

Climate Plan Update: Resilient Saanich

Risk Assessment Report

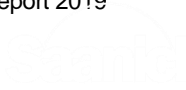


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1. Introduction

Undertaking a vulnerability and risk assessment is a common approach to exploring climate impacts and helping to define the higher priority directions in the development of a climate adaptation strategy. The outcomes from these assessments reflect our current understanding of present conditions and anticipated projections, and should be repeated periodically as new or changing impacts come to light, as climate science evolves, and as our capacity to respond changes over time.

As part of the adaptation component of the Climate Plan Update, District Staff convened two sessions in 2018 to develop a list of climate impacts, and to evaluate the severity of these impacts through a vulnerability and risk assessment. Overall, the risk assessment showed there to be no climate risks rated as very high or extreme. Impacts with the highest risk ratings are those related to ecosystems, which have a high certainty of occurring and significant consequences in terms of their permanence and implications for humans and biodiversity alike.

2. Methodology

Development of Impact Statements

A list of climate impacts was developed through a workshop with 15 District staff. In the workshop, local climate projections for temperature and precipitation, sea level rise, and wind were presented from the following sources:

- Capital Regional District *Climate Projections for the Capital Region Report* (Pacific Climate Impacts Consortium and Pinna Sustainability, 2017);
- Province of BC Flood Hazard Area Land Use Management Guidelines (2017); and,
- Cheng *et al.*, *Possible Impacts of Climate on Wind Gusts Under Downscaled Future Climate Conditions: Updated for Canada* (2014)

Staff were asked to consider how these climatic changes would translate into impacts across 11 sectors, considering the ways in which both the community would be affected, as well as municipal operations. The 11 sectors were: land use, buildings, transportation and mobility, energy supply, ecosystems, infrastructure, health, emergency response, waste, consumption, and agriculture and food.

The outcomes from this exercise were consolidated and refined into 57 impact statements that described the climate driver and its impact (e.g. “drier summers increasing risk of wildfire to buildings and infrastructure”) in four sector areas: infrastructure, agriculture and land use, ecosystems, and health and safety.

Vulnerability Assessment

Vulnerability, or the degree to which a system is susceptible to the impacts of climate change, is a function of both sensitivity and adaptive capacity. Sensitivity is defined as the degree to which a system is affected by climatic conditions (e.g. temperature increases) or a specific climate change impact (e.g. increased flooding). Adaptive capacity is defined as the ability of built, natural and social systems to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

$$\text{Vulnerability} = \text{Sensitivity} \times \text{Adaptive Capacity}$$

An online vulnerability assessment was conducted via a survey that asked both staff and key stakeholders to review the impact statements and evaluate the community's sensitivity and adaptive capacity to respond. The intent of the online vulnerability assessment was to:

- Employ a first filter to remove any impact statements that were evaluated as being very low vulnerability
- Have staff and stakeholders carefully review the impact statements and identify any areas needing modification or missing impacts

As a result of the vulnerability assessment, two low vulnerability impacts were removed, two new impacts statements were added, and 15 impacts were modified or combined. Participants ranked the community severely vulnerable to 21% of the impacts, assigned a 'major' vulnerability score to 46% of the impacts, and rated the community moderately vulnerable to 32% of the impacts.

Of the impact statements that were rated severely vulnerable, all but three were in relation to ecosystem and biodiversity impacts. Other areas with severe vulnerability ratings included risk of wildfires and health impacts from smoke, and impacts to buildings and infrastructure from sea level rise.

Risk Assessment

Risk is defined as the likelihood or probability that an event will occur, multiplied by the event's consequences. The risk assessment was undertaken in a half-day workshop format with 35 staff and stakeholders and support from ICLEI-Canada staff. Stakeholders that attended represented diverse organizations from various sectors, including:

$$\text{Risk} = \text{Likelihood} \times \text{Consequence}$$

- Island Health
- FortisBC Gas Utility
- BC Ministry of Agriculture
- BC Ministry of Transportation
- BC Climate Action Secretariat
- Emergency Management BC
- Archipelago Marine Research
- Quadra Cedar Hill Community Association
- Mount Tolmie Community Association
- Gorge Tillicum Community Association
- BC Healthy Communities

- Vancouver Island Economic Alliance
- Capital Region Food and Agriculture Initiatives Roundtable (CRFAIR)
- Madrona Farm
- Haliburton Community Organic Farm
- University of Victoria
- Capital Regional District

Prior to the workshop, a likelihood score was assigned to each impact using the following rubric:

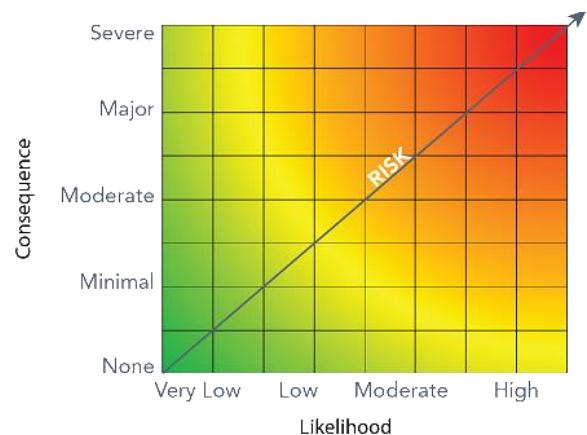
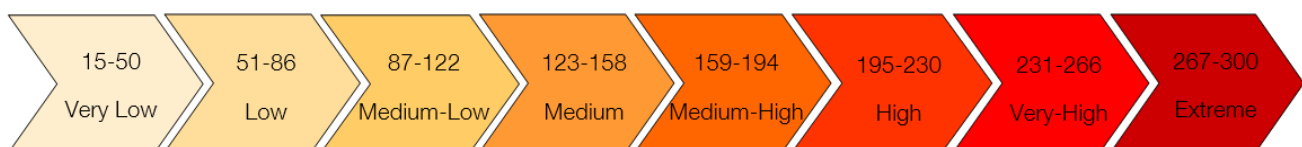
Likelihood Rating	Recurrent Impact	Single Event
Almost Certain (5)	May occur in most circumstances, several times per year	>90% chance of occurring by 2050
Likely (4)	May occur in most circumstances, about once per year	51-90% chance of occurring by 2050
Possible (3)	May occur once in 10 years	21-50% chance of occurring by 2050
Unlikely (2)	May occur once in 10 - 25 years	1-20% chance of occurring by 2050
Rare (1)	Unlikely to occur during the next 25 years	<1% change of occurring by 2050

Staff and stakeholders were arranged in small groups based on their expertise in one of four sectors: infrastructure, agriculture and land use, ecosystems, and health and safety. In most cases, there were two different groups reviewing each sector, so that each impact could be evaluated by independent groups and consistency between the ratings could be reviewed after the workshop.

For each impact statement that the groups were assigned, they were asked to first review the likelihood rating and make any modifications based on their expertise; they then assessed the consequences of the impact occurring across the following 12 criteria:

- Social consequences: public health and safety, displacement, loss of livelihood, cultural aspects;
- Economic consequences: property damage, local economy and growth, community liveability, public administration; and,
- Environmental consequences: air, water, soil and vegetation, ecosystem function.

For each subcategory (e.g., air) a score out of five was given where one was negligible and a five was a catastrophic consequence. These scores were then tallied and multiplied by the likelihood score to determine an overall risk score according the following rating system:



3. Risk Assessment Results

Highest Risk Impacts

Through the risk assessment process, there were no impacts that were rated as very high or extreme in terms of risk. Of the risks that were rated high and medium-high, all but two were related to ecosystem impacts, which have a fairly high certainty of occurring and significant consequences in terms of the permanence and implications of the changes. Two medium-high risks were identified under the health and safety theme, and the impacts under the remaining themes (land use and agriculture, and infrastructure) were identified as having medium risk ratings or lower.

Risk Rating	Number of Impacts
High	3
Medium-High	7
Medium	12
Medium-Low	12
Low	12
Very Low	4

Existing systems and capacities were considered as part of the evaluations; for example, current emergency preparedness measures that can reduce the likelihood of a particular impact and/or response protocols which can affect the consequences were taken into account. The outcomes of the risk assessment indicates that, while there are certainly climate change factors to integrate within our planning and processes, the foundational systems for dealing with these issues are already in place in many cases, the possible exception to this being the management of ecosystems.

The following summarizes the impacts with a medium risk rating or higher, by sector:

Ecosystem Impacts

- Increased average temperatures and drier summers causing native species to be stressed, affecting biodiversity and creating new opportunities for invasive species [high risk]
- Increased average temperatures causing ecological regime shifts (i.e. “what is a native plant?”) [high risk]
- Rising sea levels causing habitats to shift landward with risk of loss due to coastal squeeze, increased wave action, erosion, soil salinization and other stressors [high risk]
- Increased average temperatures and drier summers reducing groundwater recharge and affecting water quality [medium-high risk]
- More frequent and intense heat waves causing warmer temperatures in streams, decreasing water quality and impacting fisheries [medium-high risk]
- Drier summers turning wetlands turning into drier ecosystems (e.g. swamp to seasonal wetland) [medium-high risk]
- More frequent and intense rainfall events causing saturated soils, with impacts on natural bio-filtering and storage capacity (including water quality and flooding risks) [medium-high risk]

- Increased drought causing increased tree mortality rate and change in urban forest composition [medium-high risk]
- Increased average temperatures increasing pests and diseases (e.g. emerald ash borer), resulting in loss of species [medium risk]
- More frequent and intense rainfall events causing streams to be inundated, increasing erosion, sediment loads, and contaminants in water courses due to volume of storm water runoff [medium risk]
- Increased wind and storm events causing more deadwood for fire threat, and less biomass to reduce wind impacts [medium risk]

Health and Safety Impacts

- Hotter, drier summers and increased wildfires causing poor air quality and impacting health (e.g. asthma-related illnesses from smoke or humidity) [medium-high risk]
- Increased average temperatures and extreme weather, impacting lifestyle [medium-high risk]
- Increased average temperatures and drier summers increasing wildland/interface fires in Saanich [medium risk]

Land Use and Agriculture Impacts

- Coastal inundation and overland flooding reducing the availability and use of low-lying land areas [medium risk]
- Rising sea level increasing the impacts of tsunami inundation zones and risks to more properties in Saanich [medium risk]
- Drier summers increasing topsoil erosion, pests and invasive species, leading to higher agricultural inputs, and compromising food production potential and quality [medium risk]
- Increased flooding in spring and drought in summer causing shifts in viable crops [medium risk]

Infrastructure Impacts

- Sea level rise and storm surges causing flooding and damage to coastal infrastructure (e.g. drainage, transportation, buildings) [medium risk]
- Increased extreme weather events causing disruption and delays in transportation network (e.g. storms, smoke, heavy rainfall delaying flights, ferries, etc.) [medium risk]
- Increased extreme weather events causing impacts to natural ecosystems and biodiversity, compromising capacity of green infrastructure and ecosystem services [medium risk]
- Increased extreme weather events (heat waves, air quality advisories, heavy rainfall, storms) affecting active transportation [medium risk]



Level of Agreement

Most impacts were rated by two groups during the risk assessment workshop, providing a mechanism to review the level of consistency and consensus on the assigned risk. For impact statements that had high discrepancies between the two assigned risk ratings (low level of agreement), further work was done to verify the appropriate likelihood and consequence ratings and bring the two ratings to a high degree of agreement. In most cases, the discrepancy was due to one group having amended the likelihood rating, though in some cases there were differing perceptions of consequences as well.

Impact statements that were given the same rating or one risk rating difference were considered to have very high and high levels of agreement respectively. This level of agreement was deemed acceptable. A differential of two levels in the risk rating (e.g. medium and high) was considered to have a moderate level of agreement, a differential of three levels (e.g. medium and very-high) was considered to have a low level of agreement, and so on. The assessments with a moderate level of agreement or lower were reviewed to understand the different perspectives and come to consensus on an appropriate risk rating. Once a high or very high level of agreement was reached for all impacts, the higher risk rating was adopted where there was a differential between the two groups.



Summary of Level of Agreement

- 25 risk ratings had high or very high level of agreement
- 4 risk ratings had a moderate level of agreement
- 5 risk ratings had a low or very low level of agreement
- 16 impact statements were evaluated by only one group
- 1 impact statement was not evaluated by any group

Level of Agreement by Climate Driver

There was a relatively high level of agreement on the risk of extreme weather events, wind and storm events and rainfall. There appeared to be less certainty on the risks associated with drought, sea level rise, wildfire and heat.

	Extreme Weather	Wind and Storm	Drought	Rainfall	Sea Level Rise	Wildfire	Heat
High	56%	40%	29%	56%	50%	33%	52%
Moderate	22%	0%	7%	0%	17%	33%	0%
Low	0%	0%	21%	0%	17%	33%	19%
N/A (rated by one group only)	22%	60%	43%	44%	17%	0%	29%

Level of Agreement by Sector

Overall, there was a very high level of agreement within the health and safety theme, but more variation in terms of agreement in the other areas.

Level of Agreement on Risk Rating	Infrastructure	Ecosystems	Land Use and Agriculture	Health and Safety
High	46%	38%	25%	71%
Moderate	23%	0%	0%	6%
Low	0%	15%	25%	6%
N/A (rated by one group only)	31%	46%	50%	18%

4. Conclusion

The risk assessment process provided a systematic approach to analyzing risk and comparing the relative risk ratings of various impacts across sectors. Involving a variety of stakeholder organizations and staff ensured we gained insights from different experts and perspectives and considered both operational risks as well as those posed to the community at large.

A risk assessment represents a “snapshot in time”, and as such, there is a recognition that our understanding of risk will change as climate science evolves and new impacts or risks come to light, and that our resources and capacity will similarly change over time. The outcomes of this risk assessment are intended to provide a touch point upon which to review the proposed adaptation actions developed in the next phase of the project and ensure that there are not gaps, that the levels of effort and actions are in general alignment with the risk ratings, and to provide a tool to help prioritize actions and hone messaging going forward.

We thank all the individuals and organizations that have dedicated their time and expertise to the risk assessment process, and the development of the Climate Plan more broadly.



Appendix A: List of Impact Statements by Sector

Sector	Impact #	Impact Statement
Infrastructure	1	Increased extreme weather events (heat waves, air quality advisories, heavy rainfall, storms) affecting active transportation.
	2	Drier summers increasing risk of wildfire to buildings and infrastructure.
	3	More frequent and intense rainfall events causing increased sewage inflow and infiltration, sewage backups and overflow at pump stations.
	4	Sea level rise and storm surges causing flooding and damage to coastal infrastructure (e.g., drainage, transportation, buildings).
	5	More frequent and intense rainfall events causing increased overland flooding.
	6	Increased extreme weather events causing disruption and delays in transportation network (e.g. storms, smoke, heavy rainfall delaying flights, ferries, etc.)
	7	Increased extreme weather events causing impacts to natural ecosystems and biodiversity, compromising capacity of green infrastructure and associated ecosystem services.
	8	Hotter, drier summers causing water demand to exceed supply due to increased residential and agricultural consumption
	9	Hotter summer temperatures causing strain on infrastructure (e.g. road buckling, steel expansion, power lines, lift stations).
	10	Warmer summer temperatures and more intense heat waves causing buildings to overheat and/or increasing demand for air conditioning.
	11	Hotter summer temperatures decreasing efficiency of transmission systems, leading to electricity disruptions.
	12	Increased wind and storm events causing more power outages and disruption to critical infrastructure (e.g. telecommunications systems.)
	13	Increased wind and storm events causing damage to buildings.
Ecosystems	14	Increased average temperatures and drier summers reducing groundwater recharge and affecting water quality.
	15	More frequent and intense heat waves causing warmer temperatures in streams, decreasing water quality and impacting fisheries.
	16	Increased average temperatures and drier summers causing native species to be stressed, affecting biodiversity and creating new opportunities for invasive species.
	17	Increased average temperatures causing soils to become dried out more and for longer durations, affecting annual recovery of soil biota. [NOTE: This impact statement was removed as it was considered a duplicate of #16 in the risk assessment]
	18	Increased average temperatures causing ecological regime shifts (i.e. “what is a native plant?”).
	19	Drier summers turning wetlands into drier ecosystems (i.e. swamp to seasonal wetland).
	20	Rising sea levels causing habitats to shift landward with risk of loss due to coastal squeeze, increased wave action, erosion, soil salinization and other stressors.

	21	Increased average temperatures increasing pests and diseases (e.g. emerald ash borer), resulting in a loss of species.
	22	Drier summers impacting access to water by wildlife, affecting reproduction rates and biodiversity.
	23	More frequent and intense rainfall events causing streams to be inundated, increasing erosion, sediment loads, and contaminants in water courses due to volume of storm water runoff.
	24	More frequent and intense rainfall events causing saturated soils, with impacts on natural bio filtering and storage capacity (including water quality and flooding risks).
	25	Increased wind and storm events causing more deadwood for fire threat, and less biomass to reduce wind impacts.
	26	Increased drought causing increased tree mortality rate and change in urban forest composition
Land Use and Agriculture	27	Rising sea level increasing the impacts of tsunami inundation zones and risks to more properties in Saanich.
	28	More frequent and intense heat waves causing urban heat islands concentrated in dense areas.
	29	Coastal inundation and overland flooding (both temporary and permanent), resulting in a loss of agricultural land and decreased production.
	30	More frequent and intense heat waves, combined with more intense drought, leading to crop failure.
	31	Coastal inundation and overland flooding reducing the availability and use of low-lying land areas.
	32	Drier summers increasing topsoil erosion, pests and invasive species, leading to higher agricultural inputs, and compromising food production potential and quality.
	33	Increased average temperatures creating a longer growing season, shifting seasonal growth patterns and crops used.
	34	Increased flooding in spring and drought in summer causing shifts in viable crops.
Health and Safety	35	Hotter, drier summers and increased wildfires causing poor air quality and impacting health (e.g. asthma-related illnesses from smoke or humidity).
	36	Increased average temperatures and drier summers increasing wildland/interface fires in Saanich.
	37	Increased average temperatures and more frequent and intense rainfall events increasing vector borne diseases, impacting population health.
	38	Increased average temperatures and extreme weather, impacting lifestyle.
	39	More frequent and intense heat waves increasing health issues, particularly for vulnerable populations.
	40	More frequent and intense heat waves limiting access to outdoor amenities and recreation and reducing physical activity (e.g. cancelled outdoor programs; water quality advisories in lakes).
	41	More frequent and intense heat waves and less summer rainfall leading to

		reduced water quality and potential water shortages.
42		More extreme weather events and reduced air quality in summer months impacting tourism.
43		Sea level rise and storm surges leading to temporary or permanent displacement, impacting mental health.
44		More extreme weather events increasing demand for emergency responders and additional resources within and outside of Saanich (e.g. assisting other jurisdictions).
45		Extreme heat events negatively affecting health and productivity of outdoor workers.
46		Increased wind and storm events increasing the potential for personal injury.
47		Increased wind and storm events increasing the frequency and duration of power outages, and the demand on emergency response.
48		Increased risk of multiple extreme weather events, with increased health risks and strain on emergency capacity (e.g. wildfires followed by flood).
49		More frequent and intense rainfall events causing health and safety risks from increased flooding.
50		Increased extreme weather events causing temporary displacement or evacuations, with particular impacts for vulnerable populations
51		Extreme weather events leading to disruptions in supply chain and local food shortages

