FLOOD RISK ASSESSMENT REPORT

REGIONAL DISTRICT OF NANAIMO
TOWN OF QUALICUM BEACH

SEPTEMBER 2019

PREPARED FOR:

Regional District of Nanaimo

Town of Qualicum Beach

CCEM Strategies
CRITICAL CONTINUITY & EMERGENCY MANAGEMENT

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PROJECT SPONSORSHIP

This risk assessment was conducted collaboratively, with project sponsorship provided by:

- Regional District of Nanaimo – Director, Transportation and Emergency Services
- Town of Qualicum Beach – Chief Administrative Officer

The assessment was made possible with support from Public Safety Canada and the National Disaster Mitigation Program (NDMP), which was established in 2014 as part of the Government of Canada's commitment to building safer and more resilient communities.

PRODUCTION TEAM

The assessment was facilitated by a team of consultants from CCEM Strategies Ltd.

The Project was led by the following:

- Regional District of Nanaimo – Melissa Tomlinson, Emergency Planning Coordinator
- Town of Qualicum Beach – Rob Daman, Emergency Program Coordinator

COMMUNITY REPRESENTATIVES & STAKEHOLDERS

The Project Sponsors and Production Team wish to acknowledge the support and contributions of the many local government and First Nation community representatives, subject matter experts and other agency stakeholders who attended the engagement sessions and provided input and expertise to inform the process.

01 Introduction

PURPOSE

The approach taken for the risk assessment enhances the understanding of the relative flood related risks posed to the community by each flood hazard category.

When conducting a risk assessment, it is important to not only consider the hazard, but its frequency or likelihood and its consequence. Even though a hazard may be highly likely to occur, its consequences may be minimal. Similarly, a hazard event that is unlikely to occur may have very severe consequences. To fully assess the consequence of a hazard event, significant consideration to the various vulnerabilities a community might have to that hazard is required.

This risk assessment will be used as a foundation for the next phase of the region's preparedness and mitigation activities against flood related hazards. With projected increases in the frequency and severity of flood hazards the region faces due to climate change and urbanization, this risk assessment also aims to inform local decision-makers when determining adaptation strategies for the future.

SCOPE

This risk assessment considered and assessed flood related hazards, which present a risk to the region overall inclusive of the Town of Qualicum Beach, City of Parksville and District of Lantzville; Electoral Areas A, B, C, E, F, G, and H; and the region's three First Nations communities: Qualicum, Snaw-naw-as (Nanoose), and Snuneymuxw First Nations.

The risk assessment was conducted using funding from the National Disaster Mitigation Program (NDMP). There are four funding streams within the grant program, including:

- Stream 1: Risk Assessments
- Stream 2: Flood Mapping
- Stream 3: Mitigation Planning
- Stream 4: Investments in Non-Structural and Small-Scale Structural Mitigation Projects

The funding stream for this report was Stream 1: Risk Assessments. The grant funding required the completion of a Risk Assessment Information Template (RAIT).

Out of Scope

The regional risk assessment explored the level of risk and potential impacts of flood related hazards to the region overall and did not assess the risk or specific impacts to individual communities. The risk scores presented in the assessment are applicable to the *region* and may not reflect the specific risk to an individual community.

The assessment of flood hazards related to the City of Nanaimo was considered out of scope of this risk assessment.

The scope of the project focused on identifying locally owned critical assets; identification of regional critical infrastructure in all ten sectors was considered out of scope, as was the analysis of building types, and specific locations of critical infrastructure.

LIMITATIONS

Data Sources & Approach

The approach and tools used in this assessment align with the standard practices set out in Emergency Management British Columbia's (EMBC) Hazard Risk Vulnerability Analysis Toolkit (2019). The toolkit promotes the exploration and incorporation of both scientific data and local knowledge during the risk assessment process. Following this approach, assessments were conducted using a combination of observational data and background research cross-referenced against insights from local experts and community members.

The assessment of risk was completed with information available at the time the assessment was conducted. Extensive research and information gathering efforts were undertaken to source the most current and relevant information, and to engage subject matter experts and community members for inputs. Access to this local information and expertise was limited by attendance and participation levels at the engagement sessions. If individuals or organizations were not able or chose not to attend, the project team was limited in their ability to gather information from these sources to inform the assessment.

The use of anecdotal evidence in the assessment of flood hazard likelihood adds an additional layer of subjectivity to an inherently subjective process. Risk assessments rely on judgement to arrive at measures of likelihood and consequence, which inevitably introduces subjectivity and bias. The interpretation of a hazard description and the subsequent assessment of its likelihood and consequence are influenced by an analyst's individual experiences, responsibilities, and perspectives.

This assessment was undertaken by a diverse team who worked together to arrive at qualitative measures of likelihood and consequence by consensus. While each team member brought a wealth of experience and a unique outlook, repeating the assessment with a different group of people may lead to differences in the results. The risk ratings that resulted from this process should be interpreted as best estimates and not absolutes.

APPROACH

02 Engagement

A key component of the assessment was community engagement. A series of three engagement workshops were conducted to facilitate the sharing of traditional knowledge, personal perceptions, and understanding of flood-related hazards, risks and vulnerabilities in the region.

The workshops were organized and strategically facilitated to emphasize and encourage an open dialogue with all attendees, and to allow for both individual and group contributions. Each session focused on a specific component of the risk assessment process and included activities to engage participants and gather input and feedback on identified project elements. In addition to the engagement sessions, outreach to interview specific individuals was conducted to obtain more technical or scientific information related to probabilities and historical instances of flood hazard events.

The engagement participants included representatives from government and non-government agencies, first responders, Indigenous community members, industry stakeholders, neighbouring community members, and subject matter experts. Two geographic groups, "North" and "South", were created for the engagement sessions. Separating the groups into North and South enhanced participation and aided engagement efficiency and focus allowing time to adequately explain processes and capture input into multiple elements per session. In addition, separating the groups into North and South highlighted the geographic, economic, demographic, and perceived differences between the two areas. Each session group was made up of identified key area representatives who utilized their expertise, local knowledge, and geographic familiarity, to provide input and contribute to the activities and assessments. The complete list of entities who participated is included in *Appendix 6* of this document.

The engagement sessions were successful, in that outcomes and information gathered provided context and background, and the information received from participants about historical events helped to inform discussions related to flood hazard likelihood and local relevance. Perceptions shared regarding the significance of the various hazard consequences were used to inform the evaluation of impacts per flood hazard, specific to the region.

"The sessions were open, informative and I felt we were heard and the information we bring is valuable" (Engagement Session Participant).

Feedback from participants identified the benefits of the attending the workshops: contributing to the identification and prioritization of hazards; an improved understanding of local risks; preparation of a foundational tool to inform regional planning projects; and the process was beneficial for increasing and strengthening connectivity between organizations and communities.

03 Risk Assessment

HAZARD IDENTIFICATION

The first step in the risk assessment process was to identify the flood hazards that could affect the region. Three flood related hazards were identified as relevant to the region:

- Overland Flooding
- Rivers, Lakes and Stream Flooding
- Coastal Flooding

RISK ASSESSMENT

Following the identification of the flood hazards to be assessed, the next step was to determine the relative risk posed by each hazard by calculating a risk score. Risk is defined as "as a measure of the probability [likelihood] and severity of an adverse effect to health, property, the environment, or other things of value" (EMBC, 2004). To calculate the risk scores, it was necessary to assess both the likelihood of each hazard's occurrence and its potential consequences. The assessment was grounded in engagement with stakeholders, community leaders, and subject matter experts, supplemented with research into historical and notable hazard events, and the consideration of influencing factors, particularly climate change.

Risk is commonly calculated by multiplying the likelihood score by the total consequence score, as follows:

$$Risk = Likelihood \ x \ Consequence$$

Likelihood Assessment

Likelihood is the probability of an event occurring and is commonly expressed as an expected rate of occurrence e.g. once every 15 years. Estimated rates of occurrence were obtained using published and historical records of notable incidents for the region, wider province, and country. Hazard likelihood information from previous risk assessments and reports relevant to the region was also considered.

Following the collection and review of hazard frequency data, the project team assigned a likelihood rating to each flood hazard. The likelihood rating was based on a 5-point scale (see *Table 1*) which is a combination of the scale provided in the EMBC HRVA Toolkit (2019) and the scale provided by the UN International Strategy for Disaster Reduction Resilient Cities' Quick Risk Estimation Tool. The likelihood assessment used a combined scale to permit the use of historical data when no frequency data or return period information was available.

Table 1 – Likelihood Scale

EMBC				UNISDR
Likelihood	**Rating**	**Frequency**	**Probability (% Chance)**	**Historical Data (Definition/Consideration)**
Almost certain	5	Event is expected to happen once every two years or more frequently	Annual chance ≥ 50%	Has occurred 3 or more times in the last 5 years
Likely	4	Event is expected to happen about once every 3-10 years	10% ≤ annual chance < 50%	Has occurred twice in the last 5 years
Possible	3	Event is expected to happen about once every 11-50 years	2% ≤ annual chance < 10%	Has occurred once in the last 5 years
Unlikely	2	Event is expected to happen about once every 51-100 years	1% ≤ annual chance < 2%	May occur and has occurred once in the last 10 years
Rare	1	Event is expected to happen less than once every 100 years	Annual chance <1%	May only occur in exceptional circumstances and has occurred in the last 20 years

Consequence Assessment

Consequences are the physical/environmental, social, economic, and political impacts or adverse effects that may occur as the result of a hazardous event (EMBC, 2019). Understanding the potential impacts of a hazard is a key step in assessing risks to a community. Any one hazard can have a variety of impacts and these impacts can differ in severity.

To support the measurement of consequences for the three flood hazards, the Project Team adapted EMBC's 11 consequence categories, which are divided into "Human and Social Impacts" and "Physical and Economic Impacts", and have defined impact rating scales for each category.

Human and Social Impacts:

- Fatalities
- Injury/Illness
- Displacement
- Psychosocial
- Support System Impact
- Cultural Resource Impact

Physical and Economic Impacts:

- Property Damage
- Critical Infrastructure
- Environmental
- Economic
- Reputational

The project team rated the severity of potential impacts for each flood hazard using the 5-point scale associated with each consequence category (see *Table 2* and *Table 3*). Current risk treatments and/or mitigation activities were considered when the project team rated the impacts of the flood hazards.

The 11 consequence scores were summed to give a total consequence score out of 55 for each flood hazard.

Table 2 – Consequence Rating Scale (Human and Social Impacts)

Rating	Fatalities	Injury/Illness	Displacement	Psychosocial	Support System Impact	Cultural Resource Impact
1	Not likely to result in fatalities.	Not likely to result in injuries or illness.	Not likely to result in evacuation orders.	Event is unlikely to result in any short- or long term trauma.	Not likely to impact access to supports or networks. Community reciprocity, trust and cooperation are unaffected.	Little to no impact.
2 LOW	Loss of life that is manageable within the scope of normal operations.	Illness or injury that is manageable within the scope of normal operations.	Low percentage of the population evacuated, self-evacuated or sheltering in place. Supports are provided within the community.	Direct impacts to a few individuals. Psychosocial impacts can be primarily addressed by Psychological First Aid. Additional supports to those directly impacted and their families can be provided by local mental health professionals.	Hours-day-long disruption to daily life. Likely to result in some localized reduced access to supports/networks. Community reciprocity, trust, and cooperation are affected.	Recovery of the resource will take days to weeks.
3 MED	Loss of life that is beyond the scope of normal operations and may require overtime and/or additional resources.	Illness or injury that is beyond the scope of normal operations and may require additional capacity and/or resources, and/or the activation of response systems and emergency plans.	Enough of the population is evacuated, self-evacuated or sheltering in place to require external support.	Localized loss of property and/or fatalities or serious injuries. Those directly impacted are likely to experience both short- and long-term psychosocial impacts. Local and outside mental health professionals will be needed to provide support and treatment.	Days-long disruption to daily life. Likely to result in reduced access to supports or networks. Community reciprocity, trust, and cooperation are affected.	Recovery of the resource will take months.
4 HIGH	Loss of life severe enough for mass fatality procedures to be activated.	Extensive mass illness or injury requiring extra capacity and/or resources across multiple facilities in a health region and potentially specialized care from other health regions. Health authority response systems and emergency plans activated.	10-30 percent of the population evacuated or displaced.	Widespread loss of property and/or multiple fatalities or persons with serious injuries. Those directly impacted are likely to experience both short- and long-term psychosocial impacts. Local and outside mental health professionals will be needed to provide support and treatment.	Weeks or Months-long disruption to daily life. Significantly reduced access to supports or networks. Community reciprocity, trust, and cooperation are severely affected.	Recovery of the resource will take years.
5 EXTREME	Fatalities exceed capacity of existing plans and capabilities. Provincial, Federal and International resources may be required.	Extraordinary mass illness or injury. Provincial, Federal or international resources may be required. Multiple health region response systems are active.	High percentage of residents are displaced for years or permanently.	Widespread and long-term psychosocial impacts beyond those who are directly affected by property loss or fatalities. Extensive external supports required.	Months to years-long disruption to daily life. Supports or networks may be permanently changed.	Resource can never recover; destruction is permanent and irreversible (e.g., destruction of an irreplaceable artifact/knowledge).

Table 3 – Consequence Rating Scale (Physical and Economic Impacts)

Rating	Property Damage	Critical Infrastructure	Environmental	Economic	Reputational
1	Not likely to result in property damage.	Not likely to disrupt critical infrastructure services.	Not likely to result in environmental damage.	Not likely to disrupt business or financial activities.	Not likely to result in political or reputational impacts.
2 LOW	Minor, mostly non-structural damage.	Low percentage of the population impacted by few service disruptions. Disruptions last hours to days.	Localized and reversible damage. Hours to days-long clean up possible.	Days-long disruption to few businesses, financial activities, or livelihoods.	Limited or short-term political or reputational impacts.
3 MED	Localized severe damage.	Either a high percentage the population impacted by a few services OR a low percentage of the population impacted by a major or multiple service disruptions.	Full clean up possible but may take weeks.	Weeks-long losses to businesses, industry or livelihoods.	Some significant or long-term political or reputational impacts.
4 HIGH	Widespread structural damage.	High percentage of the population impacted by a major or multiple service disruptions.	Major but reversible damage. Full clean up difficult and could take months or years.	Months long losses to business, industry or livelihoods.	Significant and long term political or reputational impacts.
5 EXTREME	Widespread irreparable damage.	High percentage of the population is impacted by long-term outages.	Severe or irreversible damage. Full clean up not possible or could take decades.	Widespread or long-term loss of businesses, industry or livelihoods.	Significant and irreparable political or reputational impacts.

Findings

04 Community Profiles

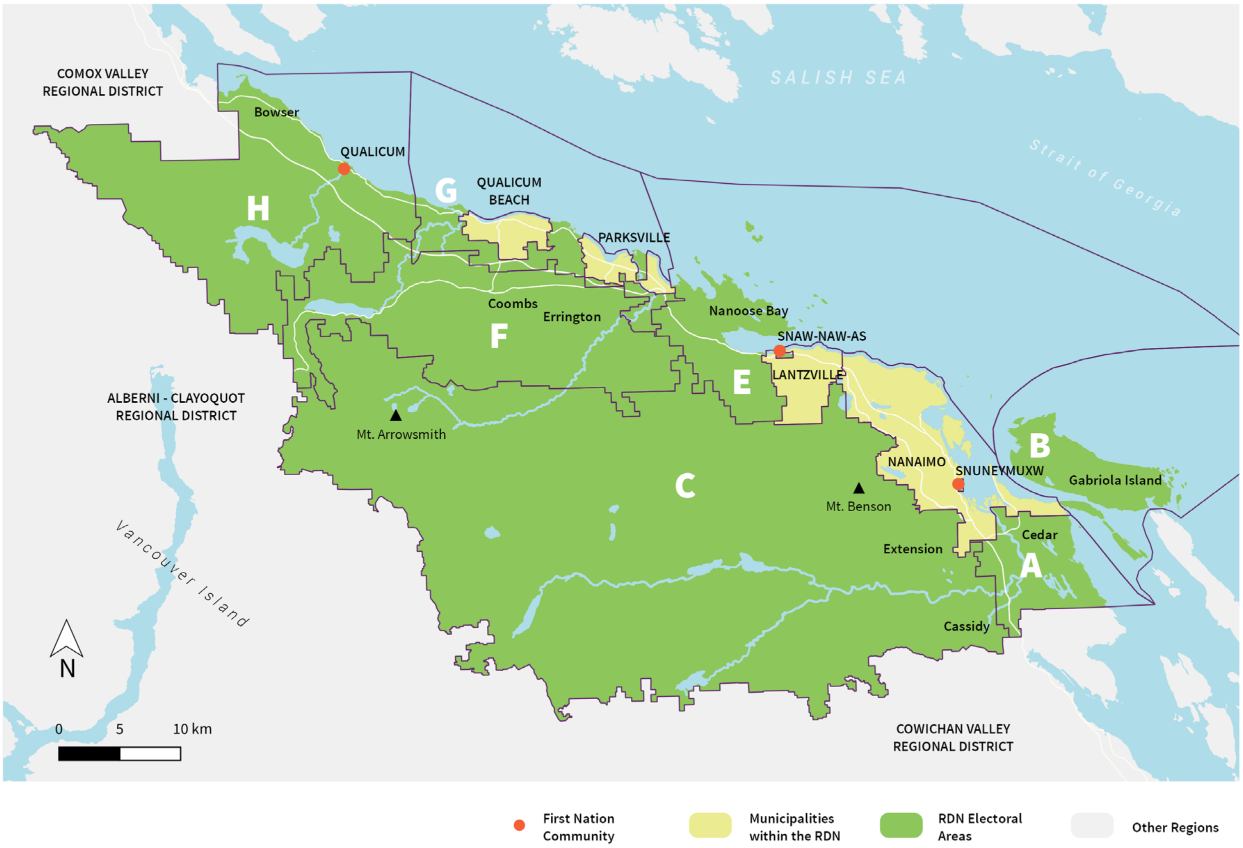
GEOGRAPHIC SETTING

Situated on the central east coast of Vancouver Island, the Regional District of Nanaimo ("the region") covers a large, geographically diverse area of over 2,000 square kilometers. Bound by the Strait of Georgia to the east, the region is bordered by Comox Valley Regional District to the north, Alberni-Clayoquot Regional District to the west, and Cowichan Valley Regional District to the south (see *Figure 1* – Map of the Regional District of Nanaimo). There are four municipalities within the region – the Town of Qualicum Beach, City of Parksville, the District of Lantzville, and the City of Nanaimo, and seven unincorporated Electoral Areas. The Regional District of Nanaimo provides both regional governance and a variety of regional and local services to its constituent communities.

The electoral areas within the region are as follows:

- Electoral Area A: Cedar, South Wellington, Yellowpoint, Cassidy
- Electoral Area B: Gabriola, Decourcy, Mudge Islands
- Electoral Area C: Extension, Nanaimo Lakes, East Wellington, Pleasant Valley
- Electoral Area E: Nanoose Bay
- Electoral Area F: Coombs, Hilliers, Errington, Whiskey Creek, Meadowood
- Electoral Area G: French Creek, San Pareil, Little Qualicum
- Electoral Area H: Bowser, Qualicum Bay, Deep Bay

The Regional District of Nanaimo is situated within the traditional territory of several First Nations, including three that have communities and other lands under their jurisdiction: Snuneymuxw, Snaw-Naw-As (Nanoose), and Qualicum First Nation (Regional District of Nanaimo, 2013).



Source: Regional District of Nanaimo, 2019a

Figure 1 – Map of the Regional District of Nanaimo

Situated between the mountains and the ocean on the east side of Vancouver Island, the Regional District of Nanaimo encompasses a wide diversity of landscapes and ecosystems. The terrain ranges from steep forested headlands in the west (the highest point, Mount Arrowsmith ridge, is 1818 m above sea level) to gently undulating lowlands in the east where the region's watersheds discharge into the Georgia Strait.

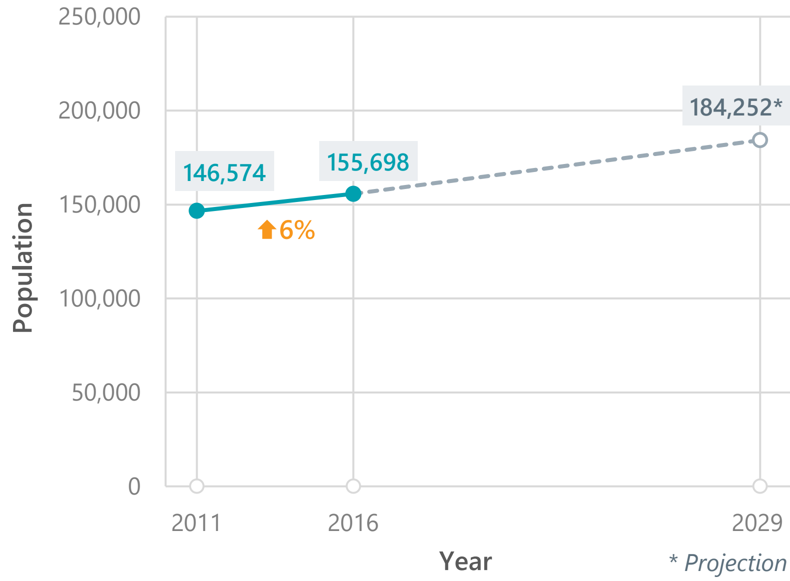
The region has a moderate coastal climate with warm dry summers (average daily high of 21°C) and mild, wet winters (average daily low of 10° C). As the region is located on the leeward side of Vancouver Island's mountain ranges, the rain shadow effect causes this region to experience a climate similar to the Mediterranean. There are two biogeoclimatic zones within the region: the Coastal Douglas Fir moist maritime zone (CDFmm), and the Coastal Western Hemlock very-dry maritime zone (CWHxm). The Coastal Douglas Fir biogeoclimatic zone dominates the portion adjacent to the coast and is the smallest and most at-risk zone in BC (CDFCP, 2018).

Most of the region's population lives and works within the lowland regions. Productive agricultural lands are found in the middle watersheds, and the majority of the upland regions are private forest land with active logging operations.

GENERAL DEMOGRAPHICS

With more than 160,000 people calling the Regional District of Nanaimo home, it is British Columbia's fifth most populous regional district (Statistics Canada, 2016). Between 2011 and 2016, the population of the region grew by 6% (see *Figure 2*). Current estimates suggest that the population will grow by another 12% over the next decade, from an estimated 164,546 residents in 2019 to 184,252 residents in 2029 (Stats BC, 2018).

Figure 2 – RDN population growth



Source: 2011 and 2016 data – Statistics Canada, 2016
2019 population estimate – Stats BC, 2018

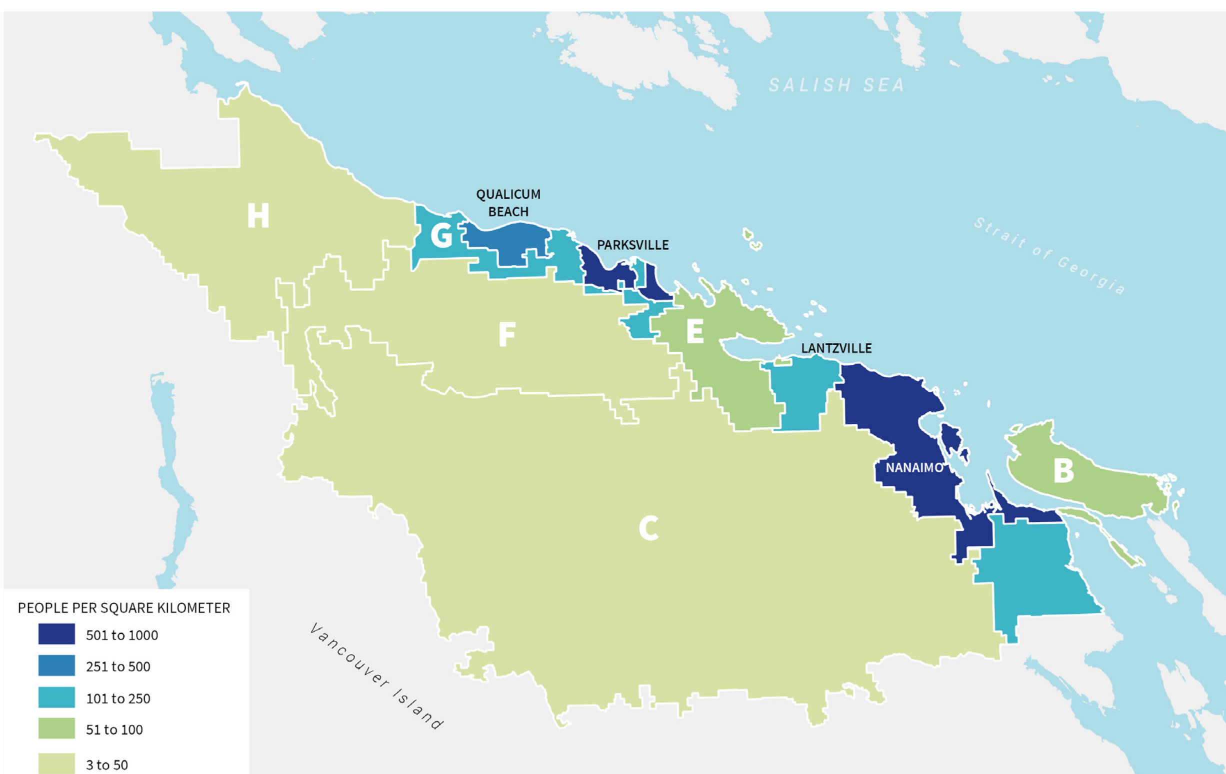


Figure 3 – Population density by municipality and electoral area

The density of settlements is highly varied across the region with a mixture of high-density urban areas, moderate density urban and suburban areas, and swathes of sparsely populated rural areas. The population density of the member municipalities and unincorporated rural electoral areas ranges from a high of 859.6 persons per km^2 in the City of Parksville to just 2.6 persons per km^2 in Electoral Area C (see *Figure 3* and) (Statistics Canada, 2016).

The First Nations reserves in the region all have a relatively small land base (see). The largest of the reserves is the Snuneymuxw "Nanaimo River" reserve, which is 2.24 km^2 (see). Although the on-reserve populations are small compared to those of the neighbouring municipalities and electoral areas, the population density of each reserve is relatively high. The Nanaimo Town 1 reserve has the highest population density in the region at 1,783.1 persons per km^2.

Table 4 – Population statistics for communities within the RDN

Community	Census 2016 Population	Land Area (km^2)	Population Density (people per km^2)
Parksville	12,514	14.56	859.6
Qualicum Beach	8,943	17.98	497.4
Electoral Area F	7,724	264.36	29.2
Electoral Area G	7,465	49.32	151.4
Electoral Area A	7,058	60.31	117
Electoral Area E	6,125	75.08	81.6
Electoral Area B	4,033	57.76	69.8
Electoral Area H	3,884	277.41	14
Lantzville	3,605	27.68	130.2
Electoral Area C	2,808	1,098.94	2.6
Nanaimo River*	371	2.24	165.7
Nanaimo Town 1†	360	0.2	1,783.1
Nanoose‡	230	0.71	326
Qualicum§	74	0.74	99.4

** Snuneymuxw First Nation Reserve Land*
† Snuneymuxw First Nation Reserve Land
‡ Snaw-Naw-As (Nanoose) First Nation Reserve Land
§ Qualicum First Nation Reserve Land

Source: Statistics Canada, 2016

AGE

There is a greater proportion of seniors (age ≥65 years) in the region compared to the province (see *Table 5*). Over a quarter (27%) of the population in the region is age 65 or over, compared to 18% of the population of British Columbia (Statistics Canada, 2016). The Town of Qualicum Beach and the City of Parksville have the greatest proportion of seniors at 52% and 42% of the population, respectively. In 2016, the median age in the region was 51.1 years, compared to a median age of 43.0 years in British Columbia. Approximately 13% of the population of the region is 14 years of age or younger.

The populations on the First Nations reserves skew much younger than the populations of the municipalities and electoral areas in the region (see). Approximately two-thirds of those living on the Qualicum, Snaw-Naw-As (Nanoose), and Snuneymuxw First Nations reserves are between the ages of 15-64 years, and close to a quarter are under the age of 15.

Table 5 – Age characteristics of communities within the RDN

Community	0 – 14 years		15 – 64 years		65 years+	
British Columbia	691,390	15%	3,107,680	67%	848,985	18%
RDN[1]	19,985	13%	93,625	60%	42,090	27%
Parksville	1155	9%	6055	48%	5305	42%
Lantzville	505	14%	2260	63%	840	23%
Qualicum Beach	555	6%	3730	42%	4660	52%
Electoral Area A	965	14%	4680	66%	1410	20%
Electoral Area B	300	7%	2220	55%	1510	37%
Electoral Area C	405	14%	1930	69%	475	17%
Electoral Area E	545	9%	3405	56%	2165	35%
Electoral Area F	1155	15%	5090	66%	1480	19%
Electoral Area G	745	10%	4000	54%	2715	36%
Electoral Area H	370	10%	2275	59%	1235	32%
Nanaimo Town 1	85	24%	235	65%	40	11%
Nanaimo River	85	23%	240	65%	45	12%
Nanoose	60	26%	150	65%	15	7%
Qualicum	15	20%	50	68%	10	14%
		BC		BC		BC

Source: Statistics Canada, 2016

[1] RDN aggregate statistics include the City of Nanaimo.

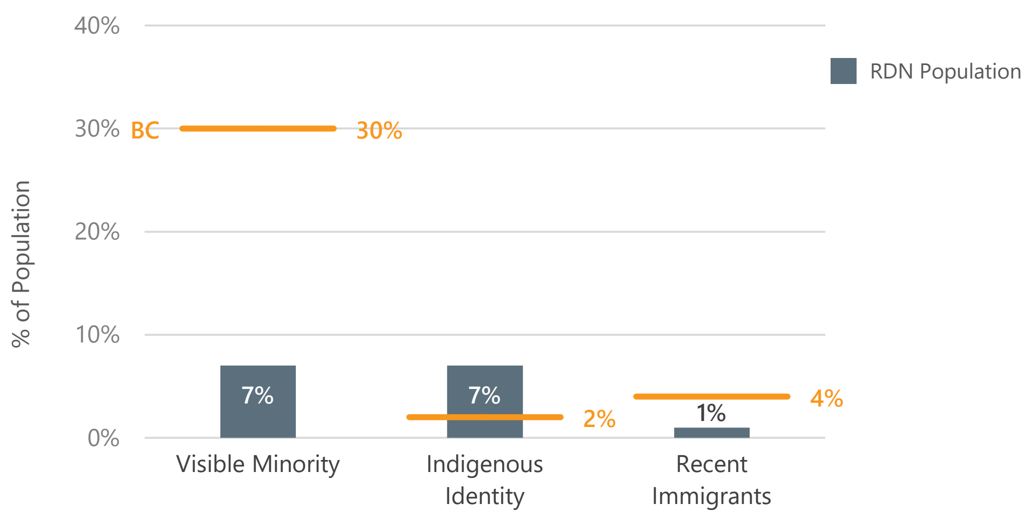
CULTURAL IDENTITY

Approximately 7% (10,855) of people within the region belong to a visible minority[2] (see *Figure 4*), which is significantly lower than the percentage of British Columbia's population belonging to a visible minority (30%). The percent of visible minorities in the municipalities and electoral areas ranges from 2% (Town of Qualicum Beach) to 7% (District of Lantzville). The visible minority population within the region consist mainly of the following groups: Chinese (2695 people, 1.8%), South Asian (2255 people, 1.5%), Filipino (1290 people, 0.9%), and Southeast Asian (985 people, 0.6%).

A further 7% (10,635 people) of the region's population identify as First Nation, Métis or Inuit, which is higher than the 2% of the population of British Columbia that identifies as Indigenous.

Of the regional district's population, only 1% are considered recent immigrants (arriving between 2011 and 2016), compared to 4% of British Columbia's population.

Figure 4 – Cultural identity statistics for the region *Source: Statistics Canada, 2016*



LANGUAGE

In 2016, 99% of the population in the regional district could conduct a conversation in English (Statistics Canada, 2016). Only 3% of the population of the region speak a language other than English or French (i.e. a "non-official language") most often at home. In British Columbia, 13% of the population speaks a non-official language most often at home.

[2] *Visible minority refers to whether a person belongs to a visible minority group as defined by the Employment Equity Act and, if so, the visible minority group to which the person belongs. The Employment Equity Act defines visible minorities as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."* (Statistics Canada, 2016)

FAMILY AND HOUSEHOLD CHARACTERISTICS

There were 68,904 occupied private dwellings in the region in 2016 (Statistics Canada, 2016). Almost three-quarters of these households (71%, 48,720 people) have 2 or more persons. Of those aged 15 years or older, 60% (81,785 people) are either married or living in a common law relationship. This is comparable to the marital status of the population in British Columbia (58% of those 15 years or older are either married or living common law).

The proportion of couples with children varies across the region but is less than the provincial statistic (48%) in all municipalities and electoral areas (see *Table 6*). A greater proportion of couples on the First Nations reserves have children, ranging from 62% of couples in Nanaimo Town 1 to 83% of couples in Nanoose.

In 2016, there were 6,780 lone parent families in the region (representing 15% of families) (see *Table 6*). Of these families, 77% were female-led. Over a quarter of families on the First Nations reserves are lone parent families (46% in Qualicum Reserve).

Table 6 – Household characteristics of communities within the RDN

Community	Total number of *census families* in private households	Lone-parent families		Total – *Couple census families* in private households	Couples with children	
		n	%		n	%
British Columbia	1,311,345	197,940	15%	1,113,400	535,610	48%
RDN	46,660	6,780	15%	39,880	13,745	34%
Parksville	3835	515	13%	3325	845	25%
Lantzville	1145	120	10%	1020	435	43%
Qualicum Beach	3025	250	8%	2775	505	18%
Electoral Area A	2240	310	14%	1925	740	38%
Electoral Area B	1320	110	8%	1215	230	19%
Electoral Area C	875	80	9%	795	340	43%
Electoral Area E	2195	135	6%	2065	500	24%
Electoral Area F	2315	350	15%	1965	765	39%
Electoral Area G	2615	215	8%	2400	630	26%
Electoral Area H	1290	100	8%	1185	280	24%
Nanaimo Town 1	100	35	35%	65	40	62%
Nanaimo River	105	30	29%	70	50	71%
Nanoose	65	30	46%	30	25	83%
Qualicum	20	5	25%	15	10	67%
			BC			BC

Source: Statistics Canada, 2016

INCOME

The median total income of households in the regional district was $62,349 in 2015, which was slightly lower than the 2015 median total income of households in British Columbia ($69,999) (see *Table 7*) (Statistics Canada, 2016). The member municipalities and electoral areas with the lowest median total household incomes were: the City of Parksville ($55,771), Electoral Area F ($54,800), Electoral Area H ($54,323), and Electoral Area B ($47,795).The lowest 2015 median total household incomes were found in the First Nations Reserves: Nanaimo River ($46,720), Nanaimo Town 1 ($42,240), Qualicum ($38,016), and Nanoose ($23,328).

Approximately 16% of households in the region are classified as low income (based on the Low-income measure, after tax (LIM-AT)), which is in line with the 16% of households in British Columbia that are classified as low income (see *Table 7*). Approximately one-fifth of households in Electoral Area F (22%) and Electoral Area H (20%) are classified as low income. The largest proportion of low-income households were found in Electoral Area B (25%).[3]

Table 7 – Income of households in the region

Community	Median total income of households in 2015 ($)	Prevalence of low income based on the *Low-income measure, after tax* (LIM-AT) (%)
Electoral Area C	$84,173	11%
Lantzville	$82,871	8%
Electoral Area E	$79,680	11%
Electoral Area G	$72,158	11%
Electoral Area A	$71,680	14%
British Columbia	$69,995	16%
Qualicum Beach	$65,692	11%
RDN	$62,349	16%
Parksville	$55,771	14%
Electoral Area F	$54,800	22%
Electoral Area H	$54,323	20%
Electoral Area B	$47,795	25%
Nanaimo River	$46,720	n/a (see note below)
Nanaimo Town 1	$42,240	n/a
Qualicum	$38,016	n/a
Nanoose	$23,32	n/a

Source: Statistics Canada, 2016

[3] *"The low-income concepts are not applied in the territories and in certain areas based on census subdivision type (such as Indian reserves). The existence of substantial in-kind transfers (such as subsidized housing and First Nations band housing) and sizeable barter economies or consumption from own production (such as product from hunting, farming or fishing) could make the interpretation of low-income statistics more difficult in these situations."* (Statistics Canada, 2016)

ECONOMY

The region's labour force participation rate[4] (55.2%) is lower than the BC average (63.9%), but it varies greatly across the individual communities (see *Table 8*) (Statistics Canada, 2016). The Town of Qualicum Beach and City of Parksville have the lowest labour force participation rates in the region (35% and 43.4%, respectively), which is likely due to the large proportion of retired persons in these areas.

The unemployment rate for the region (7.7%) is slightly higher than the BC average at 6.7% (see). Of the member municipalities and electoral areas, the highest unemployment rates were found in Electoral Area H (11.3%), Electoral Area, B (9.6%), and Electoral Area F (8.5%). The highest unemployment rates in the region were observed in three of the First Nations reserves; Nanoose (23.8%), Nanaimo Town 1 (22.2%), and Nanaimo River (19.2%).

The service sector accounts for most of the economic base within the region with service industries employing 79% of the labour force (Statistics Canada, 2016). Goods-producing industries employ 19% of the labour force. This breakdown mirrors the provincial statistics; service industries employ 80% of the labour force in BC and goods-producing industries employ 19%.

The retail sector and health care sector are the largest employers in the region with each sector providing approximately 10,000 jobs or approximately 14% of all jobs (Statistics Canada, 2016). Construction is another important economic activity in the region, providing employment for approximately 10% of the region's labour force (approximately 7,000 jobs). The tourism industry accounts for 8% of all jobs in the region (approximately 6,000 jobs) and includes accommodation, food services, entertainment and recreation, plus a variety of economic activities that support the industry.

[4] The labour force is composed of those 15 years of age and older who are either employed or actively seeking work. The labour force participation rate represents the ratio between those in the labour force and the total population that is of working age. (Statistics Canada, 2016)

Table 8 – Labour force and unemployment statistics for communities within the region

Community	Labour force participation rate (%)	Unemployment rate (%)
Qualicum	73%	0%
Electoral Area C	66%	7%
British Columbia	64%	7%
Nanoose	64%	24%
Electoral Area A	62%	8%
Electoral Area F	60%	9%
Lantzville	59%	7%
RDN	**55%**	**8%**
Nanaimo Town 1	49%	22%
Electoral Area H	47%	11%
Electoral Area E	47%	7%
Electoral Area B	46%	10%
Electoral Area G	46%	8%
Nanaimo River	46%	19%
Parksville	43%	7%
Qualicum Beach	35%	6%

BC

Source: Statistics Canada, 2016

05 Vulnerability

INTRODUCTION

To fully understand how a flood hazard might impact a community, it is necessary to consider the degree of vulnerability to the hazard. While being situated in a hazardous zone is a key determinant of risk, a community's vulnerability defines the susceptibility of the people, property, industry, resources, and the environment to harm should an event occur.

The UN Office for Disaster Risk Reduction defines vulnerability as:

The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. (UN Office for Disaster Risk Reduction, 2017)

The Government of British Columbia defines vulnerability as:

"people, property, infrastructure, industry and resources, or environments that are particularly exposed to adverse impact from a hazard event" (EMBC, n. d.)

To capture these various factors, vulnerabilities have been grouped into four sections within this report: Social Vulnerabilities (e.g., age, language, income levels); Economic Vulnerabilities (e.g. economic dependencies on industries and resources); Environmental Vulnerabilities (e.g. dependencies on sensitive natural areas); and Physical Vulnerabilities (e.g. critical infrastructure, locally owned assets). Considering how these factors increase a community's susceptibility to the impact of flood hazards will ultimately permit the prioritization of risks based on where communities are most vulnerable.

SOCIAL VULNERABILITY

The occurrence of similar flood events in different communities will likely reveal significant variations in consequences due to differing levels of social vulnerability. Social vulnerability refers to the (limited) ability of a population to withstand and recover from the adverse impacts of a hazard event. Heightened levels of social vulnerability typically stem from a combination of economic, social, and political processes, which give rise to social and economic inequalities (Perdikaris, 2014; IPCC, 2014).

Inequitable distribution of social, cultural and economic resources results in social groups that are more susceptible to the impacts of flood hazards and in greater need of coping assistance.

As part of one of the engagement workshops, participants were asked to consider local resource limitations that have the potential to contribute to vulnerability within the community. The workshop participants identified several resource limitations encountered by seniors, homeless persons, and people of low social-economic status in the region (see *Table 9*).

Many of the physical, social, and structural barriers to accessing services and supports encountered by the elderly, homeless, and low-income individuals, as identified by the workshop participants, are similar in nature. Limited income, inadequate housing or living conditions, and dependency on support services reduce the adaptive capacity and resilience of these populations.

Through the review of data collected from the engagement workshops and available census information (see *Community Profiles*), the following vulnerable populations within the region were identified.

Seniors

The region has a relatively high percentage of elderly residents (27% of the population is age 65 or over) and the population is aging. As the baby boomer generation grows older, the number of seniors in the region will increase, which is expected to have significant implications for housing, support services, and employment (Regional District of Nanaimo, n.d.).

Seniors are particularly vulnerable to the health impacts associated with natural hazards. These health impacts can be compounded by their social isolation; visual, cognitive, and hearing impairments; and agility and mobility limitations adults giving rise to increased levels of vulnerability (Health Canada, 2011).

Older adults are also more vulnerable to service disruptions which may follow hazard events. With an increased reliance on caregivers, medications, and healthcare services, any interruption to these services can disproportionately impact senior populations.

Table 9 – Resource limitations of local community groups

(Input gathered from engagement session participants)

Resource	Seniors (≥65 years of age)	Homeless	Low SES (Socio-Economic Status)
Housing	• Limited independent living facilities and other types of suitable housing. • Limited home care services available.	• Limited access to warm shelters with sanitation facilities. • No ability to stockpile food, water, fuel etc. for use in an emergency.	• Lack of affordable housing. May be housed in unsuitable/unstable accommodation that is vulnerable to hazards.
Income	• May not have savings. • May be on a fixed/low income and reliant on pension cheques or other form of income assistance that could be interrupted.	• Limited access to savings/ credit. • May be on a fixed/low income and reliant on income assistance that could be interrupted.	• Limited access to savings/credit. • May be on a fixed/low income and reliant on income assistance that could be interrupted. • Limited ability to stockpile food, water, fuel etc. for use in an emergency.
Employment	• May encounter barriers to employment due to age discrimination.	• May encounter barriers to employment due discrimination and/or to lack of a permanent address.	• May work in service sector jobs that are susceptible to interruption during emergencies.
Social Supports	• Many seniors live on their own. • May not have anyone to check on them or may become cut-off from supports.	• Limited mental health care, social workers, and drug addiction programs.	

Resource	Seniors (≥65 years of age)	Homeless	Low SES (Socio-Economic Status)
Transportation	• May no longer drive and so rely on public transportation which is limited in terms of routes and scheduling. • Use of mobility devices may limit transportation options.	• May not have a vehicle and so rely on public transportation which is limited in terms of routes and scheduling.	• May not have a vehicle and so rely on public transportation which is limited in terms of routes and scheduling.
Technology	• Lack of IT skills may limit access to current information.	• Lack of computer/phone/ internet may limit access to current information.	• Lack of computer/phone/ internet may limit access to current information.
Other	• Health/physical barriers may prevent the moving and stockpiling of resources for an emergency, e.g. water, wood, fuel, food. • Hearing/sight/physical impairments and health issues may increase dependence on medical resources/services.	• May be experiencing mental health or addiction issues. • Limited access to resources may be due to social stigma.	• Limited access to resources may be due to social stigma.

Children/Youth

The region as a whole does not have a high percentage of children and youth (just 13% of the population is 14 years of age or younger), but close to a quarter of those living on the Qualicum, Snaw-Naw-As (Nanoose), and Snuneymuxw First Nations reserves are under the age of 15. Children are particularly vulnerable when separated from their parents or guardians as they are dependent on their caregivers for access to resources, decision-making, mobility, and emotional support (Sharma, 2016). Young children are also more psychologically and physically vulnerable to the impacts from hazards.

Single-Parent Households

The structure of households has been identified as an important factor in social vulnerability (RAND, 2011). There are approximately 7,000 single parent families in the region, three-quarters of which are female-led households. Single parents are over-represented in precarious jobs and may have limited working hours in order to balance childcare responsibilities (Mitchell & Murray, 2017). As a result, these households may have lower income, lower entitlement to health benefits, and reduced social contacts. Households led by single mothers may be particularly vulnerable due to their limited access to resources that arises from issues of power and privilege, and lower wages (Donner & Rodríguez, 2011).

Low Income Households

Approximately one-fifth of households in the region are low income and the median household income on the local First Nations Reserves was found to be far lower than the provincial statistic (see *Community Profiles – Income*). Low income populations are generally more vulnerable to hazard impacts due to both the location and quality of their housing, limited mobility, and lack of insurance and savings (City of Vancouver, 2012). Limited financial resources can reduce the ability of a household to both prepare for, endure, and recover from hazard events.

Indigenous Peoples

Approximately 7% (10,635) of the region's population identify as Aboriginal (of which approximately 60% identify as First Nations, 39% identify as Métis, and <1% identify as Inuk). There is a long history of oppression and marginalization of Indigenous peoples in Canada, which has heightened the vulnerability of these populations. The impacts of colonial policies, residential schooling, inter-generational trauma, and continued racism and social exclusion have led to a greater number of health and socioeconomic inequities (Reading & Wien, 2009). Lower income, inadequate housing and living conditions, and limited access to culturally appropriate support services are just some of the factors that have reduced the adaptive capacity and resiliency of Indigenous populations to hazard events. Displacement and evacuations following a hazard event can exacerbate existing resource inequalities and can also be extremely traumatic for those who were affected by residential schools (Indigenous Corporate Training Inc., 2018).

Homeless

In recent years there has been a significant growth in the region's homeless population. The 2018 Point-in-Time (PIT) homeless count coordinated by the province documented 42 individuals experiencing homelessness between Nanoose Bay and Bowser (BC Housing, Homelessness Services Association of BC, Urban Matters, and BC Non-Profit Housing Association Homelessness Services Association of BC, Urban Matters, and BC Non-Profit Housing Association, 2018). This count likely vastly underestimates the numbers of unsheltered homeless individuals, according to the Coalition of the Homeless, as PIT data on unsheltered homeless does not include homeless people sleeping in non-visible locations (i.e. the "hidden homeless") (Weesjes, 2015). Furthermore, it is estimated that "for every person who's homeless in Canada, there are an additional 23 households that are vulnerably housed and at high risk of becoming homeless" (Hwang, 2018).

The lack of access to adequate, secure housing increases an individual's ability to endure and recover from a flood event.

There is a "clustering of vulnerability factors" in homeless populations, which can in turn result in a greater susceptibility to the adverse impacts of hazards (Settembrino, 2015). Those experiencing homelessness may be facing a number of barriers that limit access to housing including high rents, low income, substance-use disorders, disabilities, mental health issues, trauma, and discrimination. With limited access to resources and increased prevalence of health conditions, many homeless individuals are reliant on social and healthcare services that may be disrupted during a significant flood event (Gin, 2018). Homeless individuals may be less likely to evacuate or follow suggested safety precautions during a flood event due to a lack of information and distrust of messengers (Gin, 2018). Those with negative past experiences of institutional settings (e.g. hospitals, psychiatric facilities, jails, residential schools etc.) may be unwilling to enter into emergency shelters or access resources provided by authorities during disaster response and recovery.

Tourists and Travelers

Vancouver Island is a popular tourist destination receiving 4,430,000 overnight visitors (representing 23% of provincial overnight visitation) in 2014 and $1.77 billion in associated spending (Destination BC, 2017). The region itself has a number of popular tourist destinations and is also home to several major transportation hubs connecting the Regional District of Nanaimo, Vancouver Island, and the BC Mainland. With a large number of tourists visiting the local destinations in the summer months, and the addition of those using the region as a thoroughfare to reach other destinations, there may be a significant non-resident population at any one time that is potentially vulnerable to flood events. Non-residents may be unaware of the flood risks to the region and be unfamiliar with where they should go for information or to seek safety in the event of an emergency. Language barriers, scarce social supports, and limited access to financial resources (including local currency) can all heighten the vulnerability of tourists to flood events.

ECONOMIC VULNERABILITY

Economic resiliency drives a community's recovery post-disaster (FEMA, 2013). Therefore, economic vulnerability is a key determinant of a community's ability to withstand and rebound from a flood event. Single industry communities may be more susceptible to harm than those with diverse economic sectors (Bergstrand, Mayer, & Zhang, 2015). If a community is highly dependent on one major industry or employer, the community may have difficulty in recovering from damages to economic assets (i.e., property damage) and economic flows (i.e. damages to the production of goods and services).

The destruction or damage of business facilities, interruptions to public utilities and transportation networks, and the loss of suppliers following a flood event can lead to the business closures. These business closures can, in turn, lead to job losses, an increase in foreclosed homes, and a decrease in population. There may also be an accompanying decrease in tax revenue and local operating budgets, which can further impact the ability of the local economy to recover from the event.

The region has a fairly diverse economic base with four main economic sectors: 1) retail trade, 2) health care and social assistance, 3) construction, 4) accommodation and food services (see *Community Profiles – Economy*). Although the agriculture, forestry, fishing and hunting industry category accounts for only 3% of jobs within the region, these activities are important contributors to the local economy and provide a multitude of related opportunities in the region.

ENVIRONMENTAL VULNERABILITY

The region contains a diversity of valuable, sensitive ecosystems such as: older forests and second-growth forests, riparian thickets, rivers and riverine flats, estuarine vegetation, and a variety of shoreline ecosystems. The value of these ecosystems stems from their ecological, cultural, and social significance. These ecosystems provide essential habitat for many plant and animal species within the region including eagles, osprey, and herons and several red- and blue-listed[5] species and ecological communities.

Natural ecosystems also provide a variety of services that contribute to human well-being. These services include "*provisioning services* such as food, water, timber, and fiber; *regulating services*

[5] In BC, each species and ecosystem are assigned to the red, blue or yellow list based on the level of concern to their risk of being lost. Red indicates "any species or ecosystem that is at risk of being lost (extirpated, endangered or threatened)"; blue indicates "any species or ecosystem that is of special concern"; and yellow is assigned to those "species or ecosystems at the least risk of being lost" (Government of British Columbia, n.d.-b, para. 4).

that affect climate, floods, disease, wastes, and water quality; and *cultural services* that provide recreational, aesthetic, and spiritual benefits" (Millenium Ecosystem Assessment, 2005).

There are many sensitive ecosystems and natural features that are critical to the long-term health of the region. For example, some groundwater aquifers in the region are vulnerable to contamination from floods, for instance should storage of hazardous materials be compromised. With many residents using groundwater as their main source of drinking water, these populations are vulnerable to disruptions to watershed services that affect the quality and quantity of water.

While many natural areas are highly susceptible to human activities and the impacts of flood events, the natural environment can also provide a protective buffering service that reduces the magnitude or impacts of hazard events. For example, wetland and riparian areas reduce flooding through the absorption of flood waters, provide erosion and sedimentation control, and recharge groundwater. Environmental degradation diminishes the buffering capacity of these ecosystems against hazard events, which can, in turn, lead to diminished resiliency and greater hazard impacts.

The natural resources in the region are important to community identity as they have long provided economic opportunities in agriculture, forestry, and fishing while also offering aesthetic value and outdoor recreational opportunities for residents and tourists alike. Many natural areas in the region are also valuable in terms of their historical and cultural significance.

PHYSICAL VULNERABILITY

Physical vulnerability is a measure of how damage to the built environment impacts a community's ability to withstand and recover from a hazard event. The built environment encompasses the buildings, facilities, and infrastructure, e.g. transportation, electricity, telecommunication, water supply etc., that provide the flow of services critical for economic vitality and social well-being.

Public Safety Canada defines critical infrastructure (CI) as: "services essential to the health, safety, security or economic well-being of Canadians and the effective functioning of government" (2019a, para. 1). The following ten sectors are considered to be critical infrastructure in Canada:

- Health;
- Food;
- Finance;
- Water;
- Safety;
- Energy and Utilities;
- Manufacturing;
- Government; and
- Transportation; and
- Information & Communication Technology

The network of infrastructure in a community can be highly complex, with various interdependencies, meaning that impacts to one sector may have cascading effects across other sectors. Forecasting the failure of these complex networks is challenging as weaknesses in the system and feedback loops may be unknown until the system fails. Also, the responsibility for various critical assets and infrastructure is divided between different levels of government and public and private agencies, further adding to the difficulty of preparing for and mitigating against critical infrastructure disruption and damage.

Despite the challenges of planning for disruptions to critical infrastructure, proactive measures are required as disruptions could result in "catastrophic loss of life, adverse economic effects and significant harm to public confidence" (Public Safety Canada, 2019a, para. 4). The continued functioning of critical infrastructure during and after a hazard event is considered to be a key determinant of the severity of consequences and speed of recovery (FEMA, 2013).

Measuring Hazard-Specific Impacts to Critical Infrastructure

The impacts to critical infrastructure from flood hazard events were considered during the risk assessment through the use of the Consequence Ranking Scale (see *Table 3*). "Critical Infrastructure" is one of the five consequence categories under "Physical and Economic Impacts" and the associated scale considers the level of disruption to critical infrastructure services and the proportion of the population affected. The "Critical Infrastructure" consequence score assigned to each flood hazard can be found in the All Scores Table (see *Appendix 3*).

Identification of Locally Owned Critical Assets and Infrastructure

With the region spanning over 2,000 square kilometers and serving over 160,000 residents, there is a relatively extensive network of critical infrastructure. There are a multitude of critical infrastructure owners and operators in the region, including provincial, regional, and local governments, as well as public and private agencies. These CI owners and operators have responsibilities, some of which are regulatory requirements, to plan and prepare for emergencies to ensure adequate response procedures and business continuity practices are in place.

The project team worked together to identify *locally owned infrastructure* components that are fundamental to the viability and sustainability of the region. Understanding what local critical infrastructure (CI) and assets might be exposed to hazards is key to understanding how a hazard might impact the community.

Critical infrastructure owned or controlled by outside agencies was considered to be "out of scope" for the purposes of this assessment. While efforts were made to connect with external critical infrastructure owners/operators, there was minimal participation from these bodies, limiting the availability of information to inform the understanding and assessment of external critical infrastructure in the region, and external dependencies of the local government owned infrastructure.

With a focus on critical assets owned by the Electoral Areas, the Regional District of Nanaimo, Town of Qualicum Beach, City of Parksville, and District of Lantzville, the project team used the *EMBC Critical Infrastructure Assessment Tool*[6] to explore the internal dependencies of these assets.

Key terms from the Critical Infrastructure Assessment Tool:

Asset: *an item or resource that is under control of the local government. This includes tangible things like equipment, vehicles and trained staff. It can also include intangible things like radio networks and software.*

Goods & Services: *these are goods or resources and services provided to the community by the local government. This includes goods like drinking water and services like policing.*

Dependency: *this is the term used when goods and services cannot be delivered without a specific asset. For example, providing fire and rescue service as a service is dependent on fire engines and equipment, which are assets.*

The assessment tool encourages the classification of relationships between services and assets as either “Critical” or “Important”. Goods or services that must have a specific asset to which there are no alternatives are classified as “Critical”, and goods or services that need a specific asset for which there are alternatives are classed as “Important”. In reviewing the relationships between services and local assets, a far greater number of “Important” dependencies were identified than “Critical” dependencies. This finding suggests that local governments have an element of redundancy, and thus resiliency, built into their critical infrastructure.

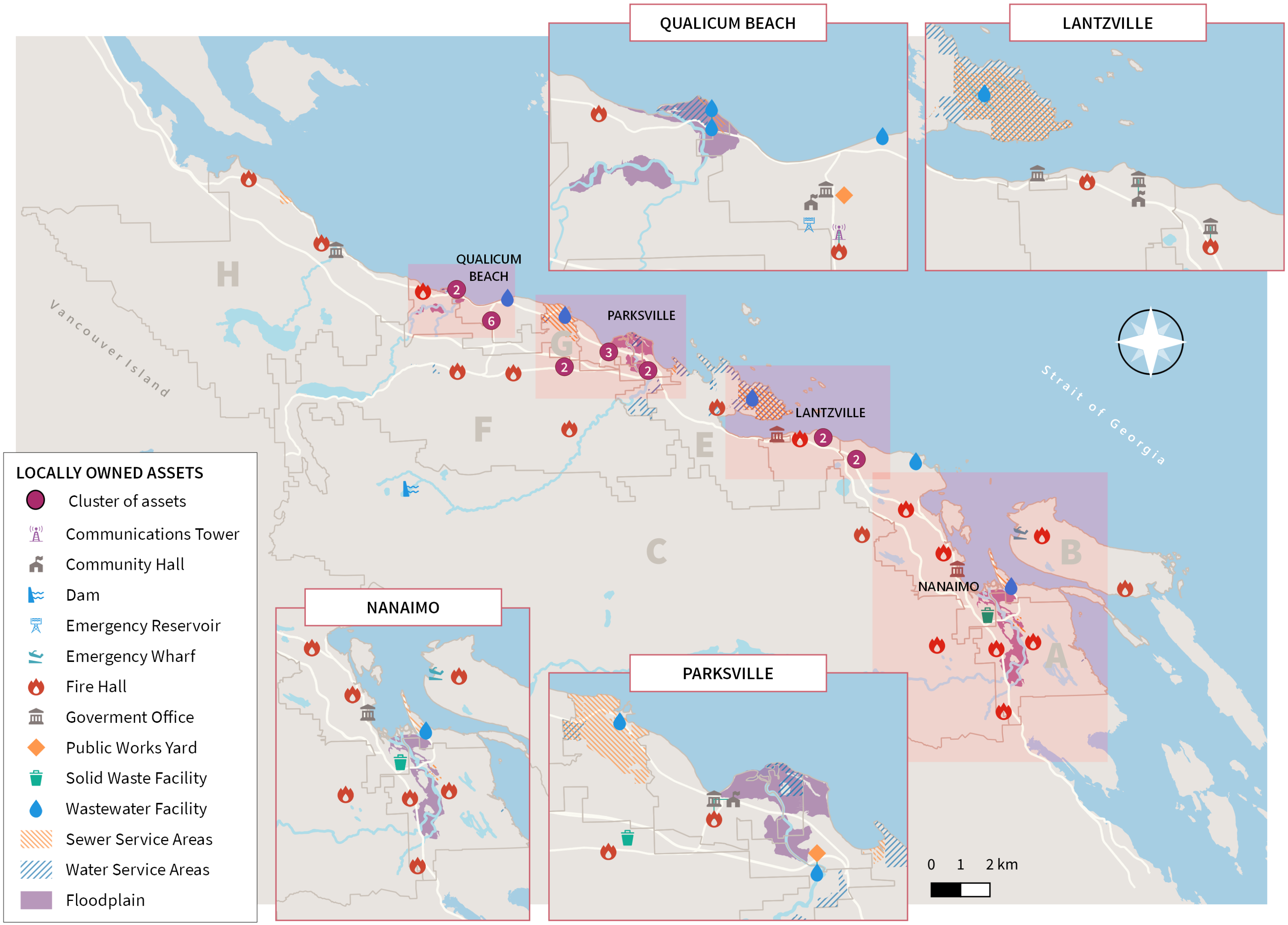
The following locally owned assets were deemed critical by the project team:

- Fire halls and their assets
- Local government and First Nation Band offices
- Communication technology and infrastructure, including SCADA
- Waste water and solid waste assets
- Drinking water assets

A map of the identified locally owned assets is provided on the following page (see *Figure 5*). The full list of the region’s local government owned/operated critical assets can be found in *Appendix 4*.

[6] The *EMBC Critical Infrastructure Assessment Tool* was developed by Emergency Management British Columbia, in partnership with Defence Research and Development Canada and the Justice Institute of BC. The tool was designed to assist local authorities in identifying services critical to residents in an emergency, the assets needed to provide those services, and the dependencies between those assets and goods and services (Government of British Columbia, 2016).

Figure 5 – Map of locally owned critical assets and infrastructure



Community perceptions of physical vulnerabilities

As part of one of the engagement session activities, participants were asked to provide details of the physical conditions that they perceive to have the potential to contribute to vulnerability within the region. Thematic analysis of inputs received revealed that participants detailed physical conditions of concern for five of the ten infrastructure sectors: Transportation, Water, Information & Communication Technology, Energy & Utilities, and Healthcare. The summarized and paraphrased results of this activity are presented below:

Transportation Sector

Highway 19

A strong majority of workshop participants expressed concern about the limited transportation connectivity in the region. Highway 19 was identified as a critical piece of infrastructure, with one participant describing it as the "spine that connects the region". Many workshop participants expressed concern that the stretches of Highway 19 are impassable in the event of a disruption or damage due to a lack of alternative routes. The "Nanoose Flats" section of highway (located in Electoral Area E) was identified as a source of particular concern as the section sees high volumes of traffic and has no detour routes. The ability to evacuate and/or access help could be limited should a flood event impact the highway.

Public Transportation

The limited availability of public transportation in rural areas of the region was highlighted by some participants. With limited bus schedules, and further reduced schedules in the event of inclement weather, some residents may have restricted ability to access resources, e.g. health care centres, food stores etc.

Ferry Infrastructure

As the region is located on an island, there is a dependency on the transportation of resources to the island by ferry. With two ferry terminals in the region (Duke Point and Departure Bay) there is some redundancy, but some participants highlighted the vulnerability of this transportation connection to extreme weather events. The dependency of the region's small island residents (e.g. those on Gabriola Island and Mudge Islands) on ferry transport was also noted.

Single Access Route Communities

Several workshop participants noted that there are many rural residences and subdivisions in the region that have only one entry/exit route. If the connecting road is damaged or blocked in a flood event these residents may have difficulty evacuating their property and first responders may have difficulty accessing and assisting residents.

Energy & Utilities

Power Lines

A majority of workshop participants commented on the susceptibility of the power grid to outages due to downed trees. The proximity of trees to overhead power lines was identified as a physical condition contributing to the community's vulnerability.

Water Sector

Arrowsmith Dam

The Arrowsmith Dam, which is located approximately 35 km south of the City of Parksville and provides the city and Nanoose Peninsula with water, was identified as a critical back-up water for 15,000+ residents by a workshop participant. The failure of the dam was also noted as a possible flood hazard event.

Water Treatment Plants

A few workshop participants expressed concern about the ability of the existing water treatment plants to provide sufficient drinking water in a hazard event.

Healthcare

Hospital

The capacity of the local healthcare facilities was identified as a vulnerability by several workshop participants. A number of comments were captured regarding the possible insufficiency of the smaller health care centres and limited access to the region's sole hospital (Nanaimo Regional Hospital) in a flood event.

Information & Communication Technology

Cell Towers

The heavy reliance on cell towers and potential for outages was noted by a number of workshop participants.

06 Climate Change

Climate change is not an abstract future concern, but rather a current, evolving reality experienced in Canada today. Driven largely by the emissions of greenhouse gases from human activities, Canada's climate has been increasing in temperature and will continue to increase in the coming years. According to a recent report, Canada's climate is warming at a rate nearly twice the global average (Environment and Climate Change Canada, 2019a). Projections suggest that by the years 2081 to 2100, Canada's climate will increase by 1.8°C if emissions are reduced, or up to 6.3°C if emissions remain high (Environment and Climate Change Canada, 2019a).

Within British Columbia, climate change has already resulted in increased average temperatures, rising sea levels, as well as increased rates of severe weather events (BC Ministry of Environment and Climate Change Strategy, 2019). Canada's oceans have also been changing due to increased temperatures contributing to waters that are less oxygenated and increased carbon dioxides in the atmosphere driving acidification of ocean surface waters (Environment and Climate Change Canada, 2019a).

With regard to the regional district of Nanaimo, climate change is likely to affect the flood hazards faced. The BC Ministry of Environment and Climate Change suggests, "the likelihood of most risk events increases over time based on projections of future climate change" (BC Ministry of Environment and Climate Change Strategy, 2019, p. 1). Through the engagement process, the majority of participants agreed that climate change would have an impact on the occurrence or severity of flood hazards. Discussion surrounding the current and anticipated impacts of climate change in relation to flood hazards are detailed in *Section 07*.

While climate change is a global phenomenon, a variety of factors determine how the impacts of climate change manifest at the local level. Of note, urbanization can substantially influence local climate resilience. The development and transformation of the natural environment to urban landscapes, composed of buildings, parking lots and roadways, increases the impermeable surfaces leading to reduced rainfall absorption which, in turn, increases the potential for localized flooding. The conversion from rural to urban also introduces materials which typically absorb more solar radiation, and thus increases local temperatures (Environment and Climate Change Canada, 2019).

With projected population growth in the region estimated at 12% over the next decade, increased development and transition from a rural to more urban environment is anticipated. The impacts of urbanization and other land cover changes, and their compounding effects on climate change, should be considered when determining adaptation and mitigation strategies for the future.

07 Flood Hazard Assessment Results & Risk Scores

Risk is commonly calculated by multiplying the likelihood score by the total consequence score, as follows:

$$Risk = Likelihood \times Consequence$$

While this equation provides a useful measure of the risk posed by each flood hazard to the region, the scores should be interpreted as best estimates and not absolutes. The qualitative methods used to assess flood hazard likelihood and consequence entail a degree of subjectivity that cannot be eliminated. Repeating the assessment with a different group of people may produce a different set of results.

RISK SCORES

The results of the analysis are presented in the risk table on the following page (see *Table 10*). Hazards are listed from highest to lowest risk. The scoring system yields a minimum total risk score of 11, and a maximum of 275 (see calculations below):

Minimum likelihood rating		*Minimum* consequence rating for all 11 categories		*Minimum* risk score
1	x	(1 x 11)	=	11
Maximum likelihood rating		*Maximum* consequence rating for all 11 categories		*Maximum* risk score
5	x	(5 x 11)	=	275

Accompanying each hazard's risk score is a measure of confidence (rated A – "very high" to E – "very low") in the likelihood estimate and impact ratings for the specific hazard event. When determining the level of confidence in the hazard assessment, the project team considered the quality and type of available data (e.g. qualitative vs. quantitative), the availability of subject matter experts during the risk assessment process, and the current body of knowledge for specific hazard events.

Table 10 – Risk Scores

Hazard	Likelihood (1-5)	Human & Social Impacts (6-30)	Physical & Economic Impacts (5-25)	Overall Consequence (11-55)	Risk	Confidence Rating
Overland Flooding	5	15	14	29	145	Ⓒ
Rivers, Lakes, and Stream Flooding	5	9	14	23	115	Ⓑ
Coastal Flooding	5	10	12	22	110	Ⓒ

Legend

Confidence Rating

Ⓐ Very high degree of confidence
Ⓑ High degree of confidence
Ⓒ Moderate confidence
Ⓓ Low confidence
Ⓔ Very low confidence

Full hazard assessment scores (including confidence ratings for all 11 consequence categories) can be found in the All Scores Table in *Appendix 3*.

The hazard descriptions below provide further insight into the risk score assigned. The descriptions detail the occurrence of the specific flood hazard category locally with relevance to the region; potential or actual consequences of the hazard as evidenced through research or notable historical incidents; as well as a discussion around evolving conditions which may affect the likelihood and/or severity of impacts due to factors such as climate change or urbanization.

HAZARD DESCRIPTIONS

Floods are the most frequent natural hazard in Canada. They can occur at any time of the year and are most often caused by heavy rainfall, rapid melting of a thick snow pack, ice jams, or more rarely, the failure of a natural or human-made dam (Public Safety Canada, 2018b).

While water level fluctuations are natural occurrences, people generally refer to high-water levels as flood conditions when the water threatens lives, property, and critical infrastructure (Public Safety Canada, 2015b). Flood, as a single hazard, is considered the most economically impactful hazard event for Canadians with respect to property damage (Public Safety Canada, 2015b),

For this risk assessment, various flood hazard types were assessed individually to provide a more specific and accurate analysis of the flood risk in the region and include:

- Overland Flooding
- Rivers, Lakes, and Stream Flooding
- Coastal Flooding

The assessment concluded that all three flood hazard types were “Almost Certain” to occur (likelihood score = 5) within the region. The susceptibility of individual areas within the region to each flooding type varies and is a function of an area’s exposure, vulnerability, and local conditions. A combination of local geography, topography and meteorological conditions may result in multiple flood types occurring at once, or one flood type causing secondary flood hazards. For example, highly populated areas are typically more developed and contain a greater presence of impermeable surfaces. Within the region, coastal areas have the greatest population density, and as such, are susceptible to the impacts of both coastal flooding, as well as surface water flooding.

The potential consequences of the various flood types are, for the most part, very similar. Possible impacts across all flood types include property damage, the requirement to evacuate resulting in population displacement, as well as impacts to the environment and cultural resources (Regional District of Nanaimo, 2019b). For these reasons, while each flood hazard has been described separately in the sections below to communicate the individual risk score and describe the relevance of the specific hazard to the region, the discussion of the consequences of the three flood hazard types, has been combined.

OVERLAND FLOODING

HAZARD	LIKELIHOOD		HUMAN & SOCIAL IMPACTS		PHYSICAL & ECONOMIC IMPACTS		RISK
Overland Flooding	5	x	(15	+	14)	=	145

Overland flooding (also known as "pluvial flooding") results from rainfall generated overland water flow, before the runoff enters any watercourse or sewer. It is usually associated with high intensity rainfall events but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability resulting in overland flow and ponding in depressions in the topography (Maksimovic, 2015). High intensity 'extreme' rainfall events in urban environments may cause sewerage or drainage systems to be completely overwhelmed and result in flooding. Agricultural areas where natural drainage has been altered over time can also be susceptible to overland flooding impacts.

Overland flooding has also been referred to as the "invisible hazard" as it can happen without notice in areas that do not typically experience regular flooding (Houston, et al., 2011). With limited or no time to prepare, coupled with the fact that typical flood mitigation measures are likely not in place, the potential consequences associated with overland flood events can be severe.

Within the region, increasing urban development in lower watershed reaches has led to an increase in impervious surfaces such as roads, buildings, driveways, sidewalks etc. This shift in the built environment has, in some areas, resulted in the loss of natural hydrologic function and an associated increase in surface runoff. This growth in urbanized areas, paired with increases in high intensity rainfall events due to climate change, is expected to result in more frequent and severe pluvial flooding events (Szewrański, et al., 2018).

Overland Flooding

Overland flooding (also known as "pluvial flooding") results from rainfall-generated overland flow. This type of flooding is usually associated with high intensity rainfall events (typically >30mm/h) but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability resulting in overland flow and ponding in depressions in the topography (Maksimovic, 2015).

High intensity 'extreme' rainfall events in urban environments may cause sewerage/drainage systems to be completely overwhelmed and result in flooding.

RIVERS, LAKES, AND STREAM FLOODING

HAZARD	LIKELIHOOD		HUMAN & SOCIAL IMPACTS		PHYSICAL & ECONOMIC IMPACTS		RISK
Rivers, Lakes, And Stream Flooding	5	x	(9	+	14)	=	115

The region contains a variety of freshwater features including a large number of rivers, lakes, and streams a selection of which are listed in *Table 11* (Regional District of Nanaimo, 2011).

Table 11 – Rivers, lakes and streams within the region

RIVERS	LAKES	STREAMS
Englishman River	Beck Lake	Beck Creek
Little Qualicum River	Cameron Lake	Bonnell Creek
Millstone River	Dolphin Lake	Chase River
Nanaimo River	Enos Lake	French Creek
Qualicum River	Hoggan Lake	Grandon Creek
	Holden Lake	Haslam Creek
	Horne Lake	Jump Creek
	Nanaimo Lakes	Kinkade Creek
	Quennell Lake	Morningstar Cr.
	Spider Lake	Morrison Creek
		Nile Creek
		Thames Creek
		Whiskey Creek

There are three major floodplains within the region: The Nanaimo River Floodplain; the Little Qualicum River Floodplain; and Englishman River Floodplain (Regional District of Nanaimo, 2018a). Each of these rivers has a notable flooding history, which is captured in a subsequent section (see *Flooding in the Region*).

In addition to these significant floodplains, additional watercourse floodplains have been identified according to the floodplain designations detailed under the "Regional District of Nanaimo Floodplain Management Bylaw No. 1469, 2006".

Under the requirements of the bylaw, land that is:

- within thirty (30) metres from the Natural Boundary of the Englishman River, Little Qualicum River, Millstone River, Nanaimo River or French Creek; or
- within fifteen (15) metres from the Natural Boundary of any other Watercourse including a lake, marsh, or pond;

is designated as floodplain. These areas have been identified based on their susceptibility to "experience periodic flooding from nearby rivers, lakes, and streams" (Government of British Columbia, n.d.-a, para. 1).

With urbanization and a projected 12% increase in population over the next decade, the region has the potential for altering the risk of fluvial floods. River morphology and dynamics are influenced by their neighboring environment, which supplies water and sediment (Ashmore &

Church, 2001). As such, development and altered land use can contribute to the risk of fluvial floods; with varying impacts on different water bodies.

Flooding in most areas of Canada typically occurs in the spring months due to freshet where melting snow and ice increases the water levels in lakes, rivers or streams (Weston, Guthrie, & McTaggart-Cowan, 2003). Along BC's west coast however, it is more common for floods to occur during the fall and winter as a result of severe rainstorms or rain-on-snow events (Weston, et. al, 2003). With global temperatures rising due to climate change, rainfall and storm events are anticipated to increase in severity and frequency, which will have a cascading effect to river and streamflow regimes that may elevate the potential for fluvial floods over time (Ashmore & Church, 2001).

A study published in 2003 predicted a climate change induced shift in the flood regime of the Englishman River. Peak annual flows for the river were predicted to be 8% larger by 2020, 14% larger by 2050 and 17% larger by 2080 (Weston, et. al, 2003, p. 657). The study stated that during rainfall events, the Englishman River is very responsive to rain and snowmelt; its flow increases rapidly during the event but will also decrease rapidly once the rainfall ends (Weston, et. al, 2003). The 'flashy' nature of the river combined with a predicted increase in flood frequency and magnitude presents an increased risk of severe flooding with rapid onset for those living on the floodplain.

Rivers, Lakes, and Stream Flooding

A type of flooding resulting from the overflow of natural lake shorelines or water from a stream or river channel onto normally dry land in the floodplain adjacent to the channel (Integrated Research on Disaster Risk, 2014, p. 16).

These floods can be caused by intense rainfall, rapid snowmelt (including freshet events), and ice jams blocking the rivers.

Freshet: *The movement of water associated with the thawing of ice and snow each spring. This runoff can result in high water levels in streams, lakes and other waterways* (Abbott & Chapman, 2018, p. 17).

Ice Jams: *The accumulation of floating ice restricting or blocking a river's flow and drainage. Ice jams tend to develop near river bends and obstructions (e.g., bridges)* (Integrated Research on Disaster Risk, 2014, p. 15).

COASTAL FLOODING

HAZARD		LIKELIHOOD		HUMAN & SOCIAL IMPACTS		PHYSICAL & ECONOMIC IMPACTS		RISK
Coastal Flooding		5	x	(10	+	12)	=	110

Coastal flooding is defined as higher-than-normal water levels along the coast caused by tidal changes or thunderstorms that result in flooding (Integrated Research on Disaster Risk, 2014, p. 13). High winds from tropical cyclones or other storms push water onshore to create a storm surge, which is the leading cause of coastal flooding. Coastal flooding can be amplified or dampened by tides – both daily tides and periodic king tides (Resource and Environment Working, n.d., p. 7).

The region has an extensive (188 km) coastline encompassing portions of Electoral Areas A, B, E, G, and H, the Town of Qualicum Beach, the City of Parksville, the District of Lantzville, and the City of Nanaimo, as well as portions of land under the jurisdiction of the Qualicum First Nation, Snaw-Naw-As (Nanoose) First Nation, and the Snuneymuxw First Nation.

Globally, coastal regions typically have the highest density of population and are experiencing rapid growth in both residential and infrastructure developments, as well as expanding economic and tourist activities (Ranasinghe & Jongejan, 2018). This trend is reflected locally, with the coastal areas of the region holding the highest concentration of the population, government infrastructure, and the highest value properties in the region. Within the region, the coastal areas with the highest density of population and infrastructure include the Town of Qualicum Beach and City of Parksville (Houston, et al. 2011, p. 11). With a higher degree of exposure to instances of coastal flooding, these areas posess a greater risk to the impacts of such an event.

Climate change is a probable contributor to the occurrence of coastal flooding. Temperature increase affects sea level rise and causes "thermal expansion of the oceans and melting of glaciers, ice caps, and ice sheets" (Shaw, Taylor, Solomon, Christian, & Forbes, 1998, p. 365). It is projected the waters along Vancouver Island's east coast will rise by a minimum of 0.8m by the year 2100 (Regional District of Nanaimo, 2019b), and that coastal regions will not only be affected by rising sea levels, but also storm surges, wave conditions and river flow (Ranasinghe & Jongejan, 2018). As these levels continue to increase, coastal communities that are extremely low-lying may be at risk of consistent flooding (Regional District of Nanaimo, 2017). Furthermore, the frequency of king tides is predicted to increase in the coming years due to the effects of climate change (Hernandez, 2018). While king tides alone can reach as high as five meters in elevation, the flooding risk and potential impacts are heightened if the king tide occurs in combination with a storm surge(Little, 2018).

As communities continue to occupy and use coastal regions, risks associated with coastal flooding will remain and flood events will likely become a more frequent occurence (Ranasinghe & Jongejan, 2018).

Coastal Flooding

Higher-than-normal water levels along the coast caused by tidal changes or thunderstorms that result in flooding, which can last from days to weeks (Integrated Research on Disaster Risk, 2014, p. 13).

High winds from tropical cyclones or other storms push water onshore to create a storm surge, which is the leading cause of coastal flooding and represents the greatest threat associated with such storms. Coastal flooding can be amplified or dampened by tides, both daily tides and periodic king tides, which are much larger tides that occur monthly or yearly due to the interaction of the earth, moon, and sun in their orbits (Resource and Environment Working, n.d., p. 7).

> **Storm Surge:** *A storm surge consists of very high waves and high water levels caused by the wind and air pressure "pushing" the water onto the shore, often resulting in high waves and flooding. Storm surge can occur along all coastal areas of Canada. It can also occur in large lakes, such as the Great Lakes* (Public Safety Canada, 2018c).
>
> **King Tide:** *King Tides (also known as perigean spring tides) are extreme high tide events that occur when the sun and moon's gravitation forces reinforce one another at times of the year when the moon is closest to the earth. They happen twice a year but are typically more dramatic during the winter* (Government of British Columbia, 2015, para. 1).

Flooding in the Region

Several notable flood incidents have occurred within the region. Researching these events helped shape the understanding of the flood hazards and their actual and potential impacts. During the engagement sessions, participants shared their most memorable hazard experiences, of which several related to historic floods in the region, e.g.:

> *"In 1997, a severe coastal rainfall event resulted in a record flow in Nash creek near Qualicum Bay. The overbank flow caused bank erosion and resulted in one house being undermined and the structure collapsed and was washed out to sea. Neighboring properties were also damaged and the RDN/MOE and EMBC constructed flood protection worked to stabilize the properties." – Representative from the Provincial Diking Authority*

> *"In 2007, after a lengthy period of abnormally warm temperatures, the above average snow-pack created significant snow melt runoff into the Nanaimo River. The river rose to flood stage overnight and approximately 60 residents awoke to their homes being flooded. The North Cedar Fire Department, Cranberry Fire Department, BC Ambulance Service, Nanaimo Search & Rescue, the RDN, and the contractor for Ministry of Transportation & Infrastructure met at Unified Command to affect the rescue of the flooded persons. Once rescue was completed, evacuees were cared for and processed by the RDN Emergency Social Services (ESS) for food and lodging until flood waters receded." – Representative from the North Cedar Fire Department*

Englishman River

As stated previously, the Englishman River near Parksville is one of the major floodplains within the region and has a history of annual flooding (Regional District of Nanaimo, 2007). In January 2018, heavy rainfall caused the river to flood, impacting Parry's RV Park. Twenty-two residents were evacuated from the area, extensive damage was caused to the park entrance, and many homes were uninhabitable for days because the water and wastewater system in the park was affected by the flood (Stoltz, 2018).

The owners and residents of Parry's RV Park are familiar with the impacts of flooding from the Englishman River. In April 2016, Parry's RV Park was placed on a state of local emergency after the river exceeded its banks. Similarly, in December 2014 the river flooded after an earthen berm failed to redirect river flow, and the community was set to a state of local emergency with a subsequent evacuation of the RV park (Regional District of Nanaimo, 2015). This event also resulted in flooding across Martindale Road which limited access to and from the RV Park. This event resulted in 12 people and their pets being evacuated, 7 of whom required 72-hour recovery services.

Martindale Road in Parksville also experiences flooding regularly. In early 2019, the Englishman River again flooded following heavy rains which led to the road being flooded near Highway 19A (Kveton, 2019).

There are also several more historic examples of the Englishman River flooding. For example, in the winter of 1949, the Englishman River flooded causing three homes in the area to be isolated (Septer, n. d.). Documentation indicates that the river flooded two further times in the subsequent months.

Nanaimo River

The Nanaimo River floodplain has been designated by the Government of BC as a "high risk" floodplain (Regional District of Nanaimo, 2018b). The river has a long-standing history of flooding. In December of 1949, winter storms caused the Nanaimo River to flood causing significant damage to property (Septer, n. d.). In the winter of 2007, the river flooded near Wilkinson and Alice Road. Initially, the RDN was alerted to a resident who was trapped in a mobile home and could not get out due to increasing waters levels (Regional District of Nanaimo, 2008). A few hours later, a full evacuation was issued for Wilkinson, Alice, and Aros Roads.

More recently, in 2014, a period of severe weather caused the river to breach its banks resulting in minor flooding. Nearby communities were placed on an evacuation alert; however, the event did not escalate further (Regional District of Nanaimo, 2014).

Little Qualicum River

Flooding is also not uncommon along the Little Qualicum River, which is also one of the region's floodplains. In December 2014, the Little Qualicum River flooded Cedar Grove Campground near Riverbend Road following the failure of an earthen berm (Regional District of Nanaimo, 2015). The flood water impacted transportation routes and required the Regional District of Nanaimo to declare a state of local emergency and issue an evacuation order. A total of 17 people, some accompanied by pets, were evacuated from the campground. Of those evacuated, 12 evacuees received 72-hour recovery support services. The heavy rain led to the evacuation of 15 homes in a neighbouring community, with another 70 homes being placed on an evacuation alert (The Canadian Press, 2014).

More historically, in October of 1921, the Little Qualicum River breached its banks following intense rains. The flood caused damage to nearby roads and led to a travel advisory for the public (Septer, n. d.).

French Creek

French Creek has a long-reported history of flooding, especially near River Crescent, Mason Trail and Lee Road, as well as near Grafton Road (BC Ministry of Environment and Climate Change, 2002). In November 2017, heavy rainfall caused French Creek to breach its banks and floodwaters damaged neighbouring homes (CTV News Vancouver Island, 2017). Flooding of French Creek into River Crescent occurred in 2005 and has also occurred more recently.

Flood Consequences

The impacts of major floods can be devastating, ranging from property damage and population displacement, to the damage and destruction of environmental and cultural resources (Regional District of Nanaimo, 2019b).

It was noted previously that flood, as a single hazard, is considered the most economically impactful hazard event for Canadians with respect to property damage (Public Safety Canada, 2015b). As evidenced by the 2013 Alberta flood, with an estimated $6 billion sustained in financial losses and property damage, flood events can cost billions of dollars (The City of Calgary, 2018). While flood insurance helps to reduce the financial burden, if homeowners or businesses have restricted, or no flood insurance coverage, it may be impossible to fully recover costs (Moudrak, et. al, 2018). The economic impacts of a flood event can place a significant strain on the ability of communities and families to recover from an incident.

Flood events leave a lasting impression on those who experience their impacts. During the engagement sessions for the project, the flooding of Whiskey Creek in 2018 was mentioned by multiple participants.

> *"The Coombs Fire Department responded to a flooding event affecting 40 homes around Whiskey Creek. A blocked culvert under the railway was identified as one of the contributory factors and has since been cleared out. The biggest challenge facing the response team was logistics and the one of the challenges and ultimate successes was the delivery of pizzas over a foot bridge." – Coombs Fire Department*

Flood incidents have the potential to cause psychological impacts, as well as support system impacts, leading to stress among those who are involved and those trying to help others cope. Following the 2013 Alberta flood, researcher Dr. Caroline McDonald-Harker conducted a study focusing on the families from one of the most significantly impacted communities, High River. In an interview, it was noted that "over half of the families [were] still suffering with some long-term effects, whether that be post-traumatic stress disorder, depression or anxiety" (CBC News, 2018, para. 4). Other studies show individuals involved in a natural disaster can still experience psychological impacts 10 years following an incident, which can place tension on relationships (CBC News, 2018).

Flood damage can pose extreme risks to residents returning home once flood waters have receded. Water impacts the structural integrity of homes and buildings, causing walls or floors to buckle and supports to weaken. Contamination from sewage and other pollutants pose a serious health hazard, as do moulds which thrive in damp conditions. For residents who rely on well-water, drinking water may be contaminated following a flood and require disinfecting (EMBC, 2015).

Flood events also have the potential to generate large quantities of debris and waste, which in turn can negatively impact recovery and re-entry efforts (BC Ministry of Environment and

Climate Change Strategy, 2018). The City of Grand Forks, in the interior of BC, experienced catastrophic flooding in May 2018 following a period of intense rainfall combined with runoff from an above-average snowpack. In total, 417 homes were damaged by floodwater in the Kootenay Boundary Regional District alone, with estimates of 67,000 cubic meters of waste generated. Debris ranged from soggy drywall and flooring, to fridges and freezers full of rotting meat, requiring significant clean up and management efforts on the part of residents, businesses, and local governments (Laanela & Keating, 2018).

While not within the Regional District of Nanaimo, the nearby City of Courtney experienced serious floods in 2009, 2010, and again in December 2014, when extreme rainfall (>180 mm in 48 hours) led to road closures and traffic delays, and flooding in homes and businesses. Approximately 15,000 Island customers were without power due to the winds accompanying the storm knocking trees onto power lines. Flooding delayed the response of BC Hydro crews due to road closures and the need to take detours to conduct repairs in affected areas. Similarly, the Cowichan Valley and City of Duncan experienced major flooding in 2007. An engagement session participant shared the impacts of this flood event:

> *"In November 2007, a major flooding event occurred in the Cowichan Valley including the City of Duncan. There was no loss of life, however, more than 300 homes and 1,000 residents were evacuated and almost 50 homes flooded. Utilities, gas and electricity were off, residents were warned in advance. While the flooding lasted about 4-6 weeks, restoration went on for upwards of 6 months before residents were able to return home. The event was generally caused by snow melt, excessive rain and higher than usual tides. An EOC was activated for the region and emergency services provided support for residents of the region."*
> *– Technical Safety BC representative*

08 Resiliency

Both vulnerability and resiliency are important, and closely related, concepts for evaluating a community's ability to cope with the impacts of a hazard event. While vulnerability looks at the factors that increase a community's susceptibility to damage from a hazard, resiliency is a measure of a community's ability to resist or recover from damage (SOPAC, 2002). Typically, the most vulnerable communities tend to be the least resilient (Bergstrand, Mayer, & Zhang, 2015).

> **UN Office for Disaster Risk Reduction (UNDRR) defines resilience as:**
>
> *"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform 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 through risk management."*
>
> (UN Office for Disaster Risk Reduction, 2017).

Just as social systems play a key role in human vulnerability to hazards, social systems also underpin many aspects of community resilience (Bergstrand, Mayer, & Zhang, 2015). Paton and Johnston (2001) identified a sense of community, or feelings of belonging, as being an important component of a community's ability to "bounce back".

The sense of connectedness and strong support networks in the region were highlighted by engagement session participants as an important aspect of current resiliency levels within the region. This sense of belonging was also emphasized by the results of the 2015-16 Canadian Community Health Survey (Provincial Health Services Authority, 2019). Almost three-quarters of the Central Vancouver Island HSDA[7] population (aged 12 and up) reported a somewhat strong or very strong sense of belonging to their local community. This sense of belonging may increase resident's involvement in community disaster response strategies (Bergstrand, Mayer, & Zhang, 2015). Several engagement session participants commented on the willingness of community members to collaborate on emergency preparedness initiatives across communities and organizations/agencies and their interest in taking a proactive approach.

Efforts to build resiliency and recovery capacity are most effective when undertaken at the regional and community level. Engagement session participants were asked to share their knowledge of current strategies that are contributing to resiliency within the region. These community and regional resiliency strategies were taken into consideration by the project team during the hazard consequence rating portion of this assessment.

[7] The Regional District of Nanaimo is included in the Central Vancouver Island Health Service Delivery Area (HSDA) along with the Alberni-Clayquot and Cowichan Valley regional districts

A selection of current resilience resources and strategies are captured below, grouped under the themes of "Prevention & Mitigation Activities" and "Preparedness & Response Resources":

PREVENTION & MITIGATION ACTIVITIES

Non-Structural Mitigation

i.e. Strategies for encouraging safer and more sustainable development.

- Strategic Plans:
  - *City of Parksville 2019-2022 Strategic Plan* – includes actions for providing diverse housing options and development, support improved access to health care, and economic development.
  - *Town of Qualicum Beach 2019-2022 Strategic Plan* – includes actions for supporting a diversity of housing, implementing the Town's Official Community Plan, improve transportation networks, and enhance alternative opportunities, and fostering economic opportunities.
  - RDN *2019-2022 Strategic Plan* – includes actions for climate change adaptation and mitigation, affordable housing, asset management, and economic diversification.
  - The *Regional Growth Strateg*y (RGS) – adopted by the RDN in 2011, it sets out a long-term strategic plan for sustainable population growth and development.
  - Official Community Plans (OCPs) – long-term strategies for land use, development, and servicing adopted by Electoral Areas and Municipalities within the region. The OCPs align with the goals of the RGS and are implemented primarily through zoning bylaws.
- Asset management programs to replace aging and existing infrastructure:
  - RDN *Asset Management Review and Implementation Report* (2019) – recently produced with a plan to develop an overall *Asset Management Plan Implementation Framework* in 2020 to operationalize the RDN's asset management program.
  - The Town of Qualicum Beach has been in the process of developing a comprehensive asset management program since 2015.
  - The City of Parksville is currently working towards the adoption of an Asset Management Strategy.
- RDN *Sea Level Rise Adaptation Program* – The RDN recently commenced the first phase of an assessment of coastal areas that may be impacted by sea level rise within the Electoral Areas, Parksville and Lantzville. When complete, the entire coastal region from Electoral Area 'H' to 'A', including Area 'B' and member municipalities will have floodplain mapping, which will be used to better inform decision-making.

- Floodplain Management Bylaw (No. 1469) – Applies within the boundaries of the Regional District of Nanaimo Electoral Areas A, C, E, F, G and H. Bylaw updated December 2018 to incorporate sea level rise.
- Parksville Development Permit Areas (DPAs) – DPAs have been established for the City of Parksville to manage the development in hazardous areas, e.g. DPA No. 10 – Wildfire Interface Management Area, DPA No. 11 – Coastal Protection Development Area, and DPA No. 12 – Flood Plan Development Area.
- *Drinking Water and Watershed Protection (DWWP) Action Plan* – details regional initiatives to protect watersheds and drinking water. 10-year Plan updated in 2019.
- *Qualicum Beach Waterfront Master Plan* (2016) which includes goals for establishing a beach profile that will protect against future damage.

Structural Mitigation

i.e. Strategies for preventing damage to infrastructure and homes.

- Enforcing building codes.
- Stormwater mitigation features, e.g. storm sewers, culverts, ditches, overland flow on roadways, streams.
- Green infrastructure, e.g. bioswales, rainwater ponds, rain gardens, top soil retention, pervious pavers, to maintain hydrological function and resiliency.
- Dike mitigation to reduce flooding.
- Sandbag stocks around region.
- Improved existing dam infrastructure with new spillway.

PREPAREDNESS & RESPONSE RESOURCES

Education and Training

i.e. Strategies for enhancing public awareness and capabilities of response personnel.

- Emergency Preparedness Expo – Workshops and activities offered for residents to help improve preparedness and response
- Public presentations and other community outreach workshops
- Neighbourhood Emergency Preparedness Program (NEPP)- program designed to build neighbourhood level resiliency.
- Social media strategy – usage is being increased to deliver public education.
- Webpage developed for Emergency Preparedness
- Completion and dissemination of risk assessments including a Hazard Risk and Vulnerability Analysis (HRVA). Improved awareness of hazards within the region through engagement sessions and communication of assessment findings.

Emergency Response

i.e. Strategies for increasing response capacity and coordination.

- Emergency Plans – facilitate a collaborative and integrated approach to effectively coordinate a response to and recovery from an emergency or disaster within the region
- Regional Emergency Management Agreemen – provides guidelines for coordinating an effective, multi-agency response when emergencies cannot be handled by local response agencies.
- Emergency Management Oceanside (EMO) – partnership between Regional District of Nanaimo, City of Parksville, and Town of Qualicum Beach to increase efficiency and effectiveness of emergency management in the region.
- Emergency Operation Centre and Reception Centres pre-identified – yearly exercises and training for activation readiness and improvements
- Emergency Support Services (ESS) – organization of trained volunteers ready to assist residents in the event of an emergency.
- Emergency communications volunteers – volunteers, including operators licensed through Industry Canada as radio operators provide emergency communications within the region.
- Emergency Notification System – mass emergency notification system to deliver both text and voice calls to those signed up to receive notifications.
- Radio communication established between schools and administration centres and school busses.
- Emergency services inter-agency partnerships established with: RCMP, BC Ambulance Service (BCAS), Fire Departments (15 departments operating 23 fire halls), Search and Rescue (SAR), Canadian Coast Guard.

Additional response resources and services can be found in *Appendix 5*.

Resilience minimizes vulnerability by developing and fortifying the social and physical capacity to cope with, adapt to, respond to, recover, and learn from disasters (Public Safety Canada, 2019b).

As evidenced by the examples noted in the table above, significant efforts have been taken, or are underway, to enhance resiliency within the region. Many of these initiatives are being driven at the local level by individual communities and are not necessarily 'regional' initiatives. Fundamental to recovery is the ability of communities to cooperate and join forces to overcome the many challenges when faced with an adverse event. Thus, community resilience takes a communal perspective to coping with disasters and encompasses ideas like problem-solving, efficiency, and adaptability (Bergstrand, Mayer, & Zhang, 2015). Consideration to coordinate and leverage the previous, current or planned efforts to enhance prevention, mitigation, preparedness, and response, by other communities and ideally at a regional level, will help to further the overall resiliency within the region.

09 Conclusion

This risk assessment is a step towards enhancing regional resilience. Through the calculation and examination of risk scores, the assessment has provided local community members, stakeholders, and decision-makers with a view of the flood risks present in the region. The findings can serve as a useful tool in promoting robust discussions, determining unacceptable levels of risk, and determining priorities for risk management, resiliency building, and emergency preparedness activities.

The risk assessment process, through engagement with local stakeholders and Indigenous community leaders, served to strengthen relationships and build a shared understanding of risks posed to the region as a method to contribute to long-term resiliency. Several workshop participants shared the value the risk assessment and engagement session offered to their member communities and agencies.

> *"We learned that familiarization with each other's methods and how you share information and what you're capable of doing and not capable of doing has benefited us now with subsequent incidents. There's more knowledge about how everybody can work together." (Engagement Session Participant)*
>
> *"The benefit of being connected together, understanding from the onset of an event what the possible scope would be, that way we can gauge how we need to be able to respond after the fact." (Engagement Session Participant)*

The results of the assessment reveal that flood hazards pose a significant risk to the region, and that the risk of floods locally is increasing, due to climate change and urbanization. Within British Columbia, climate change has already resulted in increased average temperatures, rising sea levels, as well as increased rates of severe weather events, which can lead to flooding (BC Ministry of Environment and Climate Change Strategy, 2019).

The potential hazards facing the region are more numerous than those detailed in the report, however. The results of the risk assessment can be leveraged by individual communities and stakeholder agencies, to consider the likelihood of occurrence and consequences posed to them specifically.

With the identification of the high-risk flood hazards and acknowledgement of the evolving risk locally due to climate change and urbanization, the next step for the region is to specify approaches to manage and mitigate the risk of floods.

This report serves as a resource to support current and proposed projects, or the prioritization and initiation of new projects, to support resiliency building and risk mitigation, such as:

- Assessing the capacity of local critical assets and response resources to withstand and respond to an impactful hazardous flood event and maintain or resume services (business continuity planning);
- Collaborating with critical infrastructure owners/operators, and provincial and federal government agencies to understand the current and future strategies identified to protect their assets and property from potential flood hazards, and maintain their ability to deliver services during an incident;
- Identifying the applicability, and mapping, of the various flood hazards to the specific electoral areas and communities in the region, such as preparing and updating flood hazard maps;

As the local impacts of climate change transpire, and new information becomes available, the results of this risk assessment should be re-evaluated, and the prioritization of associated mitigation and adaptation strategies reconsidered.

Future strategies to reduce the risk of disasters should aim at preventing the creation of risk; reducing existing risk; strengthening economic, social, health and environmental resilience; and enhancing preparedness for effective response and to “build back better” in recovery (UN Office for Disaster Risk Reduction, 2019). Alignment and prioritization of policies across local governments and communities within the region, as well as execution of an integrated and inclusive planning process, will be essential to manage the evolving risk and will contribute to a safer and more resilient region.

Through the efforts of the Production Team and the engagement session participants, the region has an assessment that can be confidently used in risk-based decision making, the setting of priorities for proactive hazard mitigation, and in developing an action plan towards becoming a disaster resilient community.

Appendices

APPENDIX 1. Glossary of Key Terms

Asset	Equipment or personnel used to deliver a service. People, structures, facilities, buildings, materials, and processes can all be considered Assets (EMBC, n.d., p. 4).
Consequence/ Impact	The physical/environmental, social, economic, and political impact or adverse effects that may occur as the result of a hazardous event (EMBC, 2011, p. 3).
Critical Infrastructure	The processes, systems, facilities, technologies, networks, assets and services essential to the health, safety, security or economic well-being of a community. Critical infrastructure can be stand-alone or interconnected and interdependent within and across provinces, territories and national borders. Disruptions of critical infrastructure could result in catastrophic loss of life, adverse economic effects and significant harm to public confidence (Public Safety Canada, 2019a, para. 1).
Frequency	The number of occurrences of an event in a defined period of time (Public Safety Canada, 2018a).
Hazard	A source of potential harm, or a situation with a potential for causing harm, in terms of human injury; damage to health, property, the environment and other things of value; or some combination of these (EMBC, 2011, p. 3).
Likelihood	The chance of an event or an incident happening, whether defined, measured or determined objectively or subjectively (Public Safety Canada, 2012).
Mitigation	Mitigation measures are those that eliminate or reduce the impacts and risks of hazards through proactive measures taken before an emergency or disaster occurs (Public Safety Canada, 2015a, para. 1).
Preparedness	The phase of emergency management during which action is taken to ensure that individuals, businesses, and the jurisdiction/ organization are ready to undertake emergency response and recovery (EMBC, 2019, p. 98).
Recovery	The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better", to avoid or reduce future disaster risk (UN Office for Disaster Risk Reduction, 2017).

Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform 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 through risk management (UN Office for Disaster Risk Reduction, 2017).
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UN Office for Disaster Risk Reduction, 2017).

APPENDIX 2. Hazard Definitions

The following list of hazards was compiled to capture flood hazards relevant to the region.

In total, 3 flood hazards were identified that could affect the region, determined through the review of historical data, previous HRVAs, provincial (EMBC), federal (Public Safety Canada) and international hazard lists; and engagement of community members and subject matter experts.

FLOOD HAZARDS

A flood is a general term for the overflow of water from a lake, river, or stream channel onto normally dry land (rivers, lakes and stream flooding), higher-than normal levels along the coast (coastal flooding), as well as ponding of water at or near the point where the rain fell (overland flooding) (Integrated Research on Disaster Risk, 2014, p. 14).

Coastal Flooding	Higher-than-normal water levels along the coast caused by tidal changes or thunderstorms that result in flooding, which can last from days to weeks (Integrated Research on Disaster Risk, 2014, p. 13). High winds from tropical cyclones or other storms push water onshore to create a storm surge, which is the leading cause of coastal flooding and represents the greatest threat associated with such storms. Coastal flooding can be amplified or dampened by tides, both daily tides and periodic king tides, which are much larger tides that occur monthly or yearly due to the interaction of the earth, moon, and sun in their orbits (Resource and Environment Working, n.d., p. 7). **Storm Surge:** A storm surge consists of very high waves and high water levels caused by the wind and air pressure "pushing" the water onto the shore, often resulting in high waves and flooding. Storm surge can occur along all coastal areas of Canada. It can also occur in large lakes, such as the Great Lakes (Public Safety Canada, 2018c). **King Tide:** King Tides (also known as perigean spring tides) are extreme high tide events that occur when the sun and moon's gravitation forces reinforce one another at times of the year when the moon is closest to the earth. They happen twice a year but are typically more dramatic during the winter (Government of British Columbia, 2015, para. 1).

Rivers, Lakes and Streams Flooding	A type of flooding resulting from the overflow of natural lake shorelines or water from a stream or river channel onto normally dry land in the floodplain adjacent to the channel (Integrated Research on Disaster Risk, 2014, p. 16). These floods can be caused by intense rainfall, rapid snowmelt (including **freshet** events), and **ice jams** blocking the rivers. **Freshet:** The movement of water associated with the thawing of ice and snow each spring. This runoff can result in high water levels in streams, lakes and other waterways (Abbott & Chapman, 2018, p. 17). **Ice Jams:** The accumulation of floating ice restricting or blocking a river's flow and drainage. Ice jams tend to develop near river bends and obstructions (e.g., bridges) (Integrated Research on Disaster Risk, 2014, p. 15).
Overland Flooding	Overland flooding (also known as "pluvial flooding") results from rainfall-generated overland flow. This type of flooding is usually associated with high intensity rainfall events (typically >30mm/h) but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability resulting in overland flow and ponding in depressions in the topography (Maksimovic, 2015). High intensity 'extreme' rainfall events in urban environments may cause sewerage/drainage systems to be completely overwhelmed and result in flooding.

APPENDIX 3. Hazard Assessment

Summary Scores

Hazard	Likelihood (1-5)	*Human & Social Impacts* (6-30)	*Physical & Economic Impacts* (5-25)	Overall Consequence (11-55)	Risk	Confidence Level
Overland Flooding	5	15	14	29	145	Ⓒ
Rivers, Lakes, and Stream Flooding	5	9	14	23	115	Ⓑ
Coastal Flooding	5	10	12	22	110	Ⓒ

Consequence Scores for Human & Social Impact Categories

Hazard	Fatalities (1-5)	Injury/Illness (1-5)	Displacement (1-5)	Psychosocial (1-5)	Support System Impact (1-5)	Cultural Resource Impact (1-5)	Sub-Total (6-30)
Overland Flooding	2	2	3	3	3	2	15
Rivers, Lakes, and Stream Flooding	1	1	2	2	2	1	9
Coastal Flooding	1	1	2	1	1	4	10

Consequence Scores for Physical & Environmental Impact Categories

Hazard	Property Damage (1-5)	Critical Infrastructure (1-5)	Environmental (1-5)	Economic (1-5)	Reputational (1-5)	Sub-Total (5-25)
Overland Flooding	3	3	3	2	3	14
Rivers, Lakes, and Stream Flooding	2	3	3	3	3	14
Coastal Flooding	3	3	2	2	2	12

APPENDIX 4. The Region's Critical Assets Owned/Operated by Local Government and First Nations

Critical assets are listed below by geographical location:

ELECTORAL AREA A

- Cassidy Fire Hall
- Cranberry Fire Hall (Cranberry Fire Improvement District)
- Decourcey Water System
- Duke Point Pollution Control Centre; SCADA software & equipment
- North Cedar Fire Hall (North Cedar Improvement District)
- Regional Landfill (RDN Solid Waste Department)

ELECTORAL AREA B

- Gabriola Emergency Wharfs
- Gabriola Fire Hall (Gabriola Fire Protection Improvement District)

ELECTORAL AREA C

- Arrowsmith Dam and Connections
- East Wellington Fire Hall (Mountain Improvement District)
- Extension Fire Hall

ELECTORAL AREA E

- Nanoose Fire Hall
- Nanoose Bay Peninsula (includes water treatment plant and SCADA software & equipment
- Nanoose Pollution Control Centre

ELECTORAL AREA F

- Church Road Transfer Station (RDN Solid Waste Department)

- Coombs Fire Hall
- Errington Fire Hall
- Melrose Terrace Water System
- Westurne Heights Water System
- Whiskey Creek Water Service Area

ELECTORAL AREA G

- Dashwood Fire Hall
- Englishman River Water Service
- French Creek Sewer Treatment Plant
- French Creek Water System
- Meadowood Fire Hall
- San Pariel Water System with SCADA software & equipment
- Surfside Water System

ELECTORAL AREA H

- Bow Horn Bay Fire Hall
- Deep Bay Fire Hall (Deep Bay Waterworks Improvement District)
- Greater Nanaimo Pollution Control Centre; SCADA software & equipment

FIRST NATIONS

- Qualicum First Nation Office
- Snaw-Naw-As (Nanoose) First Nation Office
- Snuneymuxw First Nation Office

DISTRICTOF LANTZVILLE

- Lantzville Fire Hall
- Lantzville Town Hall
- Lantzville Costin Hall

CITY OF PARKSVILLE

- Parksville City Hall
- Parksville Civic and Technology Centre
- Parksville Public Works Yard

- SCADA software & equipment
- Water Treatment Facility
- Parksville Fire Department

TOWN OF QUALICUM BEACH

- Berwick Station: Communications tower (multiple services)
- Qualicum Beach Fire Hall
- Qualicum Beach Public Works Yard
- Qualicum Beach Town Hall
- Qualicum Beach water system
- Qualicum Beach Civic Centre
- SCADA software & equipment
- Sanitary lift stations (Hall road, Higson Crescent)
- Transfer/emergency reservoir (one) isolated from distribution system

REGIONAL DISTRICT OF NANAIMO ASSETS WITHIN THE CITY OF NANAIMO

Main Administrative office & Transit Headquarters (Hammond Bay Rd, Nanaimo

APPENDIX 5. Response Services and Resources

An additional output from the population of the *Critical Infrastructure Assessment Tool* was a listing of response services and resources within the region.

A preliminary listing of response services and resources extracted from the *Critical Infrastructure Assessment Tool* is below. Additional efforts to continue to populate, and maintain the list, will assist the emergency management programs in the region to have a collated identification of response services and resources to support planning for restoration priorities, business continuity and resiliency initiatives.

PRIMARY RESPONSE SERVICES

Police

- Ladysmith RCMP
- Nanaimo RCMP
- Oceanside RCMP
- Gabriola RCMP

Ambulance

Ambulance Station

- Station 120 Nanaimo South
- Station 130 Parksville
- Station 138 Qualicum Beach
- Station 153 Gabriola Island
- Station 173 Bowser

Critical Care Transport Station

- Station 122/180 Nanaimo North

Fire Departments[8]

Bow Horn Bay Fire Department

- 21 Volunteer firefighters
- Nine (9) fire service vehicles
- Extraction equipment

City of Nanaimo Fire Department

- Five (5) fire halls

[8] Counts of firefighting resources were not available for all departments at the time of this report.

Coombs Fire Department

- 32 Volunteer firefighters
- Six (6) fire service vehicles
- Rescue pumper
- Two (2) fire halls

Cranberry Fire Department

- 35 Volunteer firefighters
- Two (2) fire halls

Dashwood Volunteer Fire Department

- 35 Volunteer firefighters
- Two (2) fire halls
- 12 fire service vehicles

Deep Bay Fire Department

East Wellington Fire Department

Errington Fire Department

- 40 Volunteer firefighters
- Seven (7) fire service vehicles
- Two (2) fire halls

Extension Fire Department

- 25 Volunteer firefighters

Gabriola Island Fire Department

- 40 Volunteer firefighters
- 12 fire service vehicles
- Two (2) fire halls

Lantzville Fire Department

- 28 Volunteer firefighters
- Six (6) fire service vehicles

Nanoose Fire Department

- 31 Volunteer firefighters
- Nine (9) fire service vehicles

North Cedar Fire Department

- 30 Volunteer firefighters
- 10 fire service vehicles

Parksville Fire Department

- Three (3) career firefighters
- 40 volunteer firefighters
- Eight (8) fire service vehicles
- Fire Special Operations Trailer for confined space and hazardous materials response

Qualicum Beach Fire Department

- 3 career firefighters
- 30 Volunteer firefighters
- One (1) fire hall
- 11 fire service vehicles

Other

- Canadian Coast Guard
- CFMETR Nanoose Naval BaseNanaimo Port Authority
- Western Canada Marine Response Corporation

Search and Rescue

- Arrowsmith Search and Rescue
- Nanaimo Search and Rescue
- Royal Canadian Marine Search and Rescue

SECONDARY RESPONSE SERVICES

Amateur Radio

- Emergency Communications Team (City of Parkville, Town of Qualicum, Electoral Areas E, F, G, H)
    - 15 trained volunteers
- Coast Emergency Communications Association (District of Lantzville, City of Nanaimo, Electoral Area A, B, C)
    - 40 trained volunteers

Emergency Management Programs

- Regional District of Nanaimo Emergency Management Program
- District of Lantzville Emergency Management Program (contract to RDN)
- Emergency Management Oceanside
    - City of Parksville
    - Town of Qualicum Beach

- Qualicum First Nation Emergency Program
- Snaw-Naw-As First Nation Emergency Program
- Snuneymuxw First Nation Emergency Program

Emergency Operations Centre (EOC)

- Parksville EOC
    - 45 trained staff
- Qualicum Beach EOC
    - Internally trained staff
- Regional District of Nanaimo EOC
    - 94 trained staff

Emergency Support Services

- Gabriola ESS
    - Trained volunteers
- Lantzville ESS
    - 12 trained volunteers
- Oceanside ESS (Parksville & Qualicum Beach)
    - 54 trained volunteers
- Southern Communities ESS
    - Nine (9) volunteers (undergoing training as of September 2019)
- Nanaimo ESS
    - 15 trained volunteers

Mutual aid

- Bi-directional mutual aid agreements between Parksville, Qualicum Beach, RDN, City of Nanaimo, District of Lantzville, Qualicum First Nation, Snaw-Naw-As First Nation andSnuneymuxw First Nation

Other Government

- Canadian Forces Base- Comox
- Emergency Management BC

Non-Government Organizations

- Canadian Red Cross
- Oceanside Community Safety Volunteers
- Salvation Army
- St. John Ambulance

APPENDIX 6. Engagement Sessions Participants

SESSION 1

Day 1, North Workshop (District 69)

Date: Wednesday October 10, 2018
Location: Eaglecrest Golf Club, Qualicum Beach, BC

Day 2, South Workshop (District 68)

Date: Thursday October 11, 2018
Location: Beban Park Social Centre, Nanaimo, BC

Participants

Total attendees: 66

• Alberni-Clayoquot Regional District	• Health Emergency Management BC
• Arrowsmith Search and Rescue	• Insurance Bureau of Canada
• BC Wildfire Service	• Lantzville Fire Department
• BC Ambulance Service	• Mudge Island Citizens Society
• Bow Horn Bay Fire Department	• Ministry of Transportation and Infrastructure
• CF Maritime Experimental Test Range	• Nanaimo Port Authority
• City of Parksville	• North Cedar Fire Department
• Comox Valley Emergency Program	• North Cedar Improvement District
• Comox Valley Regional District	• Oceanside Emergency Social Services
• Coombs-Hilliers Fire Department	• Oceanside RCMP
• Cowichan Valley Regional District	• Qualicum First Nation
• Provincial Dam Safety Officer	• Regional District of Nanaimo
• Department of Fisheries and Oceans	• Royal Bank of Canada
• Emergency Management BC	• School District 68
• Errington Fire Department	• Technical Safety BC
• Gabriola Emergency Social Services	• Town of Qualicum Beach
• Gabriola Fire Department	

SESSION 2

Day 1, South Workshop (District 68)

Date: Wednesday, February 20, 2019
Location: Beban Park Social Centre, Nanaimo, BC

Day 2, North Workshop (District 69)

Date: Thursday, February 21, 2019
Location: Eaglecrest Golf Club, Qualicum Beach, BC

Participants

Total attendees: 54

• Alberni-Clayoquot Regional District	• Island Radio
• BC Hydro	• Island Timberlands
• BC Parks	• Mudge Island Citizens Society
• BC Wildfire Service	• Nanaimo Port Authority
• BC Ambulance Service	• Nanaimo RCMP
• Parksville Qualicum Beach Tourism Bureau	• Nanoose Fire Department
• City of Parksville	• Nanoose Naval Base
• Canadian Coast Guard	• Oceanside Emergency Social Services
• Comox Valley Regional District	• Canadian Red Cross
• Coombs-Hilliers Fire Department	• Regional District of Nanaimo
• Cowichan Valley Regional District	• Royal Bank of Canada
• Cranberry Fire Department	• School District 68
• Provincial Dam Safety Officer	• School District 69
• Department of Fisheries and Oceans	• Snuneymuxw First Nation
• Emergency Management BC	• Technical Safety BC
• Gabriola Fire Department	• Town of Qualicum Beach
• Health Emergency Management BC	

SESSION 3

Date: Wednesday June 12, 2019
Location: Tigh-Na-Mara Resort & Conference Centre, Parksville, BC

Participants

Total attendees: 43

• Arrowsmith Search and Rescue	• Mudge Island Citizens Society
• BC Hydro	• Nanaimo Port Authority
• BC Wildfire Service	• Nanoose Naval Base
• BC Ambulance Service	• Oceanside Emergency Social Services
• City of Parksville	• Parksville Qualicum Beach Tourism Bureau
• Comox Valley Regional District	• Provincial Dam Safety Officer
• Cowichan Valley Regional District	• Provincial Diking Authority
• Cranberry Fire Department	• Regional District of Nanaimo
• Emergency Management BC	• Royal Bank of Canada
• Environment & Climate Change Canada	• School District 69
• Fisheries & Oceans Canada	• School District 68
• Gabriola Fire Department	• Technical Safety BC
• Health Emergency Management BC	• Town of Qualicum Beach
• Island Radio	• Vancouver Island University

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