Building Adaptive Capacity Report:

GUIDELINES

NB HealthADAPT Project

*Note : this document was originally produced by the project team as a tool for communities to undertake health vulnerability and adaptation to climate change assessments.

Original authors:

Tracey Wade
Mélanie Madore
Public Health, NB

With support from
Avec l'appui de

Health Canada Santé Canada

Contents

1 Introduction

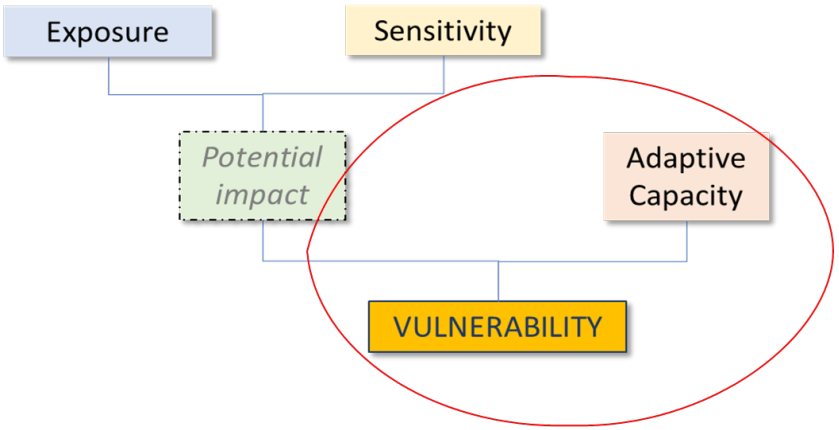
Climate change is a determinant of health. All Canadians are at risk of the health impacts of climate change; however, some populations are at higher risk. There is a growing body of evidence that climate change is affecting public health here in Canada (Clark et *al*., 2021), often by exacerbating pre-existing conditions (Pan American Health Organization, 2020). While our knowledge of the projected burden of health impacts related to climate change is limited, we do know change is happening at a rapid pace and that New Brunswickers need to prioritize preparedness.

The goal of this pilot project of NB HealthADAPT was to prepare a climate change and health vulnerability and adaptation assessment for two pilot communities (the city of Moncton and the Chaleur Region). Climate change hazards in New Brunswick include increases in average annual temperatures, increases in extreme weather events, changes in precipitation leading to more droughts, more heat waves, sea-level rise, and an increase in vector-borne diseases carried by pests (such as ticks and mosquitoes). Populations become vulnerable to these effects by the frequency and duration of exposure to the risks, their sensitivity to the situation, and how well they can adapt to the impacts.

The purpose of the ***Climate Change and Population Health Vulnerability Report*** was to define vulnerability to climate change health impacts, identify the most climate-sensitive populations, and then establish baseline information for exposure to climate change risks: extreme temperatures, extreme weather events; poor air quality; drinking and recreational water safety; food safety and security; vector-borne diseases; and UV radiation.

The purpose of this **Adaptation Measures report** is to present options for **your community** to consider as it continues to adapt to the changing climate. Several adaptation measures presented in the tables below result in the co-benefit of improving the community and making it more resilient in the long-run, and not just from a human health perspective.

Insert the purpose of this report for your community.



The concepts of exposure and sensitivity identified the potential impact of climate change. However, the vulnerability of the community to these potential impacts is modified or reduced by the community's adaptive capacity, or "ability to cope." Purposeful adaptation activities can be undertaken to reduce the health and human impacts of climate change on the populations **in your community**.

****A database of adaptation measures was compiled from input from local experts in New Brunswick, other local climate change and health vulnerability and adaptation assessments, as well as local, regional, national, and international sources of best practices.*

In assessing the wide range of measures in the database, we know that adaptation interventions are not the sole responsibility of the province, or the municipality, but need to be implemented from a variety of levels. While the focus of this report is community-based interventions, two additional levels of intervention in climate change adaptation from a health perspective are also considered: the individual or household level where one can make changes to protect their own health; and at the provincial level, which includes public health, health authorities, and provincial emergency response. The adaptation measures presented in this report present activities for implementation by all three levels of influence.

1.1 NB HealthADAPT Infographic

The NB HealthADAPT team developed an infographic to illustrate how « *adaptive communities* » can reduce climate change impacts on health. The graphic, available in both English and French, is intended for local, provincial and community audiences

in their joint pursuit of community resiliency to climate change. The infographic depicts a resilient and adaptive community in New Brunswick with seven key recommendations for our communities:

1. Protect water quality by ensuring healthy ecosystems for both plants and animals
2. Increase food security through support for growing food at home and buying local products
3. Address social inequities and build social connections to reduce challenges for those at greater risk
4. Provide places of refuge for those at greater risk to cope with extreme temperatures and extreme weather events
5. Improve air quality by investing in green energy and supporting active transportation
6. Support local efforts to build community well-being and community resiliency
7. Prevent illness from ticks and UV radiation by using and educating others on outdoor safety practices

The infographic also identifies populations at greater risk of health challenges from climate change due to social and other factors: older adults; pregnant people and young children; people who are underhoused or socio-economically disadvantaged; socially isolated people; people with pre-existing health issues; systematically marginalized groups; and outdoor workers. The infographic can be found in Appendix A.

1.2 How to Use the Tables on Adaptation Measures

Adapting to climate change can take the form of a variety of actions. For the tables below, adaptation actions are divided into one of five types:

1) Practice and Behaviour (generally an individual or household approach)
2) Capacity building including education and training (can be undertaken at any level)
3) Emergency management (primarily municipal or provincial)
4) Community planning and policy (primarily municipal, but with provincial support)
5) Warning/surveillance systems (primarily provincial, but with municipal supports)

In each section below, the adaptive actions are broken out by 7 climate exposure risks paralleling the ***Climate Change and Population Health Vulnerability Report*** : **1)** Extreme Temperatures; **2)** Extreme Weather; **3)** Air Quality; **4)** Water Quality; **5)** Food Safety/Security; **6)** Vector-Borne Diseases; and **7)** UV Radiation.

The tables in each of the following sections identify adaptation options based on input from local experts and best practices in the literature[1]. Each option is further detailed by the level of responsibility for implementation, the effects of the implementation and the long-term health impacts of the adaptation if the measure is implemented. Where feasible, indicators by which to monitor success (or failure) of the adaptation activity are also included and can be tracked over time.

Importantly, no community is starting from scratch. Indeed, **your community** and the Province have already implemented several adaptation measures which already reduce the health impact on climate change. **Using the tables below, identify which of the best practices adaptation measures already implemented by your community are highlighted *in grey italics* to illustrate the work done. The highlighting of adaptation measures already in place illustrate the municipality's ability to cope and build resilience**.

1.3 Responsibility for Actions

Actions are broken out into various spheres of responsibility. The individual/household level indicates that this action is an opportunity for people to make a change to their existing situation to improve their health. Individuals can play an important role in adaptation from making behavioural changes for one's own sake, checking in on neighbours (community-level interest) or as a community champion through actions that impact a larger number of people (e.g., building owners, people who operate cooling centres, social services, and individuals who may need to check on at-risk neighbours or family members). It is at this level where social capital is built and nurtured.

Municipal level responses are those within the mandate of municipal governments, or other organizations that represent a local/regional service, such as emergency measures or regional service commissions.

[1] *An excel database of adaptation options based on literature is available upon request : melanie.madore2@gnb.ca*

Provincial level responses can be policy-level in Public Health or other departments but may also refer to regional health authorities or provincial health networks.

2 Adaptation Measures: Extreme Heat/Cold

At the individual level, adaptive strategies dealing with extreme temperatures mainly focus on behavioural change, such as being appropriately prepared (dressed) to spend outdoors, adopting healthy lifestyles, or modifying one's interior surroundings to deal with extreme temperatures. At the municipal and provincial level, different strategies can be put in place to improve the resilience of the population to extreme temperatures such as adopting measures to promote behavioural change, capacity building, implementing a robust emergency response, and planning for possible events and mitigating their effects. One of the most significant things that a municipality can influence is social capital – that is creating a mutually supportive community by building interpersonal relationships, a shared sense of identity, a shared understanding, shared norms, shared values, trust, cooperation, and reciprocity. Social capital becomes a key effect of good climate adaptation strategies to improve health outcomes.

The Province and specifically, health authorities are responsible for providing timely health care and social services and can play a role in raising awareness and education about heat-related illnesses. Further, provincial health authorities can work with municipalities to mitigate the impacts of heat waves through adaptive community planning policies and regulations.

Table 1: Adaptation measures to reduce health impacts of extreme heat/cold

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
Behaviour / Practice	Plant native trees in the yard to increase number of shaded areas	Household / Individual level	Provides outdoor cooling locations	Reduced risk of heat-related illness/death	# of trees planted
	Install blinds in windows to reduce amount of passive heat entering home	Household / Individual level	Reduces ambient temperature in home	Reduced risk of heat-related illness	

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	Install air conditioning	Household / Individual level	Reduces ambient temperature in home	Reduced risk of heat-related illness/death	Stats can data Air conditioners (statcan.gc.ca)
	Purchase fans to increase air circulation	Household / Individual level	Provides some relief from stagnant air	Reduced risk of heat-related illness/death	
	Have a 72-hour emergency kit on hand	Household / Individual level	Food and water sources in case of power loss	Reduced mental health impacts (distress/anxiety)	
	Know where to access fresh water in an emergency	Household / individual level	Increased water security among population	Reduced mental health impacts (distress/anxiety)	
Capacity Building	Assess municipal and community agency capacity to provide interventions (e.g., with the homeless population)	Municipality	Greater understanding of community capacity	Improved response in emergency situations	# Community agencies (NGOs) partnered with the municipality.
	Develop opportunities to increase social contact (peer to peer) especially among populations most at risk, including education around why it is important.	Municipality	Increased social capital	Reduced mental health impacts related to loneliness and isolation	# and type of grassroots groups supporting populations at risk
	Have a secondary power system (generator, solar panel, wood stove, etc.) for use during an extreme cold event.	Household / Individual level	Reduced dependence on single-source heat	Reduced risk of cold-related illness/death	
	Develop messages targeted to individuals for heat mitigation measures	Municipality, province	Better education among citizens	Reduced risk of heat-related illness/death	# of communication materials targeting heat

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
					mitigation measures delivered to the public
	Targeted education and awareness messaging regarding heat-related illness and its prevention	Public Health NB	Early detection of heat illness symptoms	Reduced risk of heat-related illness/death	# publications Distribution methods
Emergency Measures	Provide free transit passes during extreme heat/ cold events to allow people to get to places with air conditioning	Municipality	Ability to access cool spaces	Reduced risk of heat-related illness/death	# days of free transit # extreme heat days # transit users
	Identify public cooling centres and provide information to the public on the locations and amenities available. These centres are differentiated from centres that are available to the public on a regular (non-emergency) basis.	Municipality	More “cool” spaces	Reduced risk of heat-related illness/death	# cooling centres identified
	Map location of emergency service locations (warming and cooling centres) and share publicly.	Municipality	Database of emergency locations and public knowledge of where they are.	Increased use of cooling and warming centres during an extreme weather event.	Number and location of warming and cooling centres.
	Establish an opt-in registry where people who are at-risk receive wellness checks under particular conditions	Municipality Province	Registry of people at risk	Reduced risk of extreme temperature-related illness/death	# of people on the opt-in registry.

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	(such as extreme heat or cold events).				
	Establish emergency water distribution	Municipality	Potable water available to public	Reduced risk of heat-related illness/death	# litres of water distributed
	Activate Heat Alert Response System (HARS)	Municipality	Broader reach of heat risk messages	Reduced risk of heat-related illness/death	# HARS alerts/month compared to # emergency heat illness responses over time
	Prepare emergency plan that includes support systems for high-risk populations identified by getting input from those at-risk groups.	Municipality	Action plans for vulnerable populations	Reduced risk of heat-related illness/death	Breadth of vulnerable population covered by EMO planning
	Work with local non-governmental organizations to identify populations most at risk (e.g., seniors living alone, people with disabilities)	Municipality	Increased social capital	Reduced risk of heat-related illness/death	Number and type of vulnerable populations covered by municipal EMO plans
	Ensure alert communications are made in as many languages as possible for the population (not just English and French)	Municipality Province	Increased understanding of emergency	Reduced risk of heat-related illness/death	# of translations (beyond FR/EN) # of shares on social media
	Work with NGOs to promote organizations that have warming/cooling tools and opportunities to	Municipality	Safe place/space for most vulnerable	Reduced risk of heat/cold-related illness/death	# NGO partners # of users of joint services

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	share (e.g., hand warmers, blankets, sweaters, cup of tea)				
Community Planning, Policy & Infrastructure	Adopt enhanced local building regulations requiring cooling strategies (e.g., green, white or reflective roofs)	Province	Reduced heat absorption for new or retrofit buildings	Reduced risk of heat-related illness/death	Adoption of "cooling" regulations # building permits issued that meet new standards
	Educate and encourage best practices on cooling systems for buildings including reflective roofs (as above)	Municipality	Reduced heat absorption for new or retrofit buildings	Reduced risk of heat-related illness/death	Adoption of "cooling" regulations # building permits issued that meet new standards
	Install native deciduous trees in parking lots, between buildings and along streets to increase the shade canopy (part of Green Development Guidelines)	Municipality	Provides outdoor cooling locations	Reduced risk of heat-related illness	# trees planted # parking lots involved
	Install permanent drinking water sources (water bottle fill stations) in public spaces	Municipality	Safe drinking water freely available to the public	Improved hydration and reduced health impacts related to dehydration	# bottle refill stations location of refill stations
	Establish public washrooms with showers	Municipality	Public places for human sanitary needs	Reduced rate of diseases related to personal hygiene practices and heat-related illness	# public washrooms # public showers Location of above

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	Planning and Development Strategy to include new Green Development Guidelines	Municipality	Higher proportion of public spaces in built environment	More natural shade areas and green space	% park space being retained % public green space with shade trees
	Track all buildings with air conditioning cooling towers	Municipality and Province	Baseline data of buildings with central cooling; and tracking for maintenance purposes	Reduced risk of heat-related illness/death; and Legionella disease	# legionella outbreaks # towers (new and old)
	Provide subsidies for low-income households to better insulate homes, purchase, or use existing air conditioning	Province	Reduced heat absorption in home and/or improved air cooling	Reduced risk of heat/cold-related illness/death	# applications $$ distributed
	Collect data with which to prepare a map of the urban heat island in city centre that identifies highest-risk areas.	Municipality	Better understanding of heat island impacts in central downtown area	Baseline for where to start reducing impacts	Adopted map of urban heat island
	Developing green urban design standards to increase green spaces and shade requirements in public locations (through green development guidelines)	Municipality	Reduction of urban heat island impacts	Reduced risk of heat-related illness/death	Adoption of Urban's forestry plan # policies dedicated to increasing shade in public places
	Include health authority in planning exercises to ensure human health is considered and included	Municipality	Health lens on decision-making for land use	Improved understanding of health impacts	# meetings/discussions with health authorities in planning review # policies/regulations adopted specifically

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
					targeted at improving health
	Provide outdoor workers with appropriate protective equipment and education about signs of heat/cold-related illnesses	Municipality	Worker safety and protection	Reduced risk of heat/cold-related health outcomes	Type of protective equipment used. Training sessions for extreme temp workers and their supervisors
	Establish new regulations for public works staff (e.g., change work hours or work at night)	Municipality	Worker safety and protection	Reduced risk of heat-related health outcomes	# and type of new work arrangements implemented directly related to reducing health risks due to extreme temps
Surveillance	Collect data on residents without air conditioning (via survey or other methods)	Municipality	Gives municipality a baseline understanding of who is more at risk of heat-related impacts	Identification of populations at risk for heat-related illness for EMO response	# responses to survey
	Early warning systems	Municipality	Education and information to the public	Improved capacity to respond appropriately	# heat alerts issued # people using municipal assets in response to heat warning (free bus, cooling shelters)
	Implement syndromic surveillance for climate-related heat impacts for emergency room visits	Province	Real-time data on temperature-related illnesses in emergency room visits.	Increased understanding of links between extreme temperatures and morbidity/mortality by hospital/region	Implementation of syndromic surveillance

3 Adaptation Measures: Extreme Weather Events

Because extreme weather events are short-term definable episodes, it is sometimes easier to prepare for them with good emergency planning. From an individual perspective, adaptive measures to extreme events may include installing backflow valves that protect against water flowing back into a basement during a flood, preparing individual emergency kits, and volunteering at local centres to help build community resilience and social capital.

At the municipal level, adaptation strategies focus on emergency management (before, during and after) and the prevention of flooding and other complications related to extreme weather events.

At the provincial level, strategies can be implemented to assist those most impacted, as well to undertake flood risk monitoring, warnings and awareness. Indeed, public health authorities must ensure that quality care is provided even when a significant proportion of the population is affected by an event (e.g., prolonged loss of power, impassable roads, etc.). The province must also ensure that mental health care supports are made available to the affected population in emergency response efforts.

Table 2 : Adaptation Measures to Reduce health impacts from Extreme Weather Events

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
Behaviour / Practice	Install back-flow valves to prevent storm water from entering home by providing municipal grants direct to homeowners.	Individual / household (municipal program)	Population is better prepared and less reliant on emergency services	Reduced risk of impacts in home	# Grants from the municipality to households. # wells tested # mould remediation efforts
	Flood-proof home by moving electrical and furnaces to elevation above established flood levels.	Individual / household	Population is better prepared and less reliant on	Reduced risk of impacts in home	

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
			emergency services		
	Have a 72-hour preparedness kit on hand	Individual / household	Population is better prepared and less reliant on emergency services	Reduced anxiety	# 72-hour kits sold
	Educate public on sources of Carbon Monoxide (CO) poisoning and appropriate use of generators and BBQs	Municipality Province	Better understanding of risks	Reduction in amount of CO poisoning incidences	# CO poisoning
	Purchase a carbon monoxide (CO) detector	Individual / Household	Dependable warning system in home	Reduction in amount of CO poisoning incidences	# CO detectors installed
Capacity Building	Volunteer at storm shelters	Individual	Increased understanding	Increased coping ability	# volunteers
	Encourage peer-to-peer or buddy system check-in within neighbourhoods	Individual Municipality	Increased social capital	Improved social connection	
	Neighbourhood maps prepared to share in planning for emergencies (door to door help for vulnerable people by neighbourhood)	Municipality	Increased social capital	Improved social connection	# and type of neighbourhood maps produced
	Provide public sessions / information on mental health resiliency prior to and following extreme events	Public Health	Improved social capital and individual resiliency	Reduced mental health issues /anxiety	# public sessions # participants

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	211 mental health and community outreach hotline	Province/ United Way	Central and easy access to health and social services	Improved access to mental and social services outside formal health care system	# calls # referrals
	Learn about remediation of buildings and sites following flood events (e.g., disposal of contaminated materials, repair)	Individual / household	Reduced risk of mould and improved air quality in home	Reduced risk of allergic reactions Long-term prevention of respiratory illnesses	# use of epi-pens associated with mould allergies # homes flooded VS # home remediation actions
Emergency Measures	Develop business continuity plans for emergency services (and health centres) during an event	Municipality Province	Less disruption and continuity of service (and ability to handle increased burden during an event)	Continued essential service provision	Existence of a continuity plan
	Establish a registry of volunteers to call upon in an emergency (events could be local, provincial or national)	Municipality EMO	Central place from which to find people to help	Increased social connections	# volunteers on registry
	Identify areas and populations at greater risk (for flooding/damage)	Municipality	Emergency response time is reduced or adjusted based on the type of event	Reduction of individual health issues	Existence of flood risk maps
	Develop a voluntary registry of vulnerable individuals (using NGOs as a point of	Municipality	Easy identification of vulnerable	Reduction of individual health	# individuals/ households identified

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	contact) in those at risk areas.		households during evacuations	issues in response to crises	
	Emergency shelters established	Province/ Municipality/Red Cross	Safe places for vulnerable to congregate	Reduced social isolation	# shelters Location of shelters
	Emergency and evacuation route plan which is shared with the public	Municipality / EMO	Planned routes for emergency use available as needed	Quicker response times; reduced stress for displaced individuals	Plan in place
	Generators for all drinking water pumping stations, and lift stations for public sewer	Municipality	Safe potable water continues to flow to residents; and public sewer functions	Health and safety of residents are maintained.	Plans in place
	Water and wastewater contingency plans	Municipality	Safe potable water continues to flow to residents; and public sewer functions	Health and safety of residents are maintained.	Plans in place
Community Planning, Policy & Infrastructure	Adoption of flood risk mapping at 10.5m elevation	Municipality	Improved preparedness Reduction in number of people at risk	Fewer injuries related to a flood event Quicker response time and fewer displaced individuals	# building permits issued in flood plain
	Development and adoption of minimum standards for construction in flood zone prohibiting development in	Municipality	Improved preparedness	Fewer injuries related to a flood event	# building permits rejected because of location within flood plain

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	known flood zones (Strategic Plan 2022-2023)		Reduction in number of people at risk	Quicker response time and fewer displaced individuals	# building permits issued in flood plain
	Ensure a wide range of partners (including health) participate in municipal plan reviews to ensure floodplain management - including increased green space, water and energy conservation measures, more permeable landscapes and improved storm water management.	Municipality	People and buildings are less susceptible to extreme events	Reduced stress and anxiety for residents Fewer injuries related to a flood event	# partners involved in plan reviews # policies focusing on climate resiliency # building permits issued in flood-prone areas # flood-proofed buildings
	Employ engineered solutions to monitor and maintain infrastructure during heavy rains	Municipality	Improved water flow during extreme events	Reduced flood impacts on roads and in homes	# basement floods # roads inundated
	Continue to implement nature-based solutions to flood mitigation including bioswales, rain gardens, etc.	Municipality	Improved water flow during extreme events	Reduced flood impacts on infrastructure, roads and in homes	Area dedicated to naturalized storm water retention
	Adopt Naturalized Stormwater Management Guidelines	Municipality	Improved water flow during extreme events	Reduced flood impacts on infrastructure, roads and in homes	Area dedicated to naturalized storm water retention
Surveillance	Alert Ready system	Municipality and Province	Improved notification to citizens	Increased preparedness of citizens	# people signed on
	Flood mapping and Flood Watch	Province			

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	511 Road closures	Province			

4 Adaptation Measures: Air Quality

Adaptation measures related to air quality are mainly related to monitoring pollution, regulating air quality and managing allergens.

At the individual level, some measures can be taken to protect oneself, such as wearing a mask or installing an air filtration system at home or at work. At the community level, awareness efforts can be put in place for citizens as well as for businesses in the community. Parks, trees, and bike paths can be developed to promote air filtration but also increase active transportation and reduce greenhouse gases. Finally, from an emergency management perspective, sharing information on the risks of poor air quality can increase the resilience of citizens. At the provincial and health authority level, the role is to monitor air quality and implement pollution limits for large industries. From a health perspective, monitoring and surveillance includes tracking emerging comorbidities such as lung disease, cancer, or cardiovascular disease.

Table 3 : Adaptation measures to reduce health impacts of poor air quality

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
Behaviour / Practice	Wear personal protective equipment (e.g., masks) when venturing into public places	Household/ Individual	Personal protection from airborne pollutants and viruses	Reduced likelihood of infection from airborne diseases or poor air quality	# people wearing masks # regulations related to mask wearing
	Ensure air filters (e.g., furnace) are replaced regularly inside home	Household/ Individual	Improved air quality in home	Reduced likelihood of airborne illnesses in home	
	Ensure air conditioning and air exchange devices are cleaned regularly	Household/ Individual	Improved air quality in home	Reduced likelihood of airborne diseases in home (e.g., Legionella)	
	Close windows on poor air quality advisory days	Individual / Household	Improved air quality in home	Reduced likelihood of infection from airborne diseases or poor air quality	

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
Capacity Building	Provide incentives for green energy investment in homes and electric vehicles	Province	Reduction in $C0_2$ emissions	Reduction in number of respiratory illnesses	# of incentives # of applications $C0_2$ reduction calculations
	Prepare public education material on benefits of planting low-pollen producing plants	Province	Better informed public	Reduction in number of allergy-related illnesses or hospital visits	
	Public service announcements and education on air quality notices	Province	More people stay indoors and remove themselves from areas of poor air quality	Improvement in respiratory health during an event.	# PSAs issued
Emergency Measures	Public outreach through traditional and social media during air quality warnings (e.g., forest fires)	Province	More people stay indoors and remove themselves from areas of poor air quality	Improvement in respiratory health during an event.	# PSAs issued
	Undertake meteorological plume modelling for forest and industrial fires	Province	Better understanding of air quality impacts	Improvement in respiratory health during an event.	
Community Planning, Policy & Infrastructure	Limit vehicle access to the city centre to reduce idling by encouraging carpooling or use of public transit	Municipality	Improved air quality for entire community with reduced traffic and reduced energy consumption	Reduction in the number of respiratory illnesses	By-laws limiting vehicular traffic

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	Adopt anti-idling policies for municipal fleet	Municipality	Improved air quality for entire community	Reduction in the number of respiratory illnesses	By-laws limiting vehicular traffic
	Support policy development related to increasing access for active transportation, community gardens, school gardens (Active Transportation Plan Phase 2)	Municipality Province (schools)	Improved air quality for entire community More gardens producing local food	Reduced traffic Improved food access Improved level of physical fitness Reduced mental illness outcomes Reduced incidence of respiratory illnesses	# km of dedicated AT links in city Level of connectivity of AT between neighbourhoods # community gardens
	Ensure municipal plan policies take measures to improve air quality through improvements to natural environmental, forestry, and development of complete communities.	Municipality	Healthy built environments Sustainably designed communities Reduced requirements for commuting to work	Improved mental wellbeing Improved social capital Improved health and physical fitness of residents	# and type of policies supporting improved air quality
	Invest in EV charging stations throughout the city to meet future demand (possibly as per Green Development Standards)	Municipality	Improved air quality for entire community	Reduction in the number of respiratory illnesses	# of EV charging stations Location of EV stations
	Establish a program to remove allergenic plants from public areas	Municipality	Improved air quality for entire community	Reduction in the number of respiratory illnesses related to allergies	

	Adaptation Options	Responsibility	Effect	Impact of Action	Indicators
	Plant more trees to improve air quality	Municipality	Cleaner air has many positive impacts on youth	Less risk of mental illness, improved school performance, decreased absenteeism	Youth mental illness rates, school performance, etc.
Surveillance	Air quality monitoring	Province	Better understanding of changing state of air quality	Reduce air quality-related health issues	AQHI tracked over time
	Monitor incidence of respiratory and cardiovascular illnesses	Province			# hospital intakes (via syndromic surveillance systems)

5 Adaptation Measures: Water Safety

As with air quality adaptation, water quality adaptation is primarily about monitoring and regulation. At the individual level, some measures can be taken home to protect such as having a treatment system or drinking water resources nearby. At the municipal level, education and prevention programs can be implemented to raise awareness of the importance of drinking water sources such as watersheds. At the provincial and health authority level, the role is primarily one of monitoring and identification of emerging contaminants.

Table 4 : Adaptation measures to reduce health impacts of poor water quality

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
Behaviour / Practice	Keep safe backup supply of drinking water at home (maybe part of the emergency 72-hour kit)	Household/ Individual	Emergency drinking water supply available	Reduction of water-related illnesses from drinking from non-safe sources	
	Conduct regular testing of well water (through Service New Brunswick), particularly after a flood event or extreme drought.	Household/ Individual	Ensure safety of potable water	Reduction in risk of water-related illnesses	% of wells tested annually / # of wells in region
	Use at home treatment to remove chemicals, bacteria and protozoa from well water sources (e.g., UV distillation, ozonation, reverse osmosis)	Household/ Individual	Improved water quality	Reduction in incidence of waterborne illnesses	
	For community-level treatment, use large-scale disinfectors such as UV filtration and turbidity filtration control	Municipality	Improved water quality	Reduction in incidence of waterborne illnesses	duration and incidence of municipal water contamination levels

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
Capacity Building	Create public messaging regarding water quality and drinking water testing (particularly for people with on-site wells)	Municipality Province	Improved water quality	Reduction in incidence of waterborne illness	# and duration of drinking water advisories # drinking water tests undertaken by households with wells
	Educate citizens on identification of blue-green algae blooms	Province	Better informed public on identifying and reporting blooms	Reduced incidence algae-related health impacts	# incidence of cyanotoxin poisoning # reported blooms
	Work with NGOs to educate the community on water presentation, conservation and reclamation activities.	Municipality Province	Improved water quality	Reduction in waterborne illness	# and location of water quality tests
Emergency Measures	Treatment plan in place and implemented when cyanobacteria or cytotoxins are detected.	Province Municipality	Threat to water quality is neutralized by removing or inactivating toxins	Reduced likelihood of waterborne illnesses	Treatment plan initiated
	Map potential exposure of drinking and wastewater infrastructure (e.g., lagoons) to floods.	Municipality	This data can be used to inform capital spending on infrastructure renewal	Better decisions to be made with regard to placement or development of drinking and waste water infrastructure.	Existing map
	Public messaging regarding boil water advisories and orders	Municipality	Better informed public	Reduction in waterborne illnesses	# and duration of boil water advisories

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
					# public messages delivered (and method)
	Signage at recreational water bodies	Province Municipality	Better informed public of risks	Reduction in waterborne illnesses	# new signs each year Location of all signs
	Back-up power for water pumping stations	Municipality	Potable water continues to flow to households	Reduced likelihood of waterborne illness	# time backup power was used
	Use biological controls in waterbody management (e.g., introducing predator or competing species)	Municipality Province	Improved water quality and reduction of threat	Reduction in waterborne illness	
Community Planning, Policy & Infrastructure	Develop policy related to acceptable levels of nutrient loading in surface waters	Province	Improved water quality	Reduced water quality-related health impacts	# and type of policies
	Establish drinking and recreational water quality guidelines and regulations	Province	Improved water quality	Reduced water quality-related health impacts	Guidelines established Regulations established
	Participation in Watershed protection organization.	Municipality	Improved water quality	Reduced water quality-related health impacts	Participation Extent of source water protection (in hectares)
	Water and wastewater contingency plans in place (e.g., “do not consume/use”)	Municipality	Improved water quality	Reduced water quality-related health impacts	Existence of plans
	Algae sampling protocol for drinking and recreational water sources	Municipality Province	Improved water quality	Reduced water quality-related health impacts	# and frequency of sampling undertaken

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
					Location of samples
	Support water preservation, conservation and reclamation initiatives within the community	Municipality Province	Improved water quality	Reduced water quality-related health impacts	
	Support/advocate for policy development for reduced waste at source, especially packaging, single-use plastic and non-recyclable plastics	Municipality Province	Improved water and soil quality; reduction of waste	Reduced impacts on overall health	
Surveillance	Increase monitoring and identification of changes in surface water algae populations	Province	Better understanding of incidence of BG algae blooms	Reduced human and pet exposure to health impacts from BG algae	# and size of known blooms
	Make water testing free to citizens with private wells (current cost is approx. $50)	Province	More accessibility to testing	Improvement in well water quality	# testing kits distributed
	Water quality advisories and programs	Province	Better educated public	Reduced health impacts from poor water quality	# and duration of water quality advisories
	Beach water surveillance	Province	Better educated public	Reduced health impacts from poor water quality	# and duration of beach water “no swim” advisories

6 Adaptation Measures: Food Security

Adaptation measures to address food insecurity at the individual level include changing behaviour to source food locally and, if possible, grow your own food or collect wild foods. Municipalities can implement various programs to improve food security such as community gardens, protecting agricultural land, and providing support to local producers (for example, with a farmers' market). At the provincial and health authority levels, efforts can be made to promote healthy eating, food sovereignty, and avoid food waste.

Table 5 : Adaptation measures to reduce health impacts from food insecurity and food safety concerns

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
Behaviour / Practice	Seek out sources for local foods, be it at grocery stores, farmers' markets, or at farm gates.	Individual / Household	More local food production to meet higher demand Lower inputs required	Higher nutritional levels Healthier community Healthier local economy	# and type of local food sources
	Join local food co-ops or CSAs (community-supported agriculture)	Individual / Household	Support local economy Build social capital	Higher nutritional levels Healthier community	# of CSAs/Co-ops Range of food products
	Share excess garden harvest with food banks or neighbours	Individual / Household	Growing social capital	Healthier community Stronger ties to community	
	Advocate for litterless municipal events and encourage drinking municipal water (not bottled)	Municipality Individual/ Household	Reduction in solid waste	Healthier community	Volume of waste collected at municipal events

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
Capacity Building	Learn how to plant a garden, harvest produce and preserve foods.	Individual / Household	Food-skilled community Less dependence on prepared food	Improved health and nutritional intake Reduction in frequency of foodborne illness	# of people involved in courses Types of courses (food handling, food prep)
	Learn how to identify and gather wild foods	Individual / Household	Reduced CO_2 impacts	Improved health and well-being	# courses or community events to support this
	Promote a seed exchange program through local libraries or organizations	Municipality	Promotion of sustainable ideals Building social capital	Healthier more connected communities	# participants in seed exchange Range in types of seeds available
	Work with community champions to build capacity for growing and harvesting nutritious and culturally appropriate foods	Municipality	Promotion of sustainable ideals Building social capital	Healthier more connected communities.	# participants # public sessions Diversity of participants
	Education on the impact of climate change on food system and food access	Municipality NGOs	Improved understanding of the interrelationships of food, health and the environment		
Emergency Measures	Prepare mobilization plans for food banks and community kitchens	Municipality Province	Food gets to those who need it in times of crisis	Most vulnerable have food	# meals delivered # households accessing food banks
	Work with NGOs to ensure vulnerable populations are covered	Municipality	Food gets to those who need it in times of crisis	Most vulnerable have food	Range of people helped

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
	Develop and share messaging related to food safety during prolonged power outages	Province (public health)	Better understanding of when food needs to be disposed of without proper refrigeration	Reduced incidence of foodborne illnesses	# of messages and medium used for sharing
	Conduct food safety inspections for premises and special events, particularly large outdoor public gatherings (during heat waves)	Province	Assurance of food safety protocol adherence	Reduced incidence of foodborne illnesses	# of inspections # incidence of foodborne illnesses from public events
Community Planning & Policy	Support and advocate for land use plan policy statements around local food systems and protection of agricultural lands and water	Municipality Provincial	Make is easier to grow food with fewer regulatory barriers	More local food available Healthier population	# of food access policy statements in land use plan
	Advocate for Statements of Public Interest related to agricultural lands protection.	Provincial	Ensures long-term protection of agricultural land from development pressures.	More land retained for food production.	# of acres protected agricultural land in municipality
	Establish agroforestry and community garden projects on vacant municipal lands	Municipality	Make is easier to grow food with fewer regulatory barriers	More local food available Healthier population	# community participants
	Allow food production can be a part of residential landscaping	Municipality	Make is easier to grow food	More local food available Healthier population	Permissive vs. restrictive by-law regulations
	Broaden community garden used to make it permitted as of right in most zones.	Municipality	Reduce regulatory barriers for people to grow their own food	More local food available	# community gardens

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
				Healthier population	Location of community gardens
	Support for strengthening the local and regional food systems including production, processing, distribution, marketing, access, consumption, and waste recovery	Municipality Province	Improved access to local food options Improved food system Reduction in food deserts and food insecurity	Increased health and nutritional intake of all people	
	Support policy development related to strengthening the local food system (production, support for local food, food sharing, gleaning and seed saving)	Municipality NGOs	Improved access to local food options Improved food system Reduction in food deserts and food insecurity	Increased health and nutritional intake of all people	
	Promotion and implementation of food charters and pledges	Municipality	Improved access to local food options Improved food system Reduction in food deserts and food insecurity	Healthy community	Adoption of food pledge or charter
Surveillance	Monitor the number of hectares of protected agricultural land in jurisdiction	Municipality	Establish baseline for potential food production	Improved nutrition Healthier population	# hectares under production % of food vendors at markets who are from the municipality

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
	Monitor trends in food bank/soup kitchen usage	Municipality	Establish baseline for vulnerable populations	Identification of vulnerable households	# of food bank users (by households and age group)

7 Adaptation Measures: Vector-Borne Diseases (VBD)

There is little literature on adaptation measures for vector-borne disease compared to other hazards. However, at the individual level, protective measures – such as wearing appropriate clothing and self-monitoring – are key. For municipalities and the province, reducing and monitoring the habitats of new pathogens helps to reduce the rate of emergence of new diseases. From the point of view of health authorities, early diagnosis and knowledge of the associated risks contribute to recovery and prevent complications.

Table 6 : Adaptation measures to reduce health impacts associated with vector-borne diseases

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
Behaviour / Practice	Prevent exposure by wearing appropriate clothing and checking for ticks after being in grassy natural areas	Individual / Household	Reduces likelihood of bites	Reduces incidence of Lyme disease	# reported cases of Lyme disease
	Reduce mosquito habitat by removing standing water in yards	Individual / Household	Reduced habitat for mosquito propagation	Reduces possible incidence of West Nile Virus	# reported cases of West Nile Virus
	Reduce mosquito habitat by removing standing water in public areas	Municipality	Reduced habitat for mosquito propagation	Reduces possible incidence of West Nile Virus	# reported cases of West Nile Virus
	Removing leaf litter along trails	Municipality	Reduces or eliminates threat (72-100% reduction in ticks)	Reduces incidence of Lyme disease	Frequency and distance along trails cleared
Capacity Building	Educate public and build awareness of Lyme disease and West Nile virus to prevent and protect population	Municipality Province	Reduction in threat	Limits incidence of WNV or Lyme disease	# reported cases of WNV or Lyme disease

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
	Work with medical practitioners for proper diagnosis and early treatment	Province	Increases understanding of VBD and impacts	Reduces likelihood of long-term health impacts	
	Collaborate with academic researchers on mapping tick habitat	Municipality	Gives decision makers a better understanding of distribution of vectors	helps in decision-making	Updated maps prepared
	Provide training on tick identification to municipal employees who work outdoors (e.g., parks, water services)	Municipality	Increased knowledge and understanding of the risks	Reduced likelihood of incidence of VBD	# staff reporting tick bites
	Make information easily available to the public on ticks, preventative measures and bites and treatment	Province	Increased knowledge and understanding of the risks and what to look for	Reduced likelihood of incidence of VBD Increased likelihood of early diagnosis	Incidence of VBD # diagnoses of VBD
Emergency Measures	Consider support for larvicide treatment on non-municipal lands (away from food production)	Municipality	Reduces threat	Limits incidence of Vector-borne diseases among humans	# possible larvaciding locations identified # of applications of larvicide in specific locations
	Consider mosquito abatement programs	Municipality	Reduces threat	Limits incidence of Vector-borne diseases among humans	# possible abatement application locations identified # of applications of program

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
Community Planning & Policy	Development of policies for outdoor workers	Municipality	Reduces threat	Limits incidence of Vector-borne diseases among humans	Existence of policies
Surveillance	Develop an active tick surveillance plan for municipal parks in partnership with Public Health	Municipality Province	Provides baseline of information for tick habitat risk areas in municipality	Reduces likelihood of incidence of VBD	# and location of active surveillance sweeps # of infected ticks found
	Undertake passive surveillance outside of formal plans	Municipality	Provides continuous assessment of risk	Reduces likelihood of incidence of VBD	# of infected ticks reported
	Monitor other mosquitoes and tick species that may become established	Province	Provides continuous assessment of risk	Reduces likelihood of incidence of VBD	# of infected vectors Types of VBDs

8 Adaptation Measures: UV Radiation

Adaptation measures for prolonged exposure to ultraviolet radiation include individual behavioural change (wearing sunscreen and protective clothing), community supports for making protective resources available, and, at the provincial level (public health), creating awareness campaigns aimed at prevention from the risks associated with UV radiation.

Table 7 : Adaptation measures to reduce health impacts associated with high levels of UV radiation

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
Behaviour / Practice	Prevent exposure by wearing protection (sunscreen, appropriate clothing, sun hats, sunglasses)	Individual / Household	Increased adoption of sun-protective measures	Reduction in skin cancers, eye disease	# cases malignant melanoma # cases basal and squamous cell carcinoma
	Internal municipal policy regarding sun safety for outdoor workers	Municipal level	Adoption of sun-protective measures	Reduction in skin cancers, eye disease	Existence of internal municipal policy
Capacity Building	Public education on "sun sense"	Province	Increased adoption of sun-protective measures	Reduction in skin cancers, eye disease	# cases malignant melanoma # cases basal and squamous cell carcinoma (compared to the baseline established)
	Identify population that does not engage in sun-protective measures and target messaging through appropriate media	Province	Increased adoption of sun-protective measures	Reduction in skin cancers, eye disease	
	Provision of sun safety material in childcare manual and recreation camp manuals	Province Municipality	Increased adoption of sun-protective measures	Reduction in skin cancers, eye disease	# uptake by child program delivery groups

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
Emergency Measures	Have sunscreen publicly available alongside hand sanitizer and water refill stations	Municipality	Facilitate access to sun care products	Reduction in skin cancers	# locations where sunscreen is publicly and freely available
	Public messaging with UV index is high	Province	Increased adoption of sun-protective measures or staying indoors	Reduction in skin cancers	# public messages Media used to share messages
Community Planning, Policy & Infrastructure	Support municipal policies to preserve trees and require provision of shade structures throughout the municipality (possibly through Green Development Guidelines)	Municipality	Increase in shade protective areas in the municipality	Reduction in skin cancers and eye disease	# and types of policies included in plans
	Require shade elements near seating areas in all public parks	Municipality	Increase in shade protective areas in the municipality	Reduction in skin cancers and eye disease	
	Require shade elements for outdoor seating at restaurants and places intended for public gathering	Municipality	Increase in shade protective areas in the municipality	Reduction in skin cancers and eye disease	
	Implement shade elements in selected areas at public beaches	Province Municipality	Increase in shade protective areas in the municipality	Reduction in skin cancers and eye disease	
	Policy development to support naturalized outdoor play areas	Municipality Province (schools)	Increased adoption of sun-protective measures; mental health and	Reduction in skin cancer rates	# naturalized play areas in municipality

	Adaptation Options	Responsibility	Effects	Impact of Action	Indicators
			wellbeing for outdoor play		
Surveillance	Public surveillance for high UV index	Province	Greater understanding of extent of sun-related cancers	New policies developed	
	Monitor and report on malignant melanoma cases	Province	Greater understanding of extent of sun-related cancers	New policies developed	# cases by year
	Monitor and report on basal cell and squamous cell carcinoma	Province	Greater understanding of extent of sun-related cancers	New policies developed	# cases by year

9 Moving Forward

As noted above, the goal of this pilot project of NB HealthADAPT was to prepare a climate change and health vulnerability and adaptation assessment for two pilot communities (the city of Moncton and the Chaleur Region). The ***Climate Change and Population Health Vulnerability Report*** define vulnerability to climate change health impacts, identified the most climate-sensitive populations, and then establish baseline information for exposure to various climate change risks. This Adaptation Measures report presented options for **your community** to consider as it continues to adapt to the changing climate. Several adaptation measures presented in the tables above result in the co-benefit of improving the community and making it more resilient in the long run, not just from a human health perspective.

9.1 Prioritization and Implementation

It is recommended that your municipal staff review the scope of identified adaptation measures and determine which measures can have the most significant impact and are the most cost-effective. In addition, some adaptation measures may have a positive impact on health based on a range of climate exposures (extreme heat and water quality). While there are financial and human resource implications for many of these proposed measures, it is likely that some measures can be easily implemented due to other ongoing work in the municipality's daily operations. For example, if a municipal land use plan review is already being undertaken, focusing on some of the actions around planning and policy noted above can help improve the community's ability to cope with climate change.

As such, it is recommended that your municipality conduct a ranking and feasibility exercise of adaptation options presented based on ease of implementation; cost of implementation; impact (reduction of health impacts for the population); and co-benefit of action on other climate priorities.

9.2 Monitoring and Evaluation

The only way to know if adaptation measures are working is by monitoring progress and evaluating results. The tables in sections 2-8 identified indicators by which efforts can be assessed against the existing baseline data provided in the Climate Change and

Population Health Vunlerability Baseline report. Data in that report, as well as the climate change sensitivity profiles prepared by the Institute for Research, Data and Training at University of New Brunswick provide the baseline to measure success of the adaptation initiatives.

Appendix A: Infographic

New Brunswick Nouveau Brunswick CANADA

Financial contribution from

Health Canada Santé Canada

The views expressed herein do not necessarily represent the views of Health Canada