikes), long-term structural projects (e.g. set-back dikes and channel naturalization), land-use planning tools (e.g. floodproofing guidelines), and other policy instruments related to public education, flood warning, and emergency response planning.
- **Flood Mapping Update (2020, draft)** Updated flood and erosion mapping for both the Riverbottom Road area and the Lower Cowichan and Koksilah floodplain is currently being finalized.
- **5-year Management Plan for Cowichan and Koksilah Rivers** The management plan involves sediment management and environment habitat management.
- Cowichan Flood Management Working Group Memorandum of Understanding (2010) Sets a shared vision, goals, and approach for regional collaboration for flood planning and management. The MOU was initiated as an outcome from the IFMP (2009) with all four jurisdictions within the floodplain joining as signatories: CVRD, Cowichan Tribes, City of Duncan, and the District of North Cowichan. The Cowichan Flood Management Working Group was formalized through a Terms of Reference in 2018 to support the MOU.
- Koksilah Water Sustainability Group (2020) Cowichan Tribes, CVRD, and the Cowichan Watershed Board recently established this group to manage watershed issues more broadly, including flood management. Signed a letter of intent with the Province related to changes in the Water Sustainability Act.

#### Lessons Learned

This section highlights key strengths, challenges, and recommendations shared during the interview to support flood planning across BC.

#### Strengths

- Watershed governance partnership with neighbouring communities Cowichan Tribes works with the other jurisdictions in the Cowichan Watershed on regional flood management and watershed governance. The IFMP partners continue to work together to implement the IFMP through the Cowichan Flood Management Working Group. Implementation of the IFMP has been flexible, with projects being adjusted as needed to account for changing governance structures and shared priorities among partners.
- Holistic approach to watershed management Cowichan Tribes takes an integrated approach to watershed and flood management. A core community teaching is that everything is connected; therefore, flood mitigation work is inherently linked to water security, drinking water management and fish habitat protection. Environmental benefits have been incorporated into flood mitigation works, including riparian area restoration techniques, side channels, and using a streamside marsh as both fish habitat and a flood attenuation area.
- **Considering social and cultural impacts from flooding** Cowichan Tribes considers social and cultural impacts as part of flood assessment and planning (e.g. how flooding could impact homes, buildings, archeological sites, and cultural sites), but also whether community members feel safe in the community. As there are longstanding cultural and ancestral ties to specific lands, relocation is not an option for members.



• Diverse staff team and internal capacity – The Lands & Governance Department leads watershed governance initiatives, including flood management, for the Nation. The Department has a small team of staff with diverse professional backgrounds including an engineer, planners, registered professional biologists, and political science and legal expertise. This in-house capacity allows Cowichan Tribes to take a leadership role on flood management projects, without the need for peer review of documents. However, despite this internal skill-set, the small team is very busy and often rely on consultants to complete technical work.

#### Challenges

- "All levels of government in one" First Nations in Canada have expansive responsibilities that combine federal, provincial, regional, and municipal governments all at once. This means that their funding and resources are stretched thin.
- Flooding has become normalized For many community members, flooding has become something they deal with regularly but don't always report to the Nation, which affects the ability of Cowichan Tribes to respond effectively. However, the recent flooding in 2020 affected some areas of the community that had never seen flooding before and was a traumatic event.
- Building engagement systems and capacity Engagement with members to develop governance tools (i.e., bylaws) was not a requirement under the Indian Act but is now a requirement under the Land Code. Cowichan Tribes is in the process of developing policies, programs, and laws for engagement in general, including around flooding and emergency planning. Outreach to broader membership can be difficult, as there are over 5,000 members both in Canada and United States. Though the Nation hasn't shared much information about flood management with members to-date, recent funding for a flood mitigation planning project will support community engagement.
- Funding programs don't support sustainable and holistic flood management Current
  Provincial and Federal funding programs are capital project-focused and provide less support for
  ongoing maintenance and management. It is a struggle to find operational dollars for maintenance
  activities like clearing vegetation off dikes, or to complete inspections. Furthermore, more funding is
  available for emergency response than flood planning and mitigation, meaning that communities
  have to go through trauma to receive the funding. Indigenous Services Canada's (ISC) funding
  model makes it difficult to plan projects in an integrated way across departments (e.g. ISC will
  provide funding for a new sewer system but not for integrating drainage as part of that plan).

#### **Opportunities for Additional Resources**

- Longer-term funding to support preventative programs Provide longer term funding (not just on an annual basis) to allow programs to continue long term and to allow job security and staff continuity.
- Adopt UNDRIP to build capacity & support self-governance The Province should engage with Nations around how to incorporate UNDRIP as a foundation for initiatives and policies in the Province. In particular, Provincial Government initiatives should find ways to draw on and build capacity in First Nation communities, reducing the need for support systems, breaking down the dependence structure, and moving towards self governance and self determination.
- Continue to respect Cowichan Tribes leadership over watershed management The Province should not oversee, but rather should respect Cowichan Tribes' rights and title, strategic objectives, and leadership over watershed management in collaboration with other regional partners.



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## **Case Study: Kwantlen First Nation**

Kwantlen First Nation (KFN) has a registered population of just over 300 members. Their main reserve is on McMillan Island (IR No. 6) near the Town of Fort Langley and is home to 41 families and all of KFN's community buildings. The main village is exposed to riverine flooding from the Fraser River, and potential flood impacts are increasing with climate change. It is projected that a 200-year flood in 2100 would cause the vast majority of McMillan Island to be under water (FBC, 2018)<sup>1</sup>.

The Nation has a long history of flooding, with a record-breaking flood in June 1894, and more recent floods in 1948 and 1972 that caused residents to be evacuated. Residents prepared to evacuate again in 2007 in anticipation of a flood, but the forecasted high-water levels did not materialize. In 2012, the administration building and HeadStart program building flooded and several families were evacuated.

Prior flood risk reduction initiatives include a ring dike around the residential area constructed in 1999 and three emergency flood protection projects in 2007 including erosion protection for the east end of the island, bank protection at the channel between McMillan and Brae Islands, and protection of a home on the north side of the island. While this assists in mitigating over bank topping it does not mitigate ground water seepage that affects many residents and several community buildings.

KFN is in the early stages of their flood management planning process for reserve lands, with a focus on McMillan Island (IR 6). KFN completed a flood hazard and risk assessment in 2018 and is currently writing an Flood Risk Management Plan and an Emergency Response Plan. More dialogue and leadership from Council is needed to identify priorities and next steps for flood management planning and action.

#### Highlights

KFN is an example of a small community that is collaborating with groups across the region to manage flood risk across their reserve lands. The Nation is taking a long-term lens, focusing on non-structural and preparedness measures to increase their community's resilience to flooding.

The Nation considers its flood management planning process to-date to be a success because of:

- Significant engagement with members when developing the Flood Risk Management Plan for McMillan Island, leading to strong integration of community knowledge and values into the Plan;
- External partnerships with regional agencies including Fraser Basin Council, Emergency Planning Secretariat, EMBC, and the Township of Langley to share and build on flood planning experiences; and
- Using First Nation Adapt funding from Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) to begin the flood planning process and develop the Flood Risk Management Plan.

This case study outlines KFN's approach to flood management planning, and highlights lessons learned from an interview with Elaine Kenny, Consultant/Project Manager with KFN.

<sup>&</sup>lt;sup>1</sup> Fraser Basin Council (March 14, 2018) Community Information Session Presentation to Kwantlen First Nation.



### **Flood Management Planning Context**

KFN is currently working on formal flood management planning documents and policies. The Nation is actively collaborating with Fraser Basin Council (FBC) and Emergency Planning Secretariat (EPS) on a new regional flood risk assessment. These initiatives include:

- Flood Risk Management Plan (in progress) The Flood Risk Management Plan outlines measures to manage flood risk on McMillan Island (IR 6), with major elements including the creation of an emergency response plan, non-structural measures like increasing flood construction levels and building restrictions (i.e. no new crawlspaces) and promoting community resilience. It has been determined that structural measures are not suitable for McMillan Island.
- Mainland Coast Salish Flood Risk Assessment (MCSFRA) The Nation received funding in June 2020 from the Union of BC Municipalities and is working in collaboration with the FBC and EPS on this project. It focuses on engagement with 32 First Nations and Tribal Councils on long term flood risk assessment in collaboration.

#### Lessons Learned

This section highlights key strengths, challenges and recommendations shared during the interview to support flood planning across BC.

#### **Strengths**

- Strong engagement with members The Nation led a number of community workshops to engage members in developing the Flood Risk Mitigation Strategy, including in presentations by the consulting team, series of questionnaires, and newsletters. These workshops were very successful and well attended, with 36 42 people attending each one. It was found that members who live on the island have a different perspective from people who live off the island around perceptions of flood risk. The extensive engagement resulted in robust inclusion of community values and knowledge into the Plan.
- Working in partnership with regional organizations KFN Council has been a strong supporter of relationships with a number of non-profit organizations, including FBC and the EPS, working to advance flood preparedness across the region. KFN staff have formed a particularly strong relationship with EPS, whose overall mandate is to support First Nations to prepare for climate change using an "all hazards" approach. These partnerships have allowed KFN to build staff capacity and support knowledge and resilience across their reserve lands. In particular, the Nation has found that there are advantages to First Nations working together and sharing their experiences, to avoid "reinventing the wheel".

#### Challenges

- Limited capacity KFN has limited capacity, with staff and Council balancing many responsibilities and projects. This has resulted in slower than desired progress and a challenge prioritizing flood management planning work in amongst other high community priorities. Stronger awareness from Council and more capacity is needed to improve short-term flood response and look at flood management from a long-term lens.
- **Building inhouse expertise** Understanding flood risk involves a steep learning curve, which takes time to build this expertise in-house. Building these skills is important to support effective and



ongoing implementation of the Flood Management Strategy over the long term. KFN is currently applying for funding to develop an in-house emergency planning team, which would be involved with flood planning and response as part of its mandate.

- Navigating the many flood management initiatives underway in BC There are a number of ongoing and overlapping regional initiatives to build flood management capacity in BC. These initiatives include FBC's Lower Mainland Flood Management Strategy project, EPS's Rising Waters initiative, the collaborative MCSFRA, and Province-led initiatives to provide flood management guideline resources to First Nations. While each of these initiatives adds important value, there is considerable overlap and uncertainty around outstanding gaps that can be confusing and time consuming for First Nation communities who want to be involved.
- Moving beyond standard templates for flood planning Reports and documents need to be tailored to be appropriate to KFN's context. The Nation has experienced some challenges working with external agencies that provide generic products that don't adequately reflect the Nation's unique context and priorities. Improved communication at the outset around expectations and approach to projects would improve this.

#### **Opportunities for Additional Resources**

- Streamlining and consolidating resources Though there is significant information available, it is often difficult to find, especially when online resources move to different addresses. A single, collected place for online resources and data would make flood planning more efficient. Additional resources that would be useful include a comprehensive table of funding opportunities and a clear list of mandates for different agencies and departments so communities know to whom to reach out.
- Create a consolidated process for building flood planning capacity among First Nations There is a strong desire among regional and provincial agencies to build flood planning capacity in BC. However, current initiatives have not yet been successful in gathering input from First Nation communities. There is an opportunity and need to create a consolidated and streamlined process for gathering First Nation input to develop a guideline for flood management risk assessment, planning, and implementation that reflects First Nation experiences, contexts, and perspectives.
- Encourage relationship building with Provincial liaisons There should be a clear liaison (e.g. regional representatives in a single Provincial department) that First Nations can reach out to and build relationships with (e.g. EMBC). This is preferable to dealing with many different departments and people for information and resources. Furthermore, it is important that these liaisons understand the unique context and capacity needs of BC First Nations and communicate the way government agencies can provide tailored support to meet these needs. For example, the liaison could host weekly planning meetings with First Nations communities during freshet, similar to the approach EPS has been taking for flood planning.
- Focused data and information specific to First Nations Respecting First Nations context and cultural values is important; for example, upholding the importance of archaeological and cultural sites. It's also important to acknowledge that there is data First Nations may not want to share publicly.



# Appendix D

# **Table of Recommendations**

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# **Appendix D: Table of Recommendations**

Item	Recommendation	Description	Cost Estimates			
B-4.2 Investigate Opportunities to Build Capacity						
4.2.1 Increase and Suppor Responsible Authorit house Staff Capacity Flood Management F	Increase and Support	• Provide grant funding to support a designated flood management staff role within each responsible authority.	\$2M to \$3M a year			
	house Staff Capacity for Flood Management Planning	<ul> <li>Develop and implement and annual flood management training, on-going community of practice hub, and provincial liaison program.</li> </ul>	\$250,000 a year			
4.2.2	Enhance and Participate in Flood Management Planning Funding Programs	<ul> <li>Increase recent levels of senior government financial support for flood management planning initiatives.</li> <li>Extend the typical grant timeline of one year to support multi-year projects.</li> <li>Increase the flexibility of funding grant programs to allow integration of flood management planning with other related community planning activities.</li> <li>Assign a provincial deputy inspector of dikes or other qualified flood safety staff to each IFMP project.</li> <li>Emphasize the importance of the flood management planning process by making a provincially-accepted IFMP a pre-requisite for funding for structural flood mitigation works.</li> </ul>	Incorporated within other recommendation costs			
4.2.3	Increase Knowledge of Flood Management Planning Among Community Leaders and Administrators	• Tri-annual training for political leaders and administrators could be delivered by provincial staff and/or a peer network group of responsible authority staff virtually.	Incorporated within other recommendation costs			
		\$2.3M to \$3.3M a year				
B-4.3 Investigate Content for a Provincial IFMP Guideline						
4.3.1	Establish a Guideline and a Roadmap for Developing Integrated Flood Management Plans	<ul> <li>Develop a 'how-to' guideline and minimum requirements roadmap to establish objectives for IFMPs in BC and provide virtual engagement and training.</li> </ul>	\$360,000			
4.3.2	Develop Minimum Provincial Flood Risk Tolerance Criteria for use in IFMPs	Define minimum flood risk tolerance to support three different IFMP frameworks: hazard-based, risk- informed, and risk-based.	\$200,000			
		\$560K a year				

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ltem	Recommendation	Description	Cost Estimates
B-4.4 Investigate IFMP Development Process			
4.4.1	Require and Fund the Development of IFMPs	<ul> <li>Implement a mechanism that will require responsible authorities with development in flood hazard areas to develop and report progress on IFMPs.</li> </ul>	Incorporated within other recommendation costs
4.4.2	Establish a Provincial Structure for Reviewing and Approving IFMPs	• Empower flood safety staff to provide 'approval in principle with conditions' letters to responsible authorities that have completed and adopted IFMPs to the satisfaction of the Province, as well as to establish and maintain a database of such approvals.	Incorporated within other recommendation costs
4.4.3	Participate in IFMP Development Steering Committees	<ul> <li>Dedicate provincial flood safety staff time to participate in IFMP development steering committees in an advisory and regulatory role.</li> </ul>	Incorporated within other recommendation costs
4.4.4	Introduce Provincially- approved IFMPs as a Requirement for Structural Flood Mitigation Funding	• Only provide provincial funding to structural flood mitigation projects which are part of an IFMP previously approved by the Province, and to encourage or require funding programs administered by others (e.g., UBCM CEPF) to do the same.	Incorporated within other recommendation costs
Total			Incorporated within other recommendation costs
Total Across All B-4 Investigations			\$2.9M to \$3.9M a year