ATTACHMENT 2

REGIONAL DISTRICT OF NANAIMO

Englishman River Flood Mapping

Overview Report- May 2021

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For more information about the Englishman River Flood Mapping project, or the RDN's broader flood management program contact:

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Key Terms

Adaptation	Process of undertaking procedures, actions, and/or developing structures to moderate potential negative impacts of climate change, while taking advantage of potential new opportunities.
Climate change	A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.
Floodplain	An area of low-lying ground adjacent to a river or ocean that is subject to flooding. Floodplains are often characterized by a relatively flat topography. Also referred to as the regulatory floodplain.
Flood Construction Level	The flood level specified in a floodplain bylaw that is used to establish the elevation of the underside of a wooden floor system or top of a concrete slab for any habitable area.
Flood Extent	Flood extent refers to the geographic reach of flood waters over land.
Flood Hazard Mapping	Maps that provide information on the hazards associated with defined flood events, such as water level, water depth, and velocity.
Flood Level	The maximum elevation of the water surface for a given flood scenario. On regulatory floodplain maps, flood levels may include freeboard to inform Flood Construction Levels (FCLs) specified in floodplain bylaws.
Freeboard	A vertical distance added to water surface elevations to account for scientific uncertainty in hydraulic and hydrological variables, the potential for waves and surges, and other natural phenomena. A freeboard of 0.6 m has been included in establishing the 200-year return period regulatory floodplain level for the Englishman River.
Regulatory Floodplain Maps	Maps used for regulatory purposes, such as defining flood levels for floodplain bylaws and informing official community plans. For the Englishman River, the regulatory river floodplain mapping is based on inundation mapping for the 200-year return period flood under climate change conditions incremented by a freeboard allowance of 0.6 m to establish the flood levels and associated floodplain limits.
Return Period Flood Event	A way of describing the probability of a flood event having a specific intensity or size. For example, a 10-year return period flood event is expected to occur, on average, once every 10 years (or, in other words, three times over the course of a 30-year mortgage). Another way to think of flood frequency and severity is by "annual exceedance probability", which is the inverse of a return period, meaning that a 10-year event could instead be thought of as having a 10% chance of occurring in any given year. Return period is <u>not</u> the strict frequency of an event. In other words, if a 10-year return period event occurs *this year*, there is still a 10% probability that it will occur *next year* as well.
Resilience	The ability of a system, community, business, or natural environment to anticipate, prevent, withstand, respond to, and recover from a hazard in a timely an efficient manner.
Risk	The chance of injury or loss as defined as a measure of the probability and severity of consequences from a hazard such as flooding. Consequences can range broadly and include adverse effects to health, property, the environment, or other things of value.
Storm Surge	A temporary increase in water level caused by low atmospheric pressure and winds.

Introduction

In BC, local governments, including the Regional District of Nanaimo (RDN) are responsible for land use management, including the management of land use in relation to natural hazards, which includes flooding. To better understand flood hazards, the RDN is leading a series of studies on the Englishman River, Little Qualicum River, Nanaimo River and the coastal zone. The studies are part the RDN's broader Sea Level Rise and Climate Adaptation Program and build on the region-wide flood risk assessment completed by the RDN in 2019. These studies will provide updated riverine floodplain maps to inform flood management planning, now and into the future.

This report summarizes key outcomes from the **Englishman River Flood Hazard Mapping Project**, including updated floodplain maps and key resources property owners can use to become more flood ready.

Floodplain Mapping

Floodplain maps helps us understand and manage flood risks. These maps show where water will flow during a flood event and what land could be affected by different size flood scenarios under current and future climate change conditions. They provide an important tool that local governments across BC use for policies and planning to build the resilience of community lands, private property, and natural habitats to flood hazards today and into the future. Floodplain maps can be used to support flood management and resilience through:

- **Land use planning**, including updating policies and regulations to reduce flood risks. For example, if you are planning a development, a site-specific flood risk assessment may be required to identify measures that will protect people and property from flooding and lower the impact of development on the natural environment.
- **Emergency planning and response**, including providing information on flood scenarios and at-risk areas.
- **Strategic infrastructure planning**, by understanding which community assets are at risk and developing strategies for managing risk through flood proofing and relocation over time.
- **Public education by sharing information** about how property owners and residents can become flood ready.

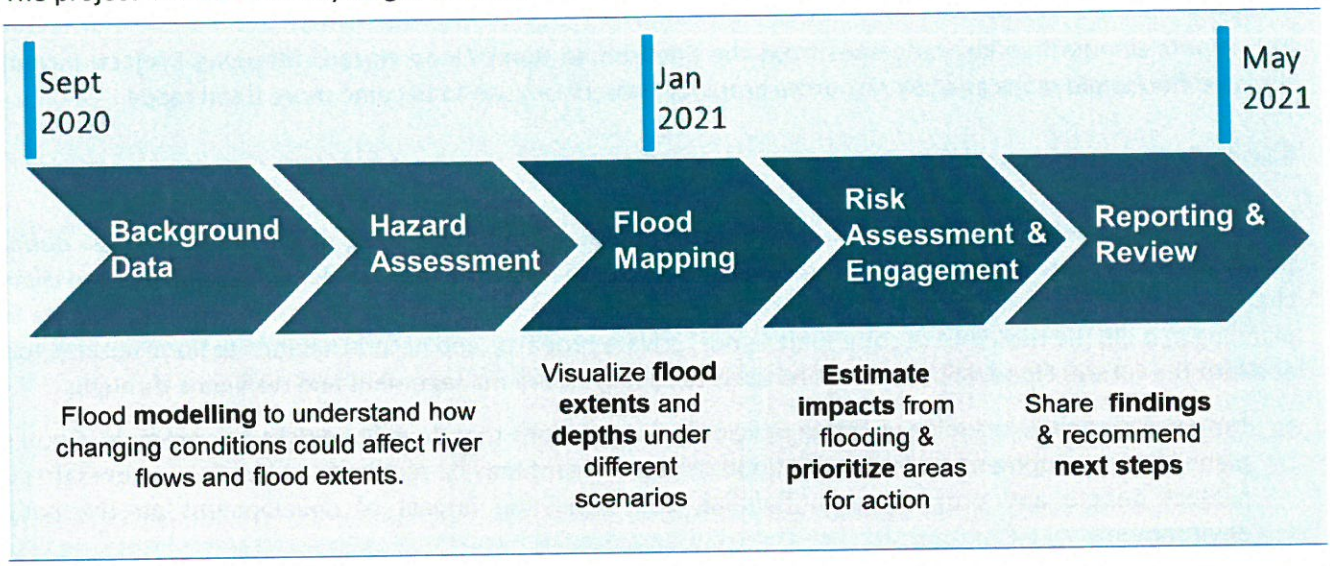
In BC, local governments may designate flood prone areas as a "regulatory floodplain" that is delineated and mapped following provincial guidelines. The RDN's current regulatory floodplain maps for the Englishman River, Little Qualicum River and the Nanaimo River were produced by the provincial government between 1984 to 1997. An update to these maps is needed to consider future climate change impacts and to make use of recent advancements in topographic data collection and hydraulic modelling techniques. Updating the RDN's regulatory floodplain map will provide a clearer picture of what flooding could look like over the remaining century so that the RDN and property owners can plan to build resilience gradually over time.

About the Englishman River Flood Hazard Mapping Project

The key objective of the Englishman River Flood Hazard Mapping Project ("the project") is to provide updated regulatory river floodplain maps to support future flood management planning across the region.

The project focuses on mapping and assessing river flood hazards in the Englishman River floodplain north of Highway 19. The study area includes properties in the RDN's Electoral Area G (including the San Pareil, Shorewood, and Martindale neighbourhoods) and a small southeastern portion of the City of Parksville.

The project involved five key stages of work:



The project involved computer modelling to analyze river characteristics and estimate how high flood waters could rise under different flood scenarios. These scenarios included flood events that may have lower water levels but happen more often (i.e., once every 10 years) and more extreme and rare flood events (i.e., once every 200 years).

This flood hazard information was used to develop regulatory river floodplain maps as well as additional flood hazard maps to better understand flood dynamics, including maximum water levels, depths, and velocities. These flood hazard maps were then used to complete a high-level flood risk assessment to better understand how flooding could impact the community and natural areas.

Stakeholder engagement played an important role in this project. Twenty-two key stakeholders in the study area participated in an online workshop on March 25th, 2021 to share their priorities for flood management. The workshop served as an opportunity to start the conversation about flood hazards and management along the Englishman River at an early stage of hazard analysis. Outcomes from the workshop provide a foundation for stakeholder engagement to guide flood adaptation planning in future phases of the overall Adaptation Program.

Map of Study Area

Project Findings

Flood Hazards in the Region

The lower regions of the Englishman River floodplain are already vulnerable to flooding today and have experienced significant flooding in recent years, including in February 2020 and January 2021.

River flooding occurs when river water levels rise above the elevation of banks and flow into neighbouring low-lying areas that are normally dry. River flooding in BC is typically caused when snow accumulates in the mountains and is followed by an intense rainfall event that causes rapid snowmelt and river flows to increase quickly beyond the riverbank's capacity. On the east coast of Vancouver Island, flooding usually occurs in the late fall or early winter as a result of storms carrying moisture from the Pacific Ocean eastward across the Island, causing high intensity rainfall and snow accumulation at higher elevations.

Climate change is projected to cause more severe and frequent flooding due to river flow levels increasing more often. This is because climate change is projected to cause more precipitation in fall, winter, and spring, with warmer average temperatures causing more of this precipitation to fall as rain rather than snow. For this study, climate change was assumed to increase flood flows in the Englishman River by 25% by the Year 2100.

Coastal flooding occurs when the flooding is caused by high tides, storm surges, and coastal waves. Climate change is projected to cause a global rise in coastal water levels, further exacerbating coastal flooding issues along Vancouver Island's shoreline. For this study, 1.0 metre of relative sea level rise was assumed for the Year 2100.

Source of photos: RDN Emergency Services

Martindale Road, February 2020 Englishman River Flood

River Flood Scenarios

The Englishman River Flood Hazard Mapping project involved detailed modelling and analysis of a range of flood scenarios. Looking at a range of different flood scenarios allows the RDN to understand what flooding could look like under a relatively likely, less severe events and under rare, much more extreme events. This information is important to inform planning for emergency response, land use, and infrastructure/asset management.

Four river flood scenarios were considered as part of this project and are described in the table below. The 200-year return period flood scenario under future climate change conditions was used to develop the regulatory floodplain mapping.

	Scenario	*Return Period*	*Climate Change (2100)*
1	Rare Flood – Current Conditions	200-year	n/a
2	Rare Flood – Future Conditions	200-year	25% river flow increase + 1 m sea level rise
3	More Frequent Flood – Current Conditions	10-year	n/a
4	More Frequent Flood – Future Conditions	10-year	25% river flow increase + 1 m sea level rise

What is a "return period flood event"?

No two floods are ever the same. Differences in snowpack, rainfall intensity, influences from climate change, and changing topography are just some of the factors that cause water levels to rise and make each flood unique. Flood specialists use detailed computer models to project what flooding could look like under different conditions. Different flood events are modelled according to their "return period", or the average frequency at which they are expected to occur in a particular area.

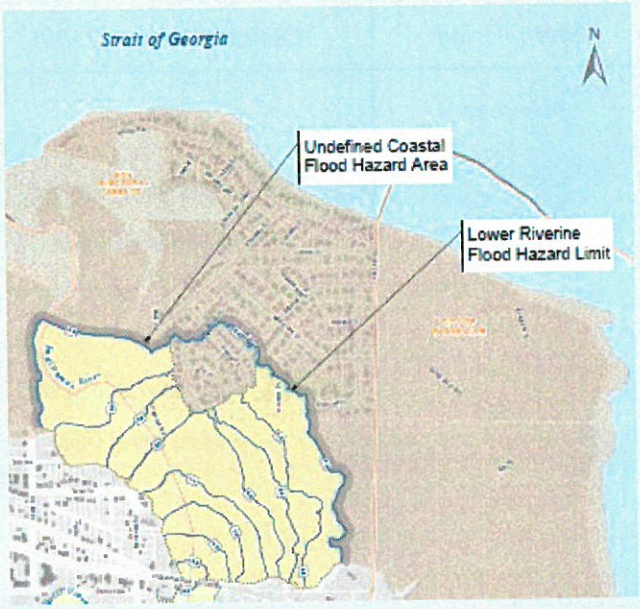
For example, a 10-year return period flood event refers to flood water levels that are expected to occur, on average, once every 10 years. In other words, you could expect to see a flood of this size three times over the course of a 30-year mortgage. In comparison, a 200-year return period flood event is a much rarer and more extreme flood event, with higher water levels that reach further and can cause more damage to build infrastructure. The 200-year return period is the provincial standard for regulatory river maps in BC, ensuring that communities are resilient to extreme and rare flooding.

Regulatory Floodplain Maps

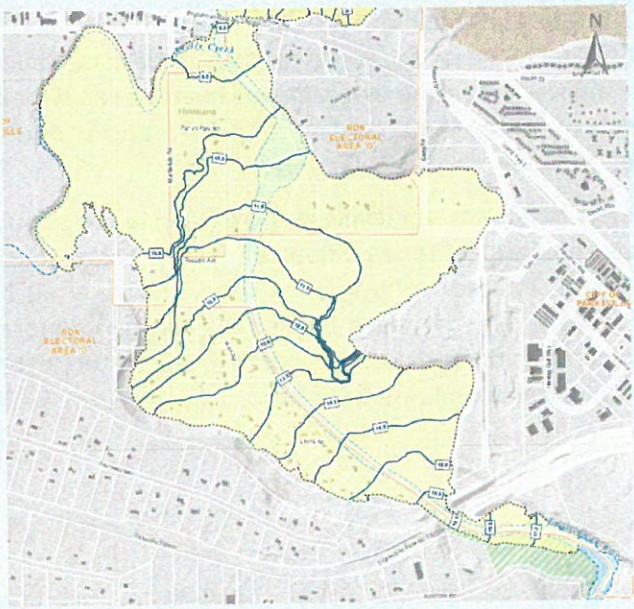
Excerpts from the updated regulatory river floodplain maps for the Englishman River (shown below) will replace the existing regulatory floodplain maps from 1985 and will contribute to the current and future development of riverine and coastal flood management planning in the region.

Excerpts from the updated Englishman River regulatory river floodplain map (Map Sheets 1 & 2). The Englishman River Delta is shaded brown and the Regulatory River Floodplain is shaded yellow.

Maps images shown here are for illustrative purposes only. Refer to source map for application of information.



Excerpt: Map Sheet 1 of 2



Excerpt: Map Sheet 2 of 2

Key things to keep in mind when reviewing the map:

- Aligned with the provincial requirements, the map shows an extreme and rare 200-year "return period" river flood event (expected to occur once every 200 years, or once every 6 or 7 generations).
- The 200-year return period flood event shown on the map accounts for future climate change impacts, providing flood levels for the year 2100 or almost 80 years from today.
- **Flood levels on the map include freeboard**, which provides an additional buffer to account for uncertainty in the flood level estimations.
- **The flood map shows flood extents** (i.e. how far on land water is expected to reach) **and flood levels** (i.e. the elevation of the water surface) **but does not show flood depths**. This means that many of the areas shown as flooded may experience only shallow flooding.
- **The map does not include the coastal flood hazard area,** as mapping of the coastal floodplain is currently being led by the RDN under a parallel project. However, coastal impacts on river flooding (including sea level rise) were accounted for in the river floodplain mapping.
- The map does not account for any influence that existing or future flood adaptation measures could have on flood extents.

Summary of Key Findings

Flood hazard analysis and mapping from this project provide important insights about flood dynamics and risks in the lower region of the Englishman River. Key findings include:

Flood Mapping	• The new regulatory flood maps show flood extents that are similar to those shown in the original 1985 provincial floodplain maps; however, flood levels are slightly higher. • **Low-lying areas in the study area are currently exposed to flood hazards.** Residential areas and roads in the Martindale and San Pareil neighbourhoods are particularly exposed, with some properties experiencing flooding on an annual or semi-annual basis. • **Climate change is expected to cause more severe flooding to occur more frequently.** By the year 2100, it is expected that relatively frequent flood events (10-year return period) in the Englishman River will have somewhat similar consequences to extreme and rare 200-year return period flood events of today. Under these future conditions, areas already exposed to flooding may experience deeper flooding, whereas shallow flooding may reach new areas.
Flood Risk Assessment	• **Lands impacted by Englishman River flooding are primarily residential communities, RV campgrounds and provincial parks.** Key tourist destinations including Rathtrevor Campground and Surfside Resort, are exposed to flooding under future climate change conditions. • **Road flooding and transportation disruption is a significant, near term risk.** Plummer Road and Martindale Road are exposed to flooding during relatively frequent events (10-year return period) under current conditions, which could block road access and emergency services to a large portion of properties in the study area. • The San Pareil Water System is relatively resilient to relatively frequent flood events (10-year return period) under current conditions. However, pumphouse infrastructure at the water intake site is at risk of future flooding during extreme flood events (200-year return period) and as a result of climate change. • Natural habitats are relatively resilient to flood impacts and can generally recover from any flood damages naturally after an event. Further studies would be needed to better understand the impact that flooding may have on water quality and species health (e.g. due to runoff from roads, septic fields, or increased turbidity). • A small region of the City of Parksville is within the study area and is vulnerable to flooding.
Geomorphology Assessment	• The Englishman River channel has remained fairly stationary and within a 30 metre riparian buffer over the past 70 years, except for some evidence of channel migration in the estuary. A 30 metre setback corridor is typical for development to leave room for natural river channel movement. Local governments periodically review regulations and may consider if additional setbacks are required in certain locations to ensure public safety and to lower the impact of development on the natural environment.

Flood Management Planning

Existing Flood Management in the RDN

The RDN and member municipalities already has adaptation approaches in place to reduce flood risks across the region, including in the Englishman River floodplain. Existing initiatives within the RDN include:

- Existing regulatory river floodplain mapping for the Englishman River, Little Qualicum River and the Nanaimo River;
- Floodplain Management Bylaw No. 1469 (first adopted in 2006), regulates the construction of new buildings in designated floodplains, including the Englishman River, Little Qualicum River and the Nanaimo River. This bylaw also establishes requirements to assess coastal flood hazards as part of coastal development proposals;
- Flood Risk Assessment Report (2019), assessed a broad range of river, coastal and stormwater flood hazards across the region;
- Sustainable Site Planning Guide (2020), provides customized guidance to help property owners and local developers lower the impact of construction, landscaping, and major renovation projects on the natural environment. In some cases, even restore or enhance natural functions to provide habitat, flood protection and better manage stormwater;
- Strategic infrastructure planning and asset management that takes adaptive flood planning into account, now and into the future;
- Emergency Program, provides resources and initiatives for emergency planning and response, including the RDN Emergency Plan, emergency alerts, and evacuation procedures;
- Public outreach & volunteer opportunities, including the Neighbourhood Emergency Preparedness Program, education and outreach, and emergency program volunteers; and
- Arrowsmith and Nanaimo Search and Rescue respond to emergency calls, under the RCMP, and is made up of dedicated volunteers, proficient in the skills necessary to respond to ground and inland water emergencies.

Key Resources for Flood Resilience

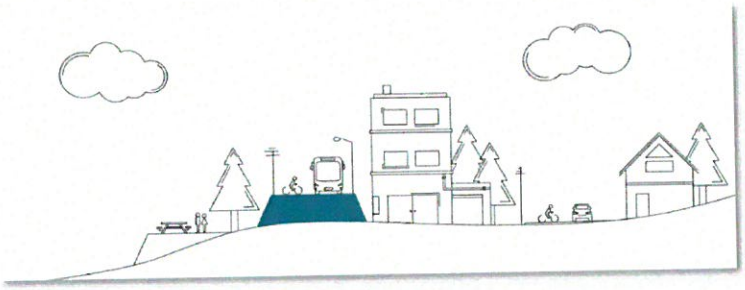
There are a number of resources that property owners and households can reference to build flood resilience on their property. Steps you can take to flood-proof your property include:

1. Complete a self-assessment of your home using the University of Waterloo – Intact Centre's home flood protection check-up tool.
2. Explore ways to flood-proof your septic system through resources on the RDN website.
3. Consider capping your well and learning about the RDN WellSmart program for protecting the supply and quality of your drinking water in the face of flood hazards.
4. Become SepticSmart by learning how to maintain and monitor a properly functioning septic system to avoid septic back up due to heavy rain saturation and clogging from silt and debris from flooding.
5. Sign up for the RDN's emergency alert system to receive notifications about flooding and evacuations right to your cellphone.
6. Look into resources through the RDN's Neighbourhood Emergency Preparedness Program, including ways to get involved as a volunteer.Review the RDN website and PreparedBC for helpful information regarding what to do before, during and after a flood.
7. Familiarize yourself with flood safety information. Review the clean-up after a flood information from Island Health and Technical Safety BC's flood safety page.

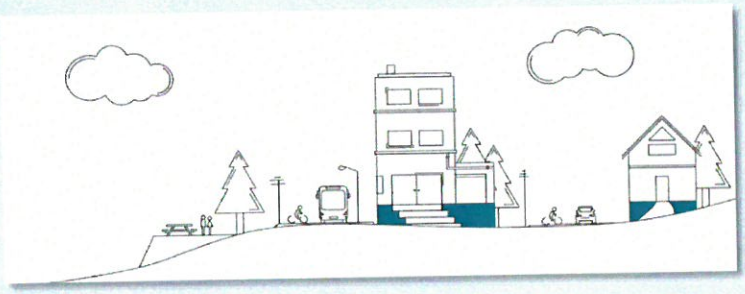
Key Considerations for Future Planning

Communities across BC draw on a range of approaches for managing flooding under current conditions and future climate change. The Province of BC Sea Level Rise Adaptation Primer (2013) outlined four high level approaches for flood management:

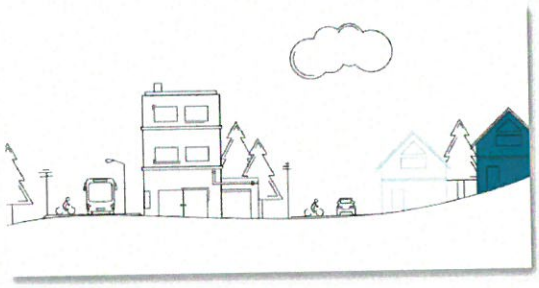
Protect: measures that aim to prevent flooding from occurring. Examples include installing bank protection such as rip rap, dikes, or nature-based approaches such as wetlands and plantings to manage erosion and flood levels.



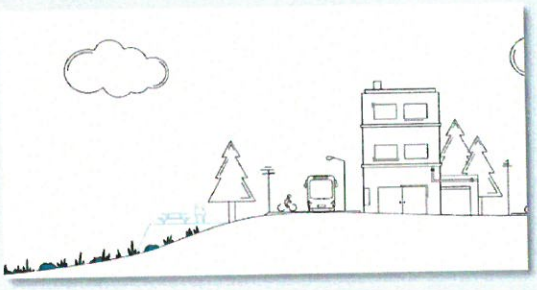
Accommodate: measures that allow flooding to happen but reduce its impact on infrastructure or property. Examples of "accommodate" measures include enabling property-level initiatives to floodproof existing structures or establishing emergency management initiatives for flood hazard areas to protect health and safety and support recovery after flooding events.



Retreat: measures that involve moving existing structures out of flood hazard areas. Examples can include moving high-risk structures and infrastructure out of flood-prone areas in select and extreme cases.



Avoid: measures that aim to manage or reduce the amount of development that happens in flood hazard areas. Examples include establishing policy and planning tools such as Flood Construction Levels (FCLs) and setbacks that guide future development to avoid building in flood-prone areas.



Images Source: District of North Vancouver North Shore Sea Level Rise Risk Assessment & Adaptive Management Strategy (2021)

Outcomes from the Englishman River Flood Hazard Mapping project builds on existing work to better understand flood hazards to support immediate land use and emergency planning needs and contributes to the next steps in the overall Adaptation Program. Though more work still needs to be done to set priorities, future flood management in the RDN will take a regional approach that considers changing environmental conditions due to climate change. Future works with continue to focus on providing policy, resources and guidance to support appropriate measures at the property and household level. No land alterations have resulted from this project and the RDN is not anticipating that the construction of major flood protection structures will be an outcome from future flood management planning.

How does floodplain mapping affect me?

Floodplain maps contain a variety of geographical and technical information that identify areas that may be at risk of flooding during severe storms. These types of maps are used to determine if a property (including buildings, structures and infrastructure) is located in a flood prone area. Another key feature of floodplain maps is defined **Flood Construction Levels (FCLs)**. An FCL is a calculated level of elevation for buildings and structures used to protect development from flood impacts. When adopted into a land use bylaw, floodplain maps with FCLs become a regulatory tool that define the elevation above which new development must be constructed so the livable area of a home is outside of the flood hazard area.

FCLs are based on the maximum flood level shown on the area's local regulatory flood maps for a 200-year return period flood event under future climate change conditions. FCLs account for flood levels resulting from changing precipitation patterns and sea level rise due to climate change.

The RDN's current Floodplain Management Bylaw No. 1469 (2006) establishes FCLs based on maximum water levels from the original floodplain map created by the province in 1985. Outcomes from the Englishman River Flood Hazard Mapping project will provide updated flood mapping information including updated FCLs that consider climate change through the RDN's floodplain management bylaw. The river floodplain maps will be considered alongside the outcomes from the Coastal Flood Hazard Mapping project that RDN is leading separately.

Eventually, all buildings come to the end of their useful life. Adaptation to a changing environment is most easily addressed as part of the normal rebuilding process. In designated areas, FCLs are a key resilience measure that property owners will interact with. Due to the rural and low-density zoning near the Englishman River only a small portion of lands remaining are eligible for subdivision and new development. This means that updating the FCLs will have relatively low immediate impact on homes in the Englishman River area; change is anticipated to occur overtime as existing homes are rebuilt.

Englishman River Estuary (Photo by The Nature Trust of British Columbia)

Revision History

Revision #	Date	Status	Revision	Author
1	May 31, 2021	Final		RNH / JTM