ONTARIO CLIMATE CHANGE AND HEALTH VULNERABILITY AND ADAPTATION ASSESSMENT GUIDELINES

Workbook



Authors: Jaclyn Paterson, Anna Yusa, Vidya Anderson, Peter Berry Acknowledgements: This publication was completed with financial support from Health Canada.

Ministry of Health and Long-Term Care Public Health Policy and Programs Branch 393 University Avenue, 21st Floor Toronto, ON M7A 2S1

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PREFACE

The Environmental Health Climate Change Framework for Action has been developed by the Population and Public Health Division of the Ministry of Health and Long-Term Care to meet the public health challenges of a changing climate in Ontario. This framework is designed to support an adaptive and resilient public health system that anticipates, addresses and mitigates the emerging risks and impacts of climate change. This framework will improve the overall effectiveness and efficiency of the public health system and its ability to:

- > Reduce incidence of adverse health outcomes from the impacts of climate change
- > Reduce public exposure to health hazards related to a changing climate
- > Identify interventions that reduce exposure to climate change impacts
- > Enhance capacity to address the risk factors associated with climate change

As part of the Environmental Health Climate Change Framework for Action, a toolkit has been developed to assist public health units across Ontario. This toolkit includes the:

- > Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines: Technical Document;
- > Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines: Workbook; and
- > Ontario Climate Change and Health Modelling Study: Report.

These documents are designed to be used in concert to enable public health units to identify vulnerabilities within their communities; identify and implement local mitigation and adaptation strategies; raise awareness about the health hazards of climate change; and reduce public health vulnerability to climate change.

STEP 1: FRAME AND SCOPE THE ASSESSMENT

Step 1: Overview

Before an assessment is initiated, the assessment needs to be framed and scoped. The project leads should identify the assessment timeframe and resources, health risks of climate change of most interest, future time periods to assess risks, adaptation needs to be considered, how the assessment will be managed, and a communication plan for informing stakeholders.

STEP 1A: DECIDE WHICH HEALTH OUTCOMES TO INCLUDE

The first decision to be made is which health outcomes are of greatest importance for including in the assessment. Use the *Priority Health Hazards* template to compile preliminary information on health outcomes and climaterelated hazards to identify which should be a priority for the assessment. In the template, record information on morbidity and mortality in your jurisdiction from extreme weather and climate events (e.g. heat events, floods), changes in air quality arising from changing concentrations of ozone, particulate matter or aeroallergens, and water, food, and vectorborne diseases that can be made worse by climate change (e.g. Lyme disease and West Nile Virus). When compiling this information, pose the following questions to help prioritize health concerns:

- > What are the priority climate-sensitive health outcomes of concern in the study area?
- > Which climate-sensitive health outcomes are of greatest concern for stakeholders and the public?
- > Did recent extreme weather and climate events raise concerns about health risks such as heat events or floods?



- > Were recent assessments conducted in the region in other sectors that highlighted issues affecting health?
- > Are neighbouring health units also conducting a health vulnerability and adaptation assessment?

STEP 1B: IDENTIFY PROJECT TEAM

Once the health outcomes to be considered are identified, a project team with relevant expertise can be created and a work plan developed.

Use the *Project Team* template to list project team members and other relevant information such as their respective areas of responsibility (e.g. health departments managing the health outcome of interest along with other sectors whose activities can affect the health outcome), expertise and/or whom they represent (individuals or organizations) and their roles in the assessment.

When identifying potential project team members, include the following stakeholders and considerations:

- > Officials from local authorities whose activities can affect the burden and pattern of climate-sensitive health outcomes
- > Representative health care providers who would diagnose and treat any identified cases
- > Core members of the project team who stay for the entire project
- > Individuals that are working on issues relevant to the mandate of the assessment in other departments or organizations (e.g. experts in disease transmission, experts on sources of ground-level ozone)
- > Communication experts to discuss how to present the results to the public in ways that empower appropriate behavioral adaptation actions
- > Ensuring a high degree of stakeholder inclusivity while having a small enough team to direct the study most effectively
- > Additional resource persons with targeted expertise on specific topics

STEP 1C: DEVELOP A VULNERABILITY AND ADAPTATION ASSESSMENT WORK PLAN

The work plan needs to consider the extent to which steps in a vulnerability and adaptation assessment are necessary to achieve the desired results. Time and financial resources may call for a delay in the implementation or removal of a particular step; this should be noted in the work plan. For example, the examination of potential health benefits and co-harms of adaptation and mitigation options implemented in other sectors might be omitted or could be undertaken when the next assessment is carried out. Reasons for not undertaking a certain step should be included in the final report to inform the framing and scoping of subsequent assessments.

The work plan should specify the management plan, key responsibilities, activities, time line and resources needed for the assessment. Use the *Work Plan* template to develop your assessment work plan.

STEP 1D: IDENTIFY QUALITATIVE AND QUANTITATIVE INFORMATION TO INFORM THE ASSESSMENT

Another activity to undertake during the scoping phase is to identify available and relevant information for the assessment. Sources of relevant information could include:

> PEER-REVIEWED LITERATURE – There are many publications on potential changes in health risks to vulnerable populations from climate hazards. Some of these include projections of future hot days and warm nights in Canada in the coming decades and maps on the current and projected ranges of the vector that causes Lyme disease in eastern Canada.



- GREY LITERATURE Grey literature may describe the current burden of climate-sensitive diseases and management approaches for the health outcomes of concern. Also, national and provincial level assessment reports in Canada include potential changes in air quality and in the frequency of extreme heat events due to climate change.
- > **CLIMATE AND WEATHER DATA** This data may be obtained from environment agencies and can include changes in precipitation patterns and occurrences of drought.
- PROVINCIAL AND COMMUNITY REPORTS These reports can provide information on a range of key vulnerability factors (e.g. relevant health reports and associated datasets).

Compile data sources into the Information Sources template.

STEP 1E: DEVELOP A COMMUNICATION PLAN

Developing a communication plan early in the process is important to ensure that the assessment is structured from the beginning to communicate identified risks effectively to those who will manage the risks and those who could be affected. The plan should specify the primary assessment output (e.g. report), to whom it will be communicated, mechanisms for sharing the results (e.g. webinars, workshops), and if outreach materials will be developed to communicate results. Refer to the *Communication Plan* template to document relevant information.

Assessment Templates

The following templates are available to help complete Step 1 of the Vulnerability and Adaptation Assessment.

- 1a | Priority Health Hazards
- 1b | Project Team
- 1c | Work Plan
- 1d | Information Sources
- 1e | Communication Plan

STEP 1A: PRIORITY HEALTH HAZARDS TEMPLATE

Use this template to compile preliminary information on climate change health outcomes and climate-related hazards in order to identify which should be a priority for the assessment. The template lists examples of climate and health outcome indicators to assist you in this step. You may have more or different hazards and indicators to include. Use the template to document data and information related to each health outcome and knowledge gaps of interest to help in prioritization. Provide information on morbidity and mortality in your jurisdiction from climate hazards. When compiling this information, pose the following questions to help prioritize health concerns:

- > What are the priority climate-sensitive health outcomes of concern in the study area?
- > Which climate-sensitive health outcomes are of greatest concern for stakeholders and the public?
- > Did recent extreme weather and climate events raise concerns about health risks such as heat events or floods?
- > Were recent assessments conducted in the region in other sectors that highlight issues affecting health?
- > Are neighbouring health units also conducting a health vulnerability and adaptation assessment?



Health Hazard Example Health Hazard Example Health Hazard Example **EXTREME TEMPERATURE OTHER EXTREME WEATHER EVENTS AIR QUALITY** (heat, cold) **EVENTS** (aeroallergens, air pollution – ground-level (e.g., storms, floods, drought) ozone, particulate matter) **Indicator Examples Indicator Examples Indicator Examples** • Heat-related morbidity and mortality • Morbidity and mortality from extreme Cardiovascular or respiratory health weather events (e.g. injuries, infections, Cold-related morbidity and mortality outcomes from aeroallergens or poor mental health outcomes air quality (ground-level ozone, particulate matter) **Data and Information Data and Information Data and Information Knowledge Gaps Knowledge Gaps Knowledge Gaps** Health Hazard Example Health Hazard Example Health Hazard Example **FOOD AND WATERBORNE DISEASES VECTORBORNE DISEASES STRATOSPHERIC** (Lyme disease, West Nile Virus) **OZONE DEPLETION Indicator Examples Indicator Examples Indicator Examples** • Illnesses or outbreaks due to food, or West Nile Virus incidence • Cases of sunburns, skin cancers, cataracts waterborne diseases • Lyme disease incidence and eye damage • Other vectorborne disease incidence **Data and Information Data and Information Data and Information**

Knowledge Gaps

Knowledge Gaps

Knowledge Gaps



STEP 1B: PROJECT TEAM TEMPLATE

Use this template to list project team members and other relevant information such as their area of responsibility (e.g. health departments managing the health outcome of interest, other sectors whose activities can affect the health outcome), expertise and/or whom they represent (individuals or organizations) and roles in the assessment.

When identifying potential project team members, include the following stakeholders, member types and considerations:

- > Officials from local authorities whose activities can affect the burden and pattern of climate-sensitive health outcomes
- > Representatives of health care providers who would diagnose and treat any identified cases
- $\,\,>\,\,$ Core members of the project team who stay for the entire project
- > Ensure a high degree of stakeholder inclusivity while having a small enough team to direct the study most effectively
- > Individuals that are working on issues relevant to the mandate of the assessment in other departments or organizations (e.g. experts in disease transmission, experts on sources of ground-level ozone)
- > Communication experts to discuss how to present the results to the public in ways that empower appropriate behavioral adaptation actions
- > Additional resource persons with targeted expertise on specific topics

PROJECT TEAM MEMBER

CONTACT INFORMATION

PROJECT TEAM MEMBER

CONTACT INFORMATION

AREA OF EXPERTISE (e.g. health specialty, non-health speciality)

AREA OF EXPERTISE (e.g. health specialty, non-health speciality)

ROLES AND RESPONSIBILITIES

(e.g. write report, conduct literature review, conduct statistical analysis, organize meetings and stakeholder workshops etc.)

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(e.g. write report, conduct literature review, conduct statistical analysis, organize meetings and stakeholder workshops etc.)



PROJECT TEAM MEMBER

PROJECT TEAM MEMBER

CONTACT INFORMATION

CONTACT INFORMATION

AREA OF EXPERTISE (e.g. health speciality, non-health speciality)

AREA OF EXPERTISE (e.g. health speciality, non-health speciality)

ROLES AND RESPONSIBILITIES

(e.g. write report, conduct literature review, conduct statistical analysis, organize meetings and stakeholder workshops etc.)

ROLES AND RESPONSIBILITIES (e.g. write report, conduct literature review, conduct statistical analysis, organize meetings and stakeholder workshops etc.)



STEP 1C: WORK PLAN TEMPLATE

The work plan should specify the management plan, key responsibilities, activities, time line and resources needed for the assessment. Use this template to document key milestones or deliverables, deadlines, resources and key contacts for undertaking the assessment. The work plan also needs to consider the extent to which all steps in a vulnerability and adaptation assessment are necessary to achieve the desired results. Time and financial resources may call for a delay in implementing or removal of a particular step; this should be noted in the work plan. Adapt the work plan template to suite the specific information needs of the assessment.

Assessment Step 1. FRAME AND SCOPE THE ASSESSMENT	Assessment Step 2. DESCRIBE CURRENT RISKS INCLUDING VULNERABILITIES AND CAPACITIES	Assessment Step 3. PROJECT FUTURE HEALTH RISKS
Milestone or Deliverable	Milestone or Deliverable	Milestone or Deliverable
Deadline	Deadline	Deadline
Resources	Resources	Resources
Lead or Key Contact	Lead or Key Contact	Lead or Key Contact



Assessment Step 4. IDENTIFY AND PRIORITIZE POLICIES AND PROGRAMS TO MANAGE THE ADDITIONAL HEALTH RISKS ASSOCIATED WITH A CHANGING CLIMATE	Assessment Step 5. ESTABLISH AN ITERATIVE PROCESS FOR MANAGING AND MONITORING HEALTH RISKS	Assessment Step 6. EXAMINE POTENTIAL HEALTH BENEFITS AND CO-HARMS OF ADAPTATION AND MITIGATION OPTIONS IMPLEMENTED IN OTHER SECTORS
Milestone or Deliverable	Milestone or Deliverable	Milestone or Deliverable
Deadline	Deadline	Deadline
Resources	Resources	Resources
Lead or Key Contact	Lead or Key Contact	Lead or Key Contact



STEP 1D: INFORMATION SOURCES TEMPLATE

Another activity to undertake during the scoping phase is to identify available and relevant data and information for the assessment. It is important to collect information on important indicators of risk for each climate hazard identified as a priority. Examples of key indicators that may be considered are included in the template. You may identify other indicators needed for the assessment in your community or region. Sources of relevant information include:

- PEER-REVIEWED LITERATURE There are many publications on potential changes in health risks to vulnerable populations from climate hazards. Some of these include projections of future hot days and warm nights in Canada in the coming decades and maps on the current and projected ranges of the vector that causes Lyme disease in eastern Canada
- GREY LITERATURE Grey literature may describe the current burden of climate-sensitive diseases and management approaches for the health outcomes of concern. Also, national and provincial level assessment reports in Canada include potential changes in air quality and in the frequency of extreme heat events due to climate change
- > **CLIMATE AND WEATHER DATA** This data may be obtained from environment agencies and can include changes in precipitation patters and occurrences of drought
- > **PROVINCIAL AND COMMUNITY REPORTS** These reports can provide information on a range of key vulnerability factors (e.g. health reports and associated datasets of relevance)

Health Hazard Examples

EXTREME TEMPERATURE (heat, cold) **EVENTS**

Indicators of Risk

- Maximum and minimum temperatures, heat index
- Increase in heat alerts/warnings
- Projected hot days and warm nights
- Projected cold days
- Excess mortality due to extreme heat
- Excess morbidity due to extreme heat
- Daily all-cause mortality (trends associated with heat)
- Percent households without any air conditioning
- Access to cooling centers
- Percent households with central air conditioning
- Number of heat wave early warning systems
- Number of municipal heat island mitigation plans

Source

Health Hazard Examples

OTHER EXTREME WEATHER EVENTS (storms, floods, droughts)

Indicators of Risk

Source

- Historical precipitation intensity, duration and frequency patterns
- Projected changes in precipitation
- Historical frequency, severity, distribution, and duration of wildfires, flooding, droughts and tornadoes
- Projected frequency, severity, distribution, and duration of wildfires, flooding, droughts and tornadoes
- Incidence of injury/death from extreme events and diseases

Health Hazard Examples

AIR QUALITY (aeroallergens, air pollution — ground-level ozone, particulate matter)

Indicators of Risk

- Stagnation air mass events
- Ground-level ozone estimates due to climate change
- Pollen counts, ragweed presence
- Number and duration of smog advisories
- Ozone and particulate matter concentrations and exceedance
- Number of vehicle miles travelled/ Automobile use
- Respiratory/allergic disease and mortality related to increased air pollution and pollens (ground-level ozone, fine particulate matter (PM2.5))
- Daily all-cause mortality (trends associated with air pollution)
- Daily non-accidental mortality (trends associated with heat and air pollution)
- Air quality monitoring capabilities
- Government regulations aimed at improving air quality

Source



Health Hazard Examples

FOOD AND WATERBORNE DISEASES

Indicators of Risk

- Foodborne diseases or outbreaks
- Water related diseases and infections (drinking and recreational water)
- Food safety surveillance and control programs

Source

Health Hazard Examples

VECTORBORNE DISEASES

(Lyme disease, West Nile Virus)

Indicators of Risk

- West Nile disease incidence in humans
- *Lyme borreliolis* incidence in humans
- Number of positive test results in reservoirs/ sentinels/vectors
- Vectorborne disease surveillance and control programs
- Projected expansion of disease vectors
- Number of vector management activities

Source

Health Hazard Examples

STRATOSPHERIC OZONE DEPLETION

Indicators of Risk

- Preventable deaths from skin cancer
- Estimated number of excess hospital admissions due to climate hazard exposure

Source

Health Hazard Examples

VULNERABLE POPULATIONS

Indicators of Risk

- \geq 65 years of age
- \geq 65 years of age living alone
- Infants and young children
- People with chronic illness/physically impaired (e.g. diabetes, cardiovascular or renal disease, nervous system disorders)
- Socially disadvantaged individuals and communities
- Newcomers
- Relevant occupational groups (e.g. outdoor workers for heat-exposure sensitivity)
- Physically active individuals
- Smoking population
- People suffering from food insecurities
- Vulnerable populations (above) living in 100and 500- year flood zones
- Population by country within 5km of coast with "very high" vulnerability to sea level rise
- Employment and unemployment rates
- Below poverty line

Source



STEP 1E: COMMUNICATION PLAN TEMPLATE

Developing a communication plan early in the process is important to ensure that the assessment is structured, from the beginning, to communicate identified risks effectively to those who will manage the risks and to those who could be affected. Use this template to specify the primary assessment output (e.g. report), to whom it will be communicated, mechanisms for sharing the results (e.g. webinars, workshops), and if outreach materials will be developed to communicate results.

Assessment Milestone or Event 1. ASSESSMENT LAUNCH Output/Outcome	Assessment Milestone or Event 2. ASSESSMENT AWARENESS AND ENGAGEMENT Output/Outcome	Assessment Milestone or Event 3. DRAFT REPORT RELEASE FOR REVIEW Output/Outcome
Target Audience	Target Audience	Target Audience
(e.g. decision-makers, public)	(e.g. decision-makers, public)	(e.g. decision-makers, public)
Communication Mechanism	Communication Mechanism	Communication Mechanism
(e.g. webinar, outreach materials)	(e.g. webinar, outreach materials)	(e.g. webinar, outreach materials)



Assessment Milestone or Event

4. FINAL REPORT RELEASE

Output/Outcome

Target Audience (e.g. decision-makers, public)

Communication Mechanism

(e.g. webinar, outreach materials)

Assessment Milestone or Event

5. POST ASSESSMENT ENGAGEMENT

Output/Outcome

Target Audience (e.g. decision-makers, public)

Communication Mechanism (e.g. webinar, outreach materials)



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STEP 2: DESCRIBE CURRENT RISKS INCLUDING VULNERABILITIES AND CAPACITIES

Step 2: Overview

This step is undertaken to describe current climate change and health risks. This involves documenting climate hazards and vulnerabilities, which are a function of sensitivities and individual and community level capacities to cope or adapt. This will provide the context for understanding where modifications to current programs could help protect health as the climate continues to change.

STEP 2A: REVIEW QUALITATIVE AND QUANTITATIVE INFORMATION

The datasets, departmental documents, peer-reviewed publications, and internet sources identified during step 1 should be reviewed for relevant information on the priority health hazards. Gaps in knowledge can be filled, to some extent, by interviewing subject matter experts to describe current exposures and vulnerabilities. Keep track of the information collected in order to quickly reference and analyze the data and to inform the assessment report.

STEP 2B: ESTIMATE CURRENT RELATIONSHIPS BETWEEN WEATHER PATTERNS AND CLIMATE-SENSITIVE HEALTH OUTCOMES

Determine the associations (if any) between the exposures and the incidence, seasonality, and geographic range of the climate-sensitive health outcomes under consideration.

Graphing the data may prove useful for identifying patterns, particularly with limited time series. It is important to consider factors that could influence any observed trends such as changes in disease control programs and changes in land use. There will be more confidence in analyses conducted using longer and larger health data sets.

When sufficient data are not available, estimates of the strength of associations can be gathered from the published literature or from interviews with subject matter experts. This information can be used to describe exposure-response relationships. Survey questionnaires may be useful for obtaining this type of information. Refer to the *Estimating Current Relationships* template to help document relevant information.

STEP 2C: DESCRIBE HISTORICAL TRENDS IN THE ENVIRONMENTAL HAZARDS OF INTEREST

Collect data and maps on recent weather and climatic trends of interest. Data can be obtained from the Ontario Ministry of the Environment and Climate Change, the Ontario Ministry of Natural Resources and Forestry, Natural Resources Canada (the atlas of Canada <u>http://atlas.nrcan.gc.ca/site/english/index.html</u>), or Environment Canada (national climate data and information archive <u>http://climate.weather.gc.ca</u>).

If relevant to important health outcomes, document how the geographic range, intensity, and duration of particular weather events have changed over recent decades. Consulting a meteorologist or climatologist can be helpful to ensure data are interpreted appropriately.



STEP 2D: CHARACTERIZE THE CURRENT VULNERABILITY OF EXPOSED INDIVIDUALS AND COMMUNITIES, INCLUDING SENSITIVITY AND ABILITY TO COPE

The extent to which a particular group is vulnerable to a specific health outcome reflects the balance between factors that increase sensitivity and the ability to cope with exposures.

- > **SENSITIVITY** is an expression of the increased responsiveness of an individual or community to an exposure, generally for biological reasons (e.g. age or the presence of pre-existing medical conditions).
- > The **ABILITY TO COPE** measures the ability of individuals and communities to plan for, respond to, and recover from exposure to climate change-related hazards.

Use vulnerability indicators for each climate hazard and pose questions to obtain indicator data. When collecting data, consider those individuals and communities that are most vulnerable. Refer to the *Vulnerability Indicators* template for examples and to record relevant information.

STEP 2E: DESCRIBE AND ASSESS THE EFFECTIVENESS OF POLICIES AND PROGRAMS TO MANAGE CURRENT VULNERABILITIES AND HEALTH BURDENS

Generate a list of all existing policies and programs that affect the climate-sensitive health outcomes considered in the assessment. Using evaluations or expert judgement, determine how well policies and programs are protecting individuals and communities against climate-related hazards. Consider the effectiveness of current programs/systems in reducing morbidity and mortality, the quality of program management and delivery, (e.g. infectious disease monitoring and surveillance) and whether existing measures are sufficient for reducing risks. Refer to the *Effectiveness of Policies and Programs* template to help document relevant information.

STEP 2F: DEVELOP A BASELINE OF INFORMATION FOR USE IN MONITORING FUTURE VULNERABILITY AND FOR EVALUATING ADAPTATION OPTIONS

Develop an explicit baseline of information from assessment results that can be used to determine the success (or failure) of future adaptation policies and programs. The baseline should describe current morbidity and mortality of the climate-sensitive health outcomes of concern, including recent trends and information on the key factors associated with the respective outcomes. It should also examine the policies and programs in place to manage those outcomes, including measures of their effectiveness. Drivers that affect the health outcome and risk level should be documented and monitored over time (e.g. policies and programs).

Assessment Templates

The following templates are available to help complete Step 2 of the Vulnerability and Adaptation Assessment.

- 2b | Estimating Current Relationships
- 2d | Vulnerability Indicators
- 2e | Effectiveness of Policies and Programs



STEP 2B: ESTIMATING CURRENT RELATIONSHIPS BETWEEN WEATHER PATTERNS AND CLIMATE-SENSITIVE HEALTH OUTCOMES TEMPLATE

Determine the associations (if any) between the exposures and the incidence, seasonality, and geographic range of the climate-sensitive health outcomes under consideration. The template below includes guiding questions and examples of key relationships that could be examined. In the last column of the template, indicate if the information is available and accessible. If it is not readily available or accessible, indicate how the data could be obtained (e.g. conduct a literature search, conduct interviews with subject matter experts). Experts can provide estimates of the impacts of extreme heat events on excess mortality or of heavy precipitation events on episodes of gastrointestinal diseases which can be used to describe exposure-response relationships. If interviews with experts will be conducted, identify key respondents who have carried out other assessments. Create survey questionnaires and keep track of the information collected in order to quickly reference and analyze the data.

Examples of Health Hazards

EXTREME TEMPERATURES (heat and cold events)

Examples of Guiding Questions

- Is the population widely exposed to extreme heat or cold? If so which populations are exposed?
- What is the incidence of heat- or cold-related illnesses or deaths?
- Is there a particular seasonality that characterizes the heat- or cold related health outcomes?
- What is the geographic range within which heat- or cold related health hazards pose health risks to individuals?
- What is the current impact of ______ on morbidity and/or mortality? How does this vary with changes in duration, intensity and frequency of the hazard?

Indicators of Duration, Intensity, Frequency, Seasonality and Geographic Range for Hazard of Interest

- Number of extreme heat and/or cold days
- Number of extreme heat and/or cold events
- Number of heat alerts called

Indicators of Mortality or Morbidity

- Number of heat or cold related hospital visits
- Number of deaths attributable to heat or cold
- Number of heat or cold-related illnesses

Is this information available/accessible? If so record this information. If not, how can it be obtained?



Examples of Health Hazards

AIR QUALITY

(aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)

Examples of guiding questions

- Is the population exposed to air pollution, aeroallergens or wildfire smoke? If so which populations are exposed?
- What is the incidence of respiratory conditions attributable to air pollution, aeroallergens or wildfire smoke?
- Are there certain times of the year when air pollution, aeroallergens and wildfire smoke pose the greatest human health risks?
- What is the geographic range within which air pollution, aeroallergens and wildfire smoke poses health risks to individuals?
- What is the current impact of ______ on morbidity and/or mortality? How does this vary with changes in duration, intensity and frequency?

Indicators of Duration, Intensity, Frequency, Seasonality and Geographic Range for Hazard of Interest

- Number of smog days
- Number of high allergen days
- Duration of allergy season

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- Number of poor air quality days due to wildfire smoke
- Geographic range of poor air quality

Indicators of Mortality or Morbidity

- Number of hospital visits attributable to smog
- Number of hospital visits due to exposure to wildfire smoke
- Number of hospital visits attributable to allergies
- Number of deaths attributable to poor air quality

Is this information available/accessible? If so record this information. If not, how can it be obtained?



STEP 2D: VULNERABILITY INDICATORS TEMPLATE

Use the template below to document information on the sensitivity and adaptive capacity of individuals and the community to climate-related health hazards. Many sensitivity and adaptive capacity indicators are relevant for all climate-related health hazards (i.e. provide an indication of vulnerability for all), while others are specific to one or more. Examples of vulnerability indicators are provided in the template to help guide data collection. Data from these indicators will also be useful for monitoring adaptation success. See Step 5b: Monitoring Indicators Template.

Health Hazards

EXTREME TEMPERATURE (heat, cold) **EVENTS**

Vulnerability Category

Exposure

Examples of Vulnerability Indicators

- Maximum and minimum temperatures, heat index
- Increase in heat alerts/warnings
- Projected hot days and warm nights
- Projected cold days
- Projected air temperature seasonal changes and extremes
- Proportion of the population living in an urban heat island

Data Source

Health Hazards

EXTREME TEMPERATURE

Vulnerability Category

Examples of Vulnerability Indicators

- Socially and economically disadvantaged populations
- Number of people with conditions that inhibit temperature regulation
- Number of seniors
- Number of children
- Heat-related morbidity and mortality
- Cold-related morbidity and mortality

Data Source

Health Hazards **EXTREME TEMPERATURE**

(heat, cold) **EVENTS**

Vulnerability Category

Adaptive Capacity

Examples of Vulnerability Indicators

- Health and social services
- Proportion of the population without air conditioning
- Access to cooling centers
- No. of heat wave early warning systems
- No. of municipal heat island mitigation plans

Data Source

Method(s) of Verifying Efficacy and **Appropriateness of Indicators**

Method(s) of Verifying Efficacy and **Appropriateness of Indicators**

Method(s) of Verifying Efficacy and **Appropriateness of Indicators**

(heat, cold) **EVENTS**

Sensitivity

Health Hazards	Health Hazards	Health Hazards
OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)	OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)	OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)
Vulnerability Category Exposure	Vulnerability Category Sensitivity	Vulnerability Category Adaptive Capacity
 Examples of Vulnerability Indicators Historical precipitation intensity, duration and frequency patterns Projected precipitation intensity, duration and frequency patterns Historical frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes Projected frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes Proportion of the population living on or near flood plains 	 Examples of Vulnerability Indicators Socially and economically disadvantaged populations Number of people with mobility limitations Number of seniors Number of pregnant women Number of children Number of people who drink alcohol, use illicit substances or take medication Morbidity and mortality from extreme weather events (e.g. injuries, infections, mental health outcomes) 	 Examples of Vulnerability Indicators Health and social services Emergency management programs Mental health programs focused on reducing mental health outcomes from floods, droughts and other extremes
Data Source	Data Source	Data Source
Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators



Health Hazards STRATOSPHERIC OZONE DEPLETION Vulnerability Category Exposure Examples of Vulnerability Indicators • Proportion of the population that does not take protective measures during sunniest parts of the day • Extension of warm season due to climate change	Health Hazards STRATOSPHERIC OZONE DEPLETION Vulnerability Category Sensitivity Examples of Vulnerability Indicators • Number of children • Number of persons working outdoors • Number of persons with skin conditions that increase sun damage risks	Health Hazards STRATOSPHERIC OZONE DEPLETION Vulnerability Category Adaptive Capacity Examples of Vulnerability Indicators • Health and social services • Health promotion activities on sun safety/sun damage prevention/cancer prevention • Urban greening/shade policies
Data Source	Data Source	Data Source
Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators



AIR QUALITY (aeroallergens,

air pollution from ozone, particulate matter and/or wildfire smoke)

Vulnerability Category

Exposure

Data Source

Examples of Vulnerability Indicators

- Stagnation air mass events
- Projected ground-level ozone and particulate matter estimates due to climate change
- Pollen counts, ragweed presence
- Number and duration of smog advisories
- Ground-level ozone and particulate matter concentrations and exceedance

Method(s) of Verifying Efficacy and Appropriateness of Indicators

Health Hazards

AIR QUALITY (aeroallergens, air pollution from ozone, particulate matter and/or wildfire smoke)

Vulnerability Category

Sensitivity

Examples of Vulnerability Indicators

- Socially and economically disadvantaged populations
- Number of seniors
- Number of children
- Number of people with chronic diseases and who smoke tobacco
- Cardiovascular or respiratory health outcomes from aeroallergens or poor air quality (groundlevel ozone, particulate matter)
- Number of persons working outdoors
- Daily all-cause mortality (trends associated with air pollution)
- Daily non-accidental mortality (trends associated with air pollution)

Method(s) of Verifying Efficacy and Method(s) of Verifying Efficacy and Appropriateness of Indicators Method(s) of Verifying Efficacy and

Health Hazards

wildfire smoke)

Adaptive Capacity

AIR QUALITY (aeroallergens,

air pollution from ozone,

particulate matter and/or

Vulnerability Category

• Health and social services

• Air quality regulations

aeroallergens or wildfire smoke

• Proportion of people who use public

• Air quality monitoring capabilities

transportation / active transportation

Examples of Vulnerability Indicators

• Health promotion activities on air pollution

prevention and protection from air pollutants,



Health Hazards

FOOD AND WATERBORNE ILLNESSES AND FOOD SECURITY ISSUES

Vulnerability Category

Exposure

Examples of Vulnerability Indicators

- Number of people on small water systems
- Number of people using natural outdoor recreational facilities (e.g., beaches)
- Number of people on flood plains
- Harmful algal blooms
- Number of outdoor events (e.g., farmers markets) during warm weather

Health Hazards

FOOD AND WATERBORNE ILLNESSES AND FOOD SECURITY ISSUES

Vulnerability Category Sensitivity

Examples of Vulnerability Indicators

- Socially and economically disadvantaged populations
- First Nations and Inuit populations relying on traditional foods
- People with suppressed or developing immune systems
- Foodborne diseases or outbreaks
- Water related diseases and infections (drinking and recreational water)

Health Hazards

FOOD AND WATERBORNE ILLNESSES AND FOOD SECURITY ISSUES

Vulnerability Category

Adaptive Capacity

Examples of Vulnerability Indicators

- Health and social services
- Food safety regulations for food processing activities and food premises
- Drinking and recreational water quality quidelines and regulations
- Water quality advisories and programs
- Number of meal programs and food banks
- Surveillance of water and foodborne diseases
- Health promotion activities on food safety and drinking water safety
- Local community ability to grow food

Data Source	Data Source	Data Source
Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators



Health Hazards	Health Hazards	Health Hazards	
VECTORBORNE DISEASES	VECTORBORNE DISEASES	VECTORBORNE DISEASES	
(Lyme disease, West Nile Virus)	(Lyme disease, West Nile Virus)	(Lyme disease, West Nile Virus)	
Vulnerability Category	Vulnerability Category	Vulnerability Category	
Exposure	Sensitivity	Adaptive Capacity	
 Examples of Vulnerability Indicators West Nile Virus incidence Lyme disease incidence Other vectorborne disease incidence West Nile disease incidence in humans Lyme borreliolis incidence in humans No. of positive test results in reservoirs/ sentinels/vectors 	 Examples of Vulnerability Indicators Number of seniors Number of children People with suppressed or developing immune systems Number of persons spending greater time outdoors for recreation Number of persons working outdoors Number of persons travelling to other parts of the world where other vectorborne diseases may be endemic 	 Examples of Vulnerability Indicators Health and social services Vectorborne diseases programs (e.g. surveillance and monitoring, larviciding, adulticiding, public awareness campaigns) 	
Data Source	Data Source	Data Source	
Method(s) of Verifying Efficacy and	Method(s) of Verifying Efficacy and	Method(s) of Verifying Efficacy and	
Appropriateness of Indicators	Appropriateness of Indicators	Appropriateness of Indicators	



STEP 2E: EFFECTIVENESS OF POLICIES AND PROGRAMS TEMPLATE

Use the Table 1 in this template to generate a list of all existing policies and programs that affect the climate-sensitive health outcomes considered in the assessment. Keep track of data sources that can be used to undertake the evaluation. Use Table 2 to record evaluation information for each policy and program under evaluation. Using existing evaluations and/or expert judgement, evaluate the effectiveness of each policy and program in reducing the relevant climate-related health risks. Two main categories of investigation should be considered when conducting an evaluation. Refer to Text Box 1 in this template for a description of process and outcome evaluations and examples of data sources.

TABLE 1. TEMPLATE FOR GENERATING A LIST OF EXISTING POLICIES OR PROGRAMS THAT AFFECT CLIMATE-SENSITIVE HEALTH OUTCOMES

Examples of Health Hazards	Examples of Health Hazards	Examples of Health Hazards	Examples of Health Hazards
GENERAL	EXTREME TEMPERATURE (heat, cold) EVENTS	OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)	STRATOSPHERIC OZONE DEPLETION
Policies or Programs	Policies or Programs	Policies or Programs	Policies or Programs
1.	1.	1.	1.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources
2.	2.	2.	2.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources
3.	3.	3.	3.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources
4.	4.	4.	4.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources
5.	5.	5.	5.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources



Examples of Health Hazards	Examples of Health Hazards	Examples of Health Hazards
AIR QUALITY (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)	FOOD AND WATERBORNE ILLNESSES AND FOOD SECURITY ISSUES	VECTORBORNE DISEASES (e.g. Lyme disease, West Nile Virus)
Policies or Programs	Policies or Programs	Policies or Programs
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources
2.	2.	2.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources
3.	3.	3.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources
4.	4.	4.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources
5.	5.	5.
Evaluation Data Sources	Evaluation Data Sources	Evaluation Data Sources



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TABLE 2. TEMPLATE FOR CONDUCTING A PROCESS AND/OR OUTCOME EVALUATION OF A CLIMATE CHANGE AND HEALTH POLICY OR PROGRAM

Policy or Program Name:

Date Template Completed:

Completed By:

*1=Highly effective, 2=Somewhat effective, 3=Not effective, 4=Unknown

Evaluation Type

PROCESS

Guiding Questions

Operational Costs

- Has the policy or program been carried out as planned?
- Has each component of the policy or program been operating effectively?
- What are the operational costs (resources used)?
- Were processes involved in implementing the policy/program efficient?

Indicator Examples

Operational Costs

- Resources used by each partner to implement program
- Resources required for collecting and monitoring surveillance data
- Staff time spent on the implementing the policy or program at various stages
- Costs to communicate messages to stakeholders and the public
- Costs of maintaining the policy or program

Evaluation Data

Operational Costs

Evaluation Result

Operational Costs

Evaluation Type

PROCESS

Guiding Questions

Protocols/Processes

- Was information provided to stakeholders accurate?
- Were relevant stakeholders engaged?
- Did stakeholders find the process useful and helpful?
- Are intended responses being followed through by the public or other stakeholders?

Indicator Examples

Protocols/Processes

- Frequency of partner notification and public alerts
- Timeliness of alert information received
- Timeliness and efficiency of message delivery to the public
- Quality of surveillance data
- Frequency of warnings and alerts issued in relation to actual weather conditions occurring
- Capacity of participating agencies to monitor and deliver surveillance and weather data

Evaluation Data

Protocols/Processes

Evaluation Result

Protocols/Processes



Evaluation Type

PROCESS

Guiding Questions

Stakeholder Engagement

- Were relevant and key messages being provided to the public in a timely manner?
- Is the target population aware of the policy/program and do they comprehend the messages?

Indicator Examples

Stakeholder Engagement

- Level of participation of agencies and other community groups in education activities
- Number and types of response measures delivered by stakeholders
- Number and diversity of engaged stakeholders and meeting frequency
- Partners' views on the degree of coordination of activities
- Stakeholders' views on the adequacy of support offered
- Level of stakeholder satisfaction
- Number of at-risk people who took preventive actions
- Number of people, their demographic makeup, and degree of compliance with intended responses
- Number of people and their demographic makeup who took advantage
 of other response measures

Evaluation Data

Stakeholder Engagement

Evaluation Result

Stakeholder Engagement

Evaluation Type

PROCESS

Guiding Questions

Communication

• Was communication effective?

Indicator Examples

Communication

- Number of planned communication elements delivered
- Vulnerable and general populations reached by each communication element
- Number and types of inquiries received
- Number and types of resources distributed
- Promotion and publicity received through media activities
- Number of media and information sources engaged as part of the outreach campaign
- Reach of key messages into media
- Accessibility of information to the public
- Number of at-risk people who perceive hazard to be a health risk
- Number of at-risk people who can identify preventive measures
- Capacity of targeted population to recall accurate messaging

Evaluation Data

Communication

Evaluation Result

Communication



Evaluation Type

OUTCOME

Guiding Questions

Outcome

- Has progress been made towards achieving intermediate objectives and ultimate policy or program goals?
- Has the policy or program been effective in reducing health risks or negative health outcomes as intended?
- Has morbidity or mortality decreased due to the public health intervention?
- Has the public health intervention lead to a desired change in awareness, knowledge, understanding and behavioural change?

Indicator Examples

Outcome

- Number of daily deaths relative to historical baseline
- Number of daily emergency calls attributable to the hazard
- Number of daily emergency room visits and hospitalizations attributable to the hazard
- Changes in health protective behaviours of at-risk population
- Changes in public awareness, knowledge and beliefs an changes in service utilization

Evaluation Data

Outcome

Evaluation Result

Outcome



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Text Box 1. Information on Conducting Evaluations of Policies and Programs for Reducing Health Risks from Climate Change Hazards

Information Sources for Evaluations of Policies or Programs

Formal evaluations are most credible and useful when information is gathered using a mix of qualitative (e.g. focus groups, in-depth interviews, open-ended survey questions) and quantitative methods (e.g. surveys, process tracking forms and records, large data sets). Informal feedback from stakeholders and target audiences, as well as observations about the performance of the policy or program from lead agencies, may be used for the evaluation; however, this type of data is often incomplete and may be biased. The most appropriate indicators and methodologies for data collection can be identified when the evaluation design addresses the following: evaluation goals, data availability, types of tools and measures needed for data collection, frequency of data collection and optimal time frame to collect the data, and organizations responsible for data collection and analysis. A collaborative approach to the evaluation process, including identifying the core objectives, is essential. Using this approach, partners and stakeholders contribute to the evaluation through their knowledge of individual and community-level vulnerabilities, target audiences for outreach activities, and existing information gaps. It is important to identify core elements of the program or policy and its ultimate goal. A schematic can guide the evaluation process by highlighting how the policy or program operates and by identifying leads with their roles and responsibilities.

Process and Outcome Evaluations

- **Process evaluation** determines if the policy or program has been carried out as planned and whether each component of the policy or program has been operating effectively. It involves gathering data during implementation to assess program-specific issues of relevance and performance as well as design and delivery. The evaluation should address pre-identified questions using a set of indicators. Data sources could include: financial reporting information, interviews, meeting summaries, website usage statistics and other inquiries received and table-top exercises.
- **Outcome evaluation** focusses on the impact of the policy or program based upon the policy or program goals and objectives. An evaluation should be focussed on issues of greatest concern to partners and stakeholders, while being as simple and cost-effective as possible. It is most appropriate for well-developed policies or programs that have made progress towards achieving intermediate objectives and ultimate goals. This type of evaluation should focus on policy or program effectiveness by measuring changes in morbidity and mortality and the impact of the public health interventions on awareness, knowledge, understanding and behavioural change. Outcome evaluations may need more resources because they require several years of observation, the establishment of baseline data, access to hospitalization and annual mortality data, and the expertise of an epidemiologist to conduct the analysis. A detailed analysis of health outcomes based on only a few years of implementation of the program or policy will likely convey a limited understanding of program impact and effectiveness.

Adapted from Heat Alert and Response Systems to Protect Health: Best Practices Guidebook. Health Canada. Ottawa, Ontario: Her Majesty the Queen in Right of Canada represented by the Minister of Health. http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/climat/response-intervention/response-intervention-eng.pdf



STEP 3: PROJECT FUTURE HEALTH RISKS

Step 3: Overview

This step requires a consideration of how the current magnitude and pattern of climate-sensitive health burdens could change in a changing climate. For this step, build on information that was collected in Step 2b (refer to the *Estimating Current Relationships template*).

STEP 3A: REVIEW QUALITATIVE AND QUANTITATIVE INFORMATION

Explore datasets, department documents, peer-reviewed publications, and internet sources to identify relevant information. Collect information to answer questions about future health burdens from climate change such as: how could climate change affect air pollution or the frequency, intensity, and duration of future heat events? When information from the aforementioned sources is unavailable, seek insight from experts.

STEP 3B: DESCRIBE HOW CURRENT RISKS COULD CHANGE UNDER DIFFERENT WEATHER AND DEVELOPMENT PATTERNS

Determine the time frame for projecting future health risks. Confidence in climate projections over the next few decades (up to 2040's) is greatest.

MOHLTC's Climate Change and Health Modeling Study provides information on projected climate-related health impacts in 2020, 2050 and 2080. Refer to this study as one source of data on potential future health risks.

To project future health risks, a common approach is to multiply current exposure-response relationships by the projected change in the relevant weather variable(s) over the time periods of interest. This approach assumes that current vulnerability will remain the same over the coming decade; which is unlikely. Vulnerability is expected to change as socio-economic and environmental factors change over time. Consider also how weather affects how climate-sensitive health risks evolve. Aim to estimate how morbidity and mortality of health outcomes could be a ltered by: (1) development patterns alone, (2) climate change alone, and (3) climate and development.

Use the following approaches to obtain relevant information:

- > Work with modeling experts to obtain quantitative projections of health risks.
- > Host an expert meeting with the goal of describing several possible development pathways over the next few decades, taking into consideration planned changes in policies and programs.
- > Use local and regional climate projections from available sources. Scenarios can be created that combine development pathways with climate change projections to facilitate projections that cover a wider range of possible futures.
- > Use a qualitative approach, through expert interviews and facilitated discussions, to estimate health risks in the next few decades.

The projected risks will have several sources of uncertainty. Describe climate uncertainties in the assessment report and the extent to which they could influence projected health risks. Refer to the *Project Future Health Risks* template to document relevant information for this step.

Assessment Templates

The following template is available to help complete Step 3 of the Vulnerability and Adaptation Assessment.

3b | Project Future Health Risks



STEP 3B: PROJECT FUTURE HEALTH RISKS TEMPLATE

Use the template below to document projections of future climate change risks to health. To project future health risks, a common approach is to multiply current exposure-response relationships by the projected change in the relevant weather variable(s) over the time periods of interest. Keep in mind that vulnerability and adaptive capacity will also evolve over time. For each climate health hazard of interest, use the guiding questions to collect and document information. Add to the list of questions to focus inquiries and to obtain relevant information for the assessment. To obtain data, employ literature searches, expert interviews, facilitated discussions at a workshop, consultations with modelling experts and other approaches. Document uncertainties and how they could affect projected health risks in the template.

Health Hazard Examples EXTREME TEMPERATURES (heat and cold events)	Health Hazard Examples EXTREME TEMPERATURES (heat and cold events)
Guiding Questions (1) How is climate change expected to affect the hazard?	Guiding Questions (2) How are vulnerability and adaptive capacity expected to change?
Time period	Time period
Projected Changes	Projected Changes
Baseline Health Risks	Baseline Health Risks
Projected changes to health risks	Projected changes to health risks
Uncertainties	Uncertainties



Health Hazard Examples OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)	Health Hazard Examples OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)
Guiding Questions (1) How is climate change expected to affect the hazard?	Guiding Questions (2) How are vulnerability and adaptive capacity expected to change?
Time period	Time period
Projected Changes	Projected Changes
Baseline Health Risks	Baseline Health Risks
Projected changes to health risks	Projected changes to health risks
Uncertainties	Uncertainties



Health Hazard Examples STRATOSPHERIC OZONE DEPLETION Guiding Questions (1) How is climate change expected to affect the hazard? Time period	Health Hazard Examples STRATOSPHERIC OZONE DEPLETION Guiding Questions (2) How are vulnerability and adaptive capacity expected to change? Time period
Projected Changes	Projected Changes
Baseline Health Risks	Baseline Health Risks
Projected changes to health risks	Projected changes to health risks
Uncertainties	Uncertainties


Health Hazard Examples AIR QUALITY (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)	Health Hazard Examples AIR QUALITY (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)
Guiding Questions (1) How is climate change expected to affect the hazard?	Guiding Questions (2) How are vulnerability and adaptive capacity expected to change?
Time period	Time period
Projected Changes	Projected Changes
Baseline Health Risks	Baseline Health Risks
Projected changes to health risks	Projected changes to health risks
Uncertainties	Uncertainties



Health Hazard Examples FOOD AND WATERBORNE CONTAMINATION	Health Hazard Examples FOOD AND WATERBORNE CONTAMINATION
Guiding Questions (1) How is climate change expected to affect the hazard?	Guiding Questions (2) How are vulnerability and adaptive capacity expected to change?
Time period	Time period
Projected Changes	Projected Changes
Baseline Health Risks	Baseline Health Risks
Projected changes to health risks	Projected changes to health risks
Uncertainties	Uncertainties



Health Hazard Examples DISEASE VECTORS (e.g. vectors for Lyme disease and West Nile Virus)	Health Hazard Examples DISEASE VECTORS (e.g. vectors for Lyme disease and West Nile Virus)
Guiding Questions (1) How is climate change expected to affect the hazard?	Guiding Questions (2) How are vulnerability and adaptive capacity expected to change?
Time period	Time period
Projected Changes	Projected Changes
Baseline Health Risks	Baseline Health Risks
Projected changes to health risks	Projected changes to health risks
Uncertainties	Uncertainties



STEP 4: IDENTIFY AND PRIORITIZE POLICIES AND PROGRAMS TO MANAGE THE ADDITIONAL HEALTH RISKS ASSOCIATED WITH A CHANGING CLIMATE

Step 4: Overview

The purpose of this step is to identify and recommend options to modify current policies and programs. It involves prioritizing options to inform timelines for implementation. Examples include:

- > Strengthening primary health care services and environmental health services
- > Strengthening early warning systems, disaster risk management and integrated disease surveillance programs
- > Mainstreaming climate change into health policy
- > Improving infrastructure and built environment initiatives to include climate change and health considerations

STEP 4A: REVIEW QUALITATIVE AND QUANTITATIVE INFORMATION

Build on step 2e (and the *Effectiveness of Policies and Programs* template) by collecting information that can be used to identify needed modifications to current policies and programs and new actions to manage climate related health risks. Collect information by:

- > Holding discussions with health authorities in other jurisdictions, scientists, practitioners, and stakeholders within and outside the health sector about the adaptations they have implemented and possible new actions
- > Conducting a literature review (e.g. peer-reviewed publications and other internet sources)

Use to the Sources for Identifying Adaptation Options template to document relevant information.

STEP 4B: INVENTORY OPTIONS TO IMPROVE THE EFFECTIVENESS OF CURRENT POLICIES AND PROGRAMS OR TO IMPLEMENT NEW ONES TO MANAGE THE HEALTH RISKS OF CLIMATE VARIABILITY AND CHANGE

Use the information collected from Step 4a to develop an adaptation inventory listing all options no matter the resource (cost, staff, time) requirements.

Include potential adaptations within and outside the health sector.

When developing the list, include key stakeholders that need to be engaged. For example, when considering strategies to reduce risks from frequent heavy precipitation events, representatives from the Ministry of the Environment and Climate Change and the local Conservation Authority could be involved. Use the *Options Inventory* template to document relevant information.





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STEP 4C: PRIORITIZE OPTIONS AND DEVELOP RESOURCE NEEDS

Identify which policies and programs are possible to implement now and in the future based on existing resource constraints (technological, human, and financial). Generate a priority list of options from which policymakers can choose.

Use one or more prioritization approaches to identify when options should be implemented. Ensure that criteria used to identify the priorities are explicitly described. Examples of criteria for prioritising options include:

- > Is the option technically feasible?
- > Is the option effective in reducing health risks?
- > Does the option have positive or negative consequences? If so, consider how best to monitor consequences and potential corrective actions. Superior options reduce negative health outcomes and improve the natural and built environment.
- > Are adequate financial resources available for implementing and sustaining the option?
- > Is the option socially acceptable?

Key considerations when prioritizing options are the current morbidity and mortality from the health outcome of concern, projections of future impacts and how well it is managed with current policies and programs. Use the Prioritize Options and Develop Resource Needs template to document relevant information.

STEP 4D: ASSESS POSSIBLE CONSTRAINTS TO IMPLEMENTING OPTIONS AND HOW TO OVERCOME THEM

For each priority policy and program, list possible constraints or barriers to implementing the options by considering the following:

- > Technological, human, and financial resources required for implementation
- > Expected time frame for implementation
- > Other possible implementation requirements

Differentiate constraints (i.e. which can be overcome) from limits (i.e. no adaptation option is possible or available options are too difficult or expensive to implement). Working with other sectors can help overcome adaptation barriers. Include other sectors in discussions of adaptation constraints to identify non-health sector opportunities to advance adaptations and promote population health. List possible constraints, barriers and limits as well as explore how they might be overcome using the *Possible Constraints* template.



STEP 4E: DEVELOP A CLIMATE CHANGE AND HEALTH ADAPTATION PLAN

The information generated in previous steps can be synthesized to develop a climate change and health adaptation plan that considers shorter and longer time scales, and that facilitates coordination and collaboration with other sectors to promote resilience. The adaptation plan does not have to be extensive, but should provide sufficient information so that those not involved in its development can understand it and use it to implement the recommended actions.

The plan should link with initiatives to address the risks of climate change in other sectors, and include specific goals and the time frame over which key actions will be accomplished. Depending on the context, the plan may include:

- > Expected results
- > Milestones
- > Sequencing of activities
- > Clear responsibilities for implementation
- > Required human and financial resources
- > Costs and benefits of interventions
- > Financing options

The plan should promote coordination and synergies with city and provincial goals. Including someone with knowledge of such goals on the project team would be an effective approach to making these linkages.

Assessment Templates

The following templates are available to help complete Step 4 of the Vulnerability and Adaptation Assessment.

- 4a | Sources for Identifying Adaptation Options
- 4b | Options Inventory
- 4c | Prioritize Options and Develop Resource Needs
- 4d | Possible Constraints



STEP 4A: SOURCES FOR IDENTIFYING ADAPTATION OPTIONS TEMPLATE

Use the template below to identify sources to help prioritize adaptation policies and programs. Information from the sources collected can help identify potential modifications to policies and programs to reduce current and future health risks from climate change. A range of information sources can be used to identify and collect relevant information (e.g. interviews, literature reviews, workshops).

Health Hazard Examples*

EXTREME TEMPERATURE (heat, cold) **EVENTS**

Guiding Questions

- Who is aware of or has implemented (possible) adaptations (e.g. scientists, MOHLTC, PHO, HC, PHAC, staff within your public health unit or other public health units)?
 - a. Have other health jurisdictions implemented adaptations that your health unit can learn from?
 - b. Could your health unit learn from work being done in other provinces or internationally?
- 2. What peer-reviewed or grey literature can you draw on to identify possible adaptations?
- 3. What are some ways this information can be collected from partners and stakeholders (e.g. workshop, webinar, teleconference and facilitated discussions)?

Key Experts, Literature, Data Collection Opportunities

Stakeholders to Engage

Health Hazard Examples*

OTHER EXTREME WEATHER EVENTS

(e.g. storms, floods, drought)

Guiding Questions

- Who is aware of or has implemented (possible) adaptations (e.g. scientists, MOHLTC, PHO, HC, PHAC, staff within your public health unit or other public health units)?
- a. Have other health jurisdictions implemented adaptations that your health unit can learn from?
- b. Could your health unit learn from work being done in other provinces or internationally?
- 2. What peer-reviewed or grey literature can you draw on to identify possible adaptations?
- 3. What are some ways this information can be collected from partners and stakeholders (e.g. workshop, webinar, teleconference and facilitated discussions)?

Key Experts, Literature, Data Collection Opportunities

Health Hazard Examples^{*}

VECTORBORNE DISEASES

(Lyme disease, West Nile Virus)

Guiding Questions

- Who is aware of or has implemented (possible) adaptations (e.g. scientists, MOHLTC, PHO, HC, PHAC, staff within your public health unit or other public health units)?
 - a. Have other health jurisdictions implemented adaptations that your health unit can learn from?
- b. Could your health unit learn from work being done in other provinces or internationally?
- 2. What peer-reviewed or grey literature can you draw on to identify possible adaptations?
- 3. What are some ways this information can be collected from partners and stakeholders (e.g. workshop, webinar, teleconference and facilitated discussions)?

Key Experts, Literature, Data Collection Opportunities

Stakeholders to Engage

Stakeholders to Engage

* Draw on results from the "Project Future Health Risks Template" in Step 3 to select climate change-related health hazards which are most relevant to your community.



AIR QUALITY

(aeroallergens, air pollution from groundlevel ozone, particulate matter and/or wildfire smoke)

Guiding Questions

- Who is aware of or has implemented (possible) adaptations (e.g. scientists, MOHLTC, PHO, HC, PHAC, staff within your public health unit or other public health units)?
 - a. Have other health jurisdictions implemented adaptations that your health unit can learn from?
 - b. Could your health unit learn from work being done in other provinces or internationally?
- 2. What peer-reviewed or grey literature can you draw on to identify possible adaptations?
- 3. What are some ways this information can be collected from partners and stakeholders (e.g. workshop, webinar, teleconference and facilitated discussions)?

Key Experts, Literature, Data Collection Opportunities

Stakeholders to Engage

Health Hazard Examples*

FOOD AND WATERBORNE DISEASES

Guiding Questions

- 1. Who is aware of or has implemented (possible) adaptations (e.g. scientists, MOHLTC, PHO, HC, PHAC, staff within your public health unit or other public health units)?
 - a. Have other health jurisdictions implemented adaptations that your health unit can learn from?
 - b. Could your health unit learn from work being done in other provinces or internationally?
- 2. What peer-reviewed or grey literature can you draw on to identify possible adaptations?
- 3. What are some ways this information can be collected from partners and stakeholders (e.g. workshop, webinar, teleconference and facilitated discussions)?

Key Experts, Literature, Data Collection Opportunities

Stakeholders to Engage

* Draw on results from the "Project Future Health Risks Template" in Step 3 to select climate change-

related health hazards which are most relevant to your community.



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STEP 4B: OPTIONS INVENTORY TEMPLATE

Use the template below to develop a list of adaptation options. Refer to the information collected in Step 4a (and documented in the *Sources for Prioritizing Policies and Programs* template) to develop the inventory of potential adaptation options. Include in the template any key stakeholders that may need to be engaged when prioritizing potential options.

Health Hazard Examples EXTREME TEMPERATURE (heat, cold) EVENTS Potential Adaptation Options	Health Hazard Examples STRATOSPHERIC OZONE DEPLETION Potential Adaptation Options	Health Hazard Examples FOOD AND WATERBORNE DISEASES Potential Adaptation Options
Health Hazard Examples OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought) Potential Adaptation Options	Health Hazard Examples AIR QUALITY (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke) Potential Adaptation Options	Health Hazard Examples VECTORBORNE DISEASES (Lyme disease, West Nile Virus) Potential Adaptation Options



STEP 4C: PRIORITIZE OPTIONS AND DEVELOP RESOURCE NEEDS TEMPLATE

Use the template below to prioritize the adaptation options.

Health Hazard Examples EXTREME TEMPERATURE (heat, cold) EVENTS	Health Hazard Examples OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)
Adaptation Option A	Adaptation Option A
Prioritisation Criteria Examples 1. Feasibility	Prioritisation Criteria Examples 1. Feasibility
2. Effectiveness in reducing health risks	2. Effectiveness in reducing health risks
3. Positive/Negative consequences	3. Positive/Negative consequences
4. Adequate financial resources	4. Adequate financial resources
5. Social acceptability	5. Social acceptability
Outcome of Prioritisation Process (e.g. Score/Ranking)	Outcome of Prioritisation Process (e.g. Score/Ranking)
Health Hazard Examples EXTREME TEMPERATURE (heat, cold) EVENTS	Health Hazard Examples OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)
Adaptation Option B	Adaptation Option B
Prioritisation Criteria Examples 1. Feasibility	Prioritisation Criteria Examples 1. Feasibility
2. Effectiveness in reducing health risks	2. Effectiveness in reducing health risks
3. Positive/Negative consequences	3. Positive/Negative consequences
4. Adequate financial resources	4. Adequate financial resources
5. Social acceptability	5. Social acceptability
Outcome of Prioritisation Process (e.g. Score/Ranking)	Outcome of Prioritisation Process (e.g. Score/Ranking)



STRATOSPHERIC OZONE DEPLETION

Adaptation Option A

Prioritisation Criteria Examples

1. Feasibility

2. Effectiveness in reducing health risks

3. Positive/Negative consequences

4. Adequate financial resources

5. Social acceptability

Outcome of Prioritisation Process (e.g. Score/Ranking)

Health Hazard Examples

STRATOSPHERIC OZONE DEPLETION

Adaptation Option B

Prioritisation Criteria Examples

1. Feasibility

- 2. Effectiveness in reducing health risks
- 3. Positive/Negative consequences

4. Adequate financial resources

5. Social acceptability

Outcome of Prioritisation Process (e.g. Score/Ranking)

Health Hazard Examples

AIR QUALITY (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)

Adaptation Option A

Prioritisation Criteria Examples

1. Feasibility

- 2. Effectiveness in reducing health risks
- 3. Positive/Negative consequences
- 4. Adequate financial resources
- 5. Social acceptability

Outcome of Prioritisation Process (e.g. Score/Ranking)

Health Hazard Examples

AIR QUALITY (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)

Adaptation Option B

Prioritisation Criteria Examples

- 1. Feasibility
- 2. Effectiveness in reducing health risks
- 3. Positive/Negative consequences
- 4. Adequate financial resources
- 5. Social acceptability

Outcome of Prioritisation Process (e.g. Score/Ranking)



Health Hazard Examples Health Hazard Examples **FOOD AND WATERBORNE DISEASES VECTORBORNE DISEASES** (Lyme disease, West Nile Virus) **Adaptation Option A Adaptation Option A Prioritisation Criteria Examples Prioritisation Criteria Examples** 1. Feasibility 1. Feasibility 2. Effectiveness in reducing health risks 2. Effectiveness in reducing health risks 3. Positive/Negative consequences 3. Positive/Negative consequences 4. Adequate financial resources 4. Adequate financial resources 5. Social acceptability 5. Social acceptability **Outcome of Prioritisation Process** (e.g. Score/Ranking) **Outcome of Prioritisation Process** (e.g. Score/Ranking) Health Hazard Examples Health Hazard Examples **FOOD AND WATERBORNE DISEASES VECTORBORNE DISEASES** (Lyme disease, West Nile Virus) **Adaptation Option B Adaptation Option B Prioritisation Criteria Examples Prioritisation Criteria Examples** 1. Feasibility 1. Feasibility 2. Effectiveness in reducing health risks 2. Effectiveness in reducing health risks 3. Positive/Negative consequences 3. Positive/Negative consequences 4. Adequate financial resources 4. Adequate financial resources 5. Social acceptability 5. Social acceptability **Outcome of Prioritisation Process** (e.g. Score/Ranking) **Outcome of Prioritisation Process** (e.g. Score/Ranking)



STEP 4D: POSSIBLE CONSTRAINTS TEMPLATE

Use the template below to list possible constraints or barriers that need to be overcome when implementing the identified adaptation options. Differentiate constraints from limits (i.e. no adaptation option is possible or available options are too difficult or expensive to implement). Include possible ways to overcome barriers in the last column.

Health Hazard Examples

EXTREME TEMPERATURE (heat, cold) **EVENTS**

Adaptation Options A

Health Hazard Examples

EXTREME TEMPERATURE (heat, cold) **EVENTS**

Adaptation Options B

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Possible Ways to Overcome Barriers

Possible Ways to Overcome Barriers



OTHER EXTREME WEATHER EVENTS

(e.g. storms, floods, drought)

Adaptation Options A

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Health Hazard Examples

OTHER EXTREME WEATHER EVENTS

(e.g. storms, floods, drought)

Adaptation Options B

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Possible Ways to Overcome Barriers



STRATOSPHERIC OZONE DEPLETION

Adaptation Options A

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Health Hazard Examples

STRATOSPHERIC OZONE DEPLETION

Adaptation Options B

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Possible Ways to Overcome Barriers

Possible Ways to Overcome Barriers



AIR QUALITY

(aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)

Adaptation Options A

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Possible Ways to Overcome Barriers

Health Hazard Examples

AIR QUALITY

(aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)

Adaptation Options B

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers



FOOD AND WATERBORNE DISEASES

Adaptation Options A

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Health Hazard Examples

FOOD AND WATERBORNE DISEASES

Adaptation Options B

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Possible Ways to Overcome Barriers



VECTORBORNE DISEASES

(Lyme disease, West Nile Virus)

Adaptation Options A

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Health Hazard Examples

VECTORBORNE DISEASES (Lyme disease, West Nile Virus)

Adaptation Options B

Guiding Questions

- 1. What are the possible constraints or barriers needing to be overcome when implementing options?
- 2. What are possible limits, which cannot be overcome?
- 3. What are the technological, human and financial resources required for implementation?
- 4. What is the expected time-frame for implementation?
- 5. What are other possible implementation requirements?
- 6. Can other sectors be involved in helping overcome adaptation barriers?
- 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance? adaptations and promote health?

Possible Constraints or Barriers

Possible Ways to Overcome Barriers



STEP 5: ESTABLISH AN ITERATIVE PROCESS FOR MANAGING AND MONITORING HEALTH RISKS

Step 5: Overview

Develop an iterative process for managing and monitoring health risks from climate change. This involves:

- > Identifying a lead agency to coordinate monitor reporting
- > Recommending when the V&A assessment should be repeated to identify new risks
- > Being aware of changes in the geographic range of health outcomes
- > Consulting with partners and stakeholders

STEP 5A: DEVELOP A MONITORING PLAN

Develop a plan for monitoring the burden of health outcomes and the effectiveness of implemented adaptation options. When completed, insert the monitoring plan in the adaptation plan (Step 4e). This step aligns with the baseline developed in Step 2f for comparing how morbidity and mortality of climate-sensitive health outcomes change over time. Morbidity and mortality should decrease with effective adaptation; however, the health burden could increase if climate-related and other factors create new or exacerbate existing risks. The monitoring plan should include:

- > What will be monitored
- > Frequency of monitoring
- $\, > \,$ Methods of data analysis and collection
- > Milestones for evaluation
- > Recommended adaptation modifications
- > Communication protocol to ensure appropriate and timely adjustments to the adaptation options

Refer to the Monitoring Plan template to collect relevant information.



STEP 5B: DEVELOP INDICATORS FOR MONITORING

An agreed set of minimum indicators and a means of verifying the efficacy and appropriateness of the indicators are needed for measuring the degree of success of health adaptation activities. Work with stakeholders to select appropriate indicators. Select indicators that enable the quantification of health burdens over time and space and that include qualitative metrics of the adaptation processes. Categorize indicators into themes if helpful, for example, by health hazard or by key characteristics of vulnerability. Steps 1a (*Priority Health Hazards* template), 1d (*Information Sources* template) and 2d (*Vulnerability Indicators* template) provide examples of indicators that can be used for monitoring adaptation effectiveness. Refer to the *Indicators for Monitoring* template which compiles these indicators. When indicators for monitoring are decided upon, include them in the monitoring plan.

STEP 5C: IDENTIFY AND SHARE LESSONS LEARNED AND BEST PRACTICES

Document lessons learned from implementing adaptations and monitoring adaptation success. Share information with partners and stakeholders to support health authorities as they conduct vulnerability and adaptation assessments and to build adaptive capacity in the province.

Assessment Templates

The following templates are available to help complete Step 5 of the Vulnerability and Adaptation Assessment.

- 5a | Monitoring Plan
- 5b | Monitoring Indicators



STEP 5A: MONITORING PLAN TEMPLATE

Use the template below to develop the monitoring plan. Insert the completed monitoring plan into the adaptation plan (Step 4e).

Health Hazard EXTREME TEMPERATURE (heat, cold) EVENTS	Health Hazard OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought)
Examples Indicator to be Monitored*	Examples Indicator to be Monitored*
Frequency of Monitoring	Frequency of Monitoring
Methods of Data Analysis and Collection	Methods of Data Analysis and Collection
Recommended Adaptation Modifications	Recommended Adaptation Modifications
Communications Activitiess	Communications Activities
Communications Activitises	communications activities

 $\ast~$ Use the Monitoring Indicators template (step 5b) for ideas on what could be monitored.



Health Hazard STRATOSPHERIC OZONE DEPLETION	Health Hazard AIR QUALITY (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)
Examples Indicator to be Monitored*	Examples Indicator to be Monitored*
Frequency of Monitoring	Frequency of Monitoring
Methods of Data Analysis and Collection	Methods of Data Analysis and Collection
Recommended Adaptation Modifications	Recommended Adaptation Modifications
Communications Activities	Communications Activities

* Use the Monitoring Indicators template (step 5b) for ideas on what could be monitored.



Health Hazard	Health Hazard
FOOD AND WATERBORNE DISEASES	VECTORBORNE DISEASES (Lyme disease, West Nile Virus)
Examples Indicator to be Monitored*	Examples Indicator to be Monitored*
Frequency of Monitoring	Frequency of Monitoring
Mathedra (Date Analysis and Calls streng	
Methods of Data Analysis and Collection	Methods of Data Analysis and Collection
Recommended Adaptation Modifications	Recommended Adaptation Modifications
Communications Activities	Communications Activities

 $\ast~$ Use the Monitoring Indicators template (step 5b) for ideas on what could be monitored.

STEP 5B: MONITORING INDICATORS TEMPLATE

This template provides indicators that can be used to monitor adaptation success. Select from this list, or identify new indicators and include them in the monitoring plan.

Health Hazards	Health Hazards	Health Hazards
(heat, cold) EVENTS	(heat, cold) EVENTS	(heat, cold) EVENTS
Vulnerability Category Exposure	Vulnerability Category Sensitivity	Vulnerability Category Adaptive Capacity
 Examples of Vulnerability Indicators Maximum and minimum temperatures, heat index Increase in heat alerts/warnings Projected hot days and warm nights Projected cold days Projected air temperature seasonal changes and extremes Proportion of the population living in an urban heat island 	 Examples of Vulnerability Indicators Socially and economically disadvantaged populations Number of people with conditions that inhibit temperature regulation Number of seniors Number of children Heat-related morbidity and mortality Cold-related morbidity and mortality 	 Examples of Vulnerability Indicators Health and social services Proportion of the population without air conditioning Access to cooling centers No. of heat wave early warning systems No. of municipal heat island mitigation plans
Data Source	Data Source	Data Source
Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators



OTHER EXTREME WEATHER EVENTS OTHER EXTREME WEATHER EVENTS OTHER EXTREME WEATHER EVENTS (e.g. storms, floods, drought) (e.g. storms, floods, drought) (e.g. storms, floods, drought)) **Vulnerability Category Vulnerability Category Vulnerability Category** Exposure Sensitivity Adaptive Capacity **Examples of Vulnerability Indicators Examples of Vulnerability Indicators Examples of Vulnerability Indicators** Historical precipitation intensity, duration and • Socially and economically • Health and social services frequency patterns disadvantaged populations • Emergency management programs • Projected precipitation intensity, duration and • Number of people with mobility limitations • Mental health programs focused on reducing Number of seniors mental health outcomes from floods, droughts frequency patterns • Historical frequency, severity, distribution, and • Number of pregnant women and other extremes duration of wildfires, flooding, droughts and • Number of children other extremes • Number of people who drink alcohol, use illicit substances or take medication • Projected frequency, severity, distribution, and duration of wildfires, flooding, droughts and • Morbidity and mortality from extreme weather events (e.g. injuries, infections, other extremes • Proportion of the population living on or near mental health outcomes) flood plains **Data Source Data Source Data Source** Method(s) of Verifying Efficacy and Method(s) of Verifying Efficacy and Method(s) of Verifying Efficacy and Appropriateness of Indicators **Appropriateness of Indicators Appropriateness of Indicators**

Health Hazards

Health Hazards



Health Hazards

Health Hazards STRATOSPHERIC OZONE DEPLETION Vulnerability Category	Health Hazards STRATOSPHERIC OZONE DEPLETION Vulnerability Category	Health Hazards STRATOSPHERIC OZONE DEPLETION Vulnerability Category
 Exposure Examples of Vulnerability Indicators Proportion of the population that does not take protective measures during sunniest parts of the day Extension of warm season due to climate change 	 Sensitivity Examples of Vulnerability Indicators Number of children Number of persons working outdoors Number of persons with skin conditions that increase sun damage risks 	 Adaptive Capacity Examples of Vulnerability Indicators Health and social services Health promotion activities on sun safety/sun damage prevention/cancer prevention Urban greening/shade policies
Data Source	Data Source	Data Source
Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators	Method(s) of Verifying Efficacy and Appropriateness of Indicators



Health Hazards

AIR QUALITY

(aeroallergens, air pollution from ozone, particulate matter and/or wildfire smoke)

Vulnerability Category

Exposure

Data Source

Examples of Vulnerability Indicators

- Stagnation air mass events
- Projected ground-level ozone and particulate matter estimates due to climate change
- Pollen counts, ragweed presence
- Number and duration of smog advisories
- Ground-level ozone and particulate matter concentrations and exceedance

Method(s) of Verifying Efficacy and

Appropriateness of Indicators

Health Hazards

AIR QUALITY

(aeroallergens, air pollution from ozone, particulate matter and/or wildfire smoke)

Vulnerability Category

Sensitivity

Examples of Vulnerability Indicators

Health Hazards

AIR QUALITY

wildfire smoke)

Adaptive Capacity

(aeroallergens, air pollution from

ozone, particulate matter and/or

Examples of Vulnerability Indicators

• Health promotion activities on air pollution

prevention and protection from air pollutants,

Vulnerability Category

• Health and social services

• Air quality regulations

aeroallergens or wildfire smoke

• Proportion of people who use public

• Air quality monitoring capabilities

transportation/active transportation

- Socially and economically disadvantaged populations
- Number of seniors
- Number of children
- Number of people with chronic diseases and who smoke tobacco
- Cardiovascular or respiratory health outcomes from aeroallergens or poor air quality (groundlevel ozone, particulate matter)
- Number of persons working outdoors
- Daily all-cause mortality (trends associated with air pollution)

Method(s) of Verifying Efficacy and

Appropriateness of Indicators

rends
Data Source

Method(s) of Verifying Efficacy and Appropriateness of Indicators



Health Hazards	Health Hazards	Health Hazards
FOOD AND WATERBORNE	FOOD AND WATERBORNE	FOOD AND WATERBORNE
ILLNESSES AND FOOD	ILLNESSES AND FOOD	ILLNESSES AND FOOD
SECURITY ISSUES	SECURITY ISSUES	SECURITY ISSUES
Vulnerability Category	Vulnerability Category	Vulnerability Category
Exposure	Sensitivity	Adaptive Capacity
 Examples of Vulnerability Indicators Number of people on small water systems Number of people using natural outdoor recreational facilities (e.g., beaches) Number of people on flood plains Harmful algal blooms Number of outdoor events (e.g., farmers markets) during warm weather) 	 Examples of Vulnerability Indicators Socially and economically disadvantaged populations First Nations and Inuit populations relying on traditional foods People with suppressed or developing immune systems Foodborne diseases or outbreaks Water related diseases and infections (drinking and recreational water) 	 Examples of Vulnerability Indicators Health and social services Food safety regulations for food processing activities and food premises Drinking and recreational water quality guidelines and regulations Water quality advisories and programs Number of meal programs and food banks Surveillance of water and foodborne diseases Health promotion activities on food safety and drinking water safety Local community ability to grow food
Data Source	Data Source	Data Source
Method(s) of Verifying Efficacy and	Method(s) of Verifying Efficacy and	Method(s) of Verifying Efficacy and
Appropriateness of Indicators	Appropriateness of Indicators	Appropriateness of Indicators



Health Hazards	Health Hazards	Health Hazards
VECTORBORNE DISEASES	VECTORBORNE DISEASES	VECTORBORNE DISEASES
(Lyme disease, West Nile Virus)	(Lyme disease, West Nile Virus)	(Lyme disease, West Nile Virus)
Vulnerability Category	Vulnerability Category	Vulnerability Category
Exposure	Sensitivity	Adaptive Capacity
 Examples of Vulnerability Indicators West Nile Virus incidence Lyme disease incidence Other vectorborne disease incidence West Nile disease incidence in humans Lyme borreliolis incidence in humans No. of positive test results in reservoirs/ sentinels/vectors 	 Examples of Vulnerability Indicators Number of seniors Number of children People with suppressed or developing immune systems Number of persons spending greater time outdoors for recreation Number of persons working outdoors Number of persons travelling to other parts of the world where other vectorborne diseases may be endemic 	 Examples of Vulnerability Indicators Health and social services Vectorborne diseases programs (e.g. surveillance and monitoring, larviciding, adulticiding, public awareness campaigns)
Data Source	Data Source	Data Source
Method(s) of Verifying Efficacy and	Method(s) of Verifying Efficacy and	Method(s) of Verifying Efficacy and
Appropriateness of Indicators	Appropriateness of Indicators	Appropriateness of Indicators



STEP 6: EXAMINE THE POTENTIAL HEALTH BENEFITS AND CO-HARMS OF ADAPTATION AND MITIGATION OPTIONS IMPLEMENTED IN OTHER SECTORS

STEP 6A: REVIEW ADAPTATION AND MITIGATION OPTIONS PROPOSED OR IMPLEMENTED IN OTHER SECTORS

Climate change adaptation and mitigation options implemented in other sectors can affect public health. Collaborative efforts to address vulnerabilities to a changing climate can promote resilience in health and other sectors simultaneously. Identify proposed and/or implemented adaptation and mitigation strategies in other sectors that may affect health as well as possible adjustments that could promote health by:

- > Engaging with other sectors
- > Engaging with local or regional climate change programs
- > Arranging for an expert evaluation of the human health implications of policies and programs proposed or implemented in other sectors

Health effects from adaptation and mitigation efforts in other sectors are generally unintended and can range from non-existent to highly significant. For example, green roofing has multiple environmental benefits, such as cooling and storm water management, that are likely to have only beneficial or neutral health effects. Changes to industrial processes to reduce carbon dioxide emissions have the potential for human exposures to potentially hazardous materials depending on the technology, the chemicals or other agents involved, and how they are implemented.

Refer to the Health Implications of Adaptation and Mitigation Options template to document relevant information.

STEP 6B: IDENTIFY SYNERGIES FOR ADAPTATION AND MITIGATION OPTIONS

Greenhouse gas mitigation is a primary prevention health measure that is required and advocated by public health officials to reduce climate change and health risks. There are many examples of actions that aim to mitigate GHG emissions and increase resilience to future climate-related health risks, such as, planting trees, buying local food, and installing green roofs. Refer to the *Synergies for Adaptation and Mitigation Options* template to document relevant information.

Assessment Templates

The following templates are available to help complete Step 6 of the Vulnerability and Adaptation Assessment.

- 6a | Health Implications of Adaptation and Mitigation Options
- 6b | Synergies for Adaptation and Mitigation Options



STEP 6A: HEALTH IMPLICATIONS OF ADAPTATION AND MITIGATION OPTIONS

Use the template below to document proposed and/or implemented adaptation and mitigation strategies in other sectors that may affect health and recommendations to minimize risks and maximize potential health gains. For example, planting trees, buying local food and installing green roofs might both mitigate greenhouse gas emissions and increase resilience to future climate-related health risks.

Examples of Sectors	Examples of Sectors	Examples of Sectors
PLANNING (e.g. Urban)	EMERGENCY MANAGEMENT	WATER AND WASTE WATER/ PUBLIC WORKS
Adaptation and Mitigation	Adaptation and Mitigation	Adaptation and Mitigation
Strategies That Can Affect Health	Strategies That Can Affect Health	Strategies That Can Affect Health
Health Implications	Health Implications	Health Implications
(Synergies/Impacts) , If Any	(Synergies/Impacts) , If Any	(Synergies/Impacts) , If Any
Recommendations to Reduce Risks/	Recommendations to Reduce Risks/	Recommendations to Reduce Risks/
Maximize Health Benefits	Maximize Health Benefits	Maximize Health Benefits



Examples of Sectors CONSERVATION AND	Examples of Sectors TRANSPORTATION	Examples of Sectors NATURAL RESOURCES
ENVIRONMENTAL MANAGEMENT Adaptation and Mitigation Strategies That Can Affect Health	Adaptation and Mitigation Strategies That Can Affect Health	Adaptation and Mitigation Strategies That Can Affect Health
Health Implications (Synergies/Impacts) , If Any	Health Implications (Synergies/Impacts), If Any	Health Implications (Synergies/Impacts) , If Any
Recommendations to Reduce Risks/ Maximize Health Benefits	Recommendations to Reduce Risks/ Maximize Health Benefits	Recommendations to Reduce Risks/ Maximize Health Benefits



Examples of Sectors PARKS AND RECREATION	Examples of Sectors INFRASTRUCTURE (e.g. roads, sewers, sidewalks)	Examples of Sectors SOCIAL SERVICES
Adaptation and Mitigation	Adaptation and Mitigation	Adaptation and Mitigation
Strategies That Can Affect Health	Strategies That Can Affect Health	Strategies That Can Affect Health
Health Implications	Health Implications	Health Implications
(Synergies/Impacts) , If Any	(Synergies/Impacts), If Any	(Synergies/Impacts) , If Any
Recommendations to Reduce Risks/	Recommendations to Reduce Risks/	Recommendations to Reduce Risks/
Maximize Health Benefits	Maximize Health Benefits	Maximize Health Benefits



Examples of Sectors TOURISM/ARTS/ENTERTAINMENT	Examples of Sectors WASTE MANAGEMENT	Contraction of the second s
Adaptation and Mitigation Strategies That Can Affect Health	Adaptation and Mitigation Strategies That Can Affect Health	
Health Implications (Synergies/Impacts) , If Any	Health Implications (Synergies/Impacts) , If Any	
Recommendations to Reduce Risks/ Maximize Health Benefits	Recommendations to Reduce Risks/ Maximize Health Benefits	

Photo Credit: Shutterstock



STEP 6B: SYNERGIES FOR ADAPTATION AND MITIGATION OPTIONS TEMPLATE

Use the template below to document actions that aim to mitigate greenhouse gas emissions and also increase resilience to future climate-related health risks. Examples include: planting trees, buying local food, and installing green roofs. When identifying synergies, ask the question: what is the likelihood/certainty that the program, policy or initiative decreases greenhouse gas emissions as well as reduces current and future health risks from a changing climate? Recommend options that are of high probability and/or certainty.

Examples of Sectors

PLANNING (e.g. Urban)

Recommendations for Options to Maximize Adaptation and Mitigation Synergies **Examples of Sectors**

WATER AND WASTE WATER/ PUBLIC WORKS

Recommendations for Options to Maximize Adaptation and Mitigation Synergies Examples of Sectors

TRANSPORTATION

Recommendations for Options to Maximize Adaptation and Mitigation Synergies

Examples of Sectors

EMERGENCY MANAGEMENT

Recommendations for Options to Maximize Adaptation and Mitigation Synergies Examples of Sectors

CONSERVATION AND ENVIRONMENTAL MANAGEMENT

Recommendations for Options to Maximize Adaptation and Mitigation Synergies **Examples of Sectors**

NATURAL RESOURCES

Recommendations for Options to Maximize Adaptation and Mitigation Synergies



Examples of Sectors

PARKS AND RECREATION

Recommendations for Options to Maximize Adaptation and Mitigation Synergies Examples of Sectors

SOCIAL SERVICES

Recommendations for Options to Maximize Adaptation and Mitigation Synergies Examples of Sectors

WASTE MANAGEMENT

Recommendations for Options to Maximize Adaptation and Mitigation Synergies

Examples of Sectors

INFRASTRUCTURE (e.g. roads, sewers, sidewalks)

Recommendations for Options to Maximize Adaptation and Mitigation Synergies Examples of Sectors

TOURISM/ARTS/ ENTERTAINMENT

Recommendations for Options to Maximize Adaptation and Mitigation Synergies












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