

City of Courtenay

Together for Climate Project Report



CITY OF

COURTENAY

2020

Contents

Acknowledgements	3
Purpose.....	4
Introduction	4
Together for Climate Project	5
ICLEI Canada’s Building Adaptive and Resilient Communities Framework.....	6
The Science of Climate Change	7
What is climate change?	7
How do we address climate change?.....	8
How will our climate change locally?	8
Climate Change Impacts & Risks	10
How do we measure climate change risk?	11
What are our top climatic risks?	11
Adaptation Actions	14
Priority Adaptation Actions.....	14
Conclusion	20
Next Steps.....	20
Appendix A: Detailed Adaptation Actions	21
References	35

Acknowledgements

The City of Courtenay would like to acknowledge the following community stakeholders for their valuable input and participation in ICLEI Canada's Together for Climate project:

- Comox Valley Development and Construction Association
- Comox Valley Regional District
- Island Health
- K'ómoks First Nation
- Ministry of Transportation and Infrastructure
- Project Watershed
- Town of Comox
- Comox Valley Conservation Partnership
- Department of National Defence

This program could not have been possible without the support, efforts and coordination of ICLEI staff and the City of Courtenay's Recreation, Planning and Engineering departments.

The City of Courtenay respectfully acknowledges that we are standing on the unceded traditional territory of the K'ómoks First Nation.

ICLEI Canada acknowledges that the *Together for Climate* project is made possible with funding from the Real Estate Foundation of British Columbia.

© 2020, City of Courtenay. All Rights Reserved.



Purpose

The purpose of this report is to outline how the City of Courtenay could proactively prepare for the impacts of climate change – specifically in response to **extreme precipitation and flooding related impacts**. The report outlines the process the municipality undertook as a participant in ICLEI Canada's Together for Climate Project – including the climate change projections for the municipality, key impacts and issues of concerns, and potential adaptive actions that could be taken to improve the resilience of the community to climate change and extreme weather. The outputs of this report could then be integrated into municipal planning decisions, including the update to the City's Official Community Plan, and other stormwater-related planning and program efforts.

Introduction

It is expected that climate change will increase the severity and frequency of storms, resulting in increased storm water run-off. Climate change is a global concern, and the City of Courtenay wanted to investigate collective, multi-jurisdictional strategies that will help the community adapt. The ICLEI Together for Climate project complements efforts that are underway at the City examining our municipal natural asset management, community planning, as well as the upcoming storm water management projects. The lessons we learn through these initiatives will help inform future storm water practices in our city, as well as other coastal communities.



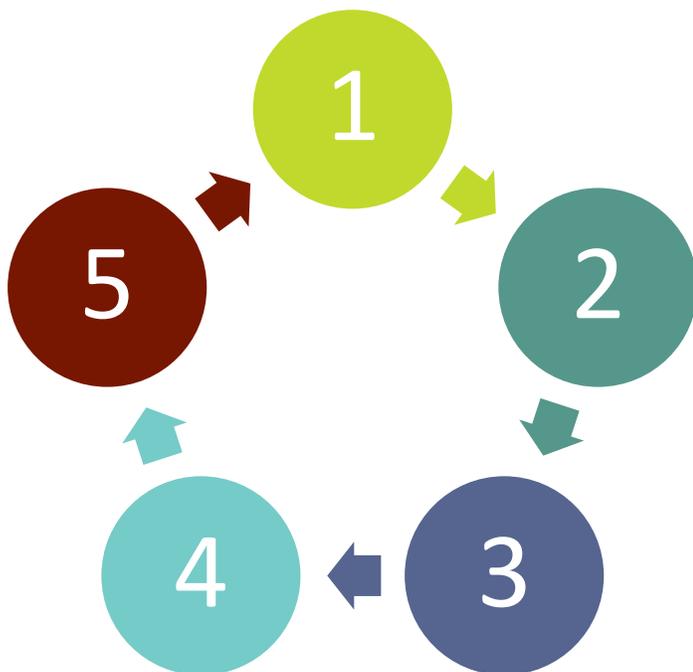
Together for Climate Project

This report was informed by the City of Courtenay's participation in ICLEI Canada's Together for Climate project. Together for Climate was a two-year initiative that engaged eight communities across Vancouver Island to develop climate adaptation strategies. This project focused on building local capacity within each community by engaging with local stakeholders and receiving input from a wide range of experts. The Together for Climate project also provided each community with the opportunity to come together at three provincial workshops to share their challenges and successes, while connecting them to a broader network of practitioners working on climate adaptation across the province and country.



ICLEI Canada's Building Adaptive and Resilient Communities (BARC) program was used to guide each Together for Climate participant through Milestones 1–3 of a five-milestone planning framework that supports municipal climate change adaptation planning. The process involved identifying local climate impacts, a community risk and vulnerability assessment, and a participatory approach to action planning to reduce vulnerability and increase resilience to the projected climatic changes.





MILESTONE ONE - INITIATE

Within this milestone, communities identify stakeholders to review and understand existing knowledge on how the regional climate is changing, followed by a brainstorming exercise to identify potential climate change impacts.

MILESTONE TWO—RESEARCH

The second milestone is meant to further develop a community's understanding of climate change impacts and the major service areas which are likely to feel these impacts most acutely. Within this milestone, a municipality will scope the climate change impacts for the region and conduct both a vulnerability and risk assessment.

MILESTONE THREE - PLAN

The third milestone provides guidance on how to establish a vision, set adaptation goals and objectives, identify adaptation options, and examine possible constraints and drivers to various actions. From there, a community will draft a Local Adaptation Strategy. Baseline data is collected and recorded, financing and budget issues are addressed, an implementation schedule is drafted, implementation responsibilities are determined, and progress and effectiveness indicators are identified in the Plan.

MILESTONE FOUR - IMPLEMENT

In the fourth milestone, communities work to ensure that they have the approval and support of council, municipal staff and the community in order to move forward on implementation. Communities will also make sure they have the appropriate implementation tools to ensure the ongoing success of the Strategy.

MILESTONE FIVE – MONITOR & REVIEW

The fifth and final milestone serves to assess whether the goals and objectives of the Strategy have been achieved, and helps communities identify any problems that have been encountered and develop solutions. Additionally, the fifth milestone helps communities communicate their progress to council and the general public.

The Science of Climate Change

What is climate change?

The climate system is complex, comprising of many interrelated and interacting components. Climate is the result of a culmination of various biogeophysical factors over a long period of time and differs from weather (Richardson et al., 2012). Climate change can be simply defined as any change in global or regional climate patterns over time and can be the cause of natural factors and human activity (Lemmen & Warren, 2016). Although natural variation has characterized the Earth's climate system for millions of years; the past 10,000 have been relatively stable – until recently.

Human activities are having a direct impact on the Earth's climate (IPCC, 2014). The two main ways that anthropogenic activities are affecting the Earth's climate are through changes in land-use (e.g., deforestation) and the combustion of fossil fuels (e.g., carbon-based energy sources) (Richardson et al., 2012). Burning fossil fuels (e.g., coal, oil, natural gas) releases carbon dioxide (CO₂) and other greenhouse gases (GHGs) into the atmosphere. Carbon dioxide is a heat-trapping gas that builds up in the atmosphere over time, it functions like a blanket, trapping in heat that would otherwise be lost to the upper layers of the atmosphere (see Figure 1 below) (Bales et al., 2015; Richardson et al., 2012). This "blanket effect" is causing the planet's atmosphere to warm, which disrupts the stability of the climate system. Although CO₂ is necessary for life, the role of CO₂ in the climate system goes beyond plants taking it in and humans breathing it out. Burning fossil fuels puts more CO₂ into the atmosphere than the system can handle and causes CO₂ to build up in the Earth's atmosphere and oceans, leading to a series of ecological and climatic problems (Bales et al., 2015).

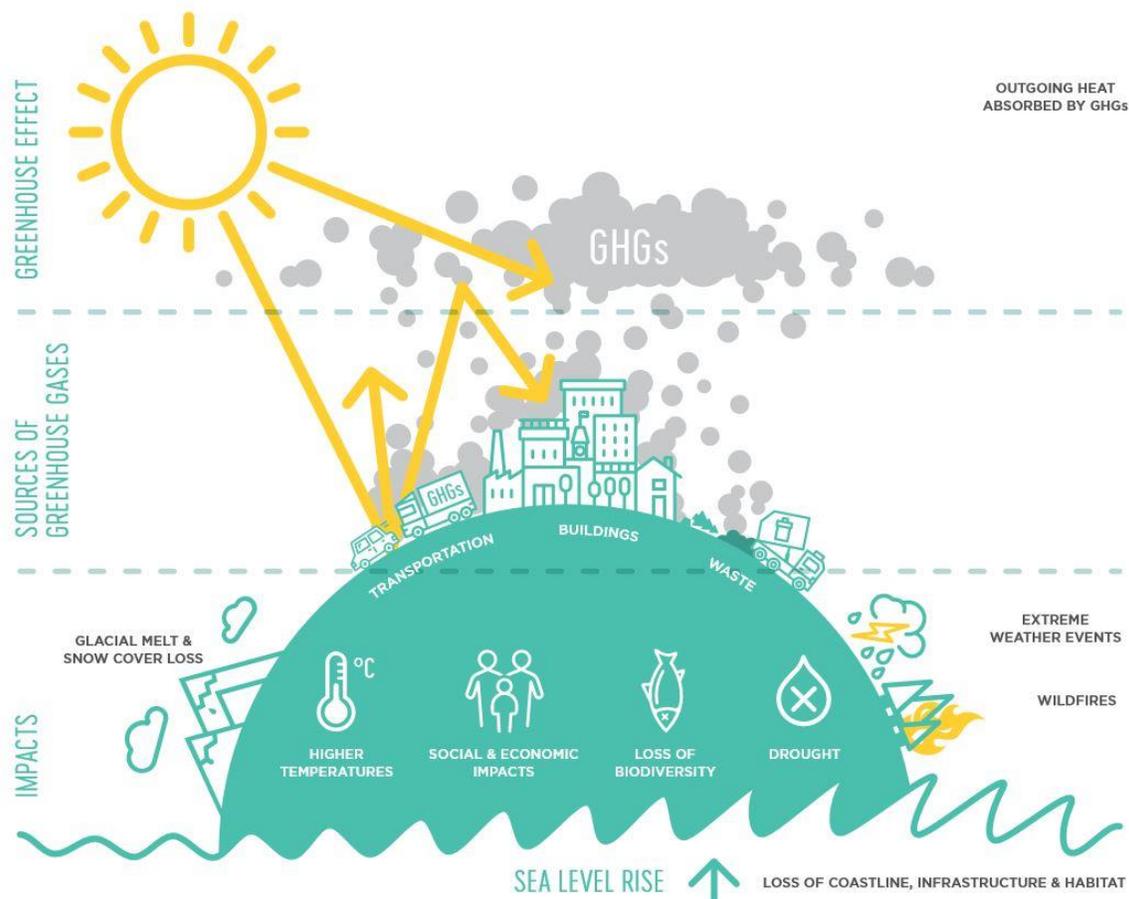


Figure 1. Image representing the sources, mechanisms, and impacts of climate change. Image retrieved with permission from the City of Victoria's Climate Leadership Plan (2018).

How do we address climate change?

Addressing climate change requires a two-pronged approach: reducing GHG emissions (mitigation) and preparing for the impacts of climate change (adaptation). Mitigation refers to the implementation of policy, regulatory and project-based measures that contribute to the stabilization or reduction of GHG concentrations in the atmosphere. These include transitioning to low-carbon energy sources and improving energy efficiency. While mitigation efforts work to contain the long-term impacts of global warming, adaptation measures are needed to address the climate change impacts that are already happening. Climate change adaptation refers to any initiative or action that increases the resilience of social, ecological, physical, and economic systems to changing climate conditions.

Adaptation and mitigation are not mutually exclusive. Many actions can have co-benefits, meaning they contribute both to resilience and to reducing GHG emissions (see Figure 2). For example, using naturalized shorelines can act as a buffer for sea-level rise, and act as a sponge for flooding and storm surges. However, they also sequester carbon, and there are fewer emissions to install, maintain and replace natural shorelines compared to a traditional concrete dike.

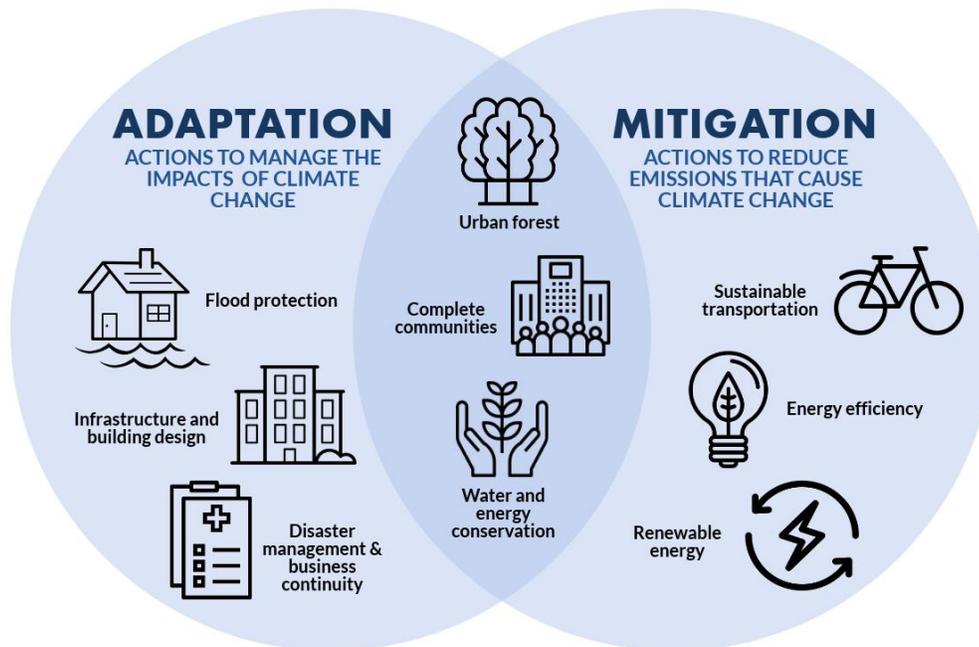


Figure 2. Interconnections and differences between adaptation and mitigation (ICLEI, 2019).

How will our climate change locally?

Recent events in the City of Courtenay, including flooding, severe thunderstorm events, and other extreme weather events highlight the need for the municipality to integrate climate change into municipal planning to safeguard the City's built, social, natural, and socioeconomic systems. Local projections of climate change are essential in understanding the implications of climatic variability on key municipal services and industry sectors that support the citizens of Courtenay while also enabling local solutions to emerge and be tailored to meet these unique needs. The Climate Atlas of Canada tool was used to access downscaled climate data for the City of Courtenay, and the following data highlights the projected precipitation changes under climate change conditions over the next century. As this

report focuses on stormwater related issues – the information below focuses primarily on a summary of precipitation and extreme weather-related indices.

Information included in the summary table below (Table 1) represents an ensemble approach, which incorporates a combination of 24 different global climate models from PCIC’s statistically downscaled data (Bias Correction with Constructed Analogues and Quantile mapping, Version 2; BCCAQv2) using a high-emissions (RC8.5) scenario. The parameters used in this report include precipitation-related variables and sea level rise. Key findings show that overall precipitation is expected to increase – primarily in the winter season. There is also going to be more heavy precipitation days, and more frequent and severe rain events.

Table 1. Summary of Climate Change Precipitation Projections for the Courtenay Area.

RCP 8.5				
Climate Variable ¹	Season	Baseline (1976 – 2005)	Ensemble Median (2021-2050)	Ensemble Median (2051-2080)
Total Precipitation	Annual	1429 mm	1483 mm	1562 mm
	Spring	267 mm	276 mm	280 mm
	Summer	117 mm	109 mm	103 mm
	Fall	437 mm	453 mm	489 mm
	Winter	607 mm	642 mm	691 mm
Heavy Precipitation Days (10 mm)	Annual	45.6 days	47.2 days	49.4 days
Heavy Precipitation Days (20 mm)	Annual	17.8 days	19.6 days	21.6 days
Max 1-Day Precipitation	Annual	59 mm	63 mm	67 mm
Max 3-Day Precipitation	Annual	88 mm	92 mm	100 mm
Relative Sea level rise ²	Relative sea level expected to rise 20-30 cm by 2100			

¹ The first five climate variables taken from the Climate Atlas of Canada tool

² Sea level rise data retrieved from Natural Resources Canada’s ‘Canada’s Marine Coasts in a Changing Climate’

It is important to note the role that uncertainty plays in the study of climate change, and any science field. While the exact outcomes of climate change are difficult to predict with absolute certainty, it is not a question of ‘if’ impacts are occurring, but rather ‘when’. There is a high degree of scientific consensus surrounding both anthropogenic climate change and the associated risks (IPCC, 2018). The risks associated with climate change are increasing globally, which will have unequivocal impacts on local businesses, schools, hospitals, and other community services. If we act now, we can significantly lessen the severity of climatic risks and start transitioning toward an aspirational vision of the future (Corner et al., 2015).

Climate Change Impacts & Risks

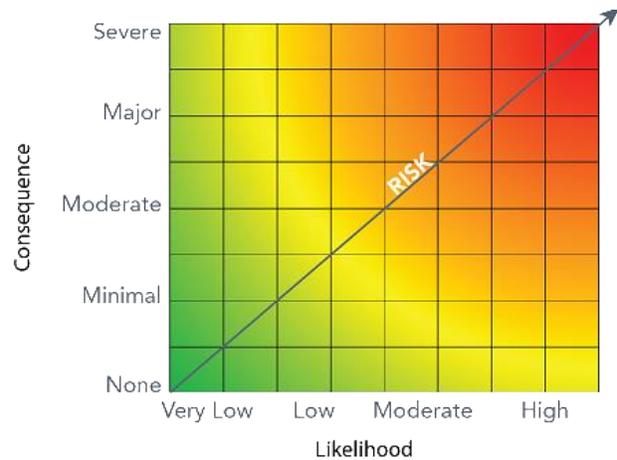
While climate change projections tell us how the climate is expected to change over time, its important to also evaluate how those changes will affect our community. In order to assess this, the City developed impact statements. Impact statements outline the climate variable (e.g. increased precipitation), the outcome of that variable (e.g. overland flooding) and the consequences of that outcome (e.g. road washouts). These impacts are then evaluated to determine which pose the highest risk to the community.

To determine its highest risks, the City undertook a climate risk assessment process with internal and external stakeholders to analyze the likelihood and consequences of various precipitation-related impacts. Those impacts which are the most likely to occur, and which will produce the greatest negative consequences should be prioritized for action planning. This information is presented in the following section.



How do we measure climate change risk?

Risk is the combination of the probability of an impact occurring and its negative consequences and can be expressed as a function where risk = likelihood x consequence. Likelihood is based on how likely it is that an impact will occur and considers both the probability of the threat occurring (e.g. increased freezing rain) and the probability of the associated outcomes occurring (e.g. increased asset damage). Likelihood ratings from 1 to 5 were assigned to each impact, where 1 was 'rare' and 5 was 'almost certain', based on localized climate projections, as well as anecdotal knowledge of current conditions.



Consequence refers to the known or estimated outcomes of a particular impact. To determine consequence, the multi-stakeholder group comprised of municipal and community stakeholders assessed impacts against 12 consequence criteria. Consequence ratings from 1 to 5 were assigned to each criterion, where 1 was 'negligible' and 5 was 'catastrophic'. Risk scores were determined by multiplying consequence ratings with likelihood ratings.

What are our top climatic risks?

Based on the methodology outlined above, the City of Courtenay identified 18 priority risks, which are outlined in Table 2 below. Overall, the highest-ranking risks pertained to heavy precipitation and flooding events, and their impacts to various infrastructure assets, such as bridges, roads, utility systems, and critical public buildings. The purpose of the risk assessment process is to prioritize the risks that are most important to focus on for action setting, which is outlined in the next section.

Table 2. Priority Climate Risks for the City of Courtenay

Medium-High Risks	
	Sea level rise and more extreme storm surges flooding and damaging infrastructure (e.g. the airbase, pump stations, dikes, etc.).
Medium Risks	
	More extreme rainfall events leading to inundation of drainage system and localized flooding, damaging infrastructure, and utilities.
	More extreme rainfall events leading to river flooding, damaging infrastructure, and utilities (e.g. Bridge System 17 th & 5 th St., cut-off north and south areas).
	More extreme rainfall events leading to flooding of parks and playgrounds (e.g. Air Park, Lewis Park).
	More extreme rainfall events causing flooding or washout and failure of road system (e.g. Dike/Comox Rd, Headquarters Rd.).

	More extreme rainfall events causing increased inflow and infiltration, leading to surface/environmental surcharges and increased demand on treatment facility. x
	Sea level rise leading to coastal inundation (at least 0.5m by 2050).
	More extreme rainfall events creating water quality issues due to increased erosion and sediment challenges.
	More extreme rainfall events accelerating loss of fish habitat and impacting population count. x
	More extreme rainfall events and sea level rise causing erosion and soil instability (less water retention in dry soils).
	More extreme rainfall events restricting access to critical public infrastructure (e.g. hospitals, transportation, utilities).
	More extreme rainfall events impacting emergency management response and vulnerable populations in particular.
Medium-Low Risks	
	Sea level rise impacting groundwater quality and increasing brackish water.
	More extreme rainfall and weather events contaminating drinking water supply (e.g., contamination from septic fields, turbidity in Comox Lake, erosion, sedimentation, etc.).
	More extreme rainfall events negatively affecting the urban forest (e.g. wind combined with saturated soils). x
	More extreme rainfall events affecting business continuity and service delivery in commercial areas. x
	More extreme rainfall events impacting cultural sites (e.g. village sites, burial sites, places with significant artifacts). x
	More extreme rainfall events affecting biodiversity and native species, creating new opportunities for invasive species. x



Adaptation Actions

A variety of adaptation actions can be used to respond to climate change impacts, including both anticipatory actions (i.e. before an impact is observed) and reactive actions (i.e. after an impact has occurred). Moreover, there are many kinds of adaptive actions that can be taken by a City, including policy-related actions, education and outreach, grey or green infrastructure interventions, zoning and bylaw actions, and more. This report outlines a variety of adaptive actions the City could consider to proactively pursue in order to prepare for the impacts of extreme precipitation, flooding, and sea-level rise-related issues.

A workshop was held in December 2019 to brainstorm potential actions the City and community could take in order to address the priority risks identified through the risk assessment process. Results of this workshop were then edited by the project team and additional actions were added based on literature and best practice reviews. These actions were then reviewed by members of the City’s Engineering and Planning departments to edit and refine into a final list of 47 potential actions. The long list of potential adaptation actions can be found in **Appendix A**. These include the impact, action, supporting actions, as well as the suggested lead and supporting department and organizations for implementation.

Priority Adaptation Actions

From the 47 suggested actions, six key actions were identified as a priority for the City of Courtenay. These actions were selected for their relevance to current City initiatives involving storm events and stormwater management. Although we have highlighted these six actions for the purpose of this report, our intention is that all the suggested actions can provide a starting point for future projects. The tables below outline the six key action areas and their associated impact, as well as potential supporting actions that could be pursued.



Impact #1: More extreme rainfall events leading to inundation of drainage system and localized flooding, damaging infrastructure, and utilities.	
Action	Support Actions
Action 1.5 - Develop economic mechanisms that promote the infiltration, collection and recycling of stormwater on private and public property.	<p>Actions to support this initiative could include:</p> <ul style="list-style-type: none"> • Explore the implementation of rebate/incentive programs for rainwater harvesting, green roofs, bioswales, etc. on private property • Explore economic incentive mechanism (e.g., ‘Stormwater fee’) that promotes a reduction in permeable surface area



Impact #2: Impact #2: More extreme rainfall events causing riverine flooding, damaging infrastructure, and utilities (e.g., Bridge System 17th & 5th St., cut-off east and west areas).	
Action	Supporting Actions
<p>Action 2.2 - Engage communities in developing neighbourhood evacuation and disaster preparedness plans</p>	<p>Develop an Integrated Rainwater Management Plan for the City’s watersheds to guide stormwater management, with the goal of balancing land use and development planning with environmental concerns. Once these plans are complete, the City should implement recommendations and monitor and review each plan on an ongoing basis to maintain watershed health and reduce the impacts of extreme runoff. Some planning considerations for the plan include:</p> <ul style="list-style-type: none"> • Planning and design approaches such as limits to impermeable surfaces, enhancing the urban tree canopy, land conservation and other low impact development options • Runoff storage and conveyance such as using pocket parks for street runoff, re-routing stormwater to waterbodies, or non-potable water storage/use • Adopt infiltration and detention practices such as green roofs, street infiltration bulges or downspout rock pits • Implement and monitoring and review process for each part of the plan and review on an ongoing basis • Plan for 100-year flood levels using a whole-system, water balance approach
<p>Action 2.4 - Develop and implement recommendations of the City’s Integrated Rainwater Management Plan to maintain watershed health and reduce the impacts of extreme runoff.</p>	<p>Actions to support this initiative could include:</p> <ul style="list-style-type: none"> • Provide first-aid and disaster scenario training to increase the pool of trained volunteers that can be called on in emergency situations. • Strengthen public education campaigns and training workshops to increase community-awareness of evacuation routes during a flood event • Work with emergency management teams to establish alternative routes • Develop and implement alternative route signage

WHAT MAKES A CLIMATE-RESILIENT WATERSHED?



Image: © Comox Valley Regional District, 2020

LEARN MORE ABOUT HOW YOU CAN HELP PROTECT OUR WATERSHED AT:
COMOXVALLEYRD.CA/WATERSHED | [f](#) [@](#) [@WEARECONNECTEDBYWATER](#)

 Comox Valley
REGIONAL DISTRICT

 CONNECTED
BY WATER

Impact #7: More extreme rainfall events affecting biodiversity, soil water content, and native species, creating new opportunities for invasive species.

Action	Supporting Actions
<p>Action #7: Enhance and protect Courtenay’s biodiversity from climate change impacts through managing invasive species, protecting rare and endangered species, and sensitive ecosystems on City owned and managed land.</p>	<p>Actions to support this initiative could include:</p> <ul style="list-style-type: none"> • Continue using the municipal park system and EDPAs to protect sensitive ecosystems • Explore the potential expansion of protected areas across the City (and region) based on the identification of refugia • Implement actions identified to protect biodiversity through the Urban Forest Strategy, including but not limited to: <ul style="list-style-type: none"> ○ Identify plants and ecosystems vulnerable to climate change and develop management strategies to help mitigate impacts. ○ Implement mitigation strategies related to climate change impacts on marine shorelines ○ Explore the potential to complete a Green Shores shoreline restoration project ○ Identify marine shorelines within the parks system that are vulnerable to climate change impacts and develop mitigation strategies • Take a landscape approach to regional conservation of sensitive ecosystems that may not be captured within the City’s jurisdiction



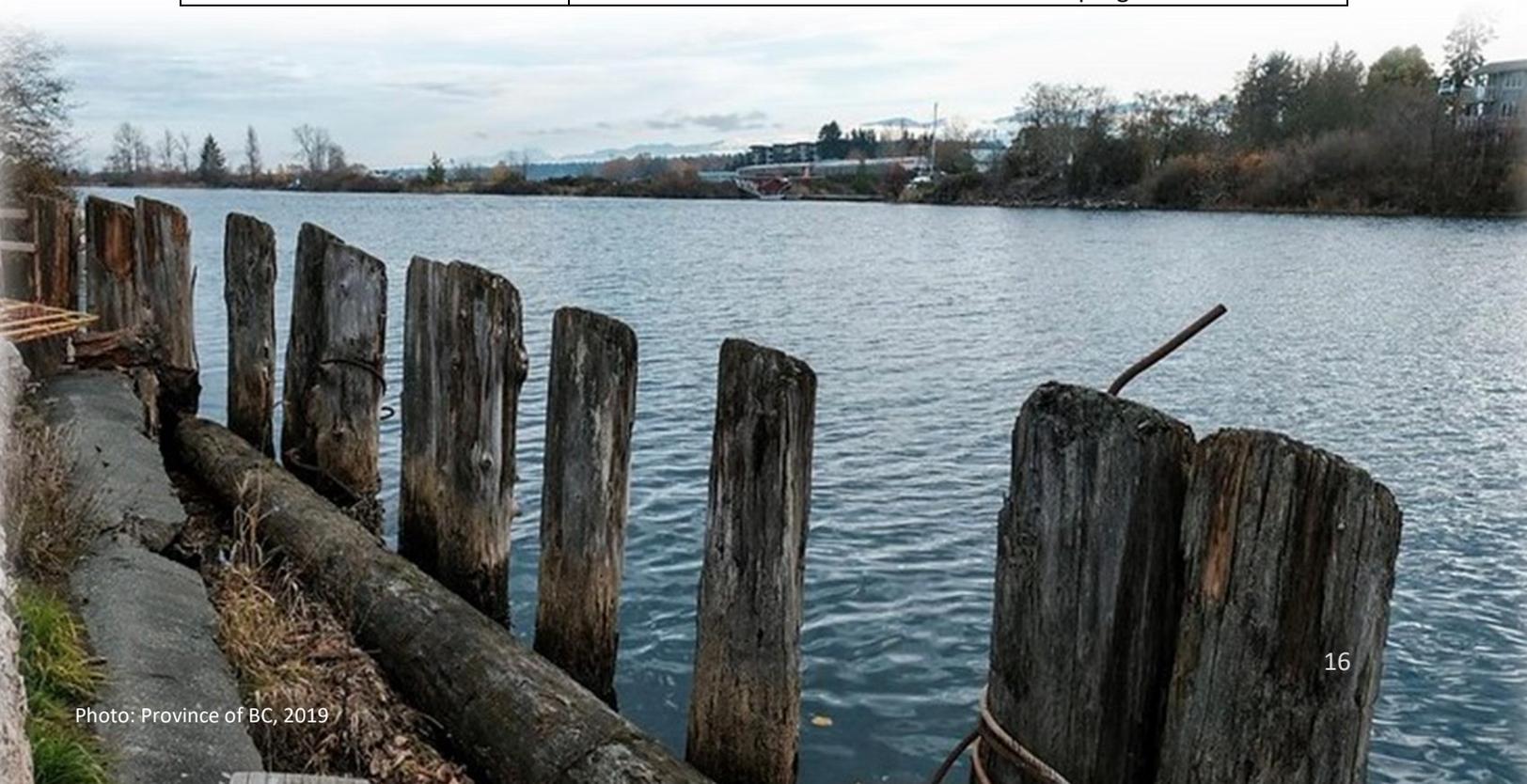
Photo: Nicole Beaulac



Photo: Cable Bay Trail

Impact #8: More extreme rainfall events impacting water quality and drinking water supply (e.g., contamination from septic fields, turbidity in Comox Lake, erosion, sedimentation, etc.)

Action	Supporting Actions
<p>Action 8.1 - Continue to work with Comox Valley Regional District and municipal neighbours in taking an integrated watershed management approach to our waterways and land use.</p>	<p>Actions to support this initiative could include:</p> <ul style="list-style-type: none"> • Support and participate in existing integrated watershed management groups • Talk to contemporaries in other municipalities to identify ongoing projects and future opportunities for integrated watershed management • Develop baseline data and indicators of baseline watershed health (e.g., measuring physical, chemical and biological characteristics of the watershed) <ul style="list-style-type: none"> ○ E.g., groundwater quality parameters, soil moisture content, total surface water area, stream flow, evaporation/evapotranspiration • Identify and prioritize areas from within the watershed that are a source of water quality and quantity issues (e.g., contamination from septic fields, turbidity in Comox Lake, erosion, sedimentation, etc.) <ul style="list-style-type: none"> ○ Assessment of the vulnerability of water quality and quantity to climate change for the Comox Lake watershed and subbasins (e.g., K'ómoks Estuary, Puntledge River watershed, Perseverance Creek watershed, Beech Creek watershed, etc.) ○ Explore opportunities for adaptation actions such as zoning, education, maintenance bylaws for onsite sewage disposal system, and/or restrict activity within watershed • Implement a water quality monitoring program within the watershed to measure and evaluate the progress



Impact #12: More extreme rainfall events impacting emergency management response and vulnerable populations in particular.

Action	Supporting Actions
<p>Action 12.1: Ensure emergency response capacity keeps pace with the need for services, given the increasing climate impacts.</p>	<p>Action to support this initiative could include:</p> <ul style="list-style-type: none"> • Schedule annual mandatory exercises to ensure adequate knowledge of Emergency Operations Centre operations • Coordinate specialized training for responders (e.g., CoastSmart, Adventure Smart) • Engage with community and regional stakeholders to identify duties, responsibilities, and response protocols strengthening collaboration and coordination • Collaborate with neighbouring communities to establish mutual aid agreements in event of isolation due to flooding



Conclusion

This document outlines the climate change planning process the City of Courtenay undertook as part of its participation in ICLEI Canada's Together for Climate project. The process was intended to evaluate local precipitation-related climate risks to the City and identify potential actions the City could proactively take to adapt to changing conditions. It is important to note that this report identifies potential strategic actions for those impacts that are considered the most significant based on the risk assessment process. This is not to say that other impacts, such as those associated with lower levels of risk, do not merit action, or that other additional actions are not worth pursuing. This report is not a substitute for prudent and strategic decision-making; it identifies areas where the City should focus its efforts but recognizes that climate change has the potential to affect all of the work we do. In order to continue our forward-thinking approach to community building, climate change will need to be factored into all areas of City business and service delivery.

Next Steps

The City of Courtenay will continue to build upon the coordination established with the local community stakeholders during ICLEI Canada's Together for Climate project. This document, and its recommendations can provide community perspective and direction when initiating future projects as they relate to climate change's effect on storm events and stormwater management.

Photo: Paul Hamilton



Appendix A: Detailed Adaptation Actions

This table includes the complete list of brainstormed adaptation actions from the City of Courtenay’s participation in the Together for Climate project. Actions are divided by priority impacts as identified through the risk assessment process. These actions can serve as a starting point for the City when determining how the municipality and its community stakeholders can prepare for a variety of precipitation-related impacts. Actions that are highlighted in blue represent the priority actions as outlined in this report.

Impact #1: More extreme rainfall events leading to inundation of drainage system and localized flooding, damaging infrastructure, and utilities.			
Action	Supporting Actions	Potential Lead Departments/Organizations	Potential Supporting Departments/Organizations
1.1 - Develop public education campaign for property owners and managers on the importance of keeping storm drains clear of leaves and other debris to reduce the risk of flooding.	<ul style="list-style-type: none"> • Use flood risk mapping to identify targeted education campaigns, hand outs etc. • Work with a broad variety of outreach partners to disseminate public education campaign 	City of Courtenay Legislative and Corporate Services	Local stewardship groups Comox Valley Regional District Neighbourhood Associations Multicultural Centres
1.2 – Research and implement low impact development solutions for rainwater management.	<p>Potential low-impact solutions could be:</p> <ul style="list-style-type: none"> • Retention ponds/systems to accommodate overflow and other low impact development projects such as raingardens, green roofs, bioswales • Permeable paving options (e.g., paving blocks/cobble stone, plastic or fibrous grid systems filled with sand, gravel or living plants) 	City of Courtenay Engineering	City of Courtenay Development Services (Planning)
1.3 - Integrate the climate change resilience assessment component of the Climate Lens for new development and infrastructural renewal projects.	<ul style="list-style-type: none"> • Identify resilience measures to be analysed and implemented (e.g., changes to location, design, and operation and maintenance) • Include data sources used to identify and evaluate the risks (e.g., climate scenarios, flood maps, projections) • Conduct a risk identification, analysis, and evaluation of vulnerable infrastructure • Establish a framework for risk mitigation – identify adaptation measures that can reduce unacceptable risks 	City of Courtenay – Development Services (Planning and Sustainability); City of Courtenay Engineering; City of Courtenay Public Works	

<p>1.4 – Establish stormwater management requirements (based on best practices) for new developments to reduce the impact of development on the City’s stormwater system.</p>	<ul style="list-style-type: none"> • Use site planning and design techniques to reduce impervious cover, disturbed soils, and stormwater impacts (e.g., conservation design, protecting open space and natural drainage features, disconnecting a site’s impervious cover) • Technical development principles should include criteria for street width/length, right-of-way width, vegetated open channels, parking lots and ratios, open space design, setbacks and frontages, sidewalks, driveways, rooftop runoff, buffer systems, tree conservation, etc. • From a watershed scale, land-use planning can encourage infill and development within targeted zones, while preserving key natural drainage features within the landscape • Mandate retention system requirements for development with installation of impervious surfaces • Building code considerations for stormwater at building level 	<p>City of Courtenay Engineering, Public Works, Planning</p>	
<p>1.5 - Develop economic mechanisms that promote the collection and recycling of greywater and stormwater on private property and City facilities.</p>	<ul style="list-style-type: none"> • Explore the implementation of rebate/incentive programs for rainwater harvesting, green roofs, bioswales, etc. on private property • Explore economic incentive mechanism (e.g., ‘Stormwater fee’) that promotes a reduction in permeable surface area 	<p>City of Courtenay Legislative and Corporate Services</p>	
<p>2: More extreme rainfall events causing riverine flooding, damaging infrastructure and utilities (e.g., Bridge System 17th & 5th St., cut-off east and west areas).</p>			
<p>2.1 - Ensure essential and important services to the community have adequate, working backup power in east and west Courtenay.</p>	<ul style="list-style-type: none"> • Establish system redundancy for critical services in both east and west Courtenay (e.g., Firehall on each side of City, etc.) • Ensure back-up power for essential and important services is not vulnerable to flooding and that they have adequate fuel for extended power shortages 	<p>City of Courtenay Public Works, Comox Valley Regional District (?)</p>	
<p>2.2 – Engage communities in developing neighbourhood evacuation and disaster preparedness plans</p>	<ul style="list-style-type: none"> • Provide first-aid and disaster scenario training to increase the pool of trained volunteers that can be called on in emergency situations. • Strengthen public education campaigns and training workshops to increase community-awareness of evacuation routes during a flood event • Work with emergency management teams to establish alternative routes 	<p>City of Courtenay; Comox Valley Regional District Emergency Management; other local governments; RCMP; etc.</p>	<p>Local non-profit organizations working in emergency management communications</p>

	<ul style="list-style-type: none"> • Develop and implement alternative route signage 		
2.3 - Implement a comprehensive operations, maintenance and inspection program for creeks/streams and stormwater infrastructure	<ul style="list-style-type: none"> • Conduct inspections to identify and prioritize repair and maintenance needs • Secure funding as required for repair and maintenance programs • Update City practices and procedures to better address the monitoring, reporting, operations and maintenance activities 	City of Courtenay Public Works department	
2.4 - Complete and implement recommendations of the City's Integrated Rainwater Management Plan to maintain watershed health and reduce the impacts of extreme runoff.	<p>The City is currently developing an Integrated Rainwater Management Plan for its watersheds to guide stormwater management, with the goal of balancing land use and development planning with environmental concerns. Once these plans are complete, the City should implement recommendations and monitor and review each plan on an ongoing basis to maintain watershed health and reduce the impacts of extreme runoff. Some planning considerations for the plan include:</p> <ul style="list-style-type: none"> • Planning and design approaches such as limits to impermeable surfaces, enhancing the urban tree canopy, land conservation and other low impact development options • Runoff storage and conveyance such as using pocket parks for street runoff, re-routing stormwater to waterbodies, or non-potable water storage/use • Adopt infiltration and detention practices such as green roofs, street infiltration bulges or downspout rock pits • Implement and monitoring and review process for each part of the plan and review on an ongoing basis • Plan for 100-year flood levels using a whole-system, water balance approach 	City of Courtenay Engineering, Public Works, and Recreation and Cultural departments	
2.5 – Initiate localized flood-prone area inventory and risk assessment to guide runoff reduction, flood risk mitigation programs, and to identify vulnerable infrastructure and utilities (e.g., Bridge System 17th & 5th).	<ul style="list-style-type: none"> • LIDAR-based mapping of flood-prone areas across the City and risk assessment to identify areas at a higher risk • Identify vulnerable road infrastructure and target areas for stormwater management • Identify neighbourhoods with higher incidences and/or risk of flooding • Incorporate flood-prone area inventory into municipal planning considerations and explore long-term strategic plans to consider the long term bridge/utility plans 	City of Courtenay Engineering and Development Services departments	

Impact #3: More extreme rainfall events leading to flooding of parks and playgrounds (e.g., Air Park, Lewis Park)			
3.1 – Assess parks in high priority areas and identify opportunities to integrate stormwater management improvements (e.g., Air Park, Lewis Park)	<ul style="list-style-type: none"> • Use localized climate projections and available mapping to identify high risk climate hazard areas • Evaluate park infrastructure for safety risks – with a focus on the natural elements (e.g., tree risk assessment, risk of flooding to natural habitats, etc.) • Evaluate built infrastructure for safety risks (e.g., bridge crossings, boardwalks, trails, light poles, etc.) • Identify areas where green infrastructure (e.g., rain gardens, bioswales, naturalized infiltration basins, permeable pavement, green roofs, rainwater harvesting, stream restoration, etc.) can be implemented to enhance stormwater management 	City of Courtenay Engineering, Planning, and Public Works departments	Conservation groups
Impact #4: More extreme rainfall events causing flooding or washout and failure of road systems (e.g., Dyke/Comox Rd., Headquarters Rd.) & Impact #15: More extreme rainfall events restricting access to critical public infrastructure (e.g. hospitals, transportation, utilities).			
4.1 - Improve communications to the public regarding road conditions and municipal facility closures during extreme weather events.	<ul style="list-style-type: none"> • Explore new ways to improve communication to the public on road conditions and municipal facility closures during extreme weather events. • Develop early warning systems (e.g., sirens, radio ads, text alerts) to be communicated to the public in the face of extreme weather (e.g., flooding). 	City of Courtenay’s Communication department; Royal Canadian Mounted Police; Comox Valley Regional District local emergency services	
4.2 – Develop localized contingency plan that includes procedures in the event of flooding and road closure.	<ul style="list-style-type: none"> • Ensure organizational charts are refined and updated with the appropriate contact information • Develop procedure to close road if flooded • Establish a viable detour route management program 	City of Courtenay Public Works department; Comox Valley Regional District; Ministry of Transportation and Infrastructure	
4.3 – Continue to update flood construction levels as new flood risk and sea level rise data becomes available, and apply the appropriate regulatory tools for widespread City-wide use (e.g., zoning updates/bylaw creation, land-use planning)	<ul style="list-style-type: none"> • Zoning bylaw update to prevent development in floodplain • Land acquisition/managed retreat and abandon road and let it be inundated by sea level rise (with remediation) 	City of Courtenay Legislative services	

<p>4.4 - For frequently flooded roads, consider road improvements (e.g., Dyke/Comox Rd., Headquarters Rd.)</p>	<ul style="list-style-type: none"> • Where possible, interventions that reduce erosion and flood risk using green infrastructure should be considered for their wide array of co-benefits for built, socioeconomic and natural systems. • Other potential grey infrastructure options include constructing a sea wall/dike to protect against flooding along Comox Road 	<p>City of Courtenay Engineering and Public Works departments</p>	
<p>4.5 Conduct a study which analyzes the management options for high risk flood areas (e.g., Dyke/Comox Rd., Headquarters Rd.)</p>	<ul style="list-style-type: none"> • Look at the various options from engineered infrastructure vs. managed retreat • Work with local First Nations (Kus-Kus-Sum) to determine appropriate actions 	<p>City of Courtenay Committee developed between City and stakeholder groups to discuss strategy for future of Comox Rd. (especially considering Kus-kus-sum project may impact this area)</p>	<p>Local First Nations (Kus-Kus-Sum)</p>
<p>Impact #5: Sea level rise leading to coastal inundation (at least 0.5 m by 2050) & Impact #16: Sea level rise and more extreme storm surges flooding and damaging infrastructure (e.g. the airbase, pump stations, dikes, etc.).</p>			
<p>5.1 – Explore “soft armouring” techniques and/or natural infrastructure to replenish or mimic natural buffers (e.g., Green Shores method)</p>	<ul style="list-style-type: none"> • Protect and restore natural wetland habitats along the shoreline through the use of GreenShores planning <ul style="list-style-type: none"> ○ E.g., beach nourishment, planting vegetation, etc. • Other options include: <ul style="list-style-type: none"> ○ Allow for shoreline migration ○ Stabilize sediment and reduce erosion by planting native vegetation ○ Create dunes along the backshore of the beach ○ Create marsh by planting appropriate native species – grasses, sedges, or rushes ○ Use natural breakwaters of oysters to dissipate wave action and protect shorelines • Create new recreation opportunities in restoration areas along the foreshore. 	<p>City of Courtenay Engineering, Recreation (Parks), and Planning</p>	
<p>5.2 – Explore regulatory and planning tools that incorporate sea level rise into planning/design/policy.</p>	<ul style="list-style-type: none"> • Explore land acquisition programs – purchase coastal land that is damaged or prone to damage and use it for conservation purposes. <ul style="list-style-type: none"> ○ Develop a policy mechanism for the acquisition of waterfront property by the City for ‘re-naturalization’ (e.g., Land trusts) 	<p>City of Courtenay Legislative and Corporate Services, Development Services</p>	

	<ul style="list-style-type: none"> • Restrict or prohibit development in erosion zones (e.g., impose special conditions as a condition of a development permit) • Establish/increase shoreline setbacks/buffers <ul style="list-style-type: none"> ○ Could increase mandatory setbacks from the coast, establish setbacks based upon projected shoreline position using calculations of increased flood and/or erosion rates or create a tiered setback system permitting smaller structures with less of a setback and greater setbacks for larger development ○ Could require that development adjacent to the shore leave buffers to provide natural protection to development, while allowing for upland migration of beaches • Preserve habitat for vulnerable species and maintain and restore wetlands • Determine areas where coastal wetlands can act as buffers to storm surge events (e.g., areas of re-naturalization) • Explore foreshore tenure opportunities for the acquisition of land. 		
<p>5.3 – Explore options to harden shorelines with “hard engineering” techniques, if necessary.</p>	<ul style="list-style-type: none"> • Determine where it may be necessary to harden the coast (e.g., areas of existing development or critical infrastructure) • Establish a policy mechanism that limits hard armouring techniques along vulnerable coastlines (where soft armouring techniques would be preferred) • Determine if/where hard armouring techniques (e.g., levees, dikes, and seawalls) would be appropriate solutions to local sea level rise • Determine if/where other engineering options could be suitable (e.g., elevated or floating development) • Collaborate with neighbouring municipalities to research and explore ways of planning for sea level rise in capital budgets 	<p>City of Courtenay Engineering and Public Works; Developers/Builders; Architects</p>	
<p>5.4 – Conduct local sea-level rise and storm surge modeling to inform the placement and protection of critical infrastructure (e.g. Coastal Hazard Mapping).</p>	<ul style="list-style-type: none"> • Create an updated floodplain map for the Courtenay area • Conduct a vulnerability and risk assessment to identify critical infrastructure and low-lying neighbourhoods vulnerable to sea level rise • Determine and target actions to high risk neighbourhoods • Develop an action strategy for reducing risk in the prioritized areas 	<p>City of Courtenay Engineering, Planning</p>	

<p>5.5 – Increase and improve public awareness of coastal vulnerability to climate change and sea level rise and foster action through education, outreach and involvement</p>	<ul style="list-style-type: none"> • Encourages support for local government and regional policy and planning mechanisms that aim to reduce the risk of sea level rise and coastal inundation • Increase public awareness about the impacts of sea level rise in order to enhance the personal preparedness of community members • Target awareness campaigns to the most vulnerable coastlines in the City and share opportunities to participate in municipal home retrofit and habitat restoration programs 	<p>City of Courtenay Legislative and Corporate Services (Communications)</p>	
<p>5.6 - Explore economic mechanisms that promote landowner coastal protection, restoration, and/or retrofit activities.</p>	<p>Examples of potential economic mechanisms that could be used:</p> <ul style="list-style-type: none"> • Conservation easements are an example of tax incentives – whereby, tax deductions are offered to landowners who donate an easement on their land “exclusively for conservation purposes” • Relocation/retrofit tax incentive – a one-time tax credit to landowners who move structures out of at-risk areas or retrofit structures to be more resilient to flooding • Tax credits could also be used when landowner exceeds to minimum standards required by existing ordinances (e.g., minimum required set backs) • Conservation tax incentives – landowners who donate easements would be assessed lesser property taxes based up the loss of value 	<p>City of Courtenay Legislative and Corporate Services</p>	
<p>Impact #6: More extreme rainfall events affecting biodiversity, soil water content, and native species, creating new opportunities for invasive species.</p>			
<p>6.1 - Enhance and protect Courtenay’s biodiversity from climate change impacts through managing invasive species, protecting rare and endangered species, and sensitive ecosystems on City owned and managed land.</p>	<ul style="list-style-type: none"> • Continue using the municipal park system and EDPAs to protect sensitive ecosystems • Explore the potential expansion of protected areas across the City (and region) based on the identification of refugia • Implement actions identified to protect biodiversity through the Urban Forest Strategy, including but not limited to: <ul style="list-style-type: none"> ○ Identify plants and ecosystems vulnerable to climate change and develop management strategies to help mitigate impacts. ○ Implement mitigation strategies related to climate change impacts on marine shorelines 	<p>City of Courtenay Development Services (Planning); Comox Valley Regional District; Environmental NGOs</p>	

	<ul style="list-style-type: none"> ○ Explore the potential to complete a Green Shores shoreline restoration project ○ Identify marine shorelines within the parks system that are vulnerable to climate change impacts and develop mitigation strategies ● Take a landscape approach to regional conservation of sensitive ecosystems that may not be captured within the City’s jurisdiction 		
6.2 - Strengthen regulations and rules that prevent the introduction and spread of invasive species	<ul style="list-style-type: none"> ● Regulate the sale of invasive species at local nurseries ● Mandate the use of certified clean fill for new developments/landscaping projects, etc. ● Minimize land clearing activities that provide an opportunity for invasive plants to colonize ● Perhaps strengthen/update the Regional District Weed Control Regulation Bylaw “Regional District Weed Control Regulation Bylaw 2001” 	City of Courtenay Legislative and Corporate Services; Private business; Comox Valley Regional District	
6.3 – Develop a strategic maintenance and control management plan for invasive species within the City (using an ecosystem-based management approach).	<ul style="list-style-type: none"> ● Continue to manage invasive species, including staying up to date on new and emerging risks. <ul style="list-style-type: none"> ○ Conduct an inventory of invasive species and emerging threats ● Consider conducting an invasive species risk assessment and prioritize management based on risk ● Work across jurisdictional boundaries with local government partners and environmental non-government organizations 	City of Courtenay Parks department; Comox Valley Regional District	
6.4 - Develop a Park and Development Acquisition Strategy, develop and maintain a list of priority park land acquisitions. Coordinate with the Local Area Plan process.	<ul style="list-style-type: none"> ● Proactively identify priority areas for park acquisition, particularly land that has ecological values and sensitive ecosystems or species; sites that will enable informal uses such as socializing and picnicking; sites identified in local area plans and in park deficient neighbourhoods; sites needed for community allotment gardens; lands necessary to daylight culverted streams; lands required to fill gaps in the Greenways Plan, etc. ● Continue to identify and implement alternative land procurement approaches ● Engage with developers to identify new opportunities for park acquisition and procurement options 	City of Courtenay Development Services (Planning); Parks/Recreation	

<p>6.5 - Increase native plantings on City owned and managed land.</p>	<ul style="list-style-type: none"> • Increase the variety of native plant species planted in parks and open spaces (considering all areas, including hanging baskets, plazas and gardens) • Increase the proportion of native ecosystems in the parks and open spaces system; and restore native ecosystem areas that are currently degraded. • Identify opportunities to expand renaturalization beyond garden beds • Develop community education and stewardship programs focused on native ecosystem condition requirements and species 	<p>City of Courtenay – Parks & Public Works</p>	
<p>Impact #7: More extreme rainfall events impacting water quality and drinking water supply (e.g., contamination from septic fields, turbidity in Comox Lake, erosion, sedimentation, etc.); Impact #17: More extreme rainfall events creating water quality issues due to increased erosion and sediment challenges. & Impact #18: Sea level rise impacting groundwater quality and increasing brackish waters.</p>			
<p>7.1 - Continue to work with Comox Valley Regional District and municipal neighbours in taking an integrated watershed management approach to our waterways and land use.</p>	<ul style="list-style-type: none"> • Support and participate in existing integrated watershed management groups • Talk to contemporaries in other municipalities to identify ongoing projects and future opportunities for integrated watershed management • Develop baseline data and indicators of baseline watershed health (e.g., measuring physical, chemical and biological characteristics of the watershed) <ul style="list-style-type: none"> ○ E.g., groundwater quality parameters, soil moisture content, total surface water area, stream flow, evaporation/evapotranspiration • Identify and prioritize areas from within the watershed that are a source of water quality and quantity issues (e.g., contamination from septic fields, turbidity in Comox Lake, erosion, sedimentation, etc.) <ul style="list-style-type: none"> ○ Assessment of the vulnerability of water quality and quantity to climate change for the Comox Lake watershed and subbasins (e.g., K'ómoks Estuary, Puntledge River watershed, Perseverance Creek watershed, Beech Creek watershed, etc.) ○ Explore opportunities for adaptation actions such as zoning, education, maintenance bylaws for onsite sewage disposal system, and/or restrict activity within watershed • Implement a water quality monitoring program within the watershed to measure and evaluate the progress 	<p>Comox Valley Regional District; City of Courtenay Development Services (Planning); Engineering; Public Works</p>	<p>Local conservation organizations (specify – e.g., Comox Valley Project Watershed Society)</p>

Impact #8: More extreme rainfall events accelerating loss of fish habitat and impacting population count.			
8.1 - Update watershed mapping by measuring the percent cover of impervious versus pervious surfaces within the watersheds within the City of Courtenay (moving target)	<ul style="list-style-type: none"> Determine where reductions in pervious surfaces have occurred within the watershed Identify areas with high surface area of impervious surfaces and target educational campaigns, incentive programs, re-vegetation projects, etc. in these areas 	City of Courtenay Development Services (Planning)	Comox Valley Project Watershed Society
8.2 – Develop an operations and maintenance protocol to ensure the ongoing protection and function of existing biofiltration wetlands	<ul style="list-style-type: none"> Conduct an annual assessment to evaluate if the biofiltration wetlands are functioning as they are meant to (if not, provide necessary maintenance) Require developers to put up a bond for maintenance on new developments that require the installation of wetland detention ponds. 	City of Courtenay Public Works, Legislative and Corporate Services; Developer	
8.3 – Identify priority subbasins to target habitat restoration efforts for enhancing fish habitat within the watershed.	<ul style="list-style-type: none"> Determine characteristics of watershed subbasin in order to guide restoration activities (e.g., drainage area, percent area logged, percent area clearcut, identify watershed type, riparian/channel/habitat conditions, and the fish target species) Identify areas contributing to the deterioration of fish habitat (e.g. hillslope, riparian, and channel components impacting fish habitat) Use the above two points to estimate the impact on fish habitat of each component (i.e., level of existing or potential disturbance) <p>Establish the primary component of habitat to be restored within identified watershed subbasins (e.g., instream, riparian) and identify appropriate restoration activities</p>	City of Courtenay Development Services (Planning)	Comox Valley Project Watershed Society; CVLT, Morrison Streamkeepers, CVCP, Tsolum River
8.4 - Daylight sections of culverted streams where opportunities exist to increase infiltration, reduce peak flows, and filter out urban pollutants (e.g., nitrogen, phosphorous).	<ul style="list-style-type: none"> Identify areas where this could be done. Some considerations for siting daylighting projects include: <ul style="list-style-type: none"> Sufficient width/area to build out the channel (e.g., space required to include gentle slopes) Look to site in less densely populated areas as built infrastructure will like pose constraints on the project (unless part of a larger economic revitalization effort) Establish partnerships with neighbouring municipalities where streams cross jurisdictional boundaries (if necessary) 	City of Courtenay Engineering, Public Works, Development Services (Planning); Comox Valley Regional District; other local governments (e.g., Town of Comox?)	ENGO's (e.g., Project Watershed, Morrison Creek Streamkeepers, etc.)

	<ul style="list-style-type: none"> Develop understanding of underlying soil types and channel material to ensure proper project design based on site conditions <p>Establish appropriate monitoring and maintenance programs to ensure that the channel and bank are stable and riparian plantings are established</p>		
8.5 – Initiate water quality pilot project to mitigate and filter contaminants from entering sensitive fish habitat.	<ul style="list-style-type: none"> Install stormwater filtration systems that filter contaminants through sand and soil layer such as in the Puget Sound (not just oil and water separators) 	City of Courtenay Engineering, Public Works	Project Watershed or other stream keeper groups
8.6– Protect fish habitat by creating more channel sinuosity in streams that have been channelized by adding natural features (e.g., sediment deposits, logs, large rocks) to slow water down and create spawning areas.	<p>Integrating the management of coarse woody debris can provide a source of food, water, shelter, and cover to a wide array of wildlife (including salmon) while simultaneously storing carbon, retaining moisture, providing a slow release of nutrients to surrounding ecosystem, and enhancing soil structure and stability.</p> <ul style="list-style-type: none"> Fully integrate coarse woody debris management into the stewardship of Courtenay’s natural areas <ul style="list-style-type: none"> CWD levels should be representative of the seral stage and type of ecosystem Establish coarse woody debris standards and integrate coarse woody debris management with other natural area management programs Work with environmental organizations to facilitate restoration and outreach activities on city-owned and private land <p>Strengthen municipal bylaws, implement access restrictions, and public education initiatives to deter the unauthorized removal of CWD</p>	City of Courtenay; Comox Valley Regional District; neighbouring municipalities (e.g., Town of Comox); DFO Oceans Habitat and Enhancement Branch	Local environmental consultants and streamkeeper groups (e.g., Brooklyn Creek Watershed Society, Comox Valley Conservation Strategy, Project Watershed, Tsolum River Restoration Society)
8.7 - Identify opportunities to reconnect the natural floodplain thereby dissipating floodwaters and associated impacts to fish and fish habitat and creating connectivity of habitat for fish	<ul style="list-style-type: none"> Examples of where this can be explored include Dyke road breach, Hwy 19A box culverts, Lewis Park connection to the Courtenay slough, Glen Urghuart Creek / superstore complex drainage (less water down the Courtenay River) <p>Prioritize the implementation of projects that reconnect the flood plain on a primary basis</p>	Comox Valley Project Watershed Society; City of Courtenay Development Services (Planning), Public Works, Engineering; Consultants	Northwest Hydraulic Consultants
8.8 – Create aquatic connectivity between lakes, rivers, and wetlands within the City of Courtenay to allow for safe fish migration and passage up and down stream.	<ul style="list-style-type: none"> Conduct upgrades to existing culverts that do not provide suitable habitat for fish to be replaced with upgraded, fish-friendly culverts and/or baffles to slow water etc. Identify culverts that provide barriers to fish migration (e.g., hanging culvert on 10th St., culver on Back Rd.) 	City of Courtenay Engineering and Public Works; Consultants; Ministry of Transportation and Infrastructure?	Project Watershed

	<ul style="list-style-type: none"> • General considerations: <ul style="list-style-type: none"> ○ Permanent rd. versus seasonal (traffic load) ○ Opening size required to pass the design flood (e.g., 100-year) ○ Unique site conditions • Design considerations: <ul style="list-style-type: none"> ○ Water velocity and depth ○ Timing of installation (to minimized flow interruption and disturbance of fish during sensitive seasons) <p>Type of culvert (perched, “normal”, or open-bottom)</p>		
Impact #9: More extreme rainfall events and sea level rise causing erosion and soil instability (less water retention in dry soils).			
9.1 – Monitor and manage coastal erosion on City owned and managed lands.	<ul style="list-style-type: none"> • Conduct study of coastal erosion along shoreline • Develop a coastal erosion master plan based on findings of the study • Undertake work in areas identified, prioritizing naturalization where possible <p>Continue using the Green Shores method to repair shoreline erosion</p>	City of Courtenay Engineering, Development Services	
9.2 - Implement stronger regulatory mechanisms to increase shoreline, marine, and riparian habitat protection.	<ul style="list-style-type: none"> • Strengthen Environmental Development Permit Areas • Prioritize habitat protection for federally and provincially listed species at risk <p>Mandate the protection of 30 m of riparian habitat of all urban streams now and grandfathered properties/industrial areas</p>	City of Courtenay Development Services, Legislative and Corporate Services	
9.3 – Explore the opportunities for regional land acquisition in areas vulnerable to erosion (e.g., coastal areas and steep sloped-riparian areas).	<ul style="list-style-type: none"> • Work with Comox Valley Regional District to explore opportunities beyond the jurisdictional boundaries of the City <p>Collaborate with other local partners to incentivize and look for opportunities to create land trusts and conservation covenants in sensitive areas</p>	City of Courtenay Development Services; Comox Valley Regional District	Comox Valley Land Trust
9.4 – Incorporate a resilience lens into natural asset management planning	<ul style="list-style-type: none"> • Continue exploring this through the Comox Lake Watershed natural asset management project <p>Continue working with this watershed- scale, multi-stakeholder project to better understand how to measure, protect, and enhance the habitats within the watershed</p>	City of Courtenay Asset Management; Consultant (Making Nature Count)	
Impact #10: More extreme rainfall events negatively affecting the urban forest (e.g., wind combined with saturated soils).			
10.1 – Improve rainwater uptake and infiltration by enhancing the resilience of the urban tree	<ul style="list-style-type: none"> • Establish targets for tree canopy cover, impermeable surfaces and planting opportunities across the city 	City of Courtenay Development Services	

<p>canopy to climate change through implementation of priority actions in the City's Urban Forest Strategy.</p> <p>*tie in with impact N.9: More extreme rainfall events negatively affecting the urban forest (e.g., wind combined with saturated soils).</p>	<ul style="list-style-type: none"> • Continue to review and update of the Tree Preservation Bylaw and create material to clarify the new requirements. • Conduct an inventory of the risks to the stands that are to be retained within the Urban Forest Strategy as a priority for inventorying • Develop and implement a citizen stewardship plan to increase citizen involvement in the management of the urban forest • Work with the Engineering Department to explore how to use the urban forest to achieve stormwater management plan objectives and vice-versa • Explore incentive mechanisms for retaining tree cover and vegetation on private land and to plant (native) shrubs and tree species <ul style="list-style-type: none"> ○ E.g. economic mechanisms (tax breaks, non-compliance fines) ○ Enhance tree protection by law 	<p>(Planning), Parks/recreation, Engineering; Stewardship organizations; Coastal Douglas-fir Community Partnership</p>	
<p>Impact #11: More extreme rainfall events impacting emergency management response and vulnerable populations in particular.</p>			
<p>11.1 - Ensure emergency response capacity keeps pace with the need for services, given the increasing climate impacts.</p>	<ul style="list-style-type: none"> • Schedule annual mandatory exercises to ensure adequate knowledge of Emergency Operations Centre operations • Coordinate specialized training for responders (e.g., CoastSmart, Adventure Smart) • Engage with community and regional stakeholders to identify duties, responsibilities, and response protocols strengthening collaboration and coordination • Collaborate with neighbouring communities to establish mutual aid agreements in event of isolation due to flooding 	<p>Comox Valley Regional District; Comox; Cumberland; Other emergency support (e.g., coast guard)</p>	<p>Emergency services (e.g., fire, ambulance, etc.)</p>
<p>11.2 – Develop public education campaign and communications to reduce safety and health risks for vulnerable populations in the face of climatic impacts (e.g., flooding).</p>	<ul style="list-style-type: none"> • Work with local partners to increase the awareness of risks and to provide the community with response information. • Target emergency preparedness efforts and communications to high-risk areas, ensuring vulnerable populations are reached • Continue to engage with residents and community service providers about personal preparedness and critical service delivery 	<p>Comox Valley Regional District; City of Courtenay Legislative and Corporate Services (ie. Comms department)</p>	
<p>Impact #12: More extreme rainfall events affecting business continuity and service delivery in commercial areas.</p>			
<p>13.1 – Continue to build community and business capacity to respond effectively in an emergency</p>	<ul style="list-style-type: none"> • Encourage businesses to review and update Business Continuity Plans • Use public education campaigns to establish a greater awareness of risk area 	<p>Emergency Services; City of Courtenay Legislative and Corporate Services</p>	<p>Comox Valley Chamber of Commerce;</p>

	<ul style="list-style-type: none"> • Create and promote opportunities for small businesses to learn about emergency management • Promote “neighbours helping neighbours” approach 	(Communications department)	
Impact #13: Sea level rise and more extreme rainfall events impacting cultural sites (e.g., village sites, burial sites, places with significant artifacts).			
13.1 – Work with local First Nations to develop an inventory of cultural sites (e.g., village sites, burial sites, places with significant artifacts) vulnerable to sea level rise and coastal flooding.	<ul style="list-style-type: none"> • Work with local First Nations to explore culturally appropriate options to mitigate the impacts of sea level rise on cultural sites • Research funding opportunities to support First Nations capacity building with regard to the implementation of climate adaptation actions, in a culturally meaningful way <p>Partner with local First Nations to establish opportunities to build public awareness of the importance of cultural sites to traditional cultures</p>	City of Courtenay (Parks, Recreation, and Culture); local First Nations	
Impact #14: More extreme rainfall events causing flooding or washout and failure of road system (e.g. Dike/Comox Rd, Headquarters Rd.). x			
14.1 - Complete upgrades to Comox Valley Water Treatment system (to buffer significant deterioration in source water quality during storm events)	<ul style="list-style-type: none"> • To be completed by Sept 2021 	Comox Valley Regional District	

References

- Bales, S., Sweetland, J., Volmert, A. (2015). How to talk about climate change and the ocean: Prepared for the National Network for Ocean and Climate Change Interpretation with support from the National Science Foundation. Washington, DC: FrameWorks Institute.
- British Columbia Ministry of Environment. (2013). Sea level rise adaptation primer: A toolkit to build adaptive capacity on Canada's south coasts. Prepared by The Arlington Group Planning + Architecture Inc., EBA, a Tetra Tech Company, DE Jardine Consulting, & Sustainability Solutions Group. Retrieved from <https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/resources/slr-primer.pdf>
- Corner, A., Lewandowsky, S., Phillips, M. and Roberts, O. (2015) The Uncertainty Handbook. Bristol: University of Bristol
- International Panel on Climate Change. (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the IPCC [R.K. Pachauri & L.A. Meyer (Eds.)], pp. 1-151. Geneva, Switzerland: IPCC. Retrieved from <https://archive.ipcc.ch/report/ar5/syr/>
- International Panel on Climate Change. (2018). Summary for Policymakers. In V, Masson-Delmotte, P. Zhai, H.O. Pörtner, D. Roberts, J. Skea, P. R. Shukla, ... T. Waterfield (Eds.), Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, pp. 1-24. Geneva, Switzerland: World Meteorological Organization.
- Lemmen, D.S. and Warren, F.J. (2016). Synthesis. In D.S. Lemmen, F.J. Warren, T.S. James and C.S.L. Mercer Clarke (Eds.), Canada's Marine Coasts in a Changing Climate, p. 17-26. Ottawa, ON: Government of Canada.
- Richardson, K., Steffen, W., & Liverman, D. (2012). Climate change: Global risks, challenges, and decisions. Cambridge, United Kingdom: University Printing House.
- Vadeboncoeur, N. (2016): Perspectives on Canada's West Coast region; in Canada's Marine Coasts in a Changing Climate, (ed.) D.S. Lemmen, F.J. Warren, T.S. James and C.S.L. Mercer Clarke; Government of Canada, Ottawa, ON, p. 207-252.