SOUTH HURON'S CLIMATE CHANGE ADAPTATION STRATEGY

MUNICIPALITY OF
2001
SOUTH HURON

The preparation of this strategy was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

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ACKNOWLEDGEMENTS

The South Huron Climate Change Adaptation Strategy was developed by the Municipality of South Huron, with financial support provided by the Government of Canada through the Federation of Canadian Municipalities, Municipalities for Climate Innovation Program.

All of the efforts mentioned below will help South Huron rise to the challenge, making sure our community is resilient to the impacts of climate change.

Contributions

The first iteration of South Huron's Climate Change Adaptation Strategy involved a culmination of efforts from municipal staff, Council, members of the Climate Change Adaptation Advisory Committee and many stakeholders within the community.

Climate Change Adaptation Advisory Committee

The Municipality would like to acknowledge the members of the Climate Change Adaptation Advisory Committee, a committee of Council, for their efforts in guiding the strategy, particular to ensure the vision, goals and actions identified within this strategy were developed to be comprehensive, inclusive and the best representative of the community. The Committee provided a range of perspectives and expertise incorporated into the strategy.

- **Steve Boles**, Chair/Public Representative with expertise in Sustainability and GHG measuring/reporting
- **Tim Cumming**, Ausable Bayfield Conservation Authority Representative
- **Alyssa Keller**, Public Representative with expertise in Water Resources
- **Ryan Munn**, Public Representative with expertise in Civil Engineering
- **Jessica Thompson**, Huron Perth Public Health Representative
- **Marissa Vaughan**, Council Representative

MESSAGE FROM THE MAYOR

[INSERT MESSAGE FROM THE MAYOR]

INTRODUCTION

Aligned with observed global changes, South Huron's climate is also changing and will have a continued impact on local weather, environment, economy, and community as a whole. Our future is dependent on the reduction of greenhouse gas (GHG) on a global scale – regardless of the exact future, climate change will have continued impacts to South Huron in some regards.

Not knowing the exact future doesn't prevent South Huron from proactively planning for the future range of projected changes. This strategy does exactly that – it prepares for the general expectations of our future to ensure that our community is resilient.

The preparation of this strategy focuses on understanding what changes South Huron is already experiencing and what the expectation of the future is. Understanding what this means for the South Huron community is vital in order to avoid disruption.

This document is the first iteration of a climate change adaptation strategy and is intended to be living document; one in which should be updated as new information becomes available and as the Municipality moves through implementing and evaluating the actions.

STRATEGY FRAMEWORK

The planning process for South Huron's climate change adaptation strategy aligns with the internationally recognized program, International Council of Local Environmental Initiatives (ICLEI) Canada's BARC (Building Adaptive and Resilient Communities) program methodology. The framework (shown in Figure 1) outlined within this program is widely utilized within municipal adaptation planning across Canada.

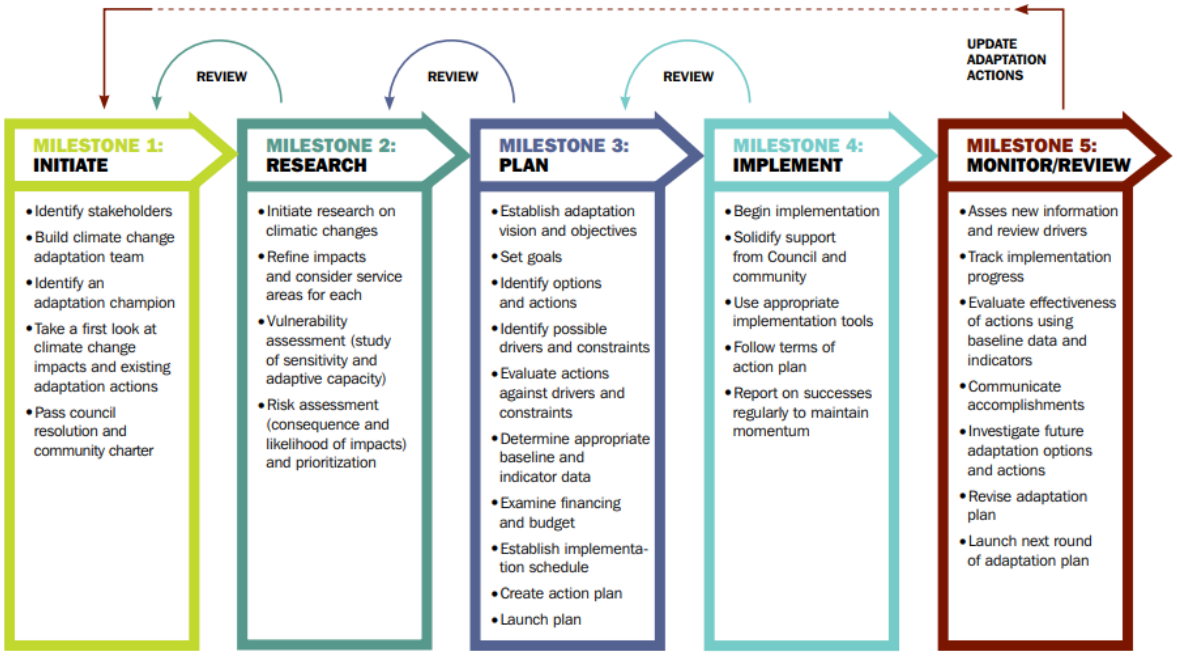


Figure 1: ICLEI BARC Milestone Framework (ICLEI Canada, 2010)

For South Huron, the ICLEI BARC framework was adapted to represent the direction of the strategy for the municipality. This strategy addresses Milestone 1 (Initiate), Milestone 2 (Research) and Milestone 3 (Plan), as shown in Figure 2. Milestone 4 (Implement) and 5 (Monitor and Review) are discussed in the implementation Plan, Evaluation and Monitoring sections, as shown in Figure 3.

Figure 2: South Huron Climate Change Adaptation Strategy Framework: Milestones 1, 2 and 3 (Adapted from ICLEI Canada, 2010)

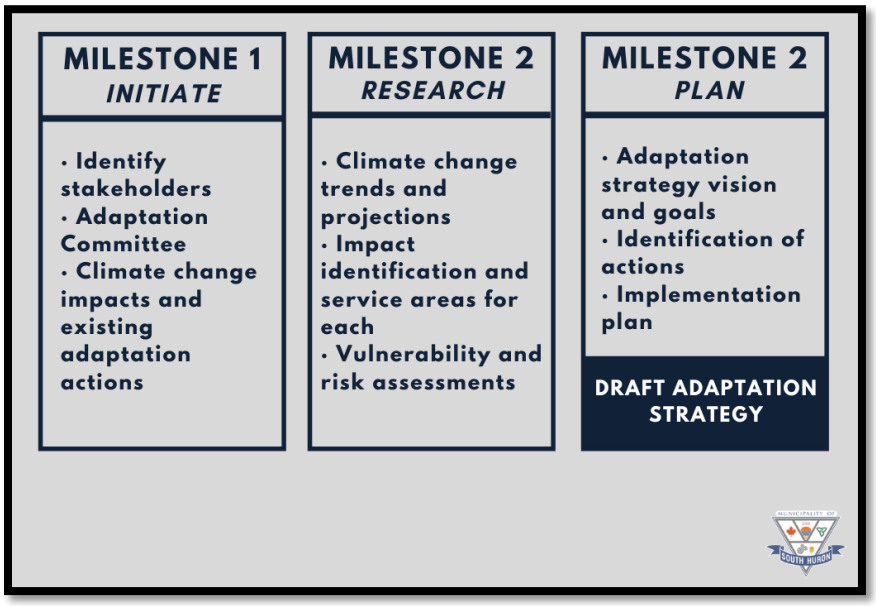
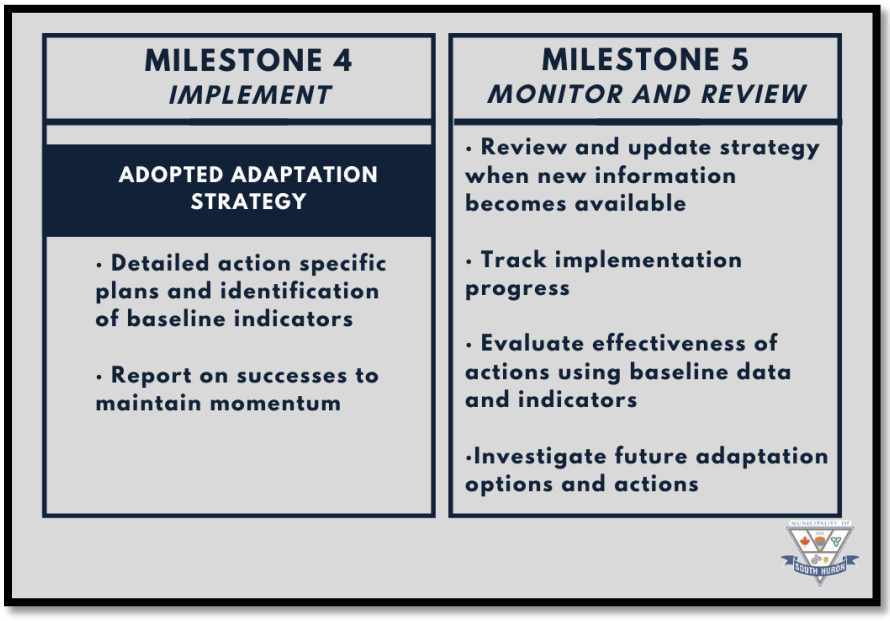


Figure 3: South Huron Climate Change Strategy Implementation: Milestones 4 and 5 (Adapted from ICLEI Canada, 2010)



The creation of this adaptation strategy was developed through a culmination of efforts from municipal staff, Council, members of the Climate Change Adaptation Advisory Committee (CCAAC) and many stakeholders within the community. Utilizing existing municipal knowledge and expertise within the community, the strategy represents the priorities for the municipality and community for the climate reality that will be faced.

The following describes the various groups engaged and their roles in shaping the adaptation strategy:

- **Municipal staff** provided insight into existing conditions and climate-related impacts that already exist within current operations, municipal operations that are most vulnerable and most at risk and potential action items that fit within the existing municipal structure.
- **Members of South Huron Council** provided insight into the impacts from climate change on Council decisions and actions that can be implemented to ensure decisions take into account future climate projections.
- **Public Stakeholders** had the opportunity to provide feedback into every milestone to help identify the needs and priorities of the community to be addressed in the strategy.
- **Climate Change Adaptation Advisory Committee (CCAAC)** provided feedback and guidance from a community and stakeholder perspective into every milestone of the project to ensure that the vision, goals and actions identified within this strategy were developed to be comprehensive, inclusive and the best representative of the community.

UNDERSTANDING CLIMATE CHANGE

When understanding climate change, it is important to decipher climate and weather, as they are often falsely understood as equivalent. *Weather* refers to the variation in short-term atmospheric conditions (temperature, wind, precipitation, humidity, and cloud cover) that occur from minutes to weeks, whereas *climate* refers to weather patterns averaged over a period of time, typically 30 years or more.

The climate system and the interactions within it is very complex and consists of five major components: the atmosphere, hydrosphere (liquid water), cryosphere (frozen elements), land surface, and the biosphere (encompasses all living things). These components actively interact and are influenced by both internal dynamics (caused by the climate system itself) and external forces (including solar variations, volcanic eruptions, albedo and human influences).

The IPCC *Fifth Assessment Report* (2014a) describes the cause of climate change as:

> *"Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century."*

Understanding what the future climate looks like is complicated. Climate modelling is complex – modelling uses a series of algorithms and equations to characterize the major components of the climate system and the natural fluctuations that occur. The future of the climate is dependent on what happens to the climate system, trends and impacts of future greenhouse gas (GHG) emissions.

In general, as described in the Intergovernmental Panel on Climate Change (IPCC) in the *Fifth Assessment Report* (2014b):

- If emissions of heat-capturing gases (GHGs) continue with no or limited reduction - the warming trend will accelerate.
- If emissions are strongly controlled - warming will be less.

Global and Canadian Climate Change Context

The global climate system is changing – and has changed throughout the planet's history. The concern with the current changes in climate across the globe is the rate of change which is seen as unprecedented.

The IPCC *Fifth Assessment* (2014b) reports that:

> "*Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history*", and; "*Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia*".

Although many indicators can be used to understand the changes in the climate system, global mean surface temperature (GMST) is the most utilized indicator used for tracking the changes. Temperature is also an indicator that can easily understood and clear to visualize. The GMST measures an average temperature for the entire globe using sea surface temperatures and near-surface air temperatures (Bush and Lemmen, 2019). Over the period of 1880 to 2012, the GMST increased by 0.85˚C with the years 2015, 2016 and 2017 recorded GMST as more than 1.0˚C above the pre-industrial average, being the warmest years on record (Bush and Lemmen, 2019). For the end of the 21st century under a business as usual scenario (GHG emissions

continue to increase at current rates to the end of the century), GSMT is projected to exceed a 2˚C increase, relative to the period of 1850 to 1900 (IPCC, 2013).

Indication of a warming climate is also evident in the changes to other climate indicators (Bush and Lemmen, 2019; IPCC, 2013):

- Increase in atmospheric water vapor and the capacity of warmer air to hold more moisture;
- Increase in ocean heat content, both surface and upper ocean portions;
- Rising of global mean sea level;
- Melting and thinning of land ice, glaciers and ice sheets globally; and
- Reduction in Arctic sea ice in all seasons, with the greatest declines in summer and fall.

Changes in climate indicators across the globe is not uniform. Canada's climate has warmed about twice the global average given the country's large land mass and location within higher northern latitudes, with the Canadian Arctic warming almost three times the global average (Bush and Lemmen, 2019). In terms of Canada's historical change in temperature, the mean temperature has increased 1.7˚C for Canada, and 2.3˚C for northern Canada, with winter experiencing the greatest warming overall (Bush and Lemmen, 2019).

South Huron's Changing Climate

For the purpose of summarizing South Huron's historical trends and future projected climate, the Climate Atlas of Canada was used as the primary source of information to gather data related to temperature, precipitation, seasonal changes. Information pertaining to extreme weather events were obtained from various scientific literature. *Appendix A: Historical Climate Trends and Future Projections for South Huron* contains a detail record of the projected change for South Huron.

In general, South Huron's future climate will include warming temperatures, changing precipitation patterns, a shift in seasonal changes and changes in the duration, frequency, and severity of extreme weather events.

In order to abridge the future climate projections for use by municipal staff and the community, Figures 4 and 5 provides a general summary of the global changes and relevant expected changes in climate for South Huron. The intention of these figures are to provide a simple representation of historical changes and what the future may look like.

Figure 4: South Huron's Changing Climate

SOUTH HURON'S CHANGING CLIMATE

Aligned with observed global changes, South Huron's climate is also changing and will have a continued impact on local weather, environment, economy, and the entire community.

The Past

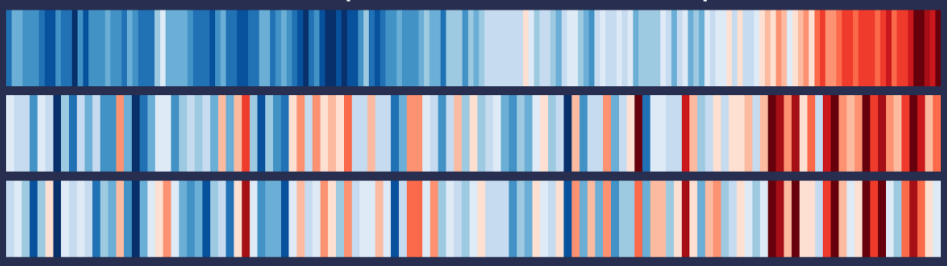
To visualize the changes to the climate, temperature is one variable that is often used because it is easily understood and clear to visualize. The images below show a simple representation of the historical changes in the average annual temperature across the globe, Canada and Ontario.

Changes in temperature are shown by the stripes changing from blue (cooler temperature) to red (warmer temperature)

Global change (from from 1850 - 2019)

Canada's change (from from 1901 - 2019)

Ontario's change (from from 1901 - 2019)



*Images retrieved from Show your Stripes (www.showyourstripes.info) (Hawkins, 2020)

The Future

The exact future climate depends on global greenhouse gas emissions. Projections of future changes provide a range of possibilities based on scenarios of low to high global emissions.

What we do know: our temperature will continue to warm, precipitation and seasonal patterns will continue to change and changes to the duration, frequency and severity of extreme weather events.

A snapshot of the projected average annual temperature change for Canada.

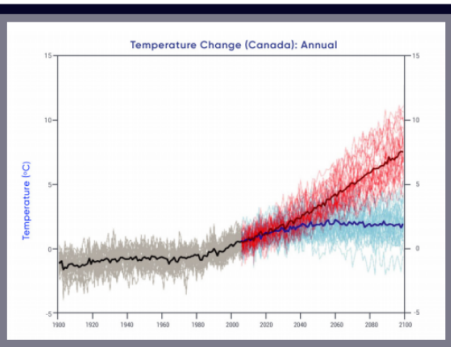


*Figure retrieved from Canada's Changing Climate Report (2020)

UNDERSTANDING FUTURE CLIMATE PROJECTIONS FOR SOUTH HURON

Future Scenario: A high emissions scenario was used where greenhouse gas emissions globally increase at current rates to the end of the century.

Projection Periods
- ***Immediate future*:** refers to the period of 2021 to 2050
- ***Near future*:** refers to the period of 2051 to 2080

Baseline Period: The period of 1978 to 2005 was used as the baseline to quantify the anticipated future projections.

RISING TO THE CHALLENGE
South Huron's Climate Change Adaptation Strategy

The Municipality of South Huron received funding from the Municipalities for Climate Innovation Program (MCIP) to prepare a climate change adaptation strategy. This infographic represents the finding from South Huron's Climate Change Adaptation Strategy.

Figure 5: South Huron's Future Climate Projections under a High Emissions Scenario

FEDERAL AND PROVINCIAL DIRECTION FOR ADAPTATION

Without addressing adaptation in current operations, climate change will cost Canadian taxpayers between $21 billion and $43 billion annually by 2050 and through adaptation investments, it is estimated that each dollar invested in adaptation in the present day will yield $9 to $38 of avoidable damages in the future (National Round Table on the Environment and the Economy, 2011). The federal and provincial governments play an important role in encouraging adaptation efforts across Canada by providing strategic direction, best practices and funding for local municipalities in order to assist them in developing adaptation strategies that best reflect the impacts on a local scale.

The Government of Canada focus on climate change is primarily the reduction of greenhouse gas emissions and reduction targets, through the following:

- In December 2015, the federal government signed the *Paris Agreement*, alongside with 195 other countries. The aim of this agreement was to limit the global average temperature to well below 2°C and limit the increase to 1.5°C. Within the Agreement, adaptation is addressed through the goal to enhance adaptive capacity, resilience strengthening and reduce vulnerabilities to climate change across a global scale (Government of Canada, 2016).
- Pan Canadian Framework on Clean Growth and Climate Change (2016) focuses on building climate resilience through infrastructure, protecting and improving human health and well-being, and reducing climate-related hazards and disaster risks (Government of Canada, 2020).
- The federal government also has contributed to scientific climate reports such as *Canada's Changing Climate Report (CCCR)* (2019), which provides a national assessment on climate change and aids decision makers in understanding how and why Canada's climate has changed and the future of Canada's climate.

The Ontario Government's direction on climate change focuses on the reduction of greenhouse gas emissions, resiliency and building a low-carbon economy, through the following:

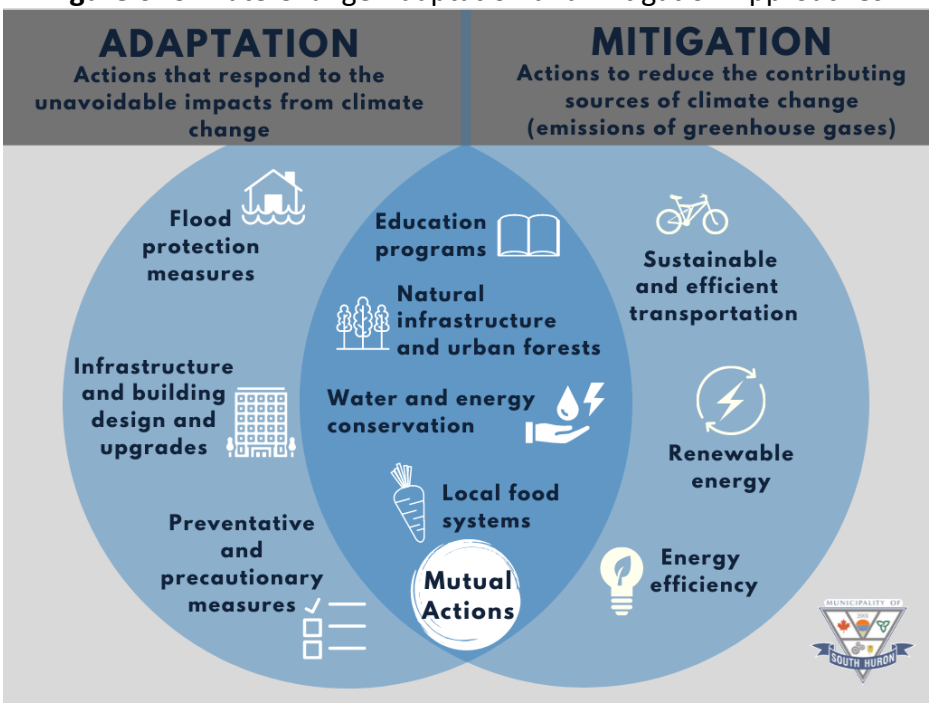
- They provide strategic direction on climate change adaptation through Ontario's *Provincial Policy Statement* (2014) which provides direction on land use and development patterns.
- In 2018, the provincial government released the *Made-in-Ontario Environmental Plan* to protect the environment and address climate change. The plan aims to build resilience of families and communities through addressing vulnerabilities and sectors that will be most impacted and reduce risk of flooding within communities. The plan also aims to hold polluters accountable and activating the private sector through the support of clean technology.
- Creation of the *Ontario's Flooding Strategy* (2020) which outlines how the Province will support the reduction of flood risk and help Ontarians be better prepared for flooding events. Many actions within this strategy support the actions identified in the provincial flooding strategy.

MUNICIPALITY'S ROLE IN RESPONDING TO CLIMATE CHANGE

Responding to climate change can be described using two approaches: adaptation and mitigation. These approaches are described below and shown in Figure 6:

- Adaptation is an action that adjusts practices, processes or structures in response to the unavoidable impacts, either opportunities or threats, caused by climate change.
- Mitigation refers to measures implemented to reduce the contributing sources of climate change (e.g. GHG emissions reduction) that contribute to the unavoidable impacts.

Figure 6: Climate Change Adaptation and Mitigation Approaches



The most effective response to climate change includes efforts of both adaptation and mitigation, designed to work concurrently and not to undermine or replace each other.

Adaptation planning provides many benefits to the South Huron and encompasses many other faucets of the community, including:

- Ensures a resilient and safe community;
- Provides reliable services and connectivity;
- Creates flexible solutions;
- Identifies community priorities;
- Enhances partnerships and collaboration; and
- Demonstrates leadership.

For the purpose of this strategy, adaptation is the focus, but some mitigation will be included where appropriate. The goal of effective adaptation is to anticipate the impacts ahead of time (proactive) rather than after the impacts have been experienced (reactive).

Understanding the potential regional impacts from climate change is important to ensure South Huron has the capacity to adapt, both operational and economically to the unavoidable changes through informed decision-making. Municipalities own approximately 60% of the core infrastructure in Canada (Canada Infrastructure, 2016). This ownership provides them a unique perspective on how the community will be impacted and in what capacity adaptation should be addressed in relevance to the municipality.

Through collaboration with internal and external stakeholders, identifying impacts and prioritizing actions to address them will ensure that there is resilience on the front line, where the impacts will be felt the greatest.

IMPACTS IDENTIFIED FOR SOUTH HURON

Impact statements represent a climate variable (anticipated change), what happens (outcome) and what the impact to the municipality is (consequence).

A total of 75 impact statements for the Municipality to consider were developed through municipal staff workshops, public survey responses and input from the Climate Change Adaptation Advisory Committee (CCAAC) members. The Master Impact Statement List is shown in detail in *Appendix B: Master Impact Statement List*. Based on engagement feedback (outlined in Appendix E: Engagement Summary), it was also articulated that the need for the strategy to include impacts on the community as well as actions to address the priorities.

Through review of the impact statements, it was determined that not all impacts fall within the jurisdiction of the municipality during the action phase (i.e., action item falls under another organization) or the impact was not considered a top priority for the community. Prioritization of impacts to carry forward was determined through a prioritizing exercise completed by municipal staff and members of the CCAAC, as well as the impact that were mentioned within the public survey responses were also identified.

As a result, it was determined that 40 priority impact statements would be carried forward to be considered in the vulnerability and risk assessments.

The following 40 impact statements (organized by primary theme) were determined as priorities and to be carried to the vulnerability and risk assessment phase:

Administration

- Increased demand for essential services and disaster recovery costs resulting in an increase in staff time and financial cost to the municipality.
- Increased power outages and electrical surges, resulting in the inability for municipal staff to utilize phones and computers, process work orders, provide communications to the entire municipality and access information for coordinated effort during extreme weather events.
- Increased liability, public and health and safety hazards and risks, private property damage, dangerous conditions that may impact the entire municipality.

Built Infrastructure (roads, sidewalks, buildings)

- Increased damage to hard surfaces (roads, sidewalks) resulting in an increase in request for service and staff time to repair/replace, increased costs and integration into asset management planning.
- Increased underground movement causing potential damage to municipal infrastructure (buildings, underground services, roads, sidewalks, cemetery) resulting in increase in request for service and staff time to monitoring and repair/replace, increased costs and integration into asset management planning.
- Increased damage and/or decreased service life of municipal infrastructure (buildings, underground services, roads, bridges/culverts), public spaces requiring the potential closure of municipal facilities, increase request for service, staff time to repair/replace infrastructure and financial cost to the municipality.
- Increased risk of deep freeze to municipal infrastructure causing deficiencies resulting in an increased immediate request for service, staff time to repair/replace the damaged infrastructure and cost to the municipality.

Community Well-being

- Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk to the public, especially vulnerable populations.
- Increased power outages and electrical surges, resulting in service disruptions for the entire municipality.
- Increased health and safety risk (thermoregulation, frostbite) to vulnerable populations resulting in an increase in the need for community cold alerts, service requests, and access to warming facility resulting in increased request for service and staff time and coordination, potentially outside of regular working hours.
- Increased health and safety risk to vulnerable populations resulting in an increase in service requests, access to cooling facility resulting in increased request for service and staff time and coordination, potentially outside of regular working hours.

Community Facilities

- Reduced air quality that may cause heat street or respiratory illnesses lead to an increased in request for service and staff time to accommodate demand for outdoor cooling facilities (pools, tree covered areas, splash pads) and indoor facilities.
- Inundated municipal outdoor facilities (sports fields, parks, natural areas and trails, cemetery, Port Blake day-use area) preventing municipal staff from maintaining these spaces leading to temporary disruptions in using these spaces, increased demand for alternative spaces and potential revenue loss (where applicable).

Emergency Services

- Increased number of displaced residents from their homes due to extreme weather events, leading to an increase usage of the Emergency Operations Centre (Town Hall), request for service, coordination and communications from municipal staff.
- Increase in occurrences of power outages, transportation disruptions, and public health and safety situations resulting in an increased demand for emergency services, communications, coordination and resources.

Energy

- Increased summer energy usage for municipally-owned facilities leading to increased utility costs for the municipality.

Fire Services

- Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk to municipal volunteer fire fighters working during periods of very hot days requiring appropriate working hours, cooling aids and relief mechanisms.
- Increased risk of fire during dry conditions resulting in an increase in fire related calls and increase in the total number of calls for fire department during dry periods.

Insects, Pest and Invasive Species

- Increased reproduction rates and range of vectors (e.g., West Nile Virus, Lyme Disease) resulting in an increased risk of exposure to vector-borne diseases for municipal outdoor workers.
- Extended growing seasons and increased survival rates for pests resulting in the potential for an increase presence and impacts (damage or loss) from invasive species to tree and vegetation within municipally owned property.

Natural Environment

- Increased stress on trees and natural areas resulting in an increase in municipal water demand and staff time to ensure the health and success of trees, increase in request for service and staff time to monitor and remove hazard trees on municipally-owned property
- Increased damage to urban trees, parks, and trails resulting in closures, increased request for service and staff time and cost to the municipality to identify and remove hazard trees.

Outdoor Maintenance and Construction

- Increase in repairs/replacements addressed under tender bids during times of overload to municipal staff resulting in increased cost and project management time to the municipality.
- Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk and demand for municipal outdoor workers to have appropriate working hours, cooling aids, personal protective gear and spaces for relief.
- Reduced quality of outdoor municipal facilities (sports fields, parks, natural areas and trails, cemetery) and lawns, gardens and drought in-tolerant trees and vegetation requiring an increase in municipal water usage, request for service, and maintenance and monitoring of the quality of spaces and potential removal of distressed species.
- Increased health and safety risk (thermoregulation, frostbite) and demand for municipal outdoor workers to have appropriate working hours, warming aids, personal protective gear and spaces for relief.

Private Property

- Increased damage to private property due to flooding resulting in an increase in number of residents contacting the municipality, specifically directed to the Building Department requesting information on flooding and assistance to address the situation.
- Increased extensive damaged to private property resulting in an increase in requests for permits (with the potential for quick turnarounds requested) resulting in an increase in staff time to consult and prepare required documentation to issue permits.

Sewage Services

- Overloading of older sanitary sewers (in particular, where inflow and infiltration of stormwater/groundwater into sanitary sewers), resulting in the potential for untreated sewage overflow by-passing secondary treatment allowing contaminants and infectious organisms entering into the receiving waterbody.
- Overwhelming of sanitary sewers resulting in the potential back up of sewage into basements, particularly in low-lying areas.
- Overflow by-pass resulting in an increase in call outs to Municipal staff due to emergency alarms, service calls and mandatory reporting to agencies (i.e., Ministry of the Environment, Conservation and Parks).

Stormwater and Flooding

- Increase in erosion rates, sediment release and surface runoff within riparian areas and unstable transition to low-lying areas, resulting in an increased risk of pollutants from the landscape, increase in bank destabilization, loss of habitat and overall impact on water quality.
- Changes in timing of spring and winter melts, potentially when ground is frozen and saturated resulting in surcharge and runoff from rapid snowmelts resulting in the potential of overburdening of the municipal stormwater system and risk of overland flooding leading to damage to municipal infrastructure.
- Increased stress on bridges/culverts, potential for road washouts, erosion and transportation disruptions requiring an increase in emergency service requests and staff time to monitor, repair/replace damages, financial cost to the municipality and increased management required during the response period.
- Changes in winter precipitation type (rain), potentially when the ground is frozen and saturated resulting in surcharge and runoff from rapid snowmelt resulting in the overburdening of the municipal stormwater system and risk of flooding leading to damage to municipal infrastructure, increase in financial cost to the municipality and management required during the response period.

Water Services

- Increased bacteria growth and dissipation of chlorine within municipally-owned water storage facilities resulting in increased staff monitoring and changes to the amount/type of chemicals (chlorine) required within the system to ensure drinking water standards are adhered to.
- Reduced quality of municipal and private property lawn/gardens, and drought in-tolerant trees and vegetation resulting in an increase in demand for municipal water.

- Increased risk of deep freeze to municipal underground water service causing breakage or freezing resulting in an increased immediate request for service, staff time to repair/replace the damaged services and cost to the municipality.

Winter Maintenance

- Increased hazardous road and walking conditions resulting in an increased use of salt and/or sand on roadways, sidewalks and in parking lots resulting in increase in staff time to monitor, increased corrosion to equipment and facilities, and greater impact on water quality within the municipality.
- Increased outdoor maintenance from precipitation falling as snow or rain requiring more staff time to monitor and operate, equipment requirements and cost to the municipality.

VULNERABILITY AND RISK ASSESSMENT

Vulnerability and risk assessments assist in determining which impacts from climate change are most important and how to best address them. The assessments completed as part of South Huron's Climate Change Adaptation Strategy aligns with the Milestones outlined in ICLEI'S Building Adaptive and Resilient Communities (BARC) Program. Milestone 2 (Research) extensively outlines vulnerability and risk assessment component and important questions required to complete them.

Appendix C: Vulnerability and Risk Assessment contains detailed scoring for each impact statement and definitions and scoring for the qualitative vulnerability and risk equations. The engagement approach for the completion of the vulnerability and risk assessment is outlined in detail in *Appendix E: Engagement Summary*.

Vulnerability

Vulnerability refers to the susceptibility of service areas within the municipality and the potential harm that may arise from climate change. The assessment provides an analysis of the sensitivity (to what degree will the functionality change) and the adaptive capacity (cost and staff intervention required to recover) to the projected changes in climate for South Huron.

Vulnerability = Sensitivity / Adaptive Capacity

Risk

The purpose of a risk assessment is to prioritize the impacts to determine which impacts should be addressed through action planning (those that pose the greatest risk). Impacts that are determined to have a low risk score although will not be included in action

planning, they will be monitored as the strategy is updated to ensure the scoring hasn't significantly changed.

Risk = Likelihood x Consequence

Vulnerability and Risk Assessment Results

The Climate Change Adaptation Advisory Committee summarized the follow parameters to carry over impact statements to the Action Planning phase that had the following scores (as outlined in *Appendix C: Vulnerability and Risk Assessment*):

- Medium-High Risk Score;
- Medium Risk Score with Vulnerability Scores of Medium (V3), Medium-High (V4) and High (V5); and
- Low-Medium and Low Risk Score with Vulnerability Scores of Medium-High (V4) and High (V5).

Note: It was also recommended by the Committee that any impacts that fell outside of the above but were deemed important may also be carried over.

Based on the scoring parameters and discussion, a total of 22 impact statements fell within the parameters and were carried over to the action planning phase as outlined in *Appendix C: Vulnerability and Risk Assessment*.

VISION AND GOALS OF THE ADAPTATION STRATEGY

Throughout consultation for the project (outlined in detail in *Appendix E: Engagement Summary*), feedback was provided by municipal staff, Council, members of the Climate Change Adaptation Advisory Committee (CCAAC) and many stakeholders within the community in relation to the strategy's overall vision (end result) and goals (how to reach the vision). Based on the responses, the CCAAC worked with municipal staff to develop the vision and goals for the adaptation strategy.

Vision

A future-ready South Huron that is resilient to the impacts of a changing climate.

Goals

Based on the impact statements from climate change identified for South Huron, a series of eight (8) goals were developed through consultation with municipal staff and the CCAAC. The goals represent priorities as they relate to the impacts from climate change identified by the strategy.

Goal 1 ***Integrate climate change adaptation into municipal planning, asset management and operations;***

Goal 2 ***Support municipal and community resilience awareness and action;***

Goal 3 ***Ensure community readiness and a coordinated response to extreme weather events;***

Goal 4 ***Reduce risks to buildings, properties and people from flooding;***

Goal 5 ***Minimize disruption to municipal service delivery;***

Goal 6 ***Reduce health and safety risks to municipal workers and community members from extreme temperatures;***

Goal 7 ***Protect and enhance the natural landscape to mitigate impact; and***

Goal 8 ***Strengthen the resiliency of municipal infrastructure and facilities***

ACTIONS

The action items identified through consultation for the project (outlined in detail in *Appendix E: Engagement Summary*) from municipal staff, Council, members of the Climate Change Adaptation Advisory Committee (CCAAC) and many stakeholders within the community have been organized according to the overarching goal in which it addresses.

A comprehensive list of the action plan is outlined in *Appendix D: Action and Implementation Plan* and contains more detailed information regarding description and scope of action, implementation lead(s) and supporting department(s), associated plans, policies, projects and strategies, anticipated timing of implementation, estimated resources (cost and staff effort) and identifying potential partnerships.

It should be noted that through consultation, additional actions with a mitigation focus were identified as important for the municipality and the community. These action items are listed under the *Additional Action Identified* goal heading. Although these actions are mitigation focused, they will assist in reducing the overall impact on the environment and reduction of community sources of GHG emissions.

A total of 38 actions were identified for the Municipality to consider for implementation to address the goals of the adaptation strategy, ranging from slight operational changes to the potential for large capital projects requiring staff effort. The action items were identified through municipal staff workshops, Council and municipal staff survey responses, public survey responses and input from the Climate Change Adaptation Advisory Committee (CCAAC) members.

The following outline the goals and associated actions of South Huron's Climate Change Adaptation Strategy:

GOAL 1: INTEGRATE CLIMATE CHANGE ADAPTATION INTO MUNICIPAL PLANNING, ASSET MANAGEMENT AND OPERATIONS

ACTIONS:

1.1 Include climate change consideration section in staff reports to Council

1.2 Develop a qualitative climate lens tool to guide staff and Council decision-making.

1.3 Develop a process to ensure climate change adaptation is considered during review of existing and development of new policies and plans for South Huron.

1.4 Integrate climate change projections into asset management planning.

1.5 Continue to lobby provincial and federal governments to support adaptation initiatives at the municipal level.

GOAL 2: SUPPORT MUNICIPAL AND COMMUNITY RESILIENCE AWARENESS AND ACTION

ACTIONS:

2.1 Initiate community-wide conversation to provide information to the entire community (residents, business) about relevant climate change topics to provide the tools required to incorporate resilience on a community-wide scale.

2.2 Develop information briefing program to be regularly sent to staff and Council to inform on current climate change information.

2.3 Create and promote regularly scheduled climate change themed challenges for the community to showcase their resilience.

2.4 Develop communication strategy to showcase municipal initiatives to the community that are related to adaptation and resilience.

GOAL 3: ENSURE COMMUNITY READINESS AND COORDINATED RESPONSES TO EXTREME WEATHER EVENTS

ACTIONS:

3.1 Investigate tools to expand municipal communications during extreme weather events to ensure information is convenient, accurately communicated and regularly updated to inform the public.

3.2 Develop a current public awareness campaign to enhance community preparedness before an extreme weather event occurs.

3.3 Identify potential partnerships and explore options to create a voluntary "Check in with your neighbour" program within South Huron.

3.4 Conduct vulnerability assessment of critical infrastructure within municipal facilities and prioritize deficiencies required to be addressed to ensure resiliency.

3.5 Develop an internal training program for all municipal staff for coordination during extreme weather events to ensure service continuity.

GOAL 4: REDUCE RISKS TO BUILDINGS, PROPERTIES AND PEOPLE FROM FLOODING

ACTIONS:

1.1 Undertake a Stormwater Master Plan for all settlement areas within the Municipality.

1.2 Support updating floodplain mapping for core development areas within the municipality.

1.3 Develop procedure for regularly updating rain Intensity-Duration-Frequency (IDF) curves to reflect changing climate variables to inform design of all municipal infrastructure.

1.4 Develop awareness program and investigate the potential for incentives to encourage lot level stormwater controls for private property.

1.5 Investigate grading control measures to be implemented for infill lots designated for development.

1.6 Incorporate low impact development (LID) strategies into lot design of municipal facility upgrades and new municipal facilities.

1.7 Reintroduction and update of sewage backflow value/ sump pump program.

1.8 Develop a guide for public to provide information to them when they inquire about what to do when private property buildings are flooded.

1.9 Require developers to utilize best practices within site plan design to ensure risk of flooding within new developments is reduced.

GOAL 5: MINIMIZE DISRUPTION TO MUNICIPAL SERVICE DELIVERY

ACTIONS:

2.1 Enhance communication pathways between departments to ensure efficient response to and recovery from disruptions to services.

2.2 Identify critical services; develop, document and train on contingency procedures.

GOAL 6: REDUCE HEALTH AND SAFETY RISKS TO MUNICIPAL WORKERS AND COMMUNITY MEMBERS FROM EXTREME TEMPERATURES

ACTIONS:

6.1 Establish municipal facility locations and operating parameters to function as temporary warming and cooling centres for community members.

6.2 Develop a public awareness campaign to provide education to the community on how to stay safe during an extreme temperature events.

6.3 Develop extreme temperature training program for municipal staff.

6.4 Establish tree planting guidelines to assist in mitigating the effects of extreme heat, particularly within urban settlement boundaries. (related to action item 7.1)

6.5 Increase public education and communication related to fire risk during extreme heat events.

GOAL 7: PROTECT AND ENHANCE THE NATURAL LANDSCAPE TO MITIGATE IMPACTS

ACTIONS:

7.1 Development of a municipal wide forest strategy. (related to action item 6.4)

7.2 Develop a naturalization strategy focused on riparian areas located on municipal properties.

7.3 Develop awareness and investigate an incentive program to encourage naturalization and environmental stewardship on private property.

7.4 Investigate the feasibility of integrating municipal natural infrastructure into asset management.

GOAL 8: STRENGTHEN THE RESILIENCY OF MUNICIPAL INFRASTRUCTURE AND FACILITIES	**ACTIONS:** 8.1 Incorporate climate change impacts into inspection process and identified deficiencies related to municipal infrastructure and facilities are completed and remediated on a regular basis. 8.2 Provide municipal staff information on green infrastructure (natural) as a means to provide support to grey infrastructure (human engineered) within municipal projects.
ADDITIONAL ACTIONS IDENTIFIED	**ACTIONS:** 9.1 Eliminate of single use plastics within Municipal offices. 9.2 Creation of a Municipal Backyard Composting Program.

IMPLEMENTATION PLAN

The preliminary implementation plan (outlined in *Appendix D: Action Plan*) for the action items identified is flexible in order to accommodate any changes to strategic direction, staffing or available financial resources. Flexibility in the plan will also allow for the implementation of new opportunities. The implementation of actions will be further refined within ICLEI BARC's Milestone 4 (Implementation) and Milestone 5 (Monitoring and Review) where project specific plans will be created to provide more detail on each action item.

The implementation of the action items will be carried out over a five year period. Action items that have been determined to be quick-wins and require low financial and staffing resources will be prioritized to be implemented earlier. Action items that require significant capital funding and greater staff effort have been prioritize to be implemented in later years to ensure project specific plans can be prepared and to ensure capacity for success.

It is important to note that the actions and implementation details outlined in this appendix are intended to be used as a guide and specific project and plans are to be incorporated into Council decision making and budget considerations. All lead and supporting department(s) roles and responsibilities will be identified at the beginning of the implementation planning phase, and that all timelines and costs related to action project specific plans will be subject to final Council approval, prior to implementation.

EVALUATION AND MONITORING

To ensure the success of the adaptation strategy, monitoring and evaluation is critical. The following evaluation and monitoring tasks are to be integrated in municipal business:

- Annual evaluation and monitoring of action items that have implemented and with an ongoing duration, including utilizing baseline indicators (as outlined in *Appendix F: Implementation Indicators*) to report on progress; and
- Five year update of the climate change adaptation strategy to report on successes, identify opportunities and redesign action items to reflect current realities.

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Glossary

Adaptation is an action that adjusts practices, processes or structures in response to the unavoidable impacts, either opportunities or threats, caused by climate change. The goal of effective adaptation is to anticipate the impacts ahead of time (proactive) rather than after the impacts have been experienced (reactive).

Climate refers to weather patterns averaged over a period of time, typically 30 years. Climate is a complex and dynamic system consisting of the Earth's atmosphere, land, snow and ice, waterbodies, and all living things. It is influenced by both internal dynamics (caused by the climate system itself) and external forces (including volcanic eruptions, solar variations and human influences).

Climate change refers to a significant variation to long-term (typically decades or longer) change in climate (global or regional) which reflects changes in weather patterns, including an increase in temperature, fluctuating precipitation patterns and extreme weather events.

Climate variability refers to the variation in climate within a smaller timeframe than climate change, typically months to years.

Global Warming refers to the long-term warming in temperature observed on a global scale. *Global warming is one aspect of climate change*. The primary *source* of global warming is in the increase of greenhouse gases (GHGs) released into the atmosphere by human-made activities which burn fossil fuels including transportation, manufacturing and electricity. Natural sources of GHG emissions include volcanic activity, the Earth's orbit, and the solar output.

The Greenhouse Effect refers to the buildup and long term presence of GHGs in the atmosphere, causing the atmosphere becomes thicker which traps the sun's radiation (heat), making the Earth's air temperature warmer.

Greenhouse Gas (GHG) refers to gases that have the property of trapping heat or longwave radiation in the atmosphere that was radiated from Earth, contributing to the *greenhouse effect* (see definition). The following gases are considered a greenhouse gas: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (synthetic gases).

Mitigation refers to measures implemented to reduce the contributing sources of climate change (ex. GHG emissions reduction) that contribute to the unavoidable impacts.

Resilience refers to the capability to respond and recover to change or disruption while maintaining an acceptable level of service or functionality.

Weather refers to the variation in short-term atmospheric conditions (temperature, wind, precipitation, humidity, cloud cover) that occur from minutes to weeks.

Abbreviations and Acronyms

BARC	Building Adaptive and Resilient Communities
CCAAC	Climate Change Adaptation Advisory Committee
CCCR	Canada's Changing Climate Report
GHG	Greenhouse Gas Emissions
GMST	Global mean surface temperature
ICLEI	International Council for Local Environmental Initiatives
IPCC	Intergovernmental Panel on Climate Change
RCP	Representative Concentration Pathways

Appendix A
HISTORICAL CLIMATE TRENDS AND FUTURE PROJETIONS FOR SOUTH HURON

Note: The following document titled *Appendix A: Historical Climate Trends and Future Projections for South Huron* shall be read in conjunction with the Municipality of South Huron's Climate Change Adaptation Strategy. This appendix contains the data summary for historical climate trends and future projections for the Municipality of South Huron.

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SUMMARY OF CLIMATE VARIABLE DATA

Projection Data

For the purpose of summarizing South Huron's historical trends and future projected climate, the Climate Atlas of Canada was used as the primary source of information to gather data. The Climate Atlas of Canada utilizes 24 CMIP5 statically downscaled climate models (Bias Correction with Constructed Analogues and Quantile mapping, version 2, BCCAQv2) with the data represent the average of the 24 models used. Grids size representing a spatial area of approximately 30km x 60km. An average across all 24 models is used.

Given the spatial area of the Municipality, approximately 425km^2, two grids utilized which encompassed South Huron completely were the Grand Bend and St. Marys grids (PCC, 2019a). Although the range and mean for the square were similar, it was identified important to capture all future projections in South Huron. The summary of projections for the entire Municipality utilize both grids and provides a range of means to describe the changes and is hereafter referred to as 'South Huron' when describing the projected changes.

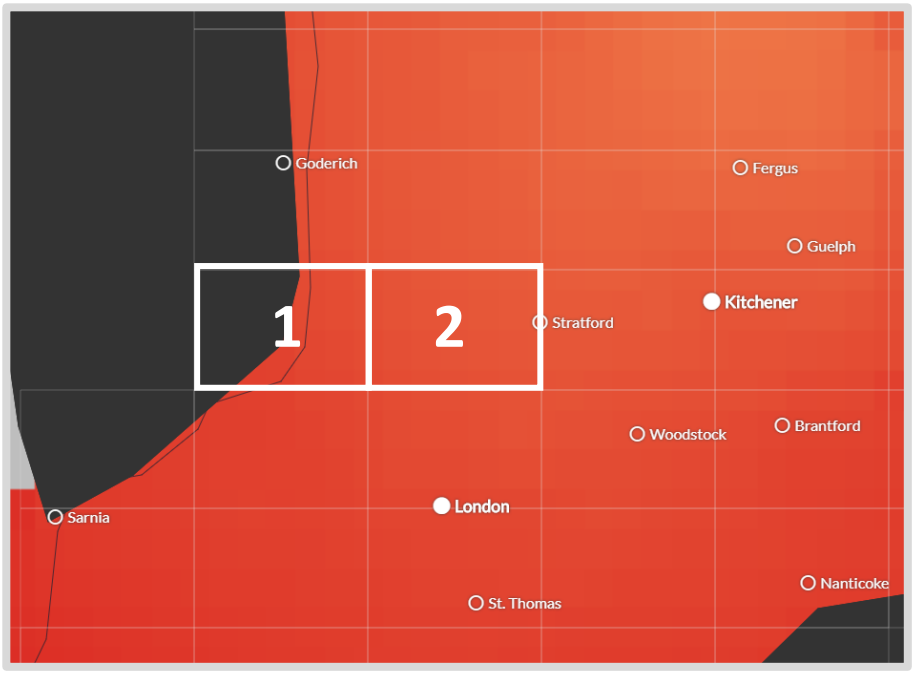


FIGURE 1: Spatial locations of Grand Bend (1) and St. Marys (2) grids utilized to summarize South Huron's future projected climate (PCC, 2019a)

Where the findings required further analysis or information was absent from the Climate Atlas of Canada, such as historical trends and future projections for extreme weather events, information from other sources were used and the parameters and sources are cited within. Literature describing southern Ontario or locations in close proximity and/or similar to South Huron were

selected. In some instances, the climate trends and future projections are described using an Ontario wide scale given the lack of regional, specific data.

Uncertainty and Data Confidence

Understanding and interpreting climate data involves uncertainty. Although there is uncertainty, it doesn't prevent us from drawing conclusions about the overall future patterns. Within climate models, there are three main sources of uncertainty that have been identified:

- Natural climate variability;
- Climate model uncertainty; and
- Future emission uncertainty.

To address uncertainty, Representative Concentration Pathways (RCPs) have been established by the Intergovernmental Panel on Climate Change (IPCC) in the Fifth Assessment Report (2014). RCPs are universally utilized to capture future trends based on predictions of how concentrations of GHGs (as a result of emissions) present in the atmosphere will change the amount of heat energy that is stored in the climate system, based on human activity. RCPs range from very low to very high emissions to the year 2100 and indicate a different amount of human-influence in terms of extra heat energy required to be stored within the climate system from greenhouse gas emissions. Development the scenarios take into account assumptions of economic growth, technology, and land-use. They also provide insight into the range of possible mitigation actions that may be taken in the future. RCPs are discussed in greater detail in the next section.

Description of each climate variable will include information regarding data confidence of climate science of the evidence and agreeance within the scientific community. A report titled *State of Climate Change Science in the Great Lakes Basin: A Focus on Climatological, Hydrological and Ecological Effects* prepared by McDermid *et al.* (2015) provides a comprehensive review of available climate science within the Great Lakes Basin and provides a summary for data confidence for many climate variable. Data confidence is an integral part of describing South Huron's future climate projections will be considered in the risk assessment phase when determining the likelihood of an impact to occur.

Representative Concentration Pathways (RCPs)

For the purpose of describing future climate projections for South Huron, the following RCPs will be utilized, as described in Canada's Changing Climate Report (Bush and Lemmen, 2019):

- RCP4.5 (Low carbon emissions scenario): In this scenario, greenhouse gas emissions continue to increase until approximately 2050, then decline rapidly.
- RCP8.5 (High carbon emissions scenario): In this scenario, greenhouse gas emissions increase at current rates to the end of the century.

It should be noted that the RCP2.6, which represents a very low carbon emissions scenario was not used in describing the projections for South Huron. Based on the *highly confident* (about 8 out of 10 chance of being correct) statement within the IPCC Fifth Assessment, observed global carbon emissions within the last 15 to 20 years are consistent with higher emissions scenarios (IPCC, 2014). It is suggested that future emissions will fall somewhere in the middle of all scenarios and will likely be captured within the RCP4.5 and RCP8.5 scenarios. Utilization of RCP4.5 and RCP8.5 remains consistent with assessments at the national and international level and will be used in this report.

Historical Baseline and Future Projection Periods

A historical baseline period allows us to understand what the outcome for a specific period was and compare it to future projections to quantify the changes. The baseline period of 1978 to 2005 was chosen for South Huron's climate projections. This baseline is utilized by the Climate Atlas of Canada and data used for this period is obtainable and reliable. Climate information retrieved from other sources for that have an alternate baseline will be noted in the report.

The future projection periods are described as the *immediate future* (referring to the period of 2021 to 2050) and the *near future* (referring to the period of 2051 to 2080), consistent with the Climate Atlas of Canada data.

Annual and Seasonal Timeframes

The variables used to describe the changes in temperature for South Huron are averaged over seasons or annually and the variables used are indicated under each variable description. Seasonal periods are particularly significant in understanding the impact to seasonal changes that may impact industries such as agriculture, recreation, construction, natural environment, etc.

The following describes the categorization of the seasons when describing historical trends and future projections:

- Spring: March, April and May;
- Sumer: June, July and August;
- Fall: September, October, and November; and
- Winter: December, January and February.

The following section describes the climate variables and related data used to describe the historical climate trends and future projections for South Huron. Each variable contains an explanation of the variable, expression of units, timeframe of the data and the relevance of the data.

TEMPERATURE VARIABLES

Mean Temperature (Annual, Seasonal)

Mean temperature refers to the average temperature of the day, calculated by averaging the daily maximum and minimum temperatures, expressed in degrees Celsius (˚C). The timeframe of this variable is annual and seasonal. This variable is relevant for the following: planning and policy, health and safety, agriculture, engineering, energy management and recreation, and insect and pest management.

TABLE 1: Projected Changes in Annual Mean Temperature for South Huron

(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
7.8 ˚C	**9.6 ˚C** (RCP 4.5 Low Emissions)	↑	**10.7 ˚C** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	9.9 ˚C (RCP 8.5 High Emissions)	↑	**12.0 ˚C** (RCP 8.5 High Emissions)	↑	●●● High evidence High agreeance

TABLE 2: Projected Changes in Seasonal Mean Temperature for South Huron

(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
7.0 ˚C Spring	**8.0 ˚C** (RCP 4.5 Low Emissions)	↑	**8.9 ˚C** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	8.8 ˚C (RCP 8.5 High Emissions)	↑	**10.7 ˚C** (RCP 8.5 High Emissions)	↑	
20.3 ˚C Summer	**21.2 ˚C** (RCP 4.5 Low Emissions)	↑	**22.3 ˚C** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	22.4 ˚C (RCP 8.5 High Emissions)	↑	**25.0 ˚C** (RCP 8.5 High Emissions)	↑	
10.5 ˚C Fall	**11.7 ˚C** (RCP 4.5 Low Emissions)	↑	**12.5 ˚C** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	12.6 ˚C (RCP 8.5 High Emissions)	↑	**15.0 ˚C** (RCP 8.5 High Emissions)	↑	
- 4.6 ˚C Winter	**- 2.5 ˚C** (RCP 4.5 Low Emissions)	↑	**- 1.2 ˚C** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	- 2.3 ˚C (RCP 8.5 High Emissions)	↑	**0.0 ˚C** (RCP 8.5 High Emissions)	↑	

Minimum and Maximum Temperature

Minimum temperature refers to the average daily minimum temperature. Maximum temperature refers to the daily maximum temperature. The mean minimum and maximum temperature is expressed in degrees Celsius (˚C). The timeframe of this variable is annual. This variable is relevant for the following: planning and policy, health and safety, agriculture, engineering, energy management and recreation and insect and pest management.

TABLE 3: Projected Changes in Annual Minimum Temperature for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
3.1 ˚C	**5.0 ˚C** (RCP 4.5 Low Emissions)	↑	**6.0 ˚C** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	7.6 ˚C (RCP 8.5 High Emissions)	↑	**9.7 ˚C** (RCP 8.5 High Emissions)	↑	●●● High evidence High agreeance

TABLE 4: Projected Changes in Annual Maximum Temperature for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
12.4 ˚C	**14.4 ˚C** (RCP 4.5 Low Emissions)	↑	**15.4 ˚C** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	14.6 ˚C (RCP 8.5 High Emissions)	↑	**16.7 ˚C** (RCP 8.5 High Emissions)	↑	●●● High evidence High agreeance

Very Hot Days

A very hot day refers to a day when the temperature rises to at least 30˚C, expressed as a count of number of days. The timeframe of this variable is annual. This variable is relevant for the following: natural environment, infrastructure, health and safety, recreation, drought/wildfire risk, energy management and insect and pest management.

TABLE 5: Projected Changes in Number of Very Hot Days for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
11.4 days	**27.3 days** (RCP 4.5 Low Emissions)	↑	**38.7 days** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	29.9 days (RCP 8.5 High Emissions)	↑	**55.5 days** (RCP 8.5 High Emissions)	↑	●●● High evidence High agreeance

Winter Days

A winter day refers to a day when the temperature drops to at least -15˚C, expressed as a count of number of days. The timeframe of this variable is annual. This variable is relevant for the following: natural environment, health and safety, recreation, infrastructure, and energy management.

TABLE 6: Projected Changes in Number of Winter Days for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
15.4 days	**7.2 days** (RCP 4.5 Low Emissions)	↓	**4.0 days** (RCP 4.5 Low Emissions)	↓	●●● High evidence High agreeance
	6.5 days (RCP 8.5 High Emissions)	↓	**1.8 days** (RCP 8.5 High Emissions)	↓	●●● High evidence High agreeance

Tropical Nights

Tropical night refers to when the lowest temperature of the day does not go below 20 ˚C, expressed as a count of number of days. This variable is relevant for the following: natural environment, health and safety, recreation, infrastructure, and energy management.

TABLE 7: Projected Changes in Number of Tropical Nights for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
4.4 days	**12.5 days** (RCP 4.5 Low Emissions)	↑	**19.9 days** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	14.6 days (RCP 8.5 High Emissions)	↑	**34 days** (RCP 8.5 High Emissions)	↑	●●● High evidence High agreeance

PRECIPITATION VARIABLES

Total Precipitation (Annual, Seasonal)

Total Precipitation refers to the total amount of rain, drizzle, snow, sleet, etc., expressed in millimetres (mm). The timeframe of this variable is annual and seasonal. This variable is relevant for the following: water resources, agriculture, flooding, and drought/ wildfire risk.

TABLE 8: Projected Changes in Total Annual Precipitation for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
937 mm	**980 mm** (RCP 4.5 Low Emissions)	↑	**1005 mm** (RCP 4.5 Low Emissions)	↓	●● High evidence Medium agreeance
	992 mm (RCP 8.5 High Emissions)	↓	**1018 mm** (RCP 8.5 High Emissions)	↓	●● High evidence Medium agreeance

TABLE 9: Projected Changes in Total Seasonal Precipitation for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
221 mm Spring	**236 mm** (RCP 4.5 Low Emissions)	↑	**244 mm** (RCP 4.5 Low Emissions)	↑	●● High evidence Medium agreeance
	242.5 mm (RCP 8.5 High Emissions)	↑	**256 mm** (RCP 8.5 High Emissions)	↑	●● High evidence Medium agreeance
221.5 mm Summer	**224 mm** (RCP 4.5 Low Emissions)	↔	**223 mm** (RCP 4.5 Low Emissions)	↔	●● High evidence Medium agreeance
	222 mm (RCP 8.5 High Emissions)	↔	**221 mm** (RCP 8.5 High Emissions)	↔	●● High evidence Medium agreeance
261 mm Fall	**266 mm** (RCP 4.5 Low Emissions)	↑	**269 mm** (RCP 4.5 Low Emissions)	↑	●● High evidence Medium agreeance
	270 mm (RCP 8.5 High Emissions)	↑	**277 mm** (RCP 8.5 High Emissions)	↑	●● High evidence Medium agreeance
234 mm Winter	**254 mm** (RCP 4.5 Low Emissions)	↑	**262 mm** (RCP 4.5 Low Emissions)	↑	●● High evidence Medium agreeance
	257 mm (RCP 8.5 High Emissions)	↑	**273 mm** (RCP 8.5 High Emissions)	↑	●● High evidence Medium agreeance

Determining the type of precipitation that is projected to fall is extremely difficult to describe given the influence of the local scale, including topography and vegetation. Precipitation type falling as freezing rain, ice and snowstorms is discussed further in the *Extreme Rainfall and Drought* section.

Heavy Precipitation Days

Heavy precipitation days refers to the total number of days per year when at least 10mm or 20mm of rain or frozen precipitation falls, expressed as a count of number of days per year. The timeframe of this variable is annual. This variable is relevant for the following: Water resources, agriculture, drought/wildfire risk, flooding, infrastructure, insects and pests, water sources, natural environment and private property.

TABLE 10: Projected Changes in Heavy Precipitation Days (10mm) for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
26 days	**28 days** (RCP 4.5 Low Emissions)	↑	**29 days** (RCP 4.5 Low Emissions)	↑	●● High evidence Medium agreeance
	29 days (RCP 8.5 High Emissions)	↑	**30 days** (RCP 8.5 High Emissions)	↑	●● High evidence Medium agreeance

TABLE 11: Projected Changes in Heavy Precipitation Days (20mm) for South Huron

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
6.0 days	**7.0 days** (RCP 4.5 Low Emissions)	↑	**7.5 days** (RCP 4.5 Low Emissions)	↑	●● High evidence Medium agreeance
	7.0 days (RCP 8.5 High Emissions)	↑	**8.0 days** (RCP 8.5 High Emissions)	↑	●● High evidence Medium agreeance

Maximum 1-day and 5-day Precipitation

Maximum total precipitation that falls over a consecutive 1-day or 5-day period, expressed in millimetres (mm). The timeframe of this variable is annual. This variable is relevant for the following: Water resources, agriculture, drought/wildfire risk, flooding, infrastructure, insects and pests, water sources, natural environment and private property.

TABLE 12: Projected Changes in Maximum 1-day Precipitation for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
41.5 mm	**44 mm** (RCP 4.5 Low Emissions)	↑	**46 mm** (RCP 4.5 Low Emissions)	↑	●● High evidence Medium agreeance
	44.5 mm (RCP 8.5 High Emissions)	↑	**47.5 mm** (RCP 8.5 High Emissions)	↑	●● High evidence Medium agreeance

TABLE 13: Projected Changes in Maximum 5-day Precipitation for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
64.5 mm	**69.5 mm** (RCP 4.5 Low Emissions)	↑	**72.5 mm** (RCP 4.5 Low Emissions)	↑	●● High evidence Medium agreeance
	69.5 mm (RCP 8.5 High Emissions)	↑	**74.5 mm** (RCP 8.5 High Emissions)	↑	●● High evidence Medium agreeance

Wet Days

The number of wet days refers to the number of days in a year with at least 0.2mm of precipitation (rain/snow), expressed as number of days. The timeframe of this variable is annual. This variable is relevant for the following: Water resources, agriculture, drought/wildfire risk, flooding, infrastructure, insects and pests, water sources, natural environment and private property.

TABLE 14: Projected Changes in the Number of Wet Days for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
177.5 days	**177.2 days** (RCP 4.5 Low Emissions)	↔	**177.4 days** (RCP 4.5 Low Emissions)	↔	●● High evidence Medium agreeance
	178.1 days (RCP 8.5 High Emissions)	↔	**176.5 days** (RCP 8.5 High Emissions)	↔	●● High evidence Medium agreeance

Dry Days

The number of dry days refers to the number of days in a year without at least 0.2mm of precipitation (rain/snow), expressed as number of days. The timeframe of this variable is annual. This variable is relevant for the following: Water resources, agriculture, drought/wildfire risk, flooding, infrastructure, insects and pests, water sources, natural environment and private property.

TABLE 15: Projected Changes in the Number of Dry Days for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
187.3 days	**187.5 days** (RCP 4.5 Low Emissions)	↔	**187.3 days** (RCP 4.5 Low Emissions)	↔	●● High evidence Medium agreeance
	186.6 days (RCP 8.5 High Emissions)	↔	**188.3 days** (RCP 8.5 High Emissions)	↔	●● High evidence Medium agreeance

SEASONAL CHANGES

Frost-Free Season

Frost free season refers to the interval between the first frost of the fall and the last frost of the spring, expressed as number of days. The timeframe of this variable is annual. This variable is relevant for the following: Natural environment, agriculture, recreation, construction, and health and well-being.

TABLE 16: Projected Changes in the Frost Free Season for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
169 days	**190.8 days** (RCP 4.5 Low Emissions)	↑	**200.1 days** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	194.3 days (RCP 8.5 High Emissions)	↑	**218.2 days** (RCP 8.5 High Emissions)	↑	●●● High evidence High agreeance

Date of Last Spring and First Fall Frost

The date of last spring frost refers to the latest date in the spring when temperatures drop below freezing, expressed as a date. The date of first fall frost refers to the earliest day in the autumn when temperatures drop below freezing, expressed as a date. The timeframe of this variable is annual. This variable is relevant for the following: Natural environment, agriculture, recreation, construction, and health and well-being.

TABLE 17: Projected Changes in the Date of Last Spring Frost for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
May 1 to May 5	**April 20 to April 24** (RCP 4.5 Low Emissions)	**Earlier**	**April 16 – April 21** (RCP 4.5 Low Emissions)	**Earlier**	●●● High evidence High agreeance
	April 18 to April 23 (RCP 8.5 High Emissions)	**Earlier**	**April 7 to April 13** (RCP 8.5 High Emissions)	**Earlier**	●●● High evidence High agreeance

TABLE 18: Projected Changes in Date of First Fall Frost for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
Oct.18 to Oct.26	**Oct. 29 to Nov. 6** (RCP 4.5 Low Emissions)	**Later**	**Nov. 3 to Nov. 13** (RCP 4.5 Low Emissions)	**Later**	●●● High evidence High agreeance
	Oct. 31 – Nov.8 (RCP 8.5 High Emissions)	**Later**	**Nov. 13 to Nov. 22** (RCP 8.5 High Emissions)	**Later**	●●● High evidence High agreeance

Freeze-Thaw Cycles

Freeze-thaw cycles refer to the total number of days per year when temperatures fluctuate between freezing and non-freezing, expressed as number of days. The timeframe of this variable is annual. This variable is relevant for the following: Infrastructure, winter maintenance, natural environment.

TABLE 19: Projected Changes in the Number of Annual Freeze-Thaw Cycles for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
61.5 days	**56.7 days** (RCP 4.5 Low Emissions)	↓	**53.6 days** (RCP 4.5 Low Emissions)	↓	Dependent on temperature data confidence and agreeance
	55.7 days (RCP 8.5 High Emissions)	↓	**47.9 days** (RCP 8.5 High Emissions)	↓	Dependent on temperature data confidence and agreeance

Through communications with a member of the Prairie Climate Centre (2019b), although the annual freeze-thaw cycle is projected to decrease, monthly projections show an increase in cycles occurring in January and February. Data pertaining to London Ontario shows an increase in January and February freeze-thaw cycles of 10 % and 20 %, respectively.

TABLE 20: Projected Changes in the Number of Monthly Freeze-Thaw Cycles for London Ontario
(Data Retrieved from: PCC, 2019b)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
9 cycles January	N/A	N/A	**10% increase** (RCP 8.5 High Emissions)	↑	Dependent on temperature data confidence and agreeance
10 cycles February	N/A	N/A	**20% increase** (RCP 8.5 High Emissions)	↑	Dependent on temperature data confidence and agreeance

Cooling Degree Days

Cooling degree days (CDD) gives an indication of the amount of air conditioning that may be required to maintain comfortable conditions in a building during warmer months. A threshold of 18˚C is used and for any day when the mean temperature exceed this value, cooling degree days are accrued. This variable is relevant for the following: Energy management, infrastructure.

TABLE 21: Projected Changes in the Number of Cooling Degree Days for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
257 CDD	**425 CDD** (RCP 4.5 Low Emissions)	↑	**536 CDD** (RCP 4.5 Low Emissions)	↑	Dependent on temperature data confidence and agreeance
	460 CDD (RCP 8.5 High Emissions)	↑	**707 CDD** (RCP 8.5 High Emissions)	↑	Dependent on temperature data confidence and agreeance

Heating Degree Days

Heating degree days (HDD) give an indication of the amount of space heating that may be required to maintain comfortable conditions in building during warmer months. A threshold temperature of 17˚C is used and for any day when the mean temperature is below this value, heating degree days are accrued. This variable is relevant for the following: Energy management, infrastructure.

TABLE 22: Projected Changes in the Number of Heating Degree Days for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
3991 HDD	**3458 HDD** (RCP 4.5 Low Emissions)	↓	**3208 HDD** (RCP 4.5 Low Emissions)	↓	Dependent on temperature data confidence and agreeance
	3416 HDD (RCP 8.5 High Emissions)	↓	**2883 HDD** (RCP 8.5 High Emissions)	↓	Dependent on temperature data confidence and agreeance

EXTREME WEATHER EVENTS

Extreme weather events can be characterized by their rarity and occurrence beyond normal range, typically occur within the tenth percentile of probability and may bring hazardous conditions with it (IPCC, 2014). According to the IPCC Fifth Assessment report, changes since the 1950s in extreme weather and climate events have been observed and climate change related risks from extreme events are already moderate (high confidence) (IPCC, 2014).

The evidence and agreeance for extreme weather event projections are inconclusive – meaning that these variables have relatively low evidence and low agreeance supporting the future projections (McDermid *et. al*, 2015). However, various models and literature suggest that future projections show shorter return of extreme events, which means that the length of time between these events is becoming shorter (Henstra and McBean, 2009).

In describing extreme weather event projections for South Huron, the following types of events are included within:

- Extreme heat;
- Extreme cold;
- Extreme Rainfall and Drought Events;
- Freezing rain, ice and snow storms; and
- Wind.

Extreme Heat and Cold Events

Number of Heatwaves

Number of heatwaves refers to when at least three days in a row reach or exceed 30˚C, expressed as a count of number of heatwave events per year. The timeframe of this variable is annual. This variable is relevant for the following: natural environment, infrastructure, health and safety, recreation, drought/wildfire risk, and energy management.

TABLE 23: Projected Changes in Number of Heatwaves for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
1.4 events	**3.8 events** (RCP 4.5 Low Emissions)	↑	**5.2 events** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	4.1 events (RCP 8.5 High Emissions)	↑	**6.6 events** (RCP 8.5 High Emissions)	↑	●●● High evidence High agreeance

Average Length of Heatwaves

Average length of heatwaves refers to when the temperature exceeds 30 ˚C for at least three consecutive days, and the average length is expressed in days. The timeframe of this variable is annual. This variable is relevant for the following: natural environment, infrastructure, health and safety, recreation, drought/wildfire risk, and energy management.

TABLE 24: Projected Changes in Average Length of Heatwaves for South Huron
(Data Retrieved from: PCC, 2019a)

HISTORICAL BASELINE (1978 – 2005)	IMMEDIATE FUTURE (2021 – 2050) PROJECTION	TREND	NEAR FUTURE (2051 – 2080) PROJECTION	TREND	DATA CONFIDENCE OF VARIABLE
3.0 days	**4.7 days** (RCP 4.5 Low Emissions)	↑	**7.1 days** (RCP 4.5 Low Emissions)	↑	●●● High evidence High agreeance
	5.1 days (RCP 8.5 High Emissions)	↑	**7.3 days** (RCP 8.5 High Emissions)	↑	●●● High evidence High agreeance

Extreme Cold Events

Extreme cold temperatures have become less cold and are expected to occur less frequently (Zhang *et al*., 2019; IPCC, 2014). This means that with an increase in temperatures, extreme cold events are less likely to occur and the cold temperature is likely to be less extreme.

As a climate variable, extreme cold weather is important to note within this report as projected to continue to occur given the importance to underground service installation practices and potential vulnerabilities of community members due to lack of acclimatization during these events (Conlon *et al.*, 2011).

Combined with a projected overall decrease in snowpack, extreme cold events are particular of concern to municipal underground services. South Huron has experienced recent extreme cold events within recent years, whereas 20 years prior, no frozen services were recorded. Table 25 shows recent (within <10 years) extreme cold events and number of services impacted.

TABLE 25: Records of Extreme Cold Events Causing Water Service Disruptions in South Huron

EXTREME COLD EVENT	SERVICES IMPACTED
Winter of 2014 (January to March)	8 frozen services
Winter of 2015 (January to March)	11 frozen services

Extreme Rainfall and Drought Events

Future projections of heavy localized rainfall and drought events are difficult to predict as their occurrences depend on many other contributing factors (Bonsal *et al*., 2019). As the global hydrologic cycle is expected

to intensify, this will result in the increase in wet and dry extremes (Warren and Lemmen, 2014). These variables are both influenced by human-induced climate change, natural climate variability and other anthropogenic factors. One notable anthropogenic factor includes changes to the local landscape. Changes made on a landscape level may inhibit or exacerbate the impacts from a changing climate, especially during heavy localized rainfall and drought events, which makes the impact from this variable extremely difficult to project.

Extreme Rainfall Events

Intensity-Duration-Frequency (IDF) curves are a useful tool to assist in understanding what the future precipitation and are widely used for flood forecasting and stormwater and draining design. An IDF curve is a plot that represents the probability that a given average rainfall intensity (mm/hr), rainfall duration (how many hours it rained at that intensity) and the rainfall frequency/return period (how often will the event be repeated).

For South Huron, no gauged station is located within municipal boundaries. The Stratford WWTP (ID: 6148105) was utilized as the IDF gauged station for South Huron.

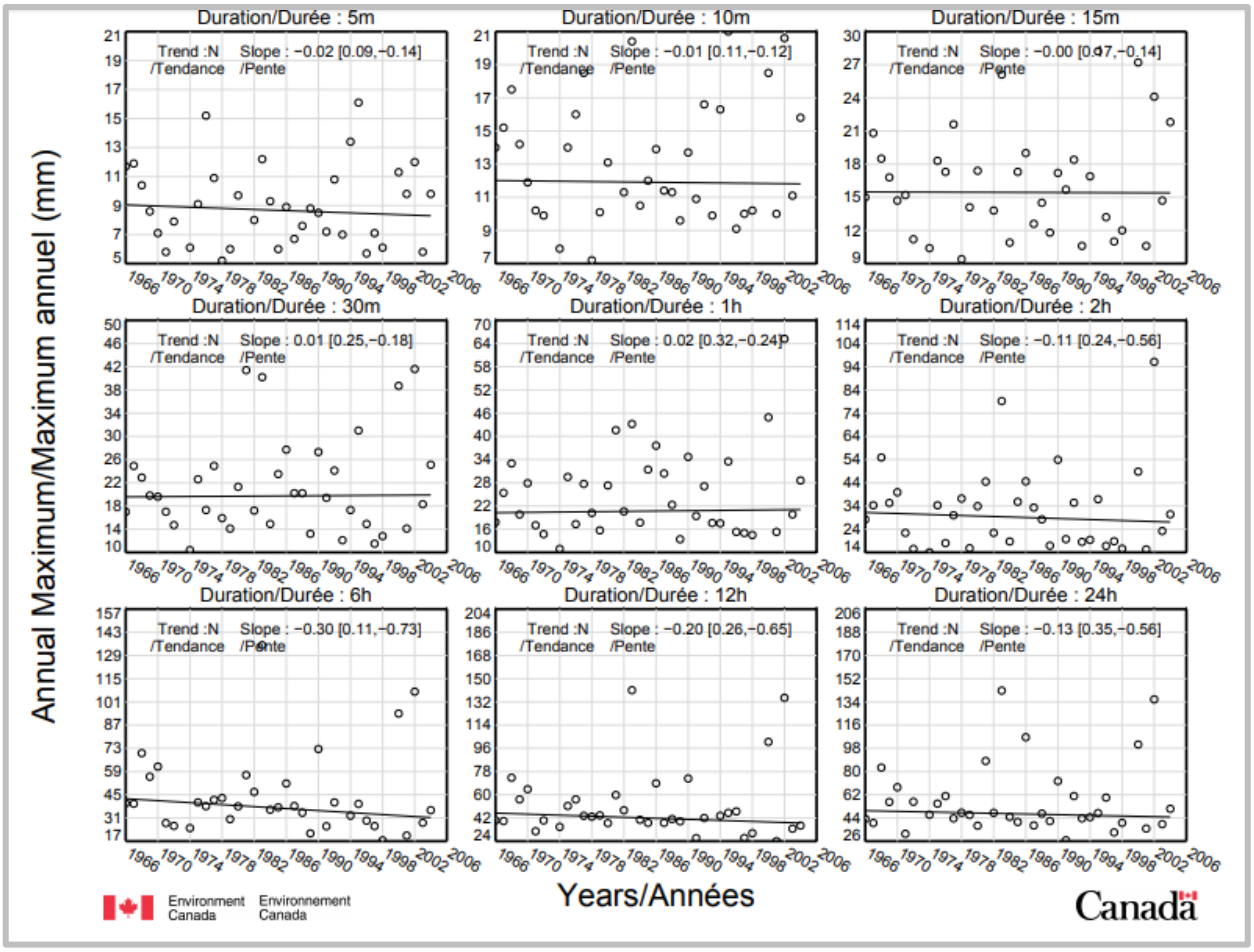
Based on the IDF curve trends (1966 – 2006) for Stratford WWTP, the historical trends for extreme rainfall for the Stratford WWTP is not significant for all duration of events as demonstrated in Figure 2 and Table 26. Data for Table 26 retrieved from Environment Canada's Engineering Climate Dataset v2.3.

TABLE 26: Summary of historical trends (1966-2004) for extreme rainfall for the Stratford WWTP

(Data adapted from CitFloodMap.com)

Duration of Event	Trend	Significance
5 minute	↓	Not Significant
10 minute	↓	Not Significant
15 minute	↑	Not Significant
30 minute	↑	Not Significant
1 hour	↑	Not Significant
2 hour	↓	Not Significant
6 hour	↓	Not Significant
12 hour	↓	Not Significant
24 hour	↓	Not Significant

FIGURE 2: Trends (1966 – 2006) for Stratford WWTP, ON 6148105
(Retrieved from CRIM, 2020)



Confidence of projected precipitation change is lower than the confidence of temperature change due to the influence of from a number of interactions on precipitation, including "*changes in the water-holding capacity of a warming atmosphere, in global atmospheric circulation, in evaporation, and in other factors*" (Flato *et al.*, 2019). With projected increased temperatures and an increase in evaporation from land and waterbodies, the atmosphere has the capacity to retain more moisture, holding approximately 7% of additional moisture per one degree Celsius of warming (Westra *et al*., 2013). This provides an increase in moisture available for precipitation and with the potential for an increase in extreme rainfall intensity.

Based on the findings from Bush and Lemmen (2019), there do not appear to be consistent trends in short-duration extreme precipitation events in Canada, however, on a global scale there is indication of an increase in extreme precipitation associated with warming (IPCC, 2014; Zhang *et al*., 2019).

In terms of future projected daily extreme precipitation amounts, these are projected to increase in the future with high confidence in the data. In terms of extreme precipitation amounts for shorter periods (a day or less), there is lack of evidence and confidence of these changes (Zhang *et al*., 2019).

The following describes the projected changes in extreme rainfall events, under a high emissions scenario (RCP 8.5) as described by (Zhang *et al*., 2019):

- Under a high emissions scenario, current extreme rainfall events that occur every 20 years is projected to occur every five years by late century.

It is anticipated that information pertaining to future extreme rainfall event projections will be updated for South Huron as more information becomes available.

Extreme Drought Events

With warmer temperatures, the threat of drought events is projected to increase, however, uncertainty exists with projections. In Canada, periodic droughts have occurred but there are no long-term changes apparent. With warming projections for Canada under all scenarios, the risk for drought is expected to increase, particularly in the southern Prairies and interior British Columbia (Bonsal *et al*., 2019). Higher summer temperatures are expected to increase evaporation rates, leading to soils drying more rapidly across the entire region. Understanding the future projections of drought heavily rely on whether precipitation will offset the amount of evaporation and transpiration (Bonsal *et al*., 2019).

Ontario's Low Water Response (OLWR) teams consists of local multi-stakeholder members and issue different levels of low water advisories, as well as encourages water conservation depending on the severity. OLWR plays an important role in understanding the impacts of drought events, locally.

Freezing Rain, Ice and Snow Events

Determining the type of precipitation that is projected to fall is extremely difficult to describe given the influence of the local scale, including topography and vegetation.

Freezing rain events are expected to increase, especially in the coldest months of the winter (Cheng *et al*., 2006). Given the projected increase in winter temperatures, it will become more favourable for freezing rain and ice events to occur during the coldest months of winter, particularly during the first half of the century. Table 27 summarizes the percentage change for projected occurrence of freezing rain events for southern Ontario using downscaled climate scenarios.

TABLE 27: Freezing rain event percentage change for southern Ontario using downscaled climate scenarios
(Cheng *et al*., 2006)

TIMEFRAME	% in 2050	% in 2080
December – February	Increase of ~40%	Increase of ~45%
November, March and April	Decrease of ~10%	Decrease of ~15%

Overall for the southern portions of Canada, it is likely that a decline in snow cover (seasonal snow accumulation) of 5-10% per decade will continue through mid-century under all emissions scenarios

(Mudryk *et al.*, 2018). With a decrease in ice cover, it is projected that lake-effect precipitation will increase (Burnett *et al.*, 2003; Notaro *et al.*, 2014). This includes an increase in lake-effect snow within the snowbelt region of the municipality within the first half of the century, where temperatures remain favourable for winter precipitation falling as snow. It is anticipated that lake-effect snow decrease mid-century under all emissions scenarios as temperatures are projected to be more favourable for precipitation to fall as rain from the increase in lake evaporation (Burnett *et al.*, 2003; Notaro *et al.*, 2015).

Wind

Wind as a variable is difficult to assess, with very few studies focusing on how wind may be impacted by climate change, particularly within a local scale. Mean and extreme wind gusts were not assessed in Bush and Lemmen (2019) given the limited observation and research available, notably focusing on the mechanisms and causes of observed and projected changes in Canada. It is anticipated that information pertaining to the wind and associated projection data will be updated for South Huron as more information becomes available and is validated by regional, national and global climate reports.

Given the relative importance of wind on infrastructure and the community, wind gust data was retrieved from Cheng *et al.* (2011) as a generalized assumption of future wind projections although data confidence of this variable is low. It is important to note that the findings of this study suggest that within a regional context, southern region (Region 1 encompasses South Huron) wind gusts are projected to be greater than that of the northern regions.

The data adapted from Cheng *et al.* (2019) presented in Tables 28 and 29 provide a projected increase (%) from the historical period of 1994 to 2007 in hourly and daily wind gust events for the period of 2081 to 2100 under a high emissions scenario for Ontario.

TABLE 28: Annual Mean Frequency of Hourly Wind Gust Events
(Data adapted from Cheng *et al.* (2011))

Hourly Wind Gust Event (km h^{-1})	Projected % Increase for 2081 to 2100 (under a High Emissions Scenario)	TREND	DATA CONFIDENCE OF VARIABLE
≥ 28	10 % – 15 %	↑	• Low evidence Low agreeance
≥ 40	10 % – 20 %	↑	• Low evidence Low agreeance
≥ 70	20 %– 40 %	↑	• Low evidence Low agreeance

TABLE 29: Annual Mean Frequency of Daily Wind Gust Events
(Adapted from Cheng *et al.* (2011))

Daily Wind Gust Event (km h^{-1})	Projected % Increase for 2081 to 2100 (under a High Emissions Scenario)	TREND	DATA CONFIDENCE OF VARIABLE
≥ 28	Less than 10%	↑	• Low evidence Low agreeance
≥ 40	10 %	↑	• Low evidence Low agreeance
≥ 70	15 % – 25%	↑	• Low evidence Low agreeance

LAKE HURON VARIABLES

Lake Huron and its coastline provides an encompassing value to the Municipality and the community that utilizes the direct and indirect environmental, social and economic services it provides. Within the boundary of the Municipality of South Huron, 0.5% of the Lake Huron is located within the municipal boundary.

Extensive research into the scientific evidence of impacts from climate change on the coastline of Lake Huron have been completed by the Lake Huron Centre for Coastal Conservation (LHCCC) report *Coastal Action Plan for the Southeastern Shores of Lake Huron* (2019).

The following summarize the changes projected to occur for the Lake Huron coastline from climate change, as noted in the coastal action plan (LHCCC, 2019):

- Increase in annual average water temperatures of 5˚C to 7˚C degrees throughout the 21st century;
- Continued decrease in the extent and duration of ice cover through the 21st century;
- Increased wind speeds; and
- Greater fluctuation in water levels.

Although the municipal boundary accounts for a small portion of the Lake Huron coastline, the projected changes will have an overall impact on the region. Lake-effect weather (weather systems are influenced by the difference in temperature of land and the lake) will be impacted by the projected changes to Lake Huron. With a noted decline in seasonal ice cover over the last five decades across Canada (Bonsal *et al*., 2019) and a decrease ice cover over Lake Huron (LHCCC, 2019) since 1973, it is likely that this change will impact lake-effect weather. With a decrease in ice cover, it is projected that lake-effect precipitation will increase (Burnett *et al*., 2003; Notaro *et al*., 2014). This includes an increase in lake-effect snow within the snowbelt region of the municipality within the first half of the century, where temperatures remain favourable for winter precipitation falling as snow. It is anticipated that lake-effect snow decrease mid-century under all emissions scenarios as temperatures are projected to be more favourable for precipitation to fall as rain from the increase in lake evaporation (Burnett *et al*., 2003; Notaro *et al*., 2015).

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Appendix B
MASTER IMPACT STATEMENT LIST

Note: The following document titled *Appendix B: Master Impact Statement List* shall be read in conjunction with the Municipality of South Huron's Climate Change Adaptation Strategy. This appendix contains the master impact statement list compiled through consultation and engagement for the strategy.

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MASTER IMPACT STATEMENT LIST

A total of 75 impact statements for the Municipality to consider were developed through municipal staff workshops, public survey responses and input from the Climate Change Adaptation Advisory Committee (CCAAC) members. The Master Impact Statement List is shown in Table 1.

The following notes are associated with the development of the *Master Impact Statement List*:

- **Impact ID** column contains a number assigned to impacts for tracking purposes with no weight or value assigned.
- **Climate Category** column refers to the general changes in climate projected to occur, divided into three categories: temperature, precipitation, and extreme weather.
- **Climatic Threat** column refers to specific changes in climate projected to occur.
- **Impact Statement** column refers to the impact statement developed based on the climate variable (anticipated change), what happens (outcome) and what the impact to the municipality is (consequence). A total of 75 impact statements have been developed.
- **Theme** column refers to the predominant theme that each impact statement fits within. Impact statements may fit into more than one theme, however, only one theme was selected for each impact in order to group the impacts statements for further consultation. A total of 15 themes have been identified and are identified below:

Theme Categories		
Energy	Insects, Pests and Invasive Species	Winter Maintenance
Community Facilities	Natural Environment	Sewage Services
Stormwater and Flooding	Built Infrastructure (roads, sidewalks, buildings)	Private Property
Water Services	Fire Services	Community Well-being
Emergency Services	Outdoor Maintenance and Construction	Administration (Finance, Clerk, Communications, Human Resources)

- **Impact Statement Identified Through** column refers to the avenue in which the impact statement was identified through. It should be noted that full impact statements were not developed through initial public consultation. Public survey responses indicated potential impacts which then were verified and further developed into detailed impact statements internally by staff and through the Climate Change Adaptation Advisory Committee members. Appendix E contains a summary of engagement approach used to develop the strategy.
- **Comments on Justification or Changes Made to the Impact Statement** column refers to the changes that occurred to the impact statement during review by the Climate Change Adaptation Advisory Committee members.
- **Carried to Risk and Vulnerability Assessment phase** column refers to whether or not the impact statement was identified as important to municipal staff and the Climate Change Adaptation Advisory Committee members. A total of 40 impact statements were carried to the Risk and Vulnerability Assessment phase (outlined in Appendix C).
- **Carried to Action Planning Phase** column refers to the impact statements that were carried over to the Action Planning Phase based on the results from the Risk and Vulnerability Assessment and the recommendations from the Climate Change Adaptation Advisory Committee members. A total of 22 impact statements were carried over to the Action Planning Phase (outlined in *Appendix D: Action Plan*).

TABLE 1: Master Impact Statement List

Impact ID	Climate Category	Climatic Threat	Impact Statement	Primary Theme	Impact Statement Identified Through:	Comments on Justification or Changes Made to Impact Statement	Carried to Risk and Vulnerability Assessment Phase	Carried to Action Planning phase
52	Extreme Weather Event	Increase in frequency of extreme weather events	Increased need for 24/7 (including after-hour services) for public to access municipal staff regarding occurrences requiring immediate attention, increase in requests for service, coordination and communications to the general public.	Administration	✓ Staff consultation ✓ Public consultation			
54	Extreme Weather Event	Increase in frequency of extreme weather events	Increased demand for essential services and disaster recovery costs resulting in an increase in staff time and financial cost to the municipality.	Administration	✓ Staff consultation ✓ Public consultation		✓	✓
59	Extreme Weather Event	Increase in frequency of extreme weather events	Increased power outages and electrical surges, resulting in the inability for municipal staff to utilize phones and computers, process work orders, provide communications to the entire municipality and access information for coordinated effort during extreme weather events.	Administration	✓ Staff consultation ✓ Public consultation		✓	✓
61	Extreme Weather Event	Increase in frequency of extreme weather events	Increased liability, public and health and safety hazards and risks, private property damage, dangerous conditions that may impact the entire municipality.	Administration	✓ Staff consultation		✓	✓
14	Temperature	Increase in Very Hot Days (over 30˚C)	Increased damage to hard surfaces (roads, sidewalks) resulting in an increase in request for service and staff time to repair/replace, increased costs and integration into asset management planning.	Built Infrastructure (roads, sidewalks, buildings)	✓ Staff consultation ✓ Public consultation		✓	✓
17	Temperature	Increase in Very Hot Days (over 30˚C)	Increased temperature within urban areas where built infrastructure is most prominent resulting in heat being trapped causing an increase in temperature within urban boundaries.	Built Infrastructure (roads, sidewalks, buildings)	✓ Staff consultation			
29	Temperature	Increased in Freeze-thaw cycles in January and February	Increased underground movement causing potential damage to municipal infrastructure (buildings, underground services, roads, sidewalks, cemetery) resulting in increase in request for service and staff time to monitoring and repair/replace, increased costs and integration into asset management planning.	Built Infrastructure (roads, sidewalks, buildings)	✓ Staff consultation ✓ Public consultation		✓	✓
55	Extreme Weather Event	Increase in frequency of extreme weather events	Increased damage and/or decreased service life of municipal infrastructure (buildings, underground services, roads, bridges/culverts), public spaces requiring the potential closure of municipal facilities, increase request for service, staff time to repair/replace infrastructure and financial cost to the municipality.	Built Infrastructure (roads, sidewalks, buildings)	✓ Staff consultation ✓ Public consultation		✓	✓
71	Extreme Weather Event	Increased frequency of extreme cold events	Increased risk of deep freeze to municipal infrastructure causing deficiencies resulting in an increased immediate request for service, staff time to repair/replace the damaged infrastructure and cost to the municipality.	Built Infrastructure (roads, sidewalks, buildings)	✓ Staff consultation		✓	✓
15	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk to the public, especially vulnerable populations.	Community Well-being	✓ Staff consultation ✓ Public consultation		✓	
18	Temperature	Increase in Very Hot Days (over 30˚C)	Increased in incidents of violent crimes resulting in disruption to the entire municipality and an increase in demand for emergency services.	Community Well-being	✓ Staff consultation			
49	Extreme Weather Event	Heavy localized flooding events	Increase in flooding in areas that may lead to an increased risk of public exposure to potential illnesses and pathogens (including water-borne illnesses, mold).	Community Well-being	✓ Staff consultation			

Impact ID	Climate Category	Climatic Threat	Impact Statement	Primary Theme	Impact Statement Identified Through:	Comments on Justification or Changes Made to Impact Statement	Carried to Risk and Vulnerability Assessment Phase	Carried to Action Planning phase
58	Extreme Weather Event	Increase in frequency of extreme weather events	Increased power outages and electrical surges, resulting in service disruptions for the entire municipality.	Community Well-being	✓ Staff consultation ✓ Public consultation		✓	
62	Extreme Weather Event	Increase in frequency of extreme weather events	Disruption to regional food distribution system resulting in potential food shortages impacting the entire municipality.	Community Well-being	✓ Public consultation			
5	Temperature	Increased Annual Temperature	Increased opportunities for the community to participate in active transportation (i.e. cycling, walking, biking) and outdoor recreation.	Community Well-being	✓ Staff consultation			
73	Extreme Weather Event	Increased frequency of extreme cold events	Increased health and safety risk (thermoregulation, frostbite) to vulnerable populations resulting in an increase in the need for community cold alerts, service requests, and access to warming facility resulting in increased request for service and staff time and coordination, potentially outside of regular working hours.	Community Well-being	✓ Staff consultation ✓ Public consultation		✓	✓
38	Extreme Weather Event	Increased frequency and duration of heatwaves	Increased health and safety risk to vulnerable populations resulting in an increase in service requests, access to cooling facility resulting in increased request for service and staff time and coordination, potentially outside of regular working hours.	Community Well-being	✓ Staff consultation ✓ Public consultation		✓	✓
7	Temperature	Increased Summer Temperature	Increased risk of bacteria growth in Lake Huron from increase surface water temperatures resulting in more beach closures and potential revenue loss from Port Blake.	Community Facilities	✓ Staff consultation			
11	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat stress or respiratory illnesses leading to outdoor programming requiring alternative locations.	Community Facilities	✓ Staff consultation ✓ Public consultation			
16	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat street or respiratory illnesses lead to an increased in request for service and staff time to accommodate demand for outdoor cooling facilities (pools, tree covered areas, splash pads) and indoor facilities.	Community Facilities	✓ Staff consultation ✓ Public consultation		✓	✓
23	Temperature	Increase in Very Hot Days (over 30˚C)	Increased energy demand during ice making in August, resulting in an increase demand for energy, potential failure from equipment overworking, leading to an overall decrease life cycle of equipment.	Community Facilities	✓ Staff consultation			
~~**30**~~	~~Precipitation~~	~~Increased in Heavy Precipitation Days (20mm)~~	~~Inundated municipal outdoor facilities (sports fields, parks, natural areas and trails, cemetery) leading to temporary disruption in using these spaces or increase in demand for alternative spaces, where applicable.~~	~~Community Facilities~~	~~✓ Staff consultation~~	DELETED: Captured in Impact #32		
32	Precipitation	Increased Spring Precipitation / Increased in Heavy Precipitation Days (20mm)	Inundated municipal outdoor facilities (sports fields, parks, natural areas and trails, cemetery, Port Blake day-use area) preventing municipal staff from maintaining these spaces leading to temporary disruptions in using these spaces, increased demand for alternative spaces and potential revenue loss (where applicable).	Community Facilities	✓ Staff consultation	ALTERED to include aspects of impacts #2, #30 and #33	✓	
~~**33**~~	~~Precipitation~~	~~Increased Spring Precipitation~~	~~Leading to inundated Port Blake day-use area preventing municipal staff from maintaining the site resulting in a delay in public usage of the park and potential lost revenues.~~	~~Community Facilities~~	~~✓ Staff consultation~~	DELETED: Captured in Impact #32		
39	Extreme Weather Event	Increased frequency and duration of heatwaves	Shift in timing and scheduling of outdoor seasonal programming (sports, events, camps) to avoid peak summer temperatures and heatwaves resulting in the potential for an increase in extended maintenance periods.	Community Facilities	✓ Staff consultation			
40	Extreme Weather Event	Heavy localized flooding events	Inundation of outdoor municipal facilities (sports fields, parks, natural areas and trails, cemetery) leading to temporary disruption of facilities and an increased cost and staff time to repair damages or address stormwater deficiencies.	Community Facilities	✓ Staff consultation			

Impact ID	Climate Category	Climatic Threat	Impact Statement	Primary Theme	Impact Statement Identified Through:	Comments on Justification or Changes Made to Impact Statement	Carried to Risk and Vulnerability Assessment Phase	Carried to Action Planning phase
53	Extreme Weather Event	Increase in frequency of extreme weather events	Increased number of displaced residents from their homes due to extreme weather events, leading to an increase usage of the Emergency Operations Centre (Town Hall), request for service, coordination and communications from municipal staff.	Emergency Services	✓ Staff consultation ✓ Public consultation		✓	✓
56	Extreme Weather Event	Increase in frequency of extreme weather events	Increase in occurrences of power outages, transportation disruptions, and public health and safety situations resulting in an increased demand for emergency services, communications, coordination and resources.	Emergency Services	✓ Staff consultation ✓ Public consultation		✓	
63	Extreme Weather Event	Increase in frequency of extreme weather events	Increased power outages and electrical surges, resulting in potential risk to the public associated with heating/cooling buildings and cooking meals.	Emergency Services	✓ Staff consultation ✓ Public consultation			
8	Temperature	Increased Summer Temperatures	Increased summer energy usage for municipally-owned facilities leading to increased utility costs for the municipality.	Energy	✓ Staff consultation		✓	
27	Temperature	Increase in Winter Temperature	Decreased winter heating costs for municipally-owned facilities leading to decreased costs to the municipality during the winter months.	Energy	✓ Staff consultation			
22	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk to municipal volunteer fire fighters working during periods of very hot days requiring appropriate working hours, cooling aids and relief mechanisms.	Fire Services	✓ Staff consultation		✓	✓
68	Extreme Weather Event	Increased frequency and duration of drought	Increased risk of fire during dry conditions resulting in an increase in fire related calls and increase in the total number of calls for fire department during dry periods.	Fire Services	✓ Public consultation		✓	✓
69	Extreme Weather Event	Increased frequency and duration of drought	Increased risk of fire at the landfill during dry conditions resulting in an increased risk of exposure to landfill operations employees and increase in fire related calls during dry periods.	Fire Services	✓ Staff consultation			
2	Temperature	Increased Annual Temperature	Increased reproduction rates and range of vectors (e.g. West Nile Virus, Lyme Disease) resulting in an increased risk of exposure to vector-borne diseases for municipal outdoor workers.	Insects, Pests and Invasive Species	✓ Staff consultation		✓	
3	Temperature	Increased Annual Temperature / Increase in Winter Temperatures	Extended growing seasons and increased survival rates for pests resulting in the potential for an increase presence and impacts (damage or loss) from invasive species to tree and vegetation within municipally owned property.	Insects, Pests and Invasive Species	✓ Staff consultation	ALTERED to include elements from impact #24	✓	✓
~~**24**~~	~~Temperature~~	~~Increase in Winter Temperatures~~	~~Increased survival rates for pests and insects, leading to impacts to tree and vegetation and potential loss of natural assets throughout municipally-owned property.~~	~~Insects, Pests and Invasive Species~~	~~✓ Staff consultation~~	DELETED: Captured in impact #3		
31	Precipitation	Increased Annual Precipitation	Increased areas with standing water (catch basins, stormwater management ponds) resulting in greater risk of areas supporting reproduction of mosquitos with the potential to increase the exposure risk of West Nile Virus.	Insects, Pests and Invasive Species	✓ Staff consultation			
20	Temperature	Increase in Very Hot Days (over 30˚C) / Increased in Freeze-thaw cycles in January and February	Increased stress on trees and natural areas resulting in an increase in municipal water demand and staff time to ensure the health and success of trees, increase in request for service and staff time to monitor and remove hazard trees on municipally-owned property.	Natural Environment	✓ Public consultation ✓ Staff consultation	ALTERED to include elements from Impact #28	✓	
~~**28**~~	~~Temperature~~	~~Increased in Freeze-thaw cycles in January and February~~	~~Increased stress on trees and natural areas resulting in an increase in request for service and staff time to monitor and remove hazard trees on municipally-owned property.~~	~~Natural Environment~~	~~✓ Staff consultation~~ ~~✓ Public consultation~~	DELETED: Captured in impact #20		

Impact ID	Climate Category	Climatic Threat	Impact Statement	Primary Theme	Impact Statement Identified Through:	Comments on Justification or Changes Made to Impact Statement	Carried to Risk and Vulnerability Assessment Phase	Carried to Action Planning phase
~~**46**~~	~~Extreme Weather Event~~	~~Heavy localized flooding events~~	~~Increase in erosion rates and sediment release within riparian areas and unstable transition to low lying areas, causing an increase in bank destabilization, loss of habitat and impact on water quality.~~	~~Natural Environment~~	~~✓ Staff consultation~~	DELETED: Captured in impact #44		
57	Extreme Weather Event	Increase in frequency of extreme weather events	Increased damage to urban trees, parks, and trails resulting in closures, increased request for service and staff time and cost to the municipality to identify and remove hazard trees.	Natural Environment	✓ Staff consultation ✓ Public consultation		✓	
64	Extreme Weather Event	Increase in frequency of extreme weather events	Increase in repairs/replacements addressed under tender bids during times of overload to municipal staff resulting in increased cost and project management time to the municipality.	Outdoor Maintenance and Construction	✓ Staff consultation		✓	
1	Temperature	Increased Annual Temperature / Increase in Very Hot Days (over 30˚C)	Extended shoulder season (spring and fall) resulting in an extended maintenance seasons and potential changes in timing of staff hiring, type of staff hired (students), scheduling and work restrictions.	Outdoor Maintenance and Construction	✓ Staff consultation	ALTERED to include elements from impact #13		
9	Temperature	Increased Summer Temperatures	Increase in landfill odors due to an increase in decomposition rate leading to an increase in complaints related to odors within the vicinity of the landfill.	Outdoor Maintenance and Construction	✓ Staff consultation			
12	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk and demand for municipal outdoor workers to have appropriate working hours, cooling aids, personal protective gear and spaces for relief.	Outdoor Maintenance and Construction	✓ Staff consultation		✓	
~~**13**~~	~~Temperature~~	~~Increase in Very Hot Days (over 30˚C)~~	~~Potential for periods of shortened windows to work outside, reduced productivity and extended periods that outdoor work cannot be completed.~~	~~Outdoor Maintenance and Construction~~	~~✓ Staff consultation~~	DELETED: Covered in Impact #1		
19	Temperature	Increase in Very Hot Days (over 30˚C)	Increased demand for pool and splash pad, resulting in disrupted disinfectant practices during a time of high chemical dissipation and limited maintenance opportunities during peak usage.	Outdoor Maintenance and Construction	✓ Staff consultation ✓ Public consultation			
34	Precipitation	Increased Spring Precipitation	Leading to increased sediment and debris on municipally-owned roadways from vehicular traffic and saturated conditions resulting in an increased service request for street cleaning services.	Outdoor Maintenance and Construction	✓ Staff consultation			
65	Extreme Weather Event	Increased frequency and duration of drought / Increased Summer Temperatures	Reduced quality of outdoor municipal facilities (sports fields, parks, natural areas and trails, cemetery) and lawns, gardens and drought in-tolerant trees and vegetation requiring an increase in municipal water usage, request for service, and maintenance and monitoring of the quality of spaces and potential removal of distressed species.	Outdoor Maintenance and Construction	✓ Staff consultation	ALTERED to include elements from impact #67 and #6	✓	✓
~~**67**~~	~~Extreme Weather Event~~	~~Increased frequency and duration of drought~~	~~Reduced quality of municipal lawn/gardens, and drought in-tolerant trees and vegetation requiring an increase in effort to maintain and remove distressed species located on municipal property.~~	~~Outdoor Maintenance and Construction~~	~~✓ Staff consultation~~	DELETED: Covered in impact #65		
74	Extreme Weather Event	Increased frequency of extreme cold events	Increased health and safety risk (thermoregulation, frostbite) and demand for municipal outdoor workers to have appropriate working hours, warming aids, personal protective gear and spaces for relief.	Outdoor Maintenance and Construction	✓ Staff consultation		✓	
48	Extreme Weather Event	Heavy localized flooding events	Increased damage to private property due to flooding resulting in an increase in number of residents contacting the municipality, specifically directed to the Building Department requesting information on flooding and assistance to address the situation.	Private Property	✓ Staff consultation ✓ Public consultation		✓	✓

Impact ID	Climate Category	Climatic Threat	Impact Statement	Primary Theme	Impact Statement Identified Through:	Comments on Justification or Changes Made to Impact Statement	Carried to Risk and Vulnerability Assessment Phase	Carried to Action Planning phase
51	Extreme Weather Event	Increase in frequency of extreme weather events	Increased extensive damaged to private property resulting in an increase in requests for permits (with the potential for quick turnarounds requested) resulting in an increase in staff time to consult and prepare required documentation to issue permits.	Private Property	✓ Staff consultation		✓	
72	Extreme Weather Event	Increased frequency of extreme cold events	Increase risk of deep freezing of private property underground water service breakage or freezing resulting in an increase in repair/replacement of the damaged services resulting in an increase in permits/agreements required for connection.	Private Property	✓ Staff consultation			
10	Temperature	Increased Summer Temperatures	Increase in anaerobic activity resulting in a decrease in dissolved oxygen (DO) leading to disruption to the treatment process, potentially requiring an increased in existing treatment or alternative process(es).	Sewage Services	✓ Staff consultation			
25	Temperature	Increase in Winter Temperatures	Decrease in duration of pond freeze-over (sewage lagoon) during the winter season resulting in the potential to discharge treated effluent year-round	Sewage Services	✓ Staff consultation			
41	Extreme Weather Event	Heavy localized flooding events	Overloading of older sanitary sewers (in particular, where inflow and infiltration of stormwater/groundwater into sanitary sewers), resulting in the potential for untreated sewage overflow by-passing secondary treatment allowing contaminants and infectious organisms entering into the receiving waterbody.	Sewage Services	✓ Staff consultation		✓	
42	Extreme Weather Event	Heavy localized flooding events	Overwhelming of sanitary sewers resulting in the potential back up of sewage into basements, particularly in low lying areas.	Sewage Services	✓ Staff consultation		✓	✓
43	Extreme Weather Event	Heavy localized flooding events	Overflow by-pass resulting in an increase in call outs to Municipal staff due to emergency alarms, service calls and mandatory reporting to agencies (i.e. Ministry of Environment, Conservation and Parks).	Sewage Services	✓ Staff consultation		✓	
44	Extreme Weather Event	Heavy localized flooding events	Increase in erosion rates, sediment release and surface runoff within riparian areas and unstable transition to low lying areas, resulting in an increased risk of pollutants from the landscape, increase in bank destabilization, loss of habitat and overall impact on water quality.	Stormwater and Flooding	✓ Staff consultation	ALTERED to include elements from Impact #20	✓	✓
4	Temperature	Increased Annual Temperature	Changes in timing of spring and winter melts, potentially when ground is frozen and saturated resulting in surcharge and runoff from rapid snowmelts resulting in the potential of overburdening of the municipal stormwater system and risk of overland flooding leading to damage to municipal infrastructure.	Stormwater and Flooding	✓ Staff consultation ✓ Public consultation	ALTERED to include elements from impacts #26 and #36	✓	
~~**26**~~	~~Temperature~~	~~Increase in Winter Temperature~~	~~Changes in timing of winter melt resulting in surcharge and runoff from rapid snowmelts resulting in an overburdening of the stormwater system.~~	~~Stormwater and Flooding~~	~~✓ Staff consultation~~	DELETED: Covered in Impact #4		
~~**36**~~	~~Precipitation~~	~~Increased Winter Precipitation~~	~~Increased rainfall during periods when the ground is frozen and saturated causing an increased~~	~~Stormwater and Flooding~~	~~✓ Staff consultation~~	DELETED: Covered in impact #4		
45	Extreme Weather Event	Heavy localized flooding events	Increase in sediment and debris within municipally-owned drains and culverts, requiring an increase in maintenance scheduling and monitoring.	Stormwater and Flooding	✓ Staff consultation			
47	Extreme Weather Event	Heavy localized flooding events	Increased stress on bridges/culverts, potential for road washouts, erosion and transportation disruptions requiring an increase in emergency service requests and staff time to monitor, repair/replace damages, financial cost to the municipality and increased management required during the response period.	Stormwater and Flooding	✓ Staff consultation ✓ Public consultation		✓	✓

Impact ID	Climate Category	Climatic Threat	Impact Statement	Primary Theme	Impact Statement Identified Through:	Comments on Justification or Changes Made to Impact Statement	Carried to Risk and Vulnerability Assessment Phase	Carried to Action Planning phase
~~**6**~~	~~Temperature~~	~~Increased Summer Temperatures~~	~~Increased number of dry periods resulting in increased irrigation required for parks, gardens, and sport fields.~~	~~Water Services~~	~~✓ Staff consultation~~	DELETED: Covered in impact #65		
21	Temperature	Increase in Very Hot Days (over 30˚C)	Increased bacteria growth and dissipation of chlorine within municipally-owned water storage facilities resulting in increased staff monitoring and changes to the amount/type of chemicals (chlorine) required within the system to ensure drinking water standards are adhered to.	Water Services	✓ Staff consultation ✓ Public consultation		✓	
60	Extreme Weather Event	Increase in frequency of extreme weather events	Increased power outages and electrical surges, resulting in back up power (short and long term) required for critical infrastructure including water and sewage pumping stations and sewage lagoons.	Water Services Sewage Services	✓ Staff consultation			
66	Extreme Weather Event	Increased frequency and duration of drought	Reduced quality of municipal and private property lawn/gardens, and drought in-tolerant trees and vegetation resulting in an increase in demand for municipal water.	Water Services	✓ Staff consultation		✓	
70	Extreme Weather Event	Increased frequency of extreme cold events	Increased risk of deep freeze to municipal underground water service causing breakage or freezing resulting in an increased immediate request for service, staff time to repair/replace the damaged services and cost to the municipality.	Water Services	✓ Staff consultation		✓	
35	Precipitation	Increased Winter Precipitation	Increased hazardous road and walking conditions resulting in an increased use of salt and/or sand on roadways, sidewalks and in parking lots resulting in increase in staff time to monitor, increased corrosion to equipment and facilities, and greater impact on water quality within the municipality.	Winter Maintenance	✓ Staff consultation	ALTERED to include aspects from impact #50	✓	✓
37	Precipitation	Increased Winter Precipitation	Increased outdoor maintenance from precipitation falling as snow or rain requiring more staff time to monitor and operate, equipment requirements and cost to the municipality.	Winter Maintenance	✓ Staff consultation		✓	✓
~~**50**~~	~~Extreme Weather Event~~	~~Increase in freezing rain events~~	~~Increased hazardous road and walking conditions resulting in an increase need for monitoring and salt/sand applications applied by municipal staff.~~	~~Winter Maintenance~~	~~✓ Staff consultation~~ ~~✓ Public consultation~~	DELETED: Covered in impact #35		
75	Precipitation	Increase in Winter Precipitation and Snow Melts	Changes in winter precipitation type (rain), potentially when the ground is frozen and saturated resulting in surcharge and runoff from rapid snowmelt resulting in the overburdening of the municipal stormwater system and risk of flooding leading to damage to municipal infrastructure, increase in financial cost to the municipality and management required during the response period.	Stormwater and Flooding	✓ Committee		✓	✓

Appendix C
VULNERABILITY AND RISK ASSESSMENT

Note: The following document titled *Appendix C: Vulnerability and Risk Assessment* shall be read in conjunction with the Municipality of South Huron's Climate Change Adaptation Strategy. This appendix contains the results of the vulnerability and risk assessment completed for the priority impact statements.

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VULNERABILITY AND RISK ASSESSMENT FRAMEWORK

Vulnerability and risk assessments assist in determining which impacts from climate change are most important and how to best address them.

The assessments completed as part of South Huron's Climate Change Adaptation Strategy aligns with the Milestones outlined in ICLEI'S Building Adaptive and Resilient Communities (BARC) Program. Milestone 2 (Research) extensively outlines vulnerability and risk assessment component and important questions required to complete them.

The engagement approach for the completion of the vulnerability and risk assessment is outlined in detail in *Appendix E: Engagement Summary*.

IMPACT STATEMENTS ASSESSED

A total of 75 impact statements for the Municipality to consider were developed through municipal staff survey and workshops, public survey responses and input from the Climate Change Adaptation Advisory Committee (CCAAC) members (as outlined in Appendix B: Master Impact Statement List).

Through review of the impact statements, it was determined that not all impacts fall within the jurisdiction of the municipality during the action phase (i.e. action item falls under another organization) or the impact was not considered a top priority for the community. Prioritization of impacts to carry forward was determined through a prioritizing exercise completed by municipal staff and members of the CCAAC, as well as the impact that were mentioned within the public survey responses were also identified.

As a result, it was determined that 40 priority impact statements would be carried forward to be considered in the vulnerability and risk assessments.

VULNERABILITY ASSESSMENT

Vulnerability refers to the susceptibility of service areas within the municipality and the potential harm that may arise from climate change. The assessment provides an analysis of the sensitivity (to what degree will the functionality change) and the adaptive capacity (cost and staff intervention required to recover) to the projected changes in climate for South Huron.

Vulnerability = Sensitivity / Adaptive Capacity

The vulnerability assessment was completed by municipal managers as it directly relates to services and existing conditions of municipal departments. The following key questions were ask during the completion of the vulnerability assessment to assist in the scoring: What is the level of exposure of the primary department be affected by these changes if they occurred? How would the department be affected by these changes if they occurred today? Is the department already subject to any existing stress?

Sensitivity

Sensitivity refers to the degree in which the functionality will change.

TABLE 1: SENSITIVITY SCORING

SENSITIVITY SCORING	DEFINITION
S1	Functionality will remain the
S2	Functionality will likely remain
S3	Functionality is likely to
S4	Functionality will become
S5	Functionality will become

Adaptive Capacity

Adaptive capacity refers to the cost and staff intervention required to recover.

TABLE 2: ADAPTIVE CAPACITY SCORING

ADAPTIVE CAPACITY SCORING	DEFINITION
AC1	Substantial costs and staff intervention ($$$$$)
AC2	Significant costs and staff intervention ($$$$)
AC3	Some costs and staff intervention ($$$)
AC4	Slight costs and staff intervention ($$)
AC5	Little or no costs and staff intervention ($)

Overall Vulnerability Scoring

TABLE 3: OVERALL VULNERABILITY SCORING

		Low	**SENSITIVITY**			*High*
		S1	**S2**	**S3**	**S4**	**S5**
Low	**AC1**	V2	V2	V4	V5	V5
	AC2	V2	V2	V3	V4	V5
ADAPTIVE CAPACITY	**AC3**	V2	V2	V3	V4	V4
	AC4	V1	V2	V2	V3	V3
High	**AC5**	V1	V1	V2	V3	V3

TABLE 4: OVERALL VULNERABILITY SCORING DEFINITIONS

OVERALL VULNERABILITY SCORING	DEFINITION
V1	Low Vulnerability
V2	Low-Medium Vulnerability
V3	Medium Vulnerability
V4	Medium - High Vulnerability
V5	High Vulnerability

RISK ASSESSMENT

The purpose of a risk assessment is to prioritize the impacts to determine which impacts should be addressed through action planning (those that pose the greatest risk). Impacts that are determined to have a low risk score although will not be included in action planning, they will be monitored as the strategy is updated to ensure the scoring hasn't significantly changed.

Risk = Likelihood x Consequence

Likelihood

The first step in completing the risk assessment is to determine the likelihood of an event is determined based on the climate science and current observations. The likelihood can be described as a recurrent event (can occur more than once) or single event (definitive and can only happen once). Table 5 describes the likelihood scoring for both recurrent and single event.

TABLE 5: LIKELIHOOD SCORING

LIKELIHOOD RANKING	RECURRENT EVENT	SINGLE EVENT
Almost Certain (5)	Could occur several times per year	More likely than not – probability greater than 50%
Likely (4)	May arise about once per year	As likely as not – 50/50 chance
Possible (3)	May arise once in 10 years	Less likely than not but still appreciable - probability less than 50% but still quite high
Unlikely (2)	May arise once in 10 to 25 years	Unlikely not but negligible – probability low but noticeably greater than zero
Rare (1)	Unlikely during the next 25	Negligible – probability very small, closer to zero

Consequence

The second step in completing the risk assessment is to consider the degree in which each impact statement would impact the entire South Huron community by considering social, economic, and environmental factors. The twelve (12) consequence categories corresponding with the social, economic and environmental factors are outlined in Table 6.

TABLE 6: RISK CONSEQUENCE CATEGORIES

SOCIAL FACTORS	ECONOMIC FACTORS	ENVIRONMENTAL FACTORS
Public health & safety	Property damage	Air
Displacement	Local economy & growth	Soil & vegetation
Loss of livelihood	Community Livability	Water
Cultural aspects	Public administration	Ecosystem function

Tables 7 (Social), Table 8 (Economic) and Table 9 (Environmental) provide the scoring and definition and each factor. Each factor is provided a score ranging from Negligible (1) to Catastrophic (5).

Social Consequences

TABLE 7: CONSEQUENCE SCORING FOR SOCIAL FACTORS

CONSEQUENCE RATING	Public Health & Safety	Displacement	Loss of Livelihood	Cultural Aspects
Catastrophic (5)	**Catastrophic (5):** Large number of fatalities or serious injuries, or permanent illness	**Catastrophic (5):** Large number of permanent displaced people on a widespread scale	**Catastrophic (5):** Large Disturbances leading to permanent changes in peoples' normal routines and way of life	**Catastrophic (5):** Unprecedented loss of cultural identify (traditions/ customs) across the wider community (cancellation of flagship annual event)
Major (4)	**Major (4):** Isolated instances of fatalities or serious injuries, or long-term illness	**Major (4):** Isolated instances of permanently displaced people on a widespread scale	**Major (4):** Large disturbances leading to prolonged changes in people's normal routines and way of life	**Major (4):** Significant loss of cultural identity (traditions/customs) for multiple social groups
Moderate (3)	**Moderate (3):** Small number of injuries or cases of illness	**Moderate (3):** Isolated instances of temporary displaced people on a widespread scale	**Moderate (3):** Moderate disturbances leading to short-term changes in people's normal routines and way of life	**Moderate (3):** Moderate impact on cultural identity (traditions/customs)
Minor (2)	**Minor (2):** Near misses or minor injuries	**Minor (2):** Isolated instances of temporary displaced people in localized areas	**Minor (2):** Minor and storm-term changes to people's normal routines and way of life	**Minor (2):** Minor impact on cultural identity (traditions/customs) for a small number of social groups
Negligible (1)	**Negligible (1):** Appearance of a threat but no actual harm	**Negligible (1):** Appearance of a threat but no actual displacement	**Negligible (1):** No changes to people's normal routine and way of life	**Negligible (1):** Appearance of a threat but no actual impact on cultural identity (transitions/customs)

Economic Consequences

TABLE 8: CONSEQUENCE SCORING FOR ECONOMIC FACTORS

CONSEQUENCE RATING	Property Damage	Local Economy and Growth	Community Livability	Public Administration
Catastrophic (5)	**Catastrophic (5):** Catastrophic damage and costs incurred by the owner ($$$$$)	**Catastrophic (5):** City-scale decline leading to widespread business failure, loss of employment and hardships	**Catastrophic (5):** Permanent decline in services, causing the city to be seen as very unattractive, moribund, and unable to support the community	**Catastrophic (5):** Public administration would fall into decay and cease to be effective
Major (4)	**Major (4):** Major damage and costs incurred by the owner ($$$$)	**Major (4):** City-scale stagnation such that businesses are unable to thrive	**Major (4):** Widespread and severe decline in services and quality of life within the community	**Major (4):** Public administration would struggle to remain effective and would be in danger of failing
Moderate (3)	**Moderate (3):** Moderate damage and costs incurred by the owner ($$$)	**Moderate (3):** Isolated areas of reduction in economic performance relative to current forecasts	**Moderate (3):** Isolated but noticeable examples of decline in services	**Moderate (3):** Public administration would be under severe pressure on several fronts
Minor (2)	**Minor (2):** Minor damage and costs incurred by the owner ($$)	**Minor (2):** Inconveniences that cause minor shortfall relative to current forecasts	**Minor (2):** There would be minor areas in which the community is unable to maintain its current services	**Minor (2):** There would be minor instances of public administration being under more than usual stress
Negligible (1)	**Negligible (1):** No damage and costs incurred by the owner ($)	**Negligible (1):** No real impact to the local economy and growth	**Negligible (1):** No real pressure on current services	**Negligible (1):** No real stress on public administration

Environmental Consequences

TABLE 9: CONSEQUENCE SCORING FOR ENVIRONMENTAL FACTORS

CONSEQUENCE RATING	Air	Water	Soil and Vegetation	Ecosystem Function
Catastrophic (5)	**Catastrophic (5):** Very frequent periods of reduced air quality	**Catastrophic (5):** Irreversible, widespread reduction in water quality/quantity	**Catastrophic (5):** Irreversible, widespread impacts to soil or vegetation	**Catastrophic (5):** Major and widespread loss of ecological functions and irrecoverable damage
Major (4)	**Major (4):** Considerable increase in periods of reduced air quality in the medium term	**Major (4):** Major, widespread reduction in water quality/quantity in the short/medium term	**Major (4):** Major, widespread impacts on soil or vegetation in the short/medium term	**Major (4):** Severe and widespread loss of ecological functions and damage that could be reversed with intensive efforts
Moderate (3)	**Moderate (3):** Moderate increase in periods of reduced air quality in the short/medium term	**Moderate (3):** Moderate, widespread reduction in water quality/quantity in the short/ medium term	**Moderate (3):** Moderate widespread impacts on soil or vegetation in the short/ medium term	**Moderate (3):** Isolated but moderate instances of damage to the ecosystem that could be reversed
Minor (2)	**Minor (2):** Minor increase in periods of reduced air quality in the short term	**Minor (2):** Minor, localized reduction in water quality/quantity in the short term	**Minor (2):** Minor, localized impacts on soil or vegetation in the short term	**Minor (2):** Isolated but minor instances of damage to the ecosystem that could be reversed
Negligible (1)	**Negligible (1):** Appearance of a threat but no real impact to air quality	**Negligible (1):** Appearance of threat but no real reduction in water quality/quantity	**Negligible (1):** Appearance of threat but no real impacts on soil vegetation	**Negligible (1):** Appearance of a threat but no real damage to the ecosystem and its function

Overall Risk Scoring

The overall risk score for each impact is determined through calculating the twelve consequence scores (social, economic, and environmental). The purpose of calculating one overall risk score and the three risk consequences scores is to ensure that certain impacts that may pose a high risk in a specific consequence category will still be captured in action planning, regardless if other consequence categories receive low risks scores which lower the overall risk score. For example, if an impact statement received a high social score, but low economic and environmental risk scores, it may be determined that the impact should be addressed during action planning to lower the social risk

Table 10 shows the risk rankings for individual risk scoring, from very low to extreme. Table 11 shows the scores for the overall risk scoring, from very low to extreme.

TABLE 10: SPECTRUM FOR SOCIAL, ECONOMIC AND ENVIRONMENTAL RISK SCORES

Very Low 5 – 16	**Low** 17 – 28	**Medium-Low** 29 – 40	**Medium** 41 – 52	**Medium – High** 53 – 64	**High** 65 – 76	**Very-High** 77 – 88	**Extreme** 89 – 100

TABLE 11: SPECTRUM FOR OVERALL RISK SCORE

Very Low 15 – 50	**Low** 51 – 86	**Medium-Low** 87 – 122	**Medium** 123 – 158	**Medium – High** 159 – 194	**High** 195 – 230	**Very-High** 231 – 266	**Extreme** 267 – 300

VULNERABILITY AND RISK ASSESSMENT RESULTS

The results from the vulnerability and risk assessments represent the perceptions and adept opinions of all members of the CCAAC and municipal staff who participated in the scoring exercise. It is important to note that the vulnerability and risk assessment scoring is a subjective exercise and is dependent on the participants. The results do not necessarily capture the perspective of every stakeholder. The impact statements carried forward to the action planning phase are those in which have been determined that they pose the greatest threat to South Huron.

Table 12 and Table 13 provide summaries of the number of impacts that fall within the overall vulnerability and risk assessment scores.

TABLE 12: SUMMARY OF OVERALL RISK ASSESSMENT RESULTS

Overall Risk Score	Number of Impacts
Extreme	0
Very High	0
High	0
Medium-High	5
Medium	20
Low-Medium	13
Low	2

TABLE 13: SUMMARY OF OVERALL VULNERABILITY ASSESSMENT RESULTS

Overall Vulnerability Score	Number of Impacts
High Vulnerability (V5)	3
Medium - High Vulnerability (V4)	9
Medium Vulnerability (V3)	10
Low - Medium Vulnerability (V2)	12
Low Vulnerability (V1)	6

The overall score was utilized using quantitative results, however, qualitative feedback obtained through discussions with committee members, staff and the general public and are included within the comment column of Table 14 (Vulnerability and Risk Assessment Results). These impacts, although may score low in the assessments, are important to consider alongside the overall score in the action planning phase to given their expressed importance. In cases where an impact may be scored low, the qualitative comments may be considered with greater weighing given the identification of importance through other consultation means.

Table 14 shows the results of the Vulnerability and Risk Assessment as a prioritized list of impact statements, presenting the impacts from highest overall ranking risk scores to the lowest ranking risk scores.

The Climate Change Adaptation Advisory Committee provided a recommendation to carry over impact statements to the Action Planning phase (as described in the Comments on Impact Statement column in Table 14) that had the following scores:

- Medium-High Risk Score
- Medium Risk Score with Vulnerability Scores of Medium (V3), Medium-High (V4) and High (V5)
- Low-Medium and Low Risk Score with Vulnerability Scores of Medium-High (V4) and High (V5)

It was also recommended by the Committee that any impacts that fell outside of the above but were deemed important may also be carried over.

TABLE 14: Vulnerability and Risk Assessment Results

				RISK ASSESSMENT					VULNERABILITY ASSESSMENT		
Impact ID	**Climate Category**	**Climatic Threat**	**Impact Statement**	**Likelihood**	**Social Risk Score (/100)**	**Economic Risk Score (/100)**	**Environmental Risk Score (/100)**	**OVERALL RISK SCORE (/300)**	**OVERALL VULNERABILTIY SCORE**	**COMMENTS ON IMPACT STATEMENT**	**CARRY FORWARD TO ACTION PLANNING?**
75	Precipitation	Increase in Winter Precipitation and Snow Melts	Changes in winter precipitation type (rain), potentially when the ground is frozen and saturated resulting in surcharge and runoff from rapid snowmelt resulting in the overburdening of the municipal stormwater system and risk of flooding leading to damage to municipal infrastructure, increase in financial cost to the municipality and management required during the response period.	5	65 (High)	66.5 (High)	52.5 (Medium-High)	**184 (Medium-High)**	**V4 (Medium-High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
53	Extreme Weather Event	Increase in frequency of extreme weather events	Increased number of displaced residents from their homes due to extreme weather events, leading to an increase usage of the Emergency Operations Centre (Town Hall), request for service, coordination and communications from municipal staff.	4	54 (Medium-High)	72 (High)	54.5 (Medium- High)	**180.5 (Medium-High)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
42	Extreme Weather Event	Heavy localized flooding events	Overwhelming of sanitary sewers resulting in the potential back up of sewage into basements, particularly in low lying areas.	3	65 (High)	65.5 (High)	38 (Low-Medium)	**168.5 (Medium-High)**	**V2 (Low-Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
61	Extreme Weather Event	Increase in frequency of extreme weather events	Increased liability, public and health and safety hazards and risks, private property damage, dangerous conditions that may impact the entire municipality.	5	59 (Medium-High)	58.5 (Medium-High)	43.5 (Medium)	**161 (Medium-High)**	**V2 (Low-Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
68	Extreme Weather Event	Increased frequency and duration of drought	Increased risk of fire during dry conditions resulting in an increase in fire related calls and increase in the total number of calls for fire department during dry periods.	5	57 (Medium-High)	53 (Medium-High)	48 (Medium)	**158 (Medium-High)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
16	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat street or respiratory illnesses lead to an increased in request for service and staff time to accommodate demand for outdoor cooling facilities (pools, tree covered areas, splash pads) and indoor facilities.	4	51 (Medium)	50.5 (Medium)	53 (Medium-High)	**154.5 (Medium)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
15	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk to the public, especially vulnerable populations.	4	50.5 (Medium)	46 (Medium)	57.5 (Medium-High)	**154 (Medium)**	**V1 (Low)**		No

41	Extreme Weather Event	Heavy localized flooding events	Overloading of older sanitary sewers (in particular, where inflow and infiltration of stormwater/ groundwater into sanitary sewers), resulting in the potential for untreated sewage overflow by-passing secondary treatment allowing contaminants and infectious organisms entering into the receiving waterbody.	3	41 (Medium)	53 (Medium-High)	58 (Medium-High)	**152 (Medium)**	**V2 (Low-Medium)**		No
38	Extreme Weather Event	Increased frequency and duration of heatwaves	Increased health and safety risk to vulnerable populations resulting in an increase in service requests, access to cooling facility resulting in increased request for service and staff time and coordination, potentially outside of regular working hours.	4	50 (Medium)	51 (Medium)	47 (Medium)	**148 (Medium)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
73	Extreme Weather Event	Continued occurrence of extreme cold events	Increased health and safety risk (thermoregulation, frostbite) to vulnerable populations resulting in an increase in the need for community cold alerts, service requests, and access to warming facility resulting in increased request for service and staff time and coordination, potentially outside of regular working hours.	5	52.5 (Medium)	48.5 (Medium)	46.5 (Medium)	**148 (Medium)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
22	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk to municipal volunteer fire fighters working during periods of very hot days requiring appropriate working hours, cooling aids and relief mechanisms.	4	46.5 (Medium)	48 (Medium)	49 (Medium)	**144 (Medium)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
54	Extreme Weather Event	Increase in frequency of extreme weather events	Increased demand for essential services and disaster recovery costs resulting in an increase in staff time and financial cost to the municipality.	4	44 (Medium)	62 (Medium-High)	37 (Low-Medium)	**143 (Medium)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
56	Extreme Weather Event	Increase in frequency of extreme weather events	Increase in occurrences of power outages, transportation disruptions, and public health and safety situations resulting in an increased demand for emergency services, communications, coordination and resources.	4	57.5 (Medium-High)	48.5 (Medium)	36.5 (Medium-Low	**143 (Medium)**	**V2 (Low-Medium)**		No
4	Temperature	Increased Annual Temperature	Changes in timing of spring and winter melts, potentially when ground is frozen and saturated resulting in surcharge and runoff from rapid snowmelts resulting in the potential of overburdening of the municipal stormwater system and risk of flooding leading to damage to municipal infrastructure.	5	43.5 (Medium)	52 (Medium)	46.5 (Medium)	**142 (Medium)**	**V2 (Low-Medium)**		No
47	Extreme Weather Event	Heavy localized flooding events	Increased stress on bridges/culverts, potential for road washouts, erosion and transportation disruptions requiring an increase in emergency service requests and staff time to monitor, repair/replace damages, financial cost to the municipality and increased management required during the response period.	5	40.5 (Medium)	58.5 (Medium-High)	37.5 (Low-Medium)	**137 (Medium)**	**V5 (High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
48	Extreme Weather Event	Heavy localized flooding events	Increased damage to private property due to flooding resulting in an increase in number of residents contacting the municipality, specifically directed to the Building Department requesting information on flooding and assistance to address the situation.	4	41.5 (Medium)	50.5 (Medium)	44 (Medium)	**136 (Medium)**	**V4 (Medium-High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**

35	Precipitation	Increased Winter Precipitation	Increased hazardous road and walking conditions resulting in an increased use of salt and/or sand on roadways, sidewalks and in parking lots resulting in increase in staff time to monitor, increased corrosion to equipment and facilities, and greater impact on water quality within the municipality.	5	45.5 (Medium)	49 (Medium)	39 (Low-Medium)	**134 (Medium)**	**V5 (High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
12	Temperature	Increase in Very Hot Days (over 30˚C)	Reduced air quality that may cause heat stress or respiratory illnesses resulting in increased health and safety risk and demand for municipal outdoor workers to have appropriate working hours, cooling aids, personal protective gear and spaces for relief.	4	46 (Medium)	39.5 (Low-Medium)	45.5 (Medium)	**131 (Medium)**	**V1 (Low)**		No
44	Extreme Weather Event	Heavy localized flooding events	Increase in erosion rates, sediment release and surface runoff within riparian areas and unstable transition to low lying areas, resulting in an increased risk of pollutants from the landscape, increase in bank destabilization, loss of habitat and overall impact on water quality.	5	36 (Low-Medium)	44 (Medium)	51 (Medium)	**131 (Medium)**	**V4 (Medium-High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
3	Temperature	Increased Annual Temperature / Increase in Winter Temperatures	Extended growing seasons and increased survival rates for pests resulting in the potential for an increase presence and impacts (damage or loss) from invasive species to tree and vegetation within municipally owned property.	3	38.5 (Low-Medium)	41.5 (Medium)	50 (Medium)	**130 (Medium)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
65	Extreme Weather Event	Increased frequency and duration of drought / Increased Summer Temperatures	Reduced quality of outdoor municipal facilities (sports fields, parks, natural areas and trails, cemetery) and lawns, gardens and drought in-tolerant trees and vegetation requiring an increase in municipal water usage, request for service, and maintenance and monitoring of the quality of spaces and potential removal of distressed species.	5	29 (Low-Medium)	44.5 (Medium)	56.5 (Medium-High)	**130 (Medium)**	**V3 (Medium)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
2	Temperature	Increased Annual Temperature	Increased reproduction rates and range of vectors (e.g. West Nile Virus, Lyme Disease) resulting in an increased risk of exposure to vector-borne diseases for municipal outdoor workers.	4	42.5 (Medium)	40.5 (Low-Medium)	46.5 (Medium)	**130 (Medium)**	**V2 (Low-Medium)**		No
55	Extreme Weather Event	Increase in frequency of extreme weather events	Increased damage and/or decreased service life of municipal infrastructure (buildings, underground services, roads, bridges/culverts), public spaces requiring the potential closure of municipal facilities, increase request for service, staff time to repair/replace infrastructure and financial cost to the municipality.	5	41 (Medium)	57 (Medium-High)	31.5 (Low- Medium)	**130 (Medium)**	**V5 (High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
29	Temperature	Increased in Freeze-thaw cycles in January and February	Increased underground movement causing potential damage to municipal infrastructure (buildings, underground services, roads, sidewalks, cemetery) resulting in increase in request for service and staff time to monitoring and repair/replace, increased costs and integration into asset management planning.	5	40 (Low-Medium)	54 (Medium-High)	33 (Low- Medium)	**127 (Medium)**	**V4 (Medium-High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**

32	Precipitation	Increased Spring Precipitation / Increased in Heavy Precipitation Days (20mm)	Inundated municipal outdoor facilities (sports fields, parks, natural areas and trails, cemetery, Port Blake day-use area) preventing municipal staff from maintaining these spaces leading to temporary disruptions in using these spaces, increased demand for alternative spaces and potential revenue loss (where applicable).	5	33 (Low-Medium)	49 (Medium)	40.5 (Low- Medium)	**123 (Medium)**	**V2 (Low-Medium)**		No
71	Extreme Weather Event	Continued occurrence of extreme cold events	Increased risk of deep freeze to municipal infrastructure causing deficiencies resulting in an increased immediate request for service, staff time to repair/replace the damaged infrastructure and cost to the municipality.	4	34 (Low-Medium)	49 (Medium)	38 (Low-Medium)	**121 (Low-Medium)**	**V4 (Medium-High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
14	Temperature	Increase in Very Hot Days (over 30˚C)	Increased damage to hard surfaces (roads, sidewalks) resulting in an increase in request for service and staff time to repair/replace, increased costs and integration into asset management planning.	5	38 (Low-Medium)	42.5 (Medium)	37.5 (Low-Medium)	**118 (Low-Medium)**	**V4 (Medium-High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
59	Extreme Weather Event	Increase in frequency of extreme weather events	Increased power outages and electrical surges, resulting in the inability for municipal staff to utilize phones and computers, process work orders, provide communications to the entire municipality and access information for coordinated effort during extreme weather events.	4	39 (Low-Medium)	50.5 (Medium)	27.5 (Low)	**117 (Low-Medium)**	**V4 (Medium-High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
37	Precipitation	Increased Winter Precipitation	Increased outdoor maintenance from precipitation falling as snow or rain requiring more staff time to monitor and operate, equipment requirements and cost to the municipality.	5	36 (Low-Medium)	40 (Low-Medium)	39.5 (Low-Medium)	**116 (Low-Medium)**	**V4 (Medium-High)**	Recommendation by the Committee made to carry impact to Action Planning phase.	**Yes**
58	Extreme Weather Event	Increase in frequency of extreme weather events	Increased power outages and electrical surges, resulting in service disruptions for the entire municipality.	4	40 (Low-Medium)	48.5 (Medium)	26.5 (Low)	**115 (Low-Medium)**	**V1 (Low)**		No
70	Extreme Weather Event	Continued occurrence of extreme cold events	Increased risk of deep freeze to municipal underground water service causing breakage or freezing resulting in an increased immediate request for service, staff time to repair/replace the damaged services and cost to the municipality.	4	31.5 (Low-Medium)	50.5 (Medium)	32.5 (Low-Medium)	**115 (Low-Medium)**	**V3 (Medium)**		No
57	Extreme Weather Event	Increase in frequency of extreme weather events	Increased damage to urban trees, parks, and trails resulting in closures, increased request for service and staff time and cost to the municipality to identify and remove hazard trees.	5	37 (Low-Medium)	42 (Medium)	34.5 (Low-Medium)	**114 (Low-Medium)**	**V1 (Low)**		No
66	Extreme Weather Event	Increased frequency and duration of drought	Reduced quality of municipal and private property lawn/gardens, and drought in- tolerant trees and vegetation resulting in an increase in demand for municipal water.	5	25 (Low-Medium)	41 (Medium)	42.5 (Medium)	**109 (Low-Medium)**	**V1 (Low)**		No

20	Temperature	Increase in Very Hot Days (over 30˚C) / Increased in Freeze-thaw cycles in January and February	Increased stress on trees and natural areas resulting in an increase in municipal water demand and staff time to ensure the health and success of trees, increase in request for service and staff time to monitor and remove hazard trees on municipally-owned property.	5	28 (Low)	39.5 (Low-Medium)	37.5 (Low-Medium)	**105 (Low-Medium)**	**V1 (Low)**		No
43	Extreme Weather Event	Heavy localized flooding events	Overflow by-pass resulting in an increase in call outs to Municipal staff due to emergency alarms, service calls and mandatory reporting to agencies (i.e. Ministry of Environment, Conservation and Parks).	3	25 (Low)	40 (Low-Medium)	38 (Low-Medium)	**103 (Low-Medium)**	**V2 (Low-Medium)**		No
51	Extreme Weather Event	Increase in frequency of extreme weather events	Increased extensive damaged to private property resulting in an increase in requests for permits (with the potential for quick turnarounds requested) resulting in an increase in staff time to consult and prepare required documentation to issue permits.	4	28.5 (Low)	47 (Medium)	26 (Low)	**102 (Low-Medium)**	**V3 (Medium)**		No
21	Temperature	Increase in Very Hot Days (over 30˚C)	Increased bacteria growth and dissipation of chlorine within municipally-owned water storage facilities resulting in increased staff monitoring and changes to the amount/type of chemicals (chlorine) required within the system to ensure drinking water standards are adhered to.	4	29 (Low-Medium)	37 (Low-Medium)	30 (Low-Medium)	**96 (Low-Medium)**	**V2 (Low-Medium)**		No
64	Extreme Weather Event	Increase in frequency of extreme weather events	Increase in repairs/replacements addressed under tender bids during times of overload to municipal staff resulting in increased cost and project management time to the municipality.	4	23.5 (Low)	49.5 (Medium)	22.5 (Low)	**96 (Low-Medium)**	**V2 (Low-Medium)**		No
74	Extreme Weather Event	Continued occurrence of extreme cold events	Increased health and safety risk (thermoregulation, frostbite) and demand for municipal outdoor workers to have appropriate working hours, warming aids, personal protective gear and spaces for relief.	5	22 (Low)	28 (Low)	23 (Low)	**79 (Low)**	**V2 (Low-Medium)**		No
8	Temperature	Increased Summer Temperatures	Increased summer energy usage for municipally-owned facilities leading to increased utility costs for the municipality.	4	23 (Low)	33.5 (Low - Medium)	22 (Low)	**79 (Low)**	**V2 (Low-Medium)**		No

Appendix D
Action and Implementation Plan

Note: The following document titled *Appendix D: Action and Implementation Plan* shall be read in conjunction with the Municipality of South Huron's Climate Change Adaptation Strategy. This appendix contains a detailed summary of the actions identified throughout the development and the associated implementation information.

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SUMMARY OF ACTION AND IMPLEMENTATION PLAN

Appendix D: Action and Implementation Plan provides a detailed summary of the action items identified through the development of the adaptation strategy. This appendix is intended to be a living document, which is to be updated as South Huron's Climate Change Adaptation Strategy undergoes an update.

A total of 38 actions were identified for the Municipality to consider for implementation to address the goals of the adaptation strategy, ranging from modest operational changes to large capital projects requiring more staff time and resources. The action items were identified through municipal staff workshops, Council and municipal staff survey responses, public survey responses and input from the Climate Change Adaptation Advisory Committee (CCAAC) members.

The following notes are important in understanding the Action and Implementation Plan:

- **Action** lists the general action identified.
- **Description/scope** provides more information about the action and the scope of the action
- **Implementation Lead(s)** identifies the department(s) to lead implementation of the action. Note: this can also be the Climate Change Adaptation Advisory Committee (or equivalent committee)
- **Supporting Department(s)** identifies the department(s) which will support the implementation of the action as directed by the implementation lead. Note: this can also be the Climate Change Adaptation Advisory Committee (or equivalent committee)
- **Associated plans, policies, projects and strategies** provides details on what the Municipality currently has in place that is related to the action item.
- **Anticipated Timing** provides detail on when the implementation would commence (stated as calendar year).
- **Duration and Frequency** provides detail on how long it is anticipated that the implementation process will take (e.g. <1 year, 1-3 years, 3+ years).
- **Estimated Resources** refers to the level of cost (operating and/or capital) and staff time/resources required for the implementation and ongoing requirements of the action.

ESTIMATED LEVEL OF COST	STAFF EFFORT
$ – *Low Cost*	■□□ – Low staff effort
$$ – *Medium Cost*	■■□ – Medium staff effort
$$$ – *High Cost*	■■■ – High staff effort

- **Potential partnership(s)** identifies community partners that may have resources and expertise in order to successfully implement the action. These partnerships will be confirmed prior to implementation of the action.

It is important to note that the action items outlined in this appendix are intended to be used as a guide. All lead and supporting department(s) roles and responsibilities will be identified at the beginning of the implementation planning phase. The timelines and costs are subject to final Council approval, prior to implementation.

Actions identified under *Goal 1: Integrate climate change adaptation into municipal planning, asset management and operations*

ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION / FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
1.1 Include climate change consideration section in staff reports to Council	This action item would include a heading within reports to council whether or not the staff report has considered climate change. Outcome may lead into the requirement to complete action item 1.2.	•Community Services	•Senior Management	•South Huron Strategic Plan	2020	Ongoing	Cost: **$** Staff Effort: ■□□	
1.2 Develop a qualitative climate lens tool to guide staff and Council decision-making.	This action item would be a high level, qualitative tool to ensure that a climate lens is applied to all projects, policies, plans and procurement considerations within the Municipality. The tool will contain questions related to the identified impacts from climate change (temperature, precipitation, seasonal changes and extreme weather).	•Community Services	•Senior Management	•South Huron Strategic Plan	2020	Ongoing	Cost: **$** Staff Effort: ■□□	
1.3 Develop a process to ensure climate change adaptation is considered during review of existing and development of new policies and plans for South Huron.	This action item would be implemented during review of existing policies/plans and during the development of new policies/plans to ensure climate change adaptation is considered.	•Community Services	•Senior Management	•South Huron Strategic Plan	2020	Ongoing	Cost: **$** Staff Effort: ■■□	
1.4 Explore the potential to integrate climate change projections into asset management planning.	This action item would involve an evaluation of the consideration of climate change into South Huron asset management planning and what steps are required for complete integration.	•Financial Services	•All Departments	•Asset Management Policy and Plan	2022	~ 1-3 years	Cost: **$$$** Staff Effort: ■■■	

Actions identified under *Goal 1: Integrate climate change adaptation into municipal planning, asset management and operations*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION / FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
1.5 Continue to lobby provincial and federal governments to support adaptation initiatives at the municipal level.	This action item would involve South Huron Council members to continue to lobby provincial and federal government support through various conferences and meetings. This action item should also ensure regular updates are provided to the community through Regular Council meetings.	•Members of Council			2020	Ongoing	Cost: **n/a** Staff Effort: **n/a**	

Actions identified under *Goal 2: Support municipal and community resilience awareness and action*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
2.1 Initiate community-Initiate community-wide conversation to provide information to the entire community (residents, business) about relevant climate change topics to provide the tools required to incorporate resilience on a community-wide scale.	This action item will involve initiating community wide conversations focused around climate change. The purpose will be to bring together relevant information that the community should know in order to be resilient. Information related to climate change science, impacts, actions, industry, innovated technology will be included.	•Climate Change Adaptation Advisory Committee	•Community Services		2021	< 1 year	Cost: **$** Staff Effort: ■□□	
2.2 Develop information briefing program to be regularly sent to staff and Council to inform on current climate change information.	This action item will involve communicating the most up to date information regarding climate change to staff and Council. Information related to climate change science, impacts, actions, industry, innovated technology will be included.	•Community Services	•Climate Change Adaptation Advisory Committee		2020	< 1 year	Cost: **$** Staff Effort: ■□□	
2.3 Create and promote regularly scheduled climate change themed challenges for the community to showcase their resilience.	This action item will involve identifying scheduled themes and promoting (potentially with small incentives) the community to showcase their resilience (e.g. for the month of April show us your natural gardens, for the month of October show us your permeable pavement or other low impact development solutions).	•Community Services	•Climate Change Adaptation Advisory Committee		2021	< 1 year	Cost: **$** Staff Effort: ■□□	

Actions identified under *Goal 2: Support municipal and community resilience awareness and action*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
2.4 Develop communication strategy to showcase municipal initiatives to the community that are related to adaptation and resilience.	This action item will involve utilizing various communication tools to showcase the action items (as outlined in the climate change adaptation strategy) as well other initiatives related to climate change adaptation and resilience that the municipality is undertaking.	•Community Services	•Climate Change Adaptation Advisory Committee		2021	< 1 year	Cost: **$** Staff Effort: ■□□	

Actions identified under *Goal 3: Ensure community readiness and coordinated responses to extreme weather events*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
3.1 Investigate tools to expand municipal communications during extreme weather events to ensure information is convenient, accurately communicated and regularly updated to inform the public.	This action item would accompany existing communication pathways. It is anticipated that this action will involve the municipality investigating the potential to enter into an agreement with a provider (e.g. Municipal511, an online comprehensive map-based services) to store municipal information regarding disruptions during major events such as flooding, fires, and available shelters. This action item would also improve communication outside of the identified impacts from climate change and identify other disruptions provide an overall benefit to the community through enhanced communication (e.g. construction, load restrictions, no winter maintenance roads).	•Community Services	•All Departments		2021	<1 year	Cost: **$** Staff Effort: ■□□	
3.2 Develop a current public awareness campaign to enhance community preparedness before an extreme weather event occurs.	This action will focus on emergency preparedness awareness campaign for the community. Information about what is available for supports in our community during an extreme weather event (such what you should do to prepare, what not to do during an extreme weather event, who to contact if you need assistance, where to find the most accurate information. The aim of this action item is to equip the community with this information and resources before an event occurs.	•Emergency Services	•Community Services	•Emergency Preparedness •ABCA: Annual Flood Emergency Planning; Flood Emergency (Contingency) Plan	2021	<1 year	Cost: **$** Staff Effort: ■■□	

Actions identified under *Goal 3: Ensure community readiness and coordinated responses to extreme weather events*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
3.3 Identify potential partnerships and explore options to create a voluntary "Check in with your neighbour" program within South Huron.	This action item will focus on creating community partnerships around developing a voluntary, self-identified program where vulnerable populations who lack support in the community have support from someone/organization in the community during an extreme weather event. It is anticipated that this action would be voluntary, self-identified model.	•Climate Change Adaptation Advisory Committee	•Administration •Community Services		2021	<1 year	Cost: **$** Staff Effort: ■□□	•Huron County (Social Services) •Huron Perth Public Health
3.4 Conduct vulnerability assessment of critical infrastructure within municipal facilities and prioritize deficiencies require to be addressed to ensure resiliency.	This action item will focus on identifying the vulnerabilities of municipal infrastructure. This action item may include assessment of condition, back-up generation capabilities, reliance on outside fuel sources, and any other limitations of the infrastructure. This action will identify potential upgrades that may be required to address the findings of the vulnerability assessment.	•Infrastructure and Development •Facilities	•Public Works		2023	1-3 years	Cost: **$$$** Staff Effort: ■■□	
3.5 Develop an internal training program for all municipal staff for coordination during extreme weather events to ensure service continuity.	This action item will focus on informing all municipal staff (outside of Managers) with the information required during an extreme weather event. Overview of sequence of events, point of contacts to be the focus.	•Human Resources	•Senior Management	•Staff training	2022	< 1 year	Cost: **$** Staff Effort: ■□□	

Actions identified under *Goal 4: Reduce risks to buildings, properties and people from flooding*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
4.1 Undertake a Stormwater Master Plan for all settlement areas within the Municipality.	This action item will focus on undertaking a Stormwater Master Plan in order to manage stormwater within existing development areas and to accommodate future growth. The aim of this action item is to create a holistic plan for stormwater management within the Municipality and identify potential capital improvement projects to improve stormwater management.	•Infrastructure and Development	•Building Services		2023	1-3 years	Cost: **$$** Staff Effort: ■■□	
4.2 Support updating floodplain mapping for core development areas within the municipality.	This action item will focus on ensuring that floodplain mapping for the Ausable Bayfield and Upper Thames Conservation Authorities is updated to reflect existing conditions.	•Members of Council			2022	1-3 years	Cost: **$** Staff Effort: ■□□	•Ausable Bayfield Conservation Authority
4.3 Develop procedure for regularly updating rain Intensity-Duration-Frequency (IDF) curves to reflect changing climate variables to inform design of all municipal infrastructure.	This action item will focus on developing a procedure for providing an update to IDF for the municipality and ensuring that the information is utilized within decision making for municipal infrastructure, in particular for stormwater and bridge/culvert infrastructure sizing.	•Infrastructure and Development	•Public Works		2021	< 1 year	Cost: **$** Staff Effort: ■□□	
4.4 Develop awareness program and investigate the potential for incentives to encourage lot level	This action item will focus on providing information and incentives for private property owners to utilize LID strategies (e.g. rain barrels, rain gardens, permeable surfaces, bioretention, and natural infrastructure).	•Community Services	•Building Services •Infrastructure and Development		2022	< 1 year	Cost: **$** Staff Effort: ■□□	

Actions identified under *Goal 4: Reduce risks to buildings, properties and people from flooding*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
stormwater controls for private property.								
4.5 Investigate grading control measures to be implemented for infill lots designated for development.	This action item will focus on investigating various measures to be implemented related to ensuring the finish grade for infill lots is adequate based on adjacent overland flow routes.	•Building Services	•Infrastructure and Development		2021	< 1 year	Cost: **$** Staff Effort: ■□□	
4.6 Incorporate low impact development (LID) strategies into lot design of municipal facility upgrades and new municipal facilities.	This action item will focus on the incorporation of LID strategies to ensure lot level stormwater management is considered when upgrading existing or designing new municipal facilities. This action item to include measures such as permeable pavements, vegetation filter strips, and enhanced grass swales.	•Facilities •Public Works	•Senior Management	•Municipal Procurement Policy	2021	< 1 year	Cost: **$** Staff Effort: ■□□	
4.7 Reintroduction and update of sewage backflow value/ sump pump program.	This action item will focus on providing educational information to the public and update program details.	•Infrastructure and Development	•Building Services •Community Services	•Existing Municipal Program	2021	<1 year	Cost: **$$** Staff Effort: ■■□	
4.8 Develop a guide for public to provide information to them when they inquire about what to do when private property buildings are flooded.	This action item will focus on providing private property owners with the information they need to know when addressing flooded buildings.	•Building Services	•Community Services		2021	<1 year	Cost: **$** Staff Effort: ■□□	
4.9 Require developers to utilize best practices within site plan	This action item will focus on endorsing the draft *Huron County Site Plan Development Technical Servicing Guide*	•Infrastructure and Development	•Members of Council		2021	< 1 year	Cost: **$**	•County of Huron

Actions identified under *Goal 4: Reduce risks to buildings, properties and people from flooding*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD(S)	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
design to ensure risk of flooding within new developments is reduced.	with a focus on communication between the municipality and the developer to recognize their responsibilities during site plan design.						Staff Effort: ■□□	

Actions identified under *Goal 5: Minimize disruption to municipal service delivery*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
5.1 Enhance communication pathways between departments to ensure efficient response to and recovery from disruptions to services.	This action item will focus on improvement of communication pathways and between departments.	•Senior Management	•All Departments		2021	<1 year	Cost: **$** Staff Effort: ■□□	
5.2 Identify critical services; develop, document and train on contingency procedures.	This action item will include identifying escalation thresholds for triggering contingency procedures for each service.	•Senior Management	•All Departments		2021	<1 year	Cost: **$** Staff Effort: ■□□	

Actions identified under *Goal 6: Reduce health and safety risks to municipal workers and community members from extreme temperatures*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
6.1 Establish municipal facility locations and operating parameters to function as temporary warming and cooling centres for community members.	This action item will focus on developing operating parameters which may include threshold to trigger operation of warming/cooling centre, hours of operation, staffing requirements, security measures, and maximum capacity for each facility.	•Emergency Services	•All Departments		2021	< 1 year	Cost: **$** Staff Effort: ■■□	•Local organizations focused on community well-being
6.2 Develop a public awareness campaign to provide education to the community on how to stay safe during an extreme temperature events.	This action item will focus on providing education to the public on the including recognizing health impacts and what options are available during these events for relief.	•Community Services	•Emergency Services		2021	< 1 year	Cost: **$** Staff Effort: ■□□	•County of Huron •Huron Perth Public Health
6.3 Develop extreme temperature training program for municipal staff.	This action item will focus on providing training to municipal staff related to extreme temperatures. The training will including recognizing threshold limit values, temperature related symptoms, appropriate personal protective equipment, scheduling of outdoor work for maximizing productivity during events, and ensuring appropriate reliefs and breaks are identified.	•Human Resources	•Senior Management	•Existing Municipal staff training	2021	<1 year	Cost: **$** Staff Effort: ■□□	
6.4 Establish tree planting guidelines to assist in mitigating the effects of extreme heat,	This action item will include identifying a strategic approach to tree planting within urban boundaries that will not have a negative impact on private and municipal infrastructure. The action will include tree	•Community Services	•Infrastructure and Development •Public Works	•Existing Municipal Tree By-law	2021	< 1 year	Cost: **$** Staff Effort: ■□□	

Actions identified under *Goal 6: Reduce health and safety risks to municipal workers and community members from extreme temperatures*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
particularly within urban settlement boundaries. (related to action item 7.1)	planting best practices including preferred species that are resilience to the changes in climate, native species, minimum distance and site considerations.							
6.5 Increase public education and communication related to fire risk during extreme heat events.	This action item will include education about fire risk during extreme heat events and increased communication during an extreme heat event relating to fire bans/by-laws in place.	•Emergency Services	•Community Services		2021	< 1 year	Cost: **$** Staff Effort: ■□□	

Actions identified under *Goal 7: Protect and enhance the natural landscape to mitigate impacts*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
7.1 Development of a municipal wide forest strategy. (related to action item 6.4)	This action item will identify municipally owned property that present the opportunity for naturalization. The focus will be to gather baseline data on the canopy cover in the municipality. Also included in this action will be tree planting guidelines and best practices; see action item 6.4 for description.	•Community Services	•Public Works	•Existing Municipal Tree By-law	2022	1-3 years	Cost: **$$** Staff Effort: ■■□	
7.2 Develop a naturalization strategy focused on riparian areas located on municipal properties.	This action item will identify riparian areas located on municipally owned property that provide an opportunity for naturalization. The focus of this action item will be to utilize natural infrastructure to protect watercourses from erosion and sedimentation. Included in this action item may be consideration of property usage and potential enhancement to encourage synergies between public usage and ecological function.	•Public Works	•Community Services		2022	< 1 year	Cost: **$** Staff Effort: ■□□	
7.3 Develop awareness and investigate an incentive program to encourage naturalization and environmental stewardship on private property.	This action item will provide property owners the information on the benefit and importance of natural features on private property. Investigation of potential incentive programs (e.g. Huron Clean Water Project) to be included in this action item.	•Community Services	•Building Services		2022	1-3 years	Cost: **$$** Staff Effort: ■■□	• Conservation Authorities

7.4 Investigate the feasibility of integrating municipal natural infrastructure into asset management.	This action item will investigate the feasibility of integrating municipal natural assets into the municipality's asset management plan. The action item will include steps required to fully integrate natural infrastructure and may include identification and valuation of natural assets.	•Financial Services	•All Departments	•Asset Management Policy and Plan	2023	1-3 years	Cost: **$** Staff Effort: ■■□	

Actions identified under *Goal 8: Strengthen the resiliency of municipal infrastructure and facilities*								
ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
8.1 Incorporate climate change impacts into inspection process and identified deficiencies related to municipal infrastructure and facilities are completed and remediated on a regular basis.	This action item will include incorporating climate change impacts into inspection processes.	•Infrastructure and Development •Facilities	•Senior Management		2022	1-3 years	Cost: **$** Staff Effort: ■□□	
8.2 Provide municipal staff information on green infrastructure (natural) as a means to provide support to grey infrastructure (human engineered) within municipal projects.	This action item will include providing information to staff on current and relevant green infrastructure projects that will provide support (and reduce impact on) grey infrastructure.	•Infrastructure and Development	•Community Services		2021	< 1 year	Cost: **$** Staff Effort: ■□□	

Additional Actions Identified

ACTION	DESCRIPTION/SCOPE	IMPLEMENTATION LEAD	SUPPORTING DEPARTMENT(S)	ASSOCIATED PLANS, POLICIES, PROJECTS AND STRATEGIES	TIMING	DURATION AND FREQUENCY	ESTIMATED RESOURCES	POTENTIAL PARTNERSHIP(S)
9.1 Eliminate of single use plastics within Municipal offices	This action item will include providing information to staff on alternatives to single use plastics and procurement considerations for purchasing.	•Community Services	•All Departments •Members of Council	•Municipal Procurement Policy	2021	< 1 year	Cost: **$** Staff Effort: ■□□	
9.2 Creation of a Municipal Backyard Composting Program	This action item will include providing information to the public on backyard composting and feasibility for subsidizing composters or securing funding to provide the community with composters.	•Community Services	•Infrastructure and Development		2022	1 -3 years	Cost: **$$** Staff Effort: ■■□	

Appendix E
Engagement Summary

Note: The following document titled *Appendix E: Engagement Summary* shall be read in conjunction with the Municipality of South Huron's Climate Change Adaptation Strategy. This appendix contains the record of engagement throughout the development of the adaptation strategy.

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BACKGROUND

Overview of the Planning Process

Engagement is an integral part in identifying the impacts, risk and vulnerabilities within our corporate functions as well as the community as a whole. By coordinating technical with consultation, the result will be practical actions and successful implementation.

In order to develop the strategy, the following will be provided with the opportunity to participate in the planning process:

- Community members;
- Stakeholders;
- Climate Change Adaptation Advisory Committee; and
- Staff members and Council.

Approach for Engagement

The engagement process aligns with the Municipality of South Huron's Engagement Policy and includes:

- Value inclusiveness — ensuring public notice and engagement is based on building trust and relationships that seek to involve all members of the community.
- Promote open, two-way communication — working with the community in a co-operative and collaborative way to share information and provide opportunities for open and constructive dialogue.
- Provide timely information — ensuring information is available in a timely manner.
- Provide clear and accessible information —using plain language in a wide variety of formats and channels of communication.
- Be fiscally sustainable — ensuring methods and resources for public notice and engagement reflect the magnitude and complexity of the initiative.
- Be transparent and accountable — sharing information and having open public engagement processes, final decisions and outcomes.
- Be environmentally sustainable — ensuring environmentally-friendly public notice and engagement methods.
- Strive for continuous improvement — seeking better ways of engaging the community and providing efficient and effective public notice and engagement processes.
- Assess engagement needs at the beginning of all initiatives.

Objectives of Engagement

The objectives of the adaptation strategy engagement process are to:

- Obtain relevant feedback and input into the development of the adaptation strategy;

- Encourage public and stakeholder interest and knowledge around climate change action for the Municipality; and
- Create an overall 'buy-in' attitude for the strategy, including within the Municipality and community.

The final decision for the inclusion of impacts, risk and vulnerabilities and actions in the adaptation strategy will be at the discretion of Municipal staff and Committee members, with the final adaptation strategy will be approved by Council.

For the purposes of the Engagement Strategy, opportunities for engagement have been grouped around five major project phases, including:

- Background, Goals and Vision;
- Impacts, Risk and Vulnerabilities;
- Action Planning;
- Draft Adaptation Strategy; and
- Final Adaptation Strategy.

SUMMARY OF ENGAGEMENT ACTIVITIES

TABLE 1: Summary of Engagement Activities

Corresponding Project Phase	Timeframe	Activity	Description / Intent	Target/Reached	Outcome	Type
Staff and Council Engagement						
All phases	On-going, weekly	Team Meeting	• Project management meetings to discuss any of the items below.	Manager of Community Services, Administration Assistant	N/A	Inform and Involve
Background, Goal and Visioning	September 18, 2019 to October 4, 2019	Online Survey #1	• Identify vision and goals, view of climate change and the impacts to South Huron	36 responses from internal staff	Preliminary identification of impact statements and potential action items.	Consult

Background, Goal and Visioning Impacts, Risk and Vulnerabilities	October 2019	Departmental Session #1	• Address any knowledge gaps identified from the staff surveys
			• Provide a summary of future climate data for our region
			• Discussion of goals and vision for the strategy (further refine what was expressed in the surveys)
			• Corporate Impact Statements
			  ○ Identify risk and opportunity statements for each department
			  ○ Identify related departments for the statements
			• Preliminary brainstorming of potential actions
				Finance – 6 staff
				Transportation – 5 staff
				Administration – 4 staff
				Infrastructure and Development – 1 staff
				Environmental Services – 1 staff
				Recreation – 9 staff
				Emergency Services – 3 staff
				Human Resources – 1 staff
				Community Services – 2 staff
				Emergency Services – 2 staff
					Preliminary discussion on impact statements and potential action items based on existing conditions.	Inform and Involve

Impacts, Risk and Vulnerabilities Action Planning	November 29, 2019	Departmental Session #2	• Impact statements prioritizing to provide insight into the method and level of effort for risk and vulnerability assessments	19 staff attended the session.	Action prioritized from most important	Involve

Corresponding Project Phase	Timeframe	Activity	Description / Intent	Target/Reached	Outcome	Type
					to least important.	
Action Planning	December 2019	Online Survey #2	• Prioritizing Actions • Identifying timeline, costs, responsibility	2 responses from internal staff	Input into action items (reflect existing municipal operations)	Involve
Draft Adaptation Strategy	May/June 2020	Email Circulation	• Draft adaptation strategy circulation for comments	6 responses from internal staff	Review and overall impressions of strategy	Consult
Final Adaptation Strategy	August 2020	Email Circulation	• Final adaptation strategy circulation (once approved by Council)	N/A	N/A	Inform
Committee, Community and Stakeholder Engagement						
All phases	On-going, monthly	Committee	• Discussion and guidance of development of adaptation strategy	Committee Members - 6	N/A	Inform, Involve, Consult
Background	September 30 to October 4, 2019	Social Media Posts	• Five consecutive social media posts on the "things you should know" about climate change in South Huron. • Raise awareness	Day 1 (AM) – 1,227 reached, 83 engagements, 23 likes/comments/shares Day 1 (PM) – 895 reached, 39 engagements, 18 likes/comments/shares Day 2 – 714 reached, 52 engagements, 15 likes/comments/shares Day 3 – 721 reached, 20 engagements, 7 likes/comments/shares Day 4 – 967 reached, 67 engagements, 11 likes/comments/shares Day 5 (survey) – 1998 reached, 207 engagements, 33 reactions/comments/shares		Inform
Background, Goal and Visioning	October 4, 2019 to October 18, 2019	Online Survey #1	• Public survey opens on last social media post as described above.	General public - 65 responses	Preliminary identification of	Consult

Corresponding Project Phase	Timeframe	Activity	Description / Intent	Target/Reached	Outcome	Type
Impacts, Risk and Vulnerabilities			• Address any knowledge gaps identified from the staff surveys • Provide a summary of future climate data for our region • Discussion of goals and vision for the strategy (further refine what was expressed in the surveys)		impact statements and potential action items.	
Action Planning	November/December 2019	Online Survey #2	• Opportunity for general public to provide insight into the preliminary action items identified for the strategy	General public - 18 responses	Comments regarding preliminary action items	Consult
Draft Adaptation Strategy	April/May 2020	Bang the Table / Social Media Post	• Draft adaptation strategy circulation	5 responses from Committee members	Review and overall impressions of strategy	Consult
Final Adaptation Strategy	August 2020	Email Circulation / News Release	• Final adaptation strategy circulation (once approved by Council)	N/A	N/A	Inform

Appendix F
Implementation Indicators

Note: The following document titled *Appendix F: Implementation Indicators* shall be read in conjunction with the Municipality of South Huron's Climate Change Adaptation Strategy. This appendix contains the proposed indicators to evaluate the implementation phase.

MEASUREMENT USING INDICATORS

A suite of indicators will be used to measure the progress and performance of action item implemented over time. An initial total of 26 baseline indicators are identified under the project goals. For each indicator, the source(s) of data are also identified.

Indicators will be reassessed throughout the project based on their efficacy and may be altered.

Goal 1: ***Integrate climate change adaptation into municipal planning, asset management and operations***	**Baseline Indicator**	**Source of Data**
	# of plans, policies, projects and strategies that include climate adaptation considerations	All departments
	# of priority adaptation actions implemented	All departments
	# of external partnerships focusing on adaptation actions	All departments
	% of annual municipal expenditures directly related to climate adaptation	All departments

Goal 2: ***Support municipal and community resilience awareness and action***	**Baseline Indicator**	**Source of Data**
	# of public events and media posts that include climate change education and awareness components	MOSH social media
	# of briefings sent to municipal staff and council related to climate change adaptation	Communications
	# of community-led projects including climate adaptation component(s)	Various community groups

	Baseline Indicator	Source of Data
Goal 3: ***Ensure community readiness and a coordinated response to extreme weather events***	Average response time (minutes or hours) for municipal staff to respond during extreme weather events	Emergency Services; Public Works
	# of public utilizing available municipal communications tools	MOSH social media, website analytics
	# of public reached during preparedness campaign	Emergency Services; Communications
	$ allocated to address deficiencies in critical infrastructure	Finance Department/asset management program

	Baseline Indicator	Source of Data
Goal 4: ***Reduce risks to buildings, properties and people from flooding***	# of reported properties experiencing flooding	Building Department; Infrastructure and Development
	% of floodplain mapping completed for the entire municipality	Conservation Authority
	% of development permitted in flood plain	Planning; Conservation Authority
	# of new properties inquiring about lot-level stormwater control features during development; OR # of existing properties inquiring about incorporating lot-level stormwater control features	Planning; Building Department; Infrastructure and Development
	% of low impact development (LID) features within the municipality	Public Works; Infrastructure and Development

Goal 5: *Minimize disruption to municipal service delivery*	**Baseline Indicator**	**Source of Data**
	# of public inquiries related to municipal service disruptions	All departments
	# of information releases related to disruptions to municipal services from weather events	Communications

Goal 6: *Reduce health and safety risks to municipal workers and community members from extreme temperatures*	**Baseline Indicator**	**Source of Data**
	# of municipal staff provided extreme temperature training	Human Resources
	# of days that cooling/warming centres are open to community members	Public Works
	# of community members receiving public awareness message about extreme temperatures and fire risk	Emergency Services; Communications/ MOSH social media

Goal 7: *Protect and enhance the natural landscape to mitigate impact*	**Baseline Indicator**	**Source of Data**
	% of total tree canopy within municipal properties/right-of-ways	Public Works; County (Forester)
	$ allocated to green infrastructure	All Departments
	Area (in acres) of watercourse riparian areas re-naturalized	Public Works

Goal 8: *Strengthen the resiliency of municipal infrastructure and facilities*	**Baseline Indicator**	**Source of Data**
	# of briefings sent to municipal staff on natural infrastructure (summaries of scientific journals, case studies, best practices)	Communications
	# of infrastructure and facility inspections that consider the impact from climate change	Public Works; Facilities