Climate Change and Health Vulnerability Report

WINDSOR-ESSEX COUNTY
HEALTH UNIT

WINDSOR-ESSEX COUNTY HEALTH unit
Bureau de santé de Windsor-comté d'Essex

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Introduction

What is climate change?

Climate change is the biggest global health threat of the 21st century (Lancet, 2018). Climate change is the long-term shift in weather conditions, such as temperature, precipitation, extreme weather events, and rising sea levels. Climate change is expected to result in warmer temperatures, longer and hotter summers, and more frequent and/or more severe weather events such as hurricanes/tornadoes, thunderstorms, wildfires, floods, and droughts. The results of climate change have the potential to influence health outcomes, and can impact one's health through temperature-related illnesses, poor air quality, water and foodborne diseases, exposure to ultraviolet rays, as well as an increased risk of vector-borne diseases. The impacts of climate change occur at global, national, provincial, and local levels (Government of Canada, 2019).

Climate change can occur due to natural causes and human activities. Natural factors such as volcanic activity, solar output, and the Earth's orbit around the Sun have contributed to changes in climate. However, human activities such as burning of fossil fuels like coal and oil and conversion of forests to farmland are the major contributors to climate change. Burning of fossil fuels produces greenhouse gases (such as carbon dioxide, methane, nitrous oxide), which have the potential to warm our planet.

The impacts of climate change on human health depend on multiple factors and vary based on the geographic region, environmental factors and the populations living in an area. Some of the impacts have a greater effect on health due to changes in exposure to temperature extremes (heatwaves, extreme cold); increases in other extreme weather events (floods, droughts); and poor air quality due to air pollutants and aeroallergens. These include illnesses due to extreme heat, drowning during a flood and injuries from falls during cold weather. Climate change due to indirect mechanisms, would affect the transmission of many infectious diseases (especially water, food and vector-borne diseases) and regional food productivity and availability.

It is very important for public health units (PHUs) to understand the local impacts of climate change in their communities and work with local government agencies to develop and implement mitigation and adaptation strategies. Better planning through investments in infrastructure and public health strategies can help communities become more resilient.

What is climate change adaptation?

Climate change adaptation refers to actions that reduce the negative impact of climate change, while taking advantage of potential new opportunities. It involves adjusting and developing policies, action plans and infrastructure because of observed or expected changes in climate. This will help communities to cope with impacts of climate change that cannot be mitigated. (Natural Resources Canada, 2015) These strategies include the development and implementation of heat warning systems, planting trees and increasing green spaces in order to decrease urban heat islands, conduct surveillance to track and identify disease trends and collaborate with community partners to create adaptation strategies.

What is climate change mitigation?

Climate change mitigation is defined as efforts to slow, stabilize, or reverse climate change by reducing greenhouse gas emissions. It involves decreasing the burning of fossil fuels, which will not only lower emissions of harmful greenhouse gases but can also lessen the release of toxic pollutants known to affect the health of people and ecosystems (AJPH, 2007). These strategies include increasing the energy efficiency in buildings, land use policies and smart community designs as well as increasing opportunities for alternative transportation such as biking, walking and public transport.

While neither adaptation nor mitigation actions alone can prevent significant climate change impacts, both taken together can significantly reduce the risks. Much of the work to prepare for climate change will happen at the federal, provincial, and municipal government levels, however PHU's can be key partners. Public health units play an essential role in educating policy makers and the public about the impacts of climate change on health, and collaborating with community partners to understand the needs and issues found within their community regarding climate change related impacts. They can assist partners in the development of policies, regulations, and initiatives to prepare and respond to the needs of the local communities. PHUs can also support and engage individuals in making personal choices to help reduce their impact on climate change.

In support of the development of a comprehensive local approach to address climate change in Windsor and Essex County (WEC), the Windsor-Essex County Health Unit (WECHU) is collaborating with Essex Region Conservation Authority (ERCA) and local municipalities to undertake development of a regional climate change strategy. The strategy will include establishment of sector-based implementation teams (e.g., Land Use and Watershed planning, Human Health and Well- being, Water Resources, Nature and Ecosystems, Energy, and Agriculture) and each team will develop a 'roadmap' for their issue area. The WECHU will lead the Human Health and Well-being implementation team and will conduct climate change and health assessment for WEC. This assessment will provide local evidence and understanding of the linkages between climate change and health within the WEC, identify promising evidence based interventions, and recognize local system gaps and strategies to address them.

Climate Change and Health Vulnerability Assessment in WEC

The purpose of this assessment is to examine possible health impacts resulting from climate change in WEC and to identify recommendations about how to enhance adaptive capacity to address these issues. According to *Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines (MOHTLC, 2016)*, the major health impacts as a result of climate change are due to following hazards:

1. Extreme temperatures
2. Extreme weather
3. Poor air quality
4. Food and water contamination
5. Vector-bone diseases
6. Ultraviolet radiation exposure

Methodology

Assessment Process:

This report describes climate-related hazards that have the potential to impact health outcomes in our community through analysis of:

- Historical climate trends and the occurrence of climate related hazards and impacts,
- Future climate change projections,
- Populations most sensitive to current and future health impacts as determined by levels of exposure, sensitivity and adaptive capacity, and,
- Current adaptive capacity actions undertaken by the WECHU, which contribute to protecting health.

Additionally, the findings will conclude with recommendations for future community level adaptive capacity and mitigation actions in efforts to prepare WEC for climate change impacts.

Note: *This assessment was developed by following the guidelines in the Ministry of Health and Long-Term Care's (MOHLTC) Climate Change and Health Vulnerability and Adaptation Assessment toolkit. In addition, the two previously completed Climate Change and Health Vulnerability Assessment by Public Health Units (Simcoe Muskoka District Health Unit and Middlesex-London Health Unit) were also reviewed. The City Of Windsor Climate Change Adaptation Plan (2012) and Essex Region Climate Collaborative - workshop reports were reviewed to determine local climate change needs and look at climate change adaptation measures in the broader community.*

Assessment Scope

Geography

The local climatic setting in the following sections were based on averages from the temperature and air quality monitors situated in downtown Windsor and west Windsor, which were the only two climate monitors available in WEC as of November 2019. The climate-related health impacts discussed in this report will focus on the experiences of WEC residents collectively as opposed to a health assessment at the municipal level.

Providing an overview of climate change impacts for each of the unique municipalities in WEC would ideally be helpful to identify specific priority areas to implement successful adaptation and mitigation strategies. However, the ability to conduct a detailed assessment for each municipality describing their climate conditions (historic and projected) and climate-related health impacts would not be feasible given the availability of project resources and data at the municipal level. Accordingly, this report will highlight the main local climate concerns, which would then guide the WECHU and its partners toward future investigations to determine the priorities for climate change program and policy planning.

Timeframe (baseline, 2020s, 2050s, 2080s)

The MOHLTC Climate Change and Health Vulnerability and Adaptation Assessment toolkit described the relevant environmental change and health impacts using projections for the 2050s and 2080s. Similarly, the indicators of climate change in this report will be described, where applicable, using the following time frames for current and future local climate conditions:

- Baseline: 1951 to 1980 and 1981 to 2010
- Near future: 2020s (2020 to 2049)
- Short term: 2050s (2050 to 2079)
- Long term: 2080s (2080 to 2100)

Climate Projections

The Intergovernmental Panel on Climate Change utilizes a range of climate projections based on a variety of future scenarios resulting from greenhouse gas (GHG) emissions caused by human activity, energy use, land use, technology and climate policies (IPCC, 2014). Projections in this report displayed the following scenarios or Representative Concentration Pathways (RCP): implementation of substantial mitigation actions (RCP 2.6); a situation with moderate mitigation efforts (RCP 4.5); and a high emissions scenario.

More specifically, the RCP 2.6 scenario assumes drastic and concerted climate policy improvements internationally resulting in declining global CO2 emissions by 2080 (van Vuuren et al., 2011). The RCP 4.5 scenario hypothesizes CO2 emissions to stabilize at half of 2000 levels by 2080 with nuclear power and renewables playing a greater role while reforestation increases regions for natural vegetation (van Vuuren et al., 2011). The RCP 8.5 or high emissions scenario combines assumptions about high population and slow income growth with modest technological advancements and energy efficiency improvements, resulting in long term high energy demand and GHG emissions in absence of climate change policies (Riahi, 2011).

The high emissions scenario was the primary focus in this report as it describes the climate trajectory if no plans for climate change adaptation or mitigation were incorporated in the future. The projection data was accessed via the Climate Data Canada portal, which is a collaboration between Environment and Climate Change Canada, the Compute Research Institute of Montreal, the Pacific Climate Impacts Consortium (PCIC), the Prairie Climate Centre and Habitat Seven. The use of this particular data portal was recommended by partners from ERCA and was incorporated in this report to uphold consistency in climate projections across the region. The following climate projection variables are described in the sections below: average temperature, number of days with temperatures above 30^{o}C, average minimum temperature, and number of days with temperatures below -15^{o}C and maximum 1 – day total precipitation.

Vulnerability, Exposure, Sensitivity and Adaptive Capacity

Assessing vulnerability to climate change is important for defining the risks posed by climate change and provides information for identifying measures to adapt to climate change impacts (Fussel & Klein, 2006).

- **Vulnerability** is defined as the degree to which a system is susceptible to and unable to cope with adverse effects of climate change, including climate variability and extremes. Each of the climate-related outcomes mentioned above will be examined through the lens of key vulnerability concepts, which include exposure, sensitivity and adaptive capacity.
- **Exposure** refers to the nature and degree to which a system is exposed to significant climatic variations. Exposure in this report refers to the geographic and temporal conditions that allow exposure to climate-related impacts to occur.
- **Sensitivity** refers to the degree to which a system is affected, either adversely or beneficially, by climate-related impact. This report will focus on the physiological and social characteristics such as age, gender, chronic conditions, or other socioeconomic vulnerabilities that affect the health impacts of climate change.
- **Adaptive capacity** refers to the ability of a system to adjust to climate change including climate variability and extremes to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. This report will present activities that are currently in progress at the WECHU, as well as provide recommendations for strategies for WEC that can increase the ability to adapt to our changing climate.

Limitations

Data Sources

Regional climate data is consistently available at only two Environment Canada weather monitors located in the City of Windsor, which may provide information that is not completely representative of the weather conditions experienced in Essex County. Moreover, these two climate monitors had instances of incomplete historic data, which limits the accuracy of baseline measures. The climate projections presented below were partially based on the baseline measures provided by these City of Windsor weather monitors.

Additionally, the projection data provided estimates only on a limited number of climate indicators such as temperature and precipitation due to the difficulty in capturing the multifaceted nature of other climate conditions when applying predictive modelling. To improve the generalizability of these models, data points from a range of weather stations were incorporated; however, downscaling the projections or retrieving future climate projections at a regional level contributes to the uncertainty in the results. Additional information on the development and testing process of the climate projection models are available in the literature and some were referenced in this report (PCIC, 2019).

Within each of the health data sources used in this report, there are limitations to consider. Data from the integrated public health information system (iPHIS), which is the passive surveillance system recording diseases of public health significance, only represents cases reported to public health. As a result, all counts will be subject to varying degrees of underreporting due to a variety of factors, such as disease awareness and medical care seeking behaviours, which may depend on severity of illness, clinical practice, changes in laboratory testing, and reporting behaviours. Cases of recently reported diseases that are rare should be interpreted with caution, as follow-up and verification by the WECHU

may still be in progress and may result in updates to the iPHIS records. The administrative hospital data extracted from the National Ambulatory Care Reporting System (NACRS) does not indicate population level disease burden, but instead reflects the degree of burden on the health care system. The inclusion of codes used in this report can be found in **Appendix A**.

Climate trends were described, where appropriate, alongside health status results to demonstrate the correlation between the environment and population health. However, it is important to note that these findings are not intended to prove a causation between climate and health. Since health status is subject to a variety of contributing factors, it would be incomplete to assess the causal relationship between climate on health without studying other social, political and economic factors, which were not included in this report.

Since this report incorporated data from a variety of sources and research areas, there were instances when the timelines used to summarize the data did not align. For example, the time periods used to describe projections were different for the climate and population size estimates. In addition, the availability of recent climate data summaries, or climate normals, were not accessible since the update frequency for this information occurs every 30-years. The alternative to receiving this information would require a manual-intensive data extraction process, which was not feasible given the resources and timelines available for preparing this report.

Community Overview

The WEC geography spans a land area of 1,851 km^2 including the following municipalities: City of Windsor, Towns of Amherstburg, Essex, Kingsville, Lakeshore, Leamington, LaSalle, and Tecumseh and Pelee Island. Local public administration in WEC is divided into three jurisdictions, which are the City of Windsor, County of Essex, and Pelee Island.

WEC is situated between Lake St. Clair and Erie on the north and south sides of the region while also bordering Detroit, Michigan. Geographically, the City of Windsor is the southernmost city in Canada and the County of Essex is the southernmost county. Counties and municipalities that neighbour WEC are Chatham-Kent (to the east, the only Canadian county neighbour), the Michigan counties of Macomb (across Lake St. Clair), Wayne (to the west and northwest), and Monroe (southwest), and the Ohio counties of Lucas (across Lake Erie and to the southwest), Ottawa (to the south), and Erie (to the southeast). The Township of Pelee is located on Pelee Island, an island found in the western half of Lake Erie. This distinct geographic positioning of WEC contributes to the unique ecological conditions experienced in the region.

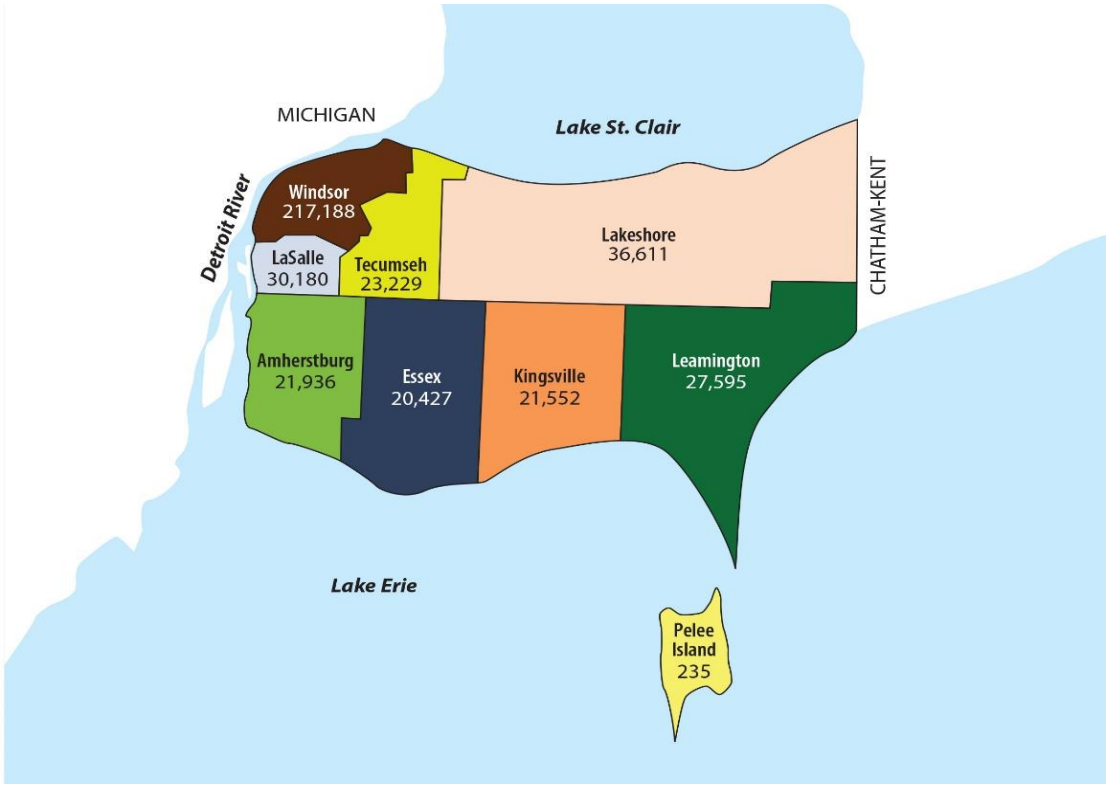
In 2016, the population of WEC was 398,953 with the City of Windsor having the greatest number of residents at 217,188 whereas the combined population of Essex County municipalities was 181,765 people. The population of each Essex County municipality range from 20,427 to 36,611 residents and Pelee Island has a population of 235 **(Figure 1)**.

From 2011 to 2016, the local population grew by 2.6%. During this period, the senior population experienced the greatest growth – almost 20% increase from 2011 (19.1%) (**Table 1**). The population pyramid in Figure 1 shows the WEC population by age and sex. As of 2016, 23.0% of the local population are 19 years of age or younger and 17.7% of the population are seniors (65 years of age or older).

The local population is expected to grow to approximately 419,000 people by 2019 and 450,000 people by 2029 (**Figure 2**). **Figure 3** shows that the proportion of seniors in WEC is projected to grow steadily; by 2029, seniors are projected to account for approximately 24% of the local population. By 2041, seniors will make up close to three in ten residents (27.6%) of the local population.

In 2017, WECHU participated in a survey, Rapid Risk Factor Surveillance System (RRFSS), that assessed the level of knowledge and perceptions of climate change and its impact on health among 799 randomly selected WEC adults (18 years or older). The results indicated the majority of respondents agreed (somewhat likely or very likely) that climate change causes extreme weather (68.8%), heat waves (79.0%) and smog advisories (75.0%). Also, two-thirds (68.0%) of respondents believed climate change would lead to more insects carrying diseases. The majority of respondents (71.3%) agreed that climate currently will impact human health with and more than half (55.3%) of survey participants classifying climate change's health impacts as negative.

Figure 1. Location and population size of Windsor and Essex County municipalities, 2016



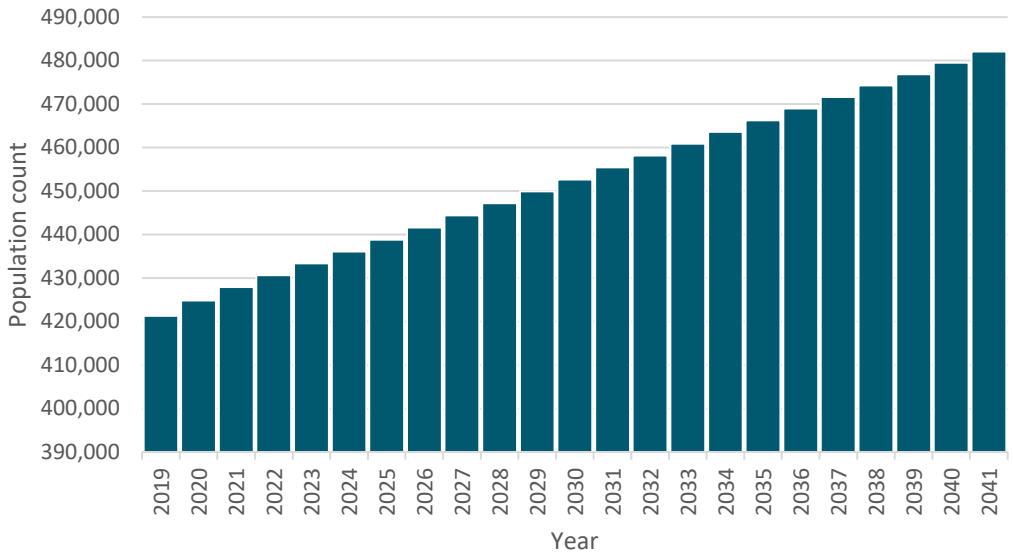
Source: Statistics Canada. Census of Population [2016].

Table 1. Summary of population age and size in Windsor and Essex County, 2011 & 2016

Characteristic	WEC 2011	WEC 2016	Population Growth
Age			
0 – 9 years old (%)	11.3	10.7	-2.8
10 – 19 years old (%)	13.2	12.3	-4.2
20 – 64 years old (%)	60.3	59.3	1.0
65 years old and over (%)	15.2	17.7	19.1
Total population	388,782	398,953	2.6
Median age of the population (years)	40.8	42.4	N/A

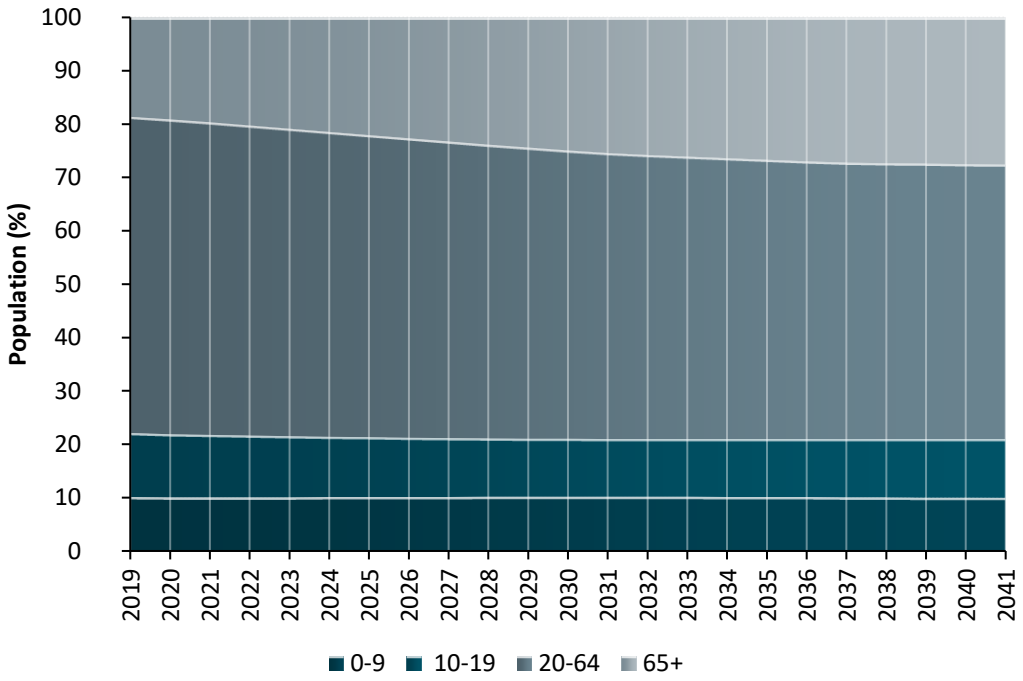
Source: Statistics Canada. Census of Population [2011 & 2016].

Figure 2. Projected population change in Windsor and Essex County, 2019-2041.



Source: Ontario Ministry of Finance. Ontario Population Projections Update [2017–2041].

Figure 3. Projected change in population structure in Windsor and Essex County, 2019-2041.



Source: Ontario Ministry of Finance. Ontario Population Projections Update [2017–2041].

Climate-Related Outcomes

1. Extreme Temperatures

The global climate is changing and the number of extreme heat and cold events are expected to be altered over time. According to the Government of Canada, temperatures in Canada have increased by 1.5°C since 1950, which is about double the rate of temperature increase globally. Temperatures are expected to continue to increase in the future, which will lead to milder winters and higher temperatures during the summer months.

Extreme heat events refer to unusually hot temperature and/or high humidex readings as compared to the typical regional average for that season (Government of Canada, 2018). To protect the public and decrease the impacts of extreme heat events, Environment and Climate Change Canada (ECCC) issues heat warnings when temperatures reach specific criteria for heat and/or humidity within a region. Currently, heat warnings for WEC are issued by ECCC when the daytime temperatures are expected to reach 31°C or greater and night time temperatures are expected reach 21°C for a minimum of two days. A heat warning will also be issued if the humidex is expected to rise to 42°C or greater for a minimum of two days.

Extreme cold events occur when winter temperatures drop significantly below average for that time of the year. The wind can also make cold temperatures feel even colder. The wind chill index measures what the temperature feels like on exposed skin based on the speed of the wind (Government of Canada, 2018). To decrease the impacts of extreme cold events, the WECHU monitors the ECCC forecast and issues a Cold Warning or an Extreme Cold Warning when the criteria are met for forecasted cold events in our area. When issuing a Cold Warning or an Extreme Cold Warning, factors that increase the impact of cold weather on health such as precipitation, low daytime temperatures, number of days/nights of cold weather in a row, and sudden onset of cold weather are also considered. Currently, a cold warning is issued when the temperature reaches -15°C (5°F) without the wind chill for one day. An extreme cold warning is issued when temperatures are -27°C (-16.6°F) with or without the wind chill for one day.

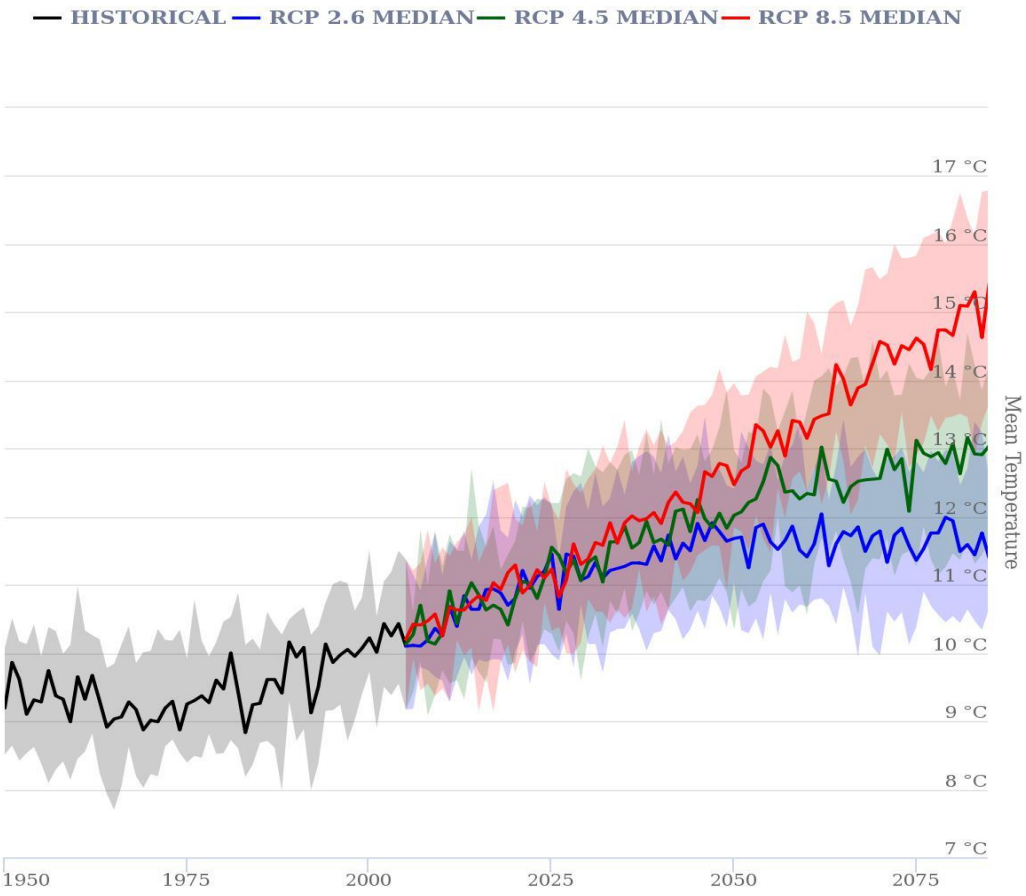
The following section will provide a historical overview of the local climate conditions in WEC by describing trends in the average temperature and yearly number of days with extreme temperatures. The 30-year climate averages (Climate Normals) prepared by Environment Canada for the local context, specifically the City of Windsor, will inform the historical climatic conditions in the region. The most recent climate normal available is for the time period between 1981 and 2010. Climate projections will also be displayed using the predictive models applied by the Intergovernmental Panel on Climate Change to represent a range of future outcomes resulting from greenhouse gas (GHG) emissions caused by human activity.

For more details on the emissions scenarios used to inform the projections, refer to the “Climate Projections” section found in the Methodology section. This report will focus on climate projections derived from the high emissions scenario to indicate the population’s exposure to climate impacts where no plans for climate change adaptation or mitigation exist.

Heat Trends

From 1951 to 1980, the annual average temperature in WEC was 9.2°C, which increased by almost 1°C between 1981 and 2010 to 10.1°C (**Figure 4**). More current long-term climate averages were not available from Environment Canada with the most recent climate average available was for the 1981 to 2010 period. The median number of days per year in WEC with temperatures above 30°C was 17 days between 1951 and 1980 and 26 from 1981 to 2010 (ECCC, 2019). More recently, WEC experienced 35 and 24 days above 30°C in 2018 and 2017. In 2012, The City of Windsor released a report aiming to identify the location of hot spots and the relationship with vulnerable populations through the development of a heat vulnerability map (City of Windsor, 2012a). The City of Windsor compared the amount of solar energy that was absorbed by urban and rural areas in 2009 and aimed to characterize the urban heat island effect, which is a phenomenon resulting in higher temperatures experienced in urban areas due to greater absorption of solar radiation from roads and building (Solecki et al., 2004). This assessment identified the following top five hottest public spaces in Windsor: Captain John Wilson Park, Pearson Park, Gino A. Marcus Community Centre, McHugh Park and Firgrove Boulevard.

Figure 4. Mean temperature historical and projections 1950 to 2080 in the City of Windsor

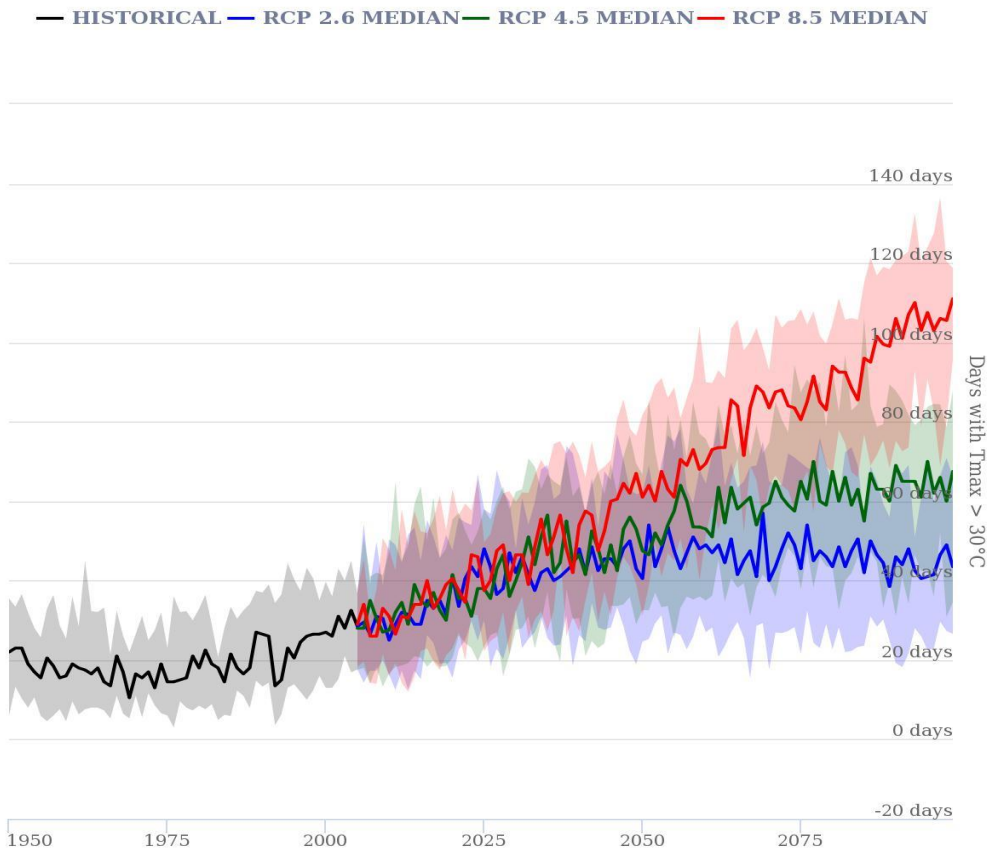


Source: Pacific Climate Impacts Consortium. Statistically Downscaled Climate Scenarios [1950-2080]

Heat Projections

Annual median temperatures are expected to increase to 11.2°C, 13.1°C and 15.3°C in the 2020s, 2050s and 2080s under a high emissions scenario (RCP8.5) (**Figure 4**) (PCIC, 2019). A projected median of 40, 66 and 95 days with temperatures above 30°C occurring in the 2020s, 2050s and 2080s (**Figure 5**) (PCIC, 2019). Both projections, annual median temperature and number of days above 30°C temperature under the RCP 2.6 and 4.5 scenarios, are also expected to rise by the 2050s; however, these climate indicators are expected to stabilize over the next 30 years. The number of tropical nights (over 22°C) is also expected to increase by over ten-fold during the 2080s compared to 1981-2010 (54 vs. 5 nights) (PCIC, 2019). The frequency of heat waves (three consecutive days exceeding 32°C) is projected to rise in WEC (Gough, Anderson, & Herod, 2016). Between 1971 and 2000, there were 0.66 heat waves per year in WEC. More recently, from 2009 to 2018 there were 15 heat waves encountered in WEC. By the 2050s, it is projected that WEC will have more than two heat waves per year, and by 2080s, more than five heat waves per year (Gough, Anderson, & Herod, 2016). According to the Ontario Climate Change and Health Modelling study, WEC has the highest projected number of heat waves in the province (Gough, Anderson, & Herod, 2016).

Figure 5. Median number of days with temperatures above 30°C in the City of Windsor, 1950 to 2080



Source: Pacific Climate Impacts Consortium. Statistically Downscaled Climate Scenarios [1950-2080]

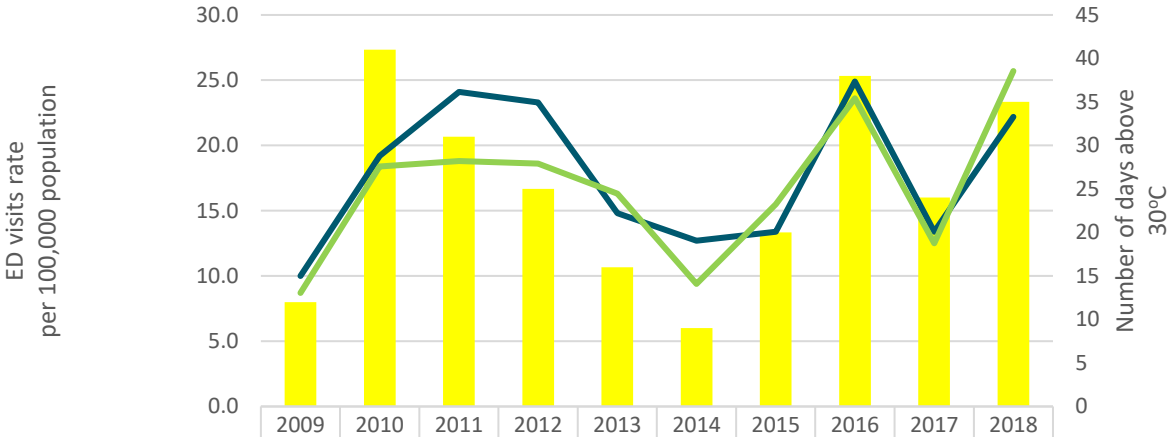
Heat – Related Illness

Heat-related illness is a set of preventable conditions ranging from mild forms to potentially fatal heat stroke. The most common heat-related illnesses are:

- **Heat rash (prickly heat)** is an itchy, painful, rash.
- **Heat cramps** usually affect people who sweat a lot during physical activity and the body loses salt and water. This leads to muscle pains or spasms and can also be an early symptom of heat exhaustion.
- **Heat exhaustion** occurs when core body temperature rises, usually because of hot and humid conditions, and not drinking enough water. Some of the symptoms include heavy sweating, pale skin, fast and weak pulse rate, muscle cramps, dizziness, headache, nausea or vomiting, and fainting.
- **Heat stroke,** also known as sunstroke is a medical emergency. This occurs when the body temperature is not controlled properly and it rises above 40 °C. Some of the symptoms include high body temperature, hot, red, and dry skin, rapid, weak pulse and shallow breathing (Government of Canada, 2018).

As observed by local data, trends in the number of days with a maximum temperature above 30°C was similar to the patterns in the rate of heat-related emergency department visits (**Figure 6**). The current rate of heat-related morbidities experienced among WEC residents is expected to rise with an increase in heat exposure to the population. From 2009 to 2018, the rate of heat-related emergency department visits ranged from 10.0 to 24.9 cases per 100,000 population (CIHI, 2019). WEC residents have consistently experienced similar levels of heat-related morbidity compared to the province. During this ten-year period, the rate of heat-related ED visits in WEC were 82% higher in males compared to females. In particular, WEC males of ages 65+ years had the highest average heat-related ED visit rates between 2009 and 2018 (**Figure 7**).

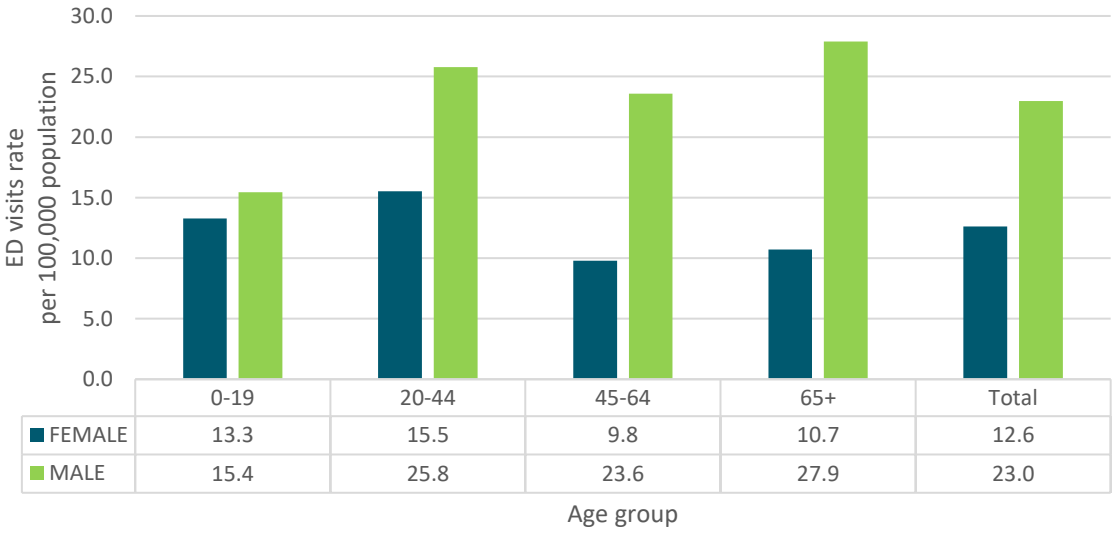
Figure 6. Age-standardized rates of heat-related emergency department visits in Windsor and Essex County and Ontario, 2009-2018



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
# Days above 30°C	12	41	31	25	16	9	20	38	24	35
WEC	10.0	19.2	24.1	23.3	14.8	12.7	13.4	24.9	13.4	22.2
ON	8.7	18.4	18.8	18.6	16.3	9.4	15.5	23.6	12.5	25.7

Source: Canadian Institute for Health Information. Ambulatory Emergency External Cause Database [2009-2018]

Figure 7. Average heat-related emergency department visits in Windsor and Essex County by sex and age-group, 2009-2018



	0-19	20-44	45-64	65+	Total
FEMALE	13.3	15.5	9.8	10.7	12.6
MALE	15.4	25.8	23.6	27.9	23.0

Source: Canadian Institute for Health Information. Ambulatory Emergency External Cause Database [2009-2018]

High Risk Groups

Extreme heat events can cause a variety of health issues from heat cramps and rashes to more serious conditions such as heat exhaustion and heat stroke. Extended periods of high day and nighttime temperatures can lead to physiological stress on the human body which exacerbates conditions like respiratory and cardiovascular diseases, diabetes mellitus and renal disease (WHO, 2019). While everyone is potentially at risk from extreme heat, certain groups will be more sensitive to these impacts. These populations include:

- Children
- Seniors
- Outdoor workers
- Pregnant women and newborn
- Individuals who have chronic conditions (e.g., cardiovascular or respiratory system diseases, renal illnesses, diabetes mellitus)
- Individuals taking certain medications (e.g., antihypertensives, antidepressants, antipsychotics, anti-Parkinson's agents) as these drugs interfere with the body's cooling functions or water/salt retention
- Individual living in low income households or experiencing homelessness as they may have limited resources to adequately take protective actions (government of Canada, 2019)

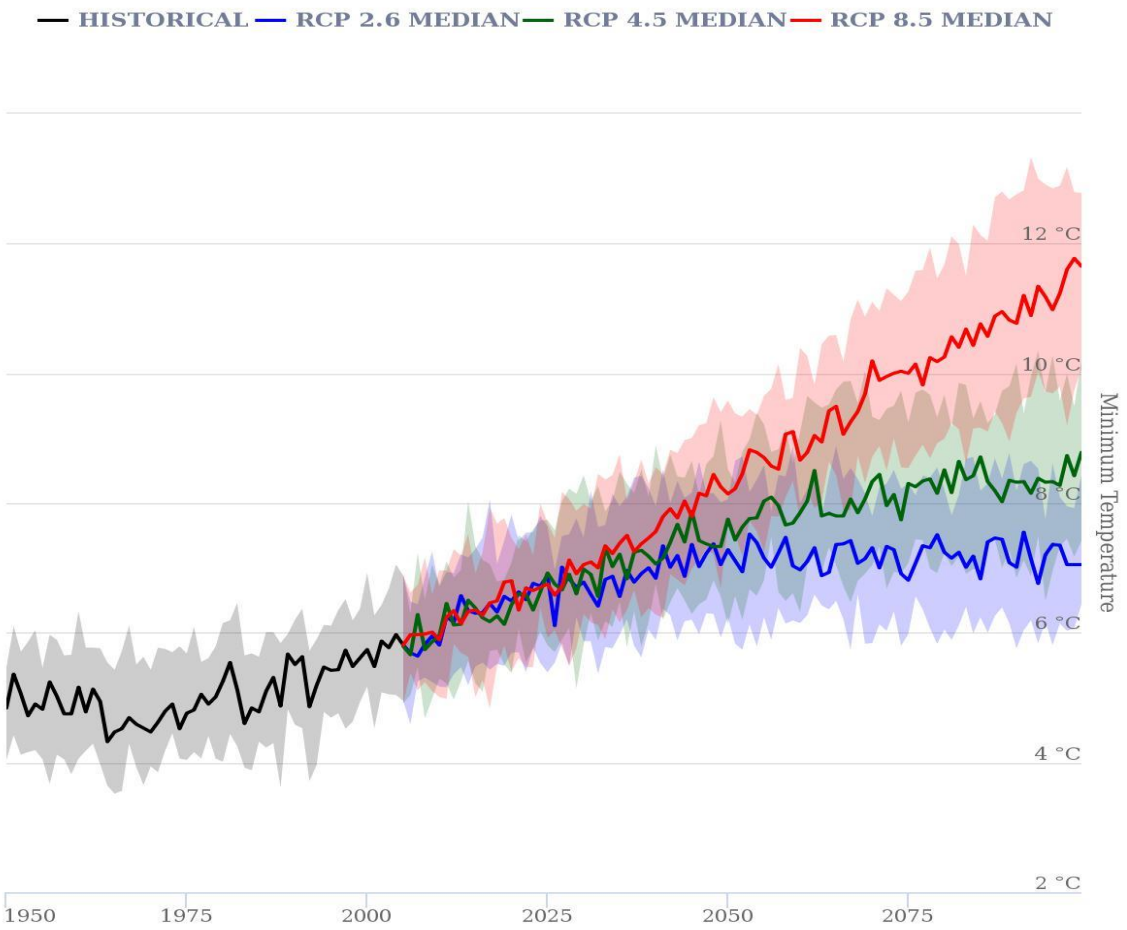
Cold Trends

There has been a reduction in the median number of cold days and an increase in annual minimum temperature since 1951. Between 1951 and 1980 in WEC, the median annual minimum temperature was 4.8°C. The median number of days with temperatures less than -15°C during the 1951 and 1980 period was 8.0 days. From 1981 to 2010, the median minimum temperature increased to 5.5°C in WEC (ECCC, 2019). The median number of days with temperatures below -15°C decreased to 5.8 days annually. More current long-term climate averages were not available from Environment Canada with the most recent climate average available was for the 1981 to 2010 period.

Cold Projections

Annual median minimum temperatures are expected to increase to 6.7°C, 8.6°C and 10.6°C in the 2020s, 2050s and 2080s under a high emissions scenario (**Figure 8**) (PCIC, 2019). A projected median of 2, 0 and 0 days with temperatures below -15°C may occur in the 2020s, 2050s and 2080s. This decline in the projected number of days with temperatures below -15°C demonstrate seasonal temperature increases during the winter.

Figure 8. Minimum temperature historical and projections 1950 to 2080 in the City of Windsor



Source: Pacific Climate Impacts Consortium. Statistically Downscaled Climate Scenarios [1950-2080]

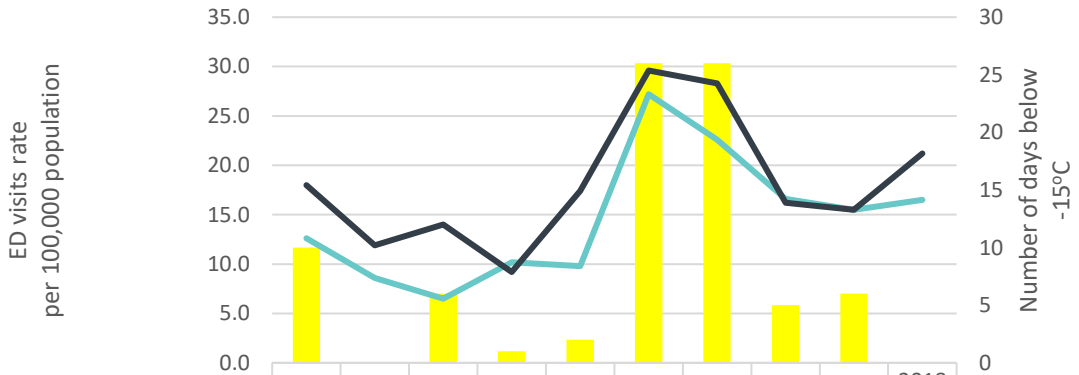
Cold – Related Illness

Cold weather can result in the development of cold-related illness. The most common cold-related illnesses are:

- **Windburn** occurs when cold wind removes the top layer of oil from the skin making red, sore, very dry and itchy. **Frostnip and frostbite** occur when skin and other tissues freeze, as a result, blood and oxygen can no longer circulate. Frostnip and frostbite mainly affect fingers and toes. Frost nip is a mild form of frost bite and doesn't damage cellular tissues. Frostbite affects the skin and underlying cellular tissues. Skin may appear waxy, grey, and hard to the touch**.** Severe frostbite can cause permanent damage, if it is not treated immediately.
- **Hypothermia** is a medical emergency. Hypothermia occurs when the body loses heat faster than it can produce it. There are different stages of hypothermia from mild (shivering, goosebumps) to more severe symptoms (difficulty speaking, thinking and walking). (Government of Canada, 2018)

The rate of cold-related ED visits followed a similar trend as the number of days during the year with temperatures below -15°C (**Figure 9**). From 2009 to 2018, the rate of cold-related ED visits in WEC ranged from 6.5 to 27.2 cases per 100,000 population. The overall cold-related ED visit rates have been similar between WEC and Ontario residents since 2009. During this time period, the rate of cold-related ED visits in WEC were, on average, 130% higher in males compared to females (**Figure 10**). Specifically, WEC males in the 20 to 44 and 65+ year age groups experienced the highest rates followed closely by the 44 to 64 year age group.

Figure 9. Age-standardized cold-related emergency department visits in Windsor and Essex County and Ontario, 2009-2018

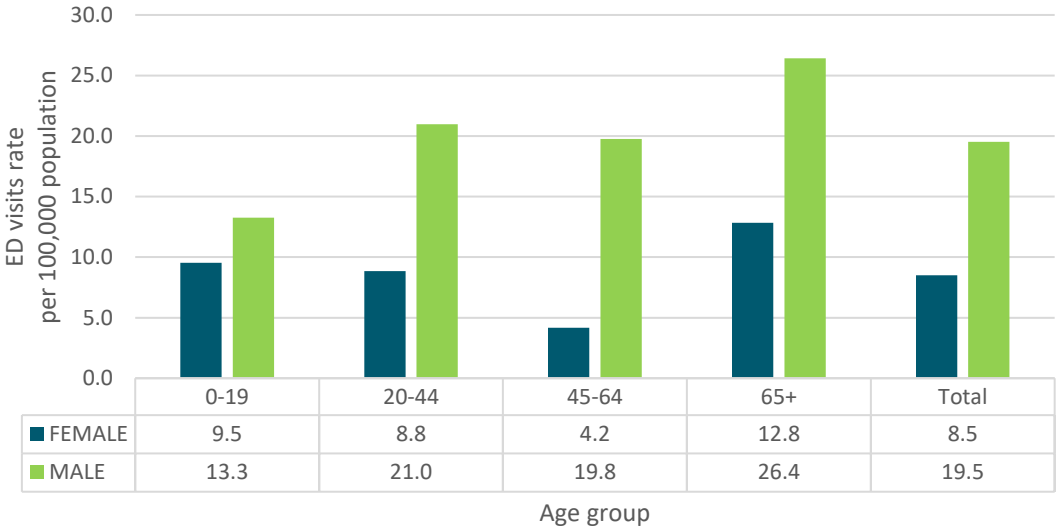


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 *
# Days below -15°C	10	0	6	1	2	26	26	5	6	0
WEC	12.6	8.6	6.5	10.2	9.8	27.2	22.6	16.6	15.5	16.5
ON	18	11.9	14	9.2	17.4	29.6	28.3	16.2	15.5	21.2

Source: Canadian Institute for Health Information. Ambulatory Emergency External Cause Database [2009-2018]

* 2018 Climate data for the City of Windsor was incomplete and available up to October 31st, 2018

Figure 10. Average cold-related ED visits (per 100,000) in Windsor and Essex County by sex and age-group, 2009-2018



	0-19	20-44	45-64	65+	Total
FEMALE	9.5	8.8	4.2	12.8	8.5
MALE	13.3	21.0	19.8	26.4	19.5

Source: Canadian Institute for Health Information. Ambulatory Emergency External Cause Database [2009-2018]

High Risk Groups

Exposure to extreme cold can cause a variety of serious health outcomes, including frostbite and hypothermia. While all WEC residents can be affected by extreme cold, certain individuals are more susceptible to the health impacts, including:

- Infants under the age of one year
- Seniors over the age of 65 years
- People who are experiencing homelessness or living in homes that are poorly insulated (with no heat or no power)
- Individuals who have chronic conditions or are on certain medications
- Outdoor workers (Government of Canada, 2019)

Adaptive Capacity for Extreme Temperatures

Current Actions Taken by the WECHU

1. Identification of populations and communities at risk (Community Needs Assessment, 2019).
2. Extreme temperature warnings – the WECHU issues extreme temperature warnings (heat and cold warnings) to inform the residents and community partners through various media channels (social media, website and media advisories) in WEC of the forecast for extreme temperature events.
3. Develop and implement an extreme temperatures response plan in collaboration with community partners.
4. Provide education and recommendations, through various media channels, for precautions surrounding extreme temperatures to residents and community partners.

5. Participate in official plan reviews with municipalities and provide policy recommendations related to cooling spaces and energy conservation.
6. Participate in various stakeholder and advisory committees such as WEC extreme temperature advisory committee and Windsor Essex County Environment Committee
7. Development of the WECHU Emergency Response Plan and Hazard Identification and Risk Assessment.
8. Development of the WECHU Continuity of Operations Plan (COOP).

Future Recommendations

Activities	Key Partners
Develop extreme temperature and power outage emergency response exercise.	Community Emergency Management Coordinators (CEMCs) Community organizations Health care providers
Support local policy development related to extreme temperature responses including the provision of water fountains and bottle filling stations in public areas, increasing green spaces, installing green roofs and heat resilient buildings.	CEMCs Municipal partners Local businesses
Regular review of best practice guidelines and interventions for extreme temperature events.	Municipal partners Community organizations
Increase targeted messaging to specific at risk groups (i.e., outdoor workers, youth).	Municipal partners Community organizations Schools
Advocate for the creation of more cooling spaces (i.e., splash pads, planting more trees).	Municipal partners

2. Extreme Weather

Extreme weather can be characterized as unpredictable, unseasonable, or severe weather patterns. As the average temperature globally increases, it is predicted that weather patterns across Canada will change and there will be more extreme weather events, such as intense precipitation, flooding and tornados (Government of Canada, 2014).

Precipitation comes in the form of rain, snow and hail. As the Earth's surface warms, changes in evaporation of surface water increases the potential for moisture in the air thereby leading to more intense precipitation events that can cause flooding. Across Canada, total precipitation has increased in the spring and fall, however there is a decreasing amount of winter precipitation, such as snow and hail (Government of Canada, 2014).

Flooding

Floods are typically caused by seasonal melting snow, ice jams, heavy spring rains and summer thunderstorms. Flash flooding is often caused by violent rain storms or breaking dams, and usually occurs with little or no advance warning (EMO, 2016). Flooding events are often described as "100 year" floods which means there is predicted to be one flooding event in a 100 year time period or a 1% chance of a flood occurring. Flooding can be categorized as the following:

- **Riverine**: A flood due to the increase of the water level beyond the capacity of a natural or somewhat natural floodplain (EMO, 2012). This can also be considered "slow rise flooding" and can result from a quick thaw following a winter season with heavy ice and snowfall (Government of Canada, 2013).
- **Urban**: A flood can be considered an urban flood if it results in the widespread flooding of an urban area (EMO, 2012). This is typically caused by a "flash flood" or a heavy precipitation which causes water to exceed the capacity of the urban watershed. The style, age and capacity of municipal infrastructure can negatively affect the capacity of watersheds to cope with increased storm runoff due to climate change. Often times, urban flooding results in greater social, property and business/financial impact.
- **Storm Surge**: Storm surge is defined as an abnormal, sudden rise of sea (or lake) level associated with a storm event (EMO, 2012).

Tornados

A tornado is a violently rotating column of air, in contact with the ground, and is often visible as a funnel cloud (Glickman, 2000). Special atmospheric conditions are required for the formation of a tornado. The atmospheric conditions required vary slightly depending on the type of tornado, but essentially all tornadoes require low-level moisture, atmospheric instability and a lifting mechanism. These conditions can be met when a cool air mass from the north collides with warm, moist air from the south, forcing the warm air to rise quickly. Tornadoes can occur at any time of the year and at any time of day. They are most common in Ontario from May to September, with a peak occurrence in June and early July (Etkin et al., 2001).

Tornadoes can cause a wide variety of property and infrastructure damage, from broken windows to uprooted trees, to the complete destruction of buildings. In addition, power outages can occur due to downed poles and power lines. There is often a very short warning time for people to seek appropriate

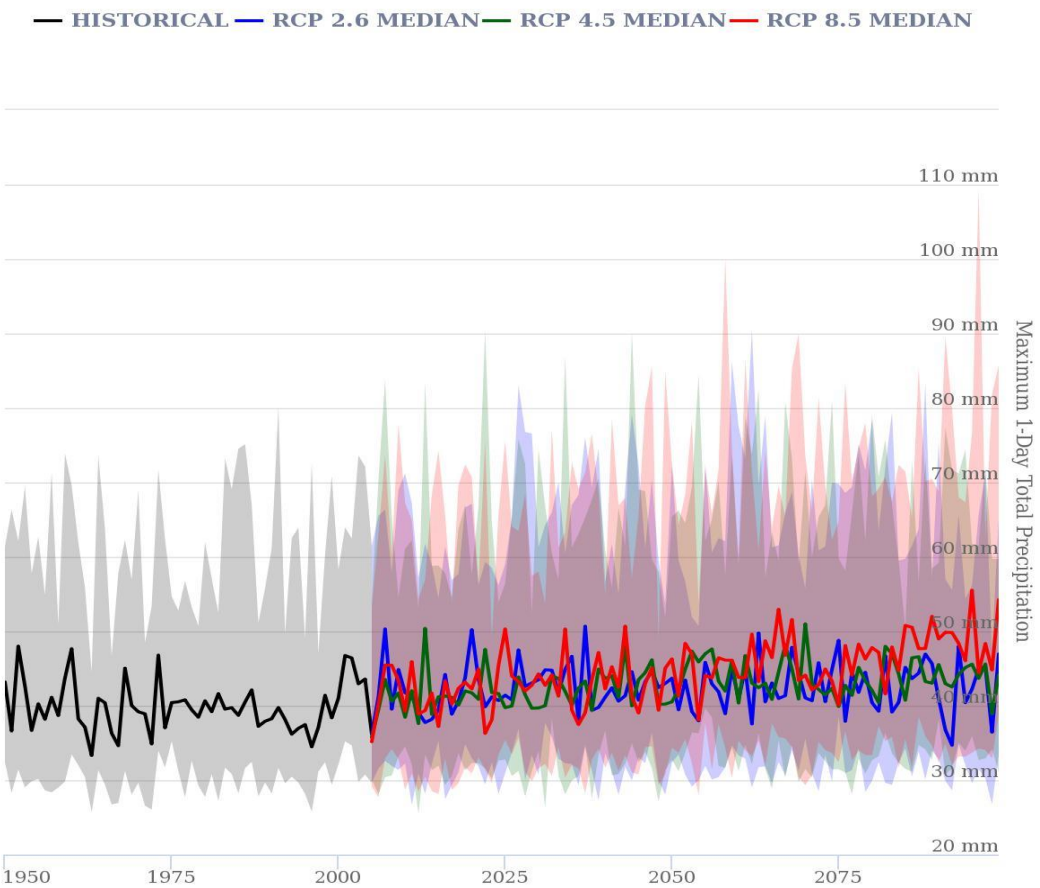
shelter, due to their quick occurrence, which can cause an increase in injuries and fatalities (Greenough et al, 2001).

Extreme Weather Trends

Rainfall/ flooding

Between 1951 and 1980, the median annual precipitation was 818.3 mm in the City of Windsor, which later increased by 2.5% to 838.7 mm from 1981 to 2010 (**Figure 11**). The median maximum precipitation in one day during the 1951 and 1980 period was 39.7 mm. More recently, from 1981 to 2010, the maximum precipitation median was similar to the previous time period at 39.5 mm. On September 29th 2016, the Windsor Airport weather station reported 78 mm of precipitation, while another gauge in the city measured 106 mm and the Town of Tecumseh received an estimated 190 mm. Between August 28th and 29th 2017, 140.5 mm of rain fell in the south west region impacting the municipalities of Lakeshore, Belle River, Tecumseh and parts of the City of Windsor. Both of these storm events were classified as 100-year storms resulting in thousands of flooded homes and abandoned vehicles on roadways.

Figure 11. Maximum 1 – day total precipitation historical and projections 1950 to 2080 in the City of Windsor



Source: Pacific Climate Impacts Consortium. Statistically Downscaled Climate Scenarios [1950-2080]

Tornados

In 2009 and 2010, three tornadoes impacted the region; most notably on June 6, 2010 in Leamington where a F1 tornado with speeds up to 180 km/h destroyed 12 homes and approximately 4,500 hydro customers lost power resulting in a local state of emergency (Public Safety Canada, 2016). Also, in August of 2017, two tornados impacted residents of Windsor and LaSalle which resulted in thousands of homes losing power, uprooted trees along with major damages to homes and businesses (CBC, 2017). Prior to these recent events, documented tornadoes in WEC did not occur as frequently (1946, 1974 and 1985).

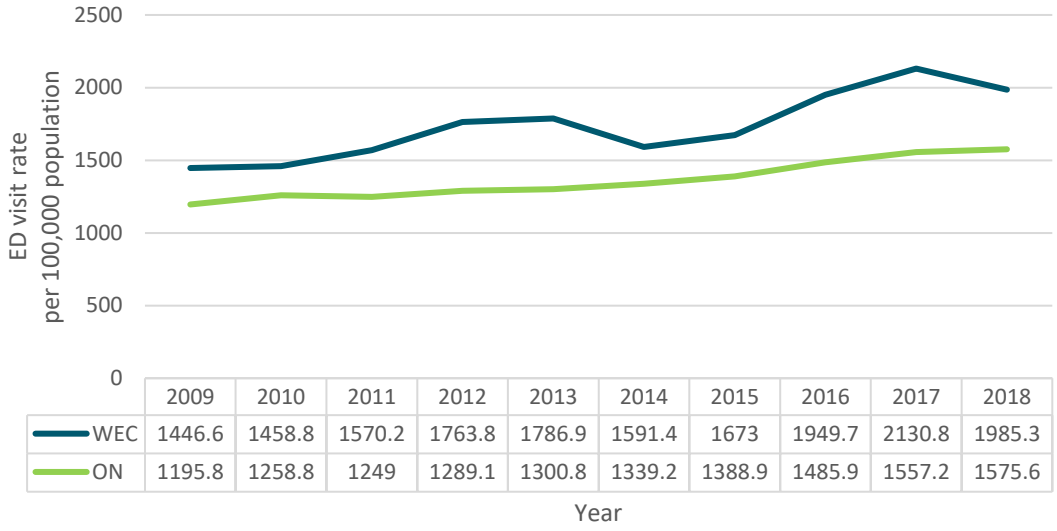
Extreme Weather Projections

Annual precipitation is expected to increase to 880.1 mm, 899.8 mm and 950.7 mm in 2020s, 2050s and 2080s under a RCP8.5 scenario (PCIC, 2019). Historical and projected one day maximum precipitation is shown in **Figure 11**. Overall the maximum one day precipitation is not expected to change drastically from the historical trends based on any RCP emissions scenario. The median maximum precipitation in one day will rise to 43.0 mm, 46.1 mm and 47.7 mm in 2020s, 2050s and 2080s. Compared to the period between 1981 and 2010, seasonal precipitation is expected to increase by 15% during winter (189.3 mm vs. 218.0 mm) and by 16.6% during spring (240.9 mm vs 280.8 mm) by the 2080s. Conversely, season rainfall is expected to decrease during the summer months by 4.3% (251.3 mm vs. 241.0 mm) by the 2080s (City of Windsor, 2018). Overall, precipitation events are projected to fall at a faster rate (mm/h) at increased frequency. Intensity Duration Frequency (IDF) curves are a mathematical function that relates the rainfall intensity with its duration and frequency of occurrence. According to the IDF curves for southern Ontario, projections using Windsor, ON airport indicate a 25% and 40% increase in 10 and 100-year storms by the 2090s (City of Windsor, 2012b).

Health Impacts

People with pre-existing mental health issues may be more likely to experience stress, anxiety, depression associated with a natural disaster (Berry, Paterson & Buse, 2014). Natural disasters can have a profound impact on mental health due to its implications on residents' finances and shelter (Berry, Paterson & Buse, 2014). Research has identified association between flooding events and mental health outcomes, such as anxiety and depression (Ebi, 2006). The rates of mental health-related ED visits, including psychotic, mood, anxiety and selected adult disorders, for WEC and Ontario is shown in (**Figure 12)**. The rate of mental health ED visits in WEC ranged from 1446.6 to 2130.8 per 100,000 residents annually from 2009 to 2018 which represents a 37.2% increase. Residents in WEC consistently demonstrated higher rates of these mental health conditions compared to Ontario overall. In general, the rates of mental health ED visits have steadily increased since 2009. Female WEC residents experience mental health-related ED visits at a 9.4% higher rate compared to males on average between 2009 and 2018 (**Figure 13**).

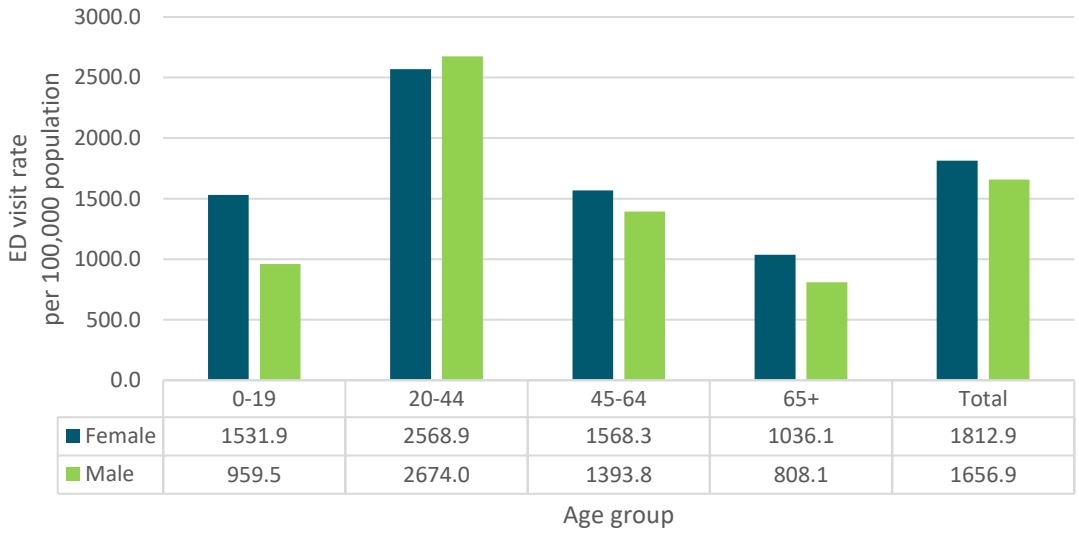
Figure 12. Age-standardized mental health-related emergency department visits in Windsor and Essex County and Ontario, 2009-2018



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
WEC	1446.6	1458.8	1570.2	1763.8	1786.9	1591.4	1673	1949.7	2130.8	1985.3
ON	1195.8	1258.8	1249	1289.1	1300.8	1339.2	1388.9	1485.9	1557.2	1575.6

Source: Canadian Institute for Health Information. Ambulatory Emergency External Cause Database [2009-2018]

Figure 13. Average rate of mental health emergency department visits (per 100,000) in Windsor and Essex County by sex and age-group, 2009-2018



	0-19	20-44	45-64	65+	Total
Female	1531.9	2568.9	1568.3	1036.1	1812.9
Male	959.5	2674.0	1393.8	808.1	1656.9

Source: Canadian Institute for Health Information. Ambulatory Emergency External Cause Database [2009-2018]

High Risk Groups

The health impacts due to flooding events are varied and as such, impact some populations more than others, such as:

- Children, elderly, or those with a compromised immune system, may be at higher risk of illness due to ingesting contaminated food or drinking water during a flood (CDC, 2019)
- Persons with limited mobility or existing medical issues may have a harder time leaving their home during a flooding event
- People living in low income housing, tenants in rental homes, or those without flood insurance may also experience a greater impact due to flooding and post-flooding living conditions, mould, etc.
- Residents of retirement homes and long-term care homes may experience displacement and interruption in their typical care (Du et al, 2010)
- People with pre-existing mental health conditions such as anxiety and depression may also be more vulnerable, due to the social and economic impacts of flooding

Many of the same priority populations are at risk during a tornado, however there is a higher risk of injuries, trauma and death, to those that are unable to take cover. This often times includes:

- Outdoor workers
- The elderly
- Those that are homeless or precariously housed

Adaptive Capacity to Extreme Weather

Current Actions Taken by the WECHU

1. Identification of populations and communities at risk (Community Risk Assessment, 2019).
2. Monitor extreme weather events forecasted and issued by Environment and Climate Change Canada.
3. Provide public education in regards to personal emergency preparedness.
4. Provide health and safety messaging during extreme weather events.
5. Participate in municipal emergency response planning with municipal partners.
6. Work with EMS on their vulnerable population planning and response during weather emergencies.
7. Participate in official plan reviews with policy statements in regards to climate change – watershed management (ERCA), storm water management strategies (City of Windsor Sewage Masterplan committee).
8. Development of the WECHU Emergency Response Plan and Hazard Identification and Risk Assessment.
9. Development of the WECHU Continuity of Operations Plan (COOP).

Future Recommendations

Activities	Key Partners
Identification of areas at a greater risk for flooding and development of a risk registry of vulnerable individuals such as home owners and businesses.	ERCA Municipal partners
Develop an early monitoring system of health outcomes from extreme weather events.	Health care providers Community organizations
Advocate for critical infrastructure assessments to minimize impacts of extreme weather events.	ERCA Municipal partners
Develop public notifications and messages for extreme weather events in languages other than English.	ERCA Municipal partners
Participate in official plan reviews and work with partners to develop policy statements related to creation and preservation of greenspace, energy and water conservation, infrastructure assessment, storm water management strategies.	Municipal partners ERCA

3. Poor Air Quality

Air pollution is made up of toxic materials from human activities like driving, farming, industries and natural disasters like wildfires. When levels are high enough it can harm our health and the environment. Air pollution is worsened by the changing climate as it leads to more smog production. Air pollution also contributes to the changing climate by increasing the temperature and reducing the ozone layer (WHO, 2019).

It affects our health by making it harder for us to breathe, causes throat or lung irritation, or produces new or worsening episodes of your current heart or lung conditions. The amount of pollutant in the air, length of time you are around it, your health status and genetics all play a part in how air pollution will affect your health. Negative health effects increase as air pollution worsens. Even a modest increase in pollution can cause more visits to the emergency department, hospital admissions and deaths (Government of Canada, 2016).

There are many things that pollute the air that we breathe. The two major air pollutants that pose a risk to our health are: ground-level ozone (O_3) and fine particulate matter ($PM_{2.5}$). Ground level ozone and particulate matter are often used in calculating the Air Quality Health Index (AQHI) score/risk. The AQHI is a scale made for the public to help identify how the quality of air around you affects your health. This tool was made by environmental and health professionals to communicate what the health risks are. It provides tips for both at risk and general populations. The higher the score, the more risks there are to your health (Government of Canada, 2019). Within WEC there are two stations that measure AQHI: Windsor West and Windsor Downtown (MECP, 2019).

Special Air Quality Statement (SAQS) is issued when a high risk (7 or greater) AQHI score is likely to last for 1 or 2 hours for the area. The purpose is to allow the public to take the proper safety measures as it relates to their health. **Smog and Air Health Advisory (SAHA)** is issued when a high risk (7 or greater) AQHI is likely to last a minimum of 3 hours for the area. The statement helps to alert those with breathing problems to reduce or avoid unnecessary exposure to smog. It also informs industries that are major producers of pollution in the area that they should consider reducing their emissions for a short period of time if possible.

Air Pollutant Trends

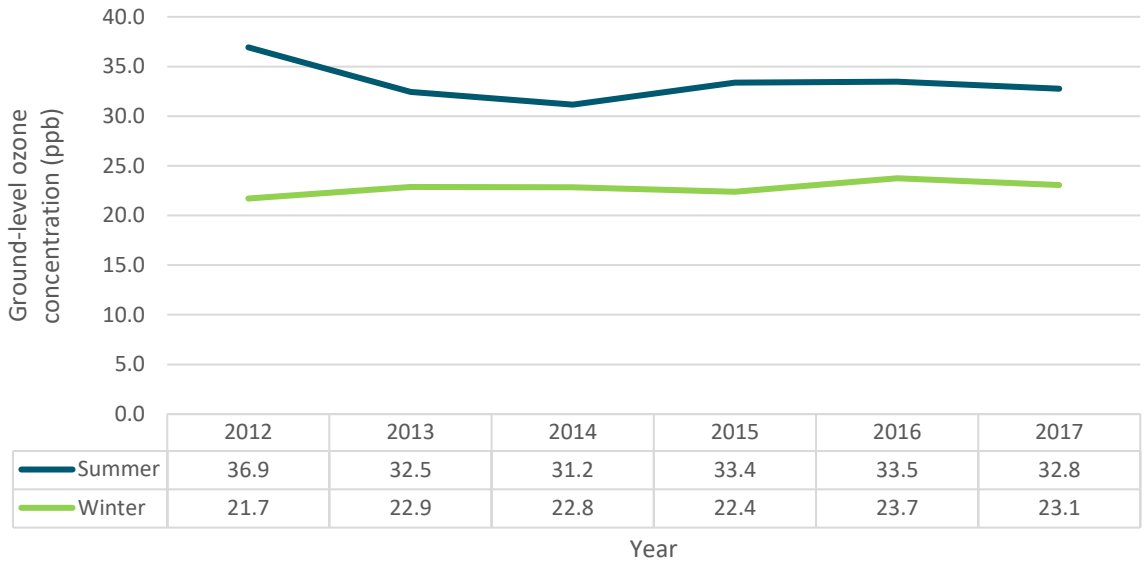
Ground-Level Ozone

Ground level ozone (O_3) is a gas that has no odour or colour. It is made by a reaction between volatile organic compounds (VOCs), nitrogen oxides (NOX) and sunlight. Levels are highest from noon to early evening between the months of May and September. Both VOCs and NOX come from human activities (burning of fuels in vehicles, industries, power plants) and natural sources (hydrocarbons released by plants and soil) (Government of Canada, 2019).

In the downtown area of the City of Windsor, between 2012 and 2017, summer (May – September) ground-level ozone concentrations, measured in part per billion (ppb), decreased by 12%. In the winter, during this same time period, (January – April & Oct – December) concentrations remained stable during this time period (**Figure 14**). Similarly, the ozone trend reported by the West Windsor air quality monitoring station indicated a decline in summer concentrations and consistent concentrations during

the winter months between 2012 and 2017 (**Figure 15**). A ground-level ozone exceedance is defined as an event when ozone levels surpass 80 ppb during a one-hour period. Cumulatively, there have been 59 and 65 hourly exceedances reported at Windsor Downtown and Windsor West's air quality stations from 2012 to 2017 (**Figure 16**). The number of exceedances have dramatically dropped in the past five years from 45 hourly exceedances reported in 2012 at Windsor Downtown's station to less than five ozone exceedances between 2013 and 2017 with the exception of 2016, which demonstrated 15 exceedances at Windsor West's air quality station. Projections of ozone exceedances above 80 ppb for WEC displayed in the *Ontario Climate Change and Health Modelling Study* estimate 11 and 12 days per year of ozone exceedances during the 2050s and 2080s respectively. These results indicate that pollution caused by ground-level ozone is reducing, which may have contributed to the improving respiratory health outcomes in the population **Figure 18**.

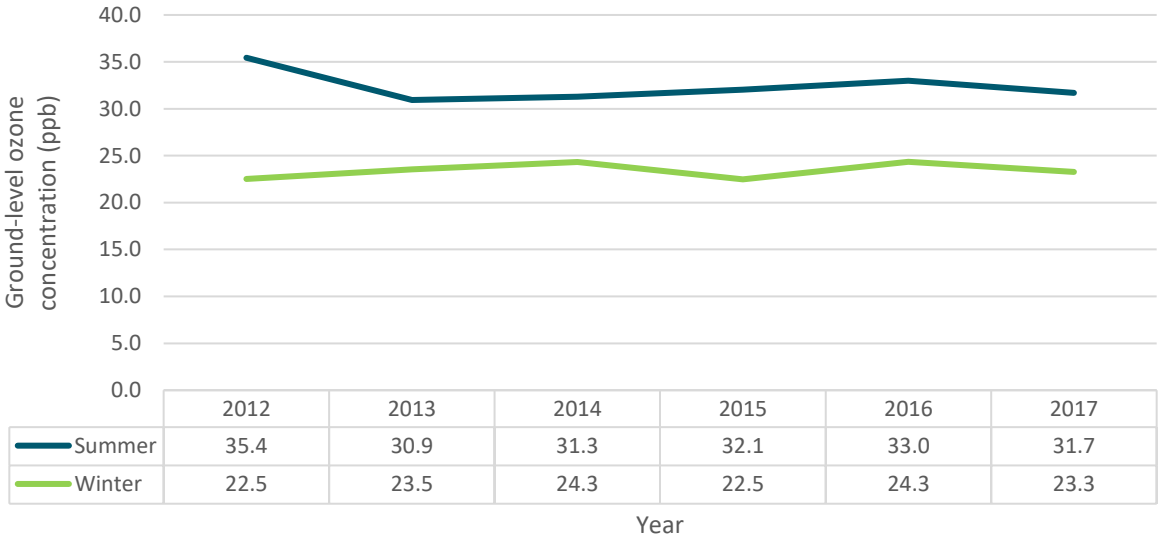
Figure 14. Trend of ozone summer and winter average concentrations at the Windsor Downtown air quality monitoring system, 2012-2017



	2012	2013	2014	2015	2016	2017
Summer	36.9	32.5	31.2	33.4	33.5	32.8
Winter	21.7	22.9	22.8	22.4	23.7	23.1

Source: Ministry of the Environment, Conservation and Parks [2012-2017]

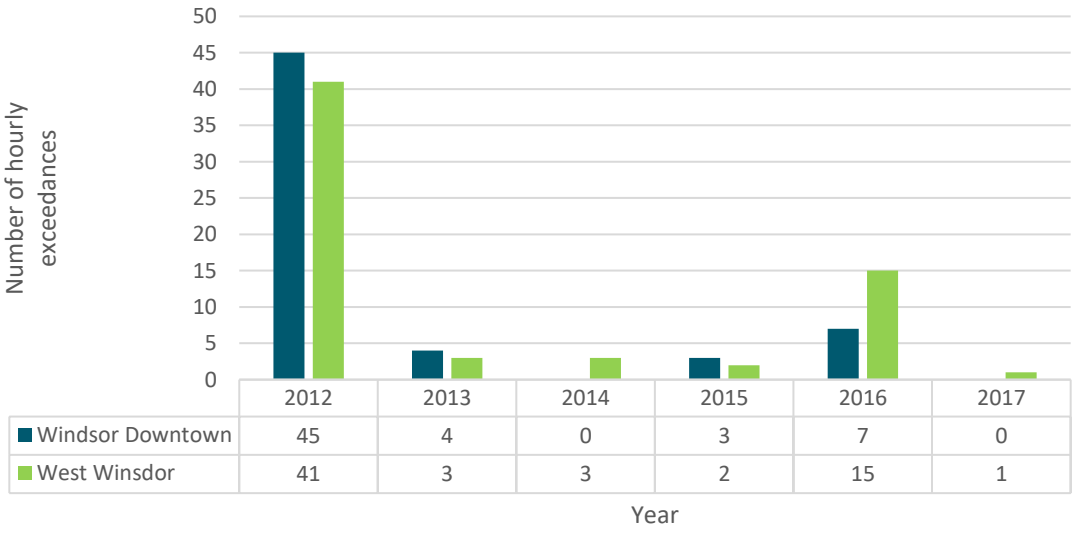
Figure 15. Trend of ozone summer and winter average concentrations at the West Windsor air quality monitoring system, 2012-2017



	2012	2013	2014	2015	2016	2017
Summer	35.4	30.9	31.3	32.1	33.0	31.7
Winter	22.5	23.5	24.3	22.5	24.3	23.3

Source: Ministry of the Environment, Conservation and Parks [2012-2017]

Figure 16. Number of hourly ozone exceedances (>80ppb) at the Windsor Downtown and West Windsor air monitoring stations, 2012-2017.



	2012	2013	2014	2015	2016	2017
Windsor Downtown	45	4	0	3	7	0
West Winsdor	41	3	3	2	15	1

Source: Ministry of the Environment, Conservation and Parks [2012-2017]

Particulate Matter (PM2.5)

Fine particulate matter (PM2.5) are inhalable particles less than 2.5 microns in diameter and are a main contributor of air pollution and adverse respiratory health outcomes (MECP, 2017). An exceedance in PM2.5 is defined as a daily average reading greater than 30 µg/m^3. PM2.5 exceedances occurred seven times between 2013 and 2017 with two events identified at Windsor Downtown and five events at Windsor West's air quality station.

The Windsor-Detroit bridge crossing is responsible for 25% of Canada-US trade making it the busiest land border crossing in North America. An air quality study conducted in the Detroit and Windsor airshed in 2008 showed similar particulate matter concentrations between these two cities (Miller et al., 2010). A study examining the association between ambient air quality and health in Windsor found respiratory hospitalizations increased with pollutant concentrations while controlling for temperature, humidity and barometer pressure changes (Luginaah et al., 2005).

WEC received five SAQS in 2018 indicating that a high-risk AQHI alert was expected to last for one to two hours. Additionally, a SAHA was issued in 2018 when the high-risk AQHI alert was expected to persist for at least three hours. The annual median number of days with smog advisories issued between 2003 and 2014 in WEC was 13 (range: 0 to 46 advisories) (MECP, 2016) (**Figure 17**). Since 2003, there has been a decline in smog advisories occurring annually.

Figure 17. Number of days under a smog advisory in Windsor and Essex County, 2003-2014.

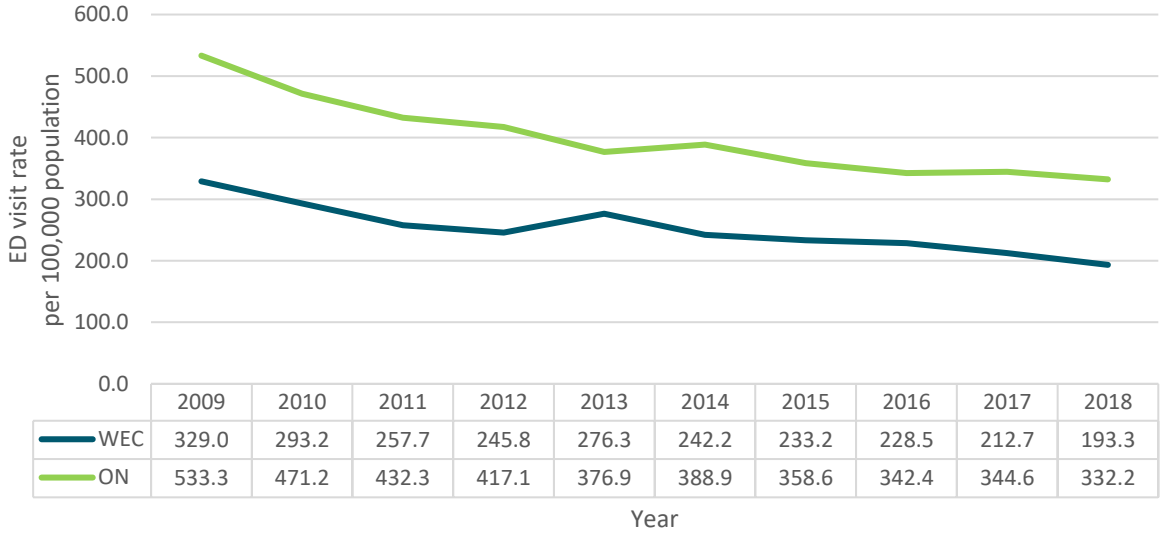
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Days under smog advisory	17	16	46	14	38	12	5	10	8	24	0	0

Source: Ministry of the Environment, Conservation and Parks [2003-2014].

Health Impacts

The rate of asthma-related ED visits in WEC decreased by 70.2% between 2009 and 2018 (**Figure 18**). Residents in WEC consistently demonstrated lower rates of asthma in the ED compared to Ontario overall. Female WEC residents experience asthma-related ED visits at a 30.3% higher rate compared to males on average between 2009 and 2018 (**Figure 19**). Although young males (0 to 19 years) in WEC experienced the highest rates of asthma-related ED visits, females consistently demonstrate high rates of asthma ED visits across age groups, especially females below 45 years of age.

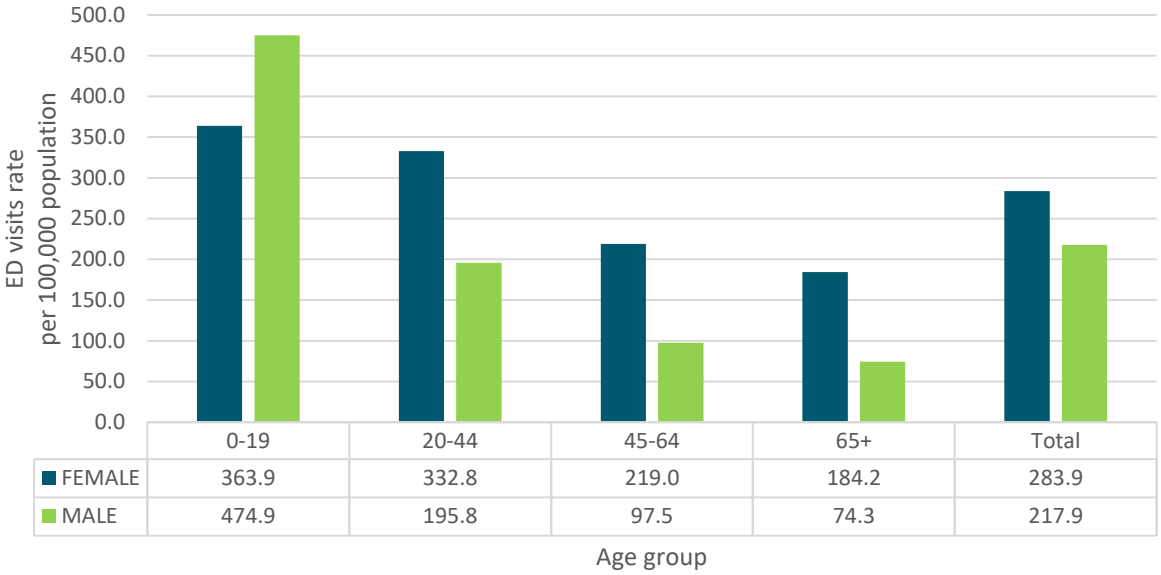
Figure 18. Age-standardized asthma-related emergency department visits in Windsor and Essex County and Ontario, 2009-2018



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
WEC	329.0	293.2	257.7	245.8	276.3	242.2	233.2	228.5	212.7	193.3
ON	533.3	471.2	432.3	417.1	376.9	388.9	358.6	342.4	344.6	332.2

Source: Canadian Institute for Health Information. Ambulatory Emergency External Cause Database [2009-2018].

Figure 19. Average asthma-related emergency department visits in Windsor and Essex County by sex and age-group, 2009-2018



Source: Canadian Institute for Health Information. Ambulatory Emergency External Cause Database [2009-2018].

High Risk Groups

Air pollution affects us all, but those at a higher risk are:

- People with existing heart, lung or diabetic conditions
- Infants and young children
- Older adults/elderly
- People who spend more time outdoors (for work, physical activity etc.)
- Pregnant women

Young children, particularly those that spend more time outdoors, are more affected by air pollution not only because they breathe in more air in relation to their body weight but also because their immune and lung systems are also not fully developed (Government of Canada, 2019). For people who play sports or do heavy work outdoors, more air pollution may enter the lungs because they are breathing more frequently and deeply (Government of Canada, 2019). Older adults/ the elderly have a higher risk because they may have weaker lungs, heart, and defense system or have an undiagnosed heart or lung condition (Government of Canada, 2019). Some lung and heart conditions that put people at risk for the health effects of air pollution include asthma, lung cancer, chronic obstructive pulmonary disease (COPD) and history of heart attacks and heart failure (Government of Canada, 2019).

Adaptive Capacity to Air Quality

Current Actions Taken by the WECHU

1. Identification of populations and communities at risk (Community Risk Assessment, 2019).
2. Participate in various stakeholder and advisory committees such as Windsor Essex County Environment Committee and County Wide Active Transportation System committee.
3. Monitor AQHI and provide education and recommendations for precautions surrounding air quality to public and community partners. This is provided through social media, website and media interviews.
4. Participate in official plan reviews with municipalities and provide policy recommendations related to air quality, transportation and green space.

Future Recommendations

Activities	Key Partners
Support local policy development related to active transportation, reducing vehicle emissions, and improved public transit.	Municipal partners ERCA
Monitor traffic related air pollution and its impacts on the community.	Municipal partners

4. Food and Water Contamination

Climate change is likely to have considerable impacts on both food and water safety. Increased precipitation and runoff, extreme temperatures, and storms can affect the growth, survival, and spread of microorganisms that can lead to both water- and food-borne illness (USGCRP, 2016).

Foodborne illness is most influenced by increase in air and water temperature and precipitation. These changes can affect foodborne illness by:

- Increase in growth and survival of disease causing pathogens in crops, livestock and the environment
- Contamination of food through cooking practices and food handling that are influenced by a longer period of warm temperatures
- Spread of new invasive species by birds and animals that transfer pathogens to food. (Critical Reviews in Environmental Science and Technology, 2012)

In addition to causing infectious diseases, climate change is also expected to threaten the production, quality, and distribution of food (USGCRP, 2016). It can lead to a decrease in crop yields due to the increased intensity and frequency of droughts and contamination of irrigation water during flooding events (Health Canada, 2008).

The WECHU conducts inspections to make sure food premises owners and food handlers are meeting the minimum standards of the Ontario Food Premises Regulation. Regular inspections prevent and reduce foodborne illness in our community. There are about 2,600 food premises inspected in WEC. These food premises range from full service restaurants, churches and catering vehicles.

Water-borne illnesses can occur through direct contact with contaminated drinking or recreational water. Changes in water quantity and quality can occur due to heavy precipitation and spring melt and can transport pathogens into water supplies (USGCRP, 2016). The risk of infectious disease exposure also increase during flood events by allowing pathogens to enter the water supply through contamination of groundwater. Climate change also leads to increased algal blooms in oceans and lakes due to nutrient loading from fertilizer run-off into water bodies. These algal blooms can decrease access to water for drinking, agriculture and recreational use and lead to health issues (WHO, 2018).

There are several of types of drinking water systems across WEC from which residents access water, ranging from large municipal systems to private wells and surface water. While the majority of WEC residents are serviced by a municipal drinking water system, it is important to note there are 55 small drinking water systems. Drinking water in Ontario must meet specific standards set by Health Canada. The WECHU works with different community partners (i.e., operators of municipal water systems, operators of small drinking water systems) to make sure everyone has access to clean drinking water. Boil water or drinking water advisories are issued when drinking water has been contaminated or there's a chance for contamination.

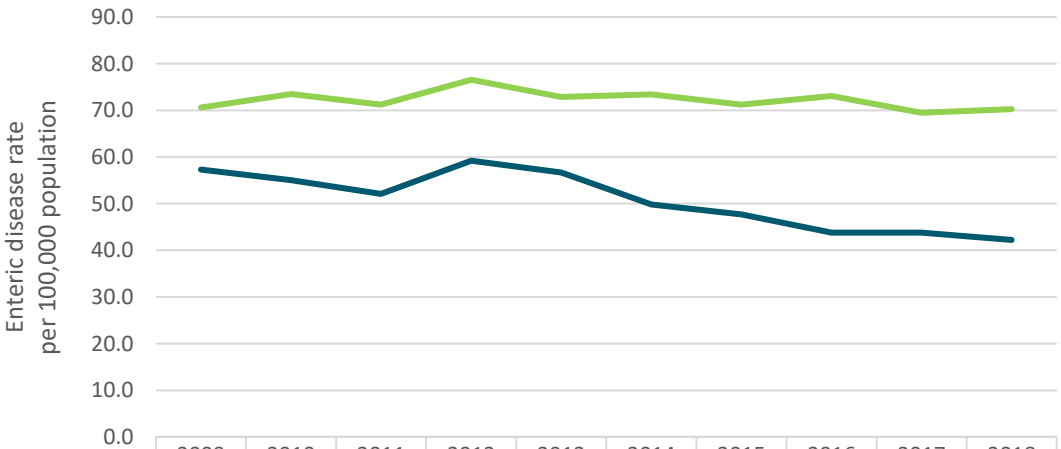
The WECHU monitors nine local beaches in region during summer months for safety and sample the water each week to test for E. coli levels and blue-green algae, as an indicator of public health risk. Pools, whirlpools, splash pads, wading pools, and waterslides in WEC are also inspected.

Food and Water Borne Disease Trends

The food-borne and water-borne diseases can present with a variety of symptoms, which may include nausea, vomiting, abdominal cramps and diarrhea. Many individuals with food - and water-borne illnesses will recover quickly, often with no treatment. In some cases, these illnesses can be life threatening and can have more severe effect on vulnerable populations. The food- and water-borne illnesses commonly go unreported due to the presence of mild symptoms, short duration of symptoms, and the occurrence of asymptomatic infections, as well as factors related to request and submission of samples for microbiological testing.

Microorganisms and vectors associated with infectious diseases, such as salmonellosis, cholera and giardiasis, may benefit from the future 1-2^{o}C rise in local temperatures via increased development, incubation and replication of the pathogen combined with an extended transmission season (Xu et al., 2016). This may lead to increased outbreaks as a result of increased temperature and flooding (Xu et al., 2016). Between 2016 and 2018, the most common enteric diseases in WEC were campylobacter enteritis, salmonellosis and giardiasis. Overall, the rate of enteric diseases in WEC has declined since 2009 by 36% and continues to be lower than the province (42.2 vs. 57.3 cases per 100,000 population) (**Figure 20**). Within these common enteric diseases, however, exists priority groups (age and/or sex) which disproportionately experience negative health outcomes. Due to the smaller case counts of these diseases when conducting subgroup analyses for WEC residents, the following sections will aggregate case counts and average age-specific rates over this three-year period.

Figure 20. Age-standardized rate of enteric disease in Windsor and Essex County and Ontario, 2009-2018



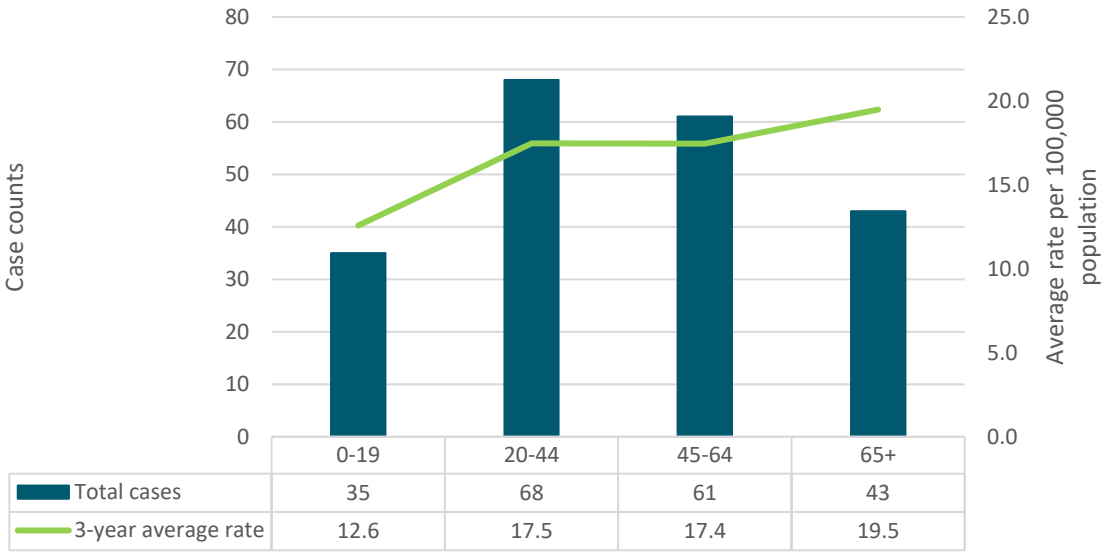
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
WEC	57.3	55.1	52.1	59.2	56.7	49.8	47.7	43.8	43.8	42.2
Ontario	70.6	73.5	71.2	76.6	72.9	73.5	71.2	73.1	69.5	70.3

Source: Ontario Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [2009-2018];
Public Health Ontario. Infectious Disease (ID) Query Tool [2009-2018].

Campylobacter enteritis

Between 2016 and 2018, campylobacter enteritis was identified on 207 different occasions. Of the 207 cases identified, one-third (32.9%) were between the ages of 20 to 44 years and almost another one-third (29.5%) of cases were from the 45 to 64 years age group (**Figure 21**). The average rate for both these age groups was over 17.0 cases per 100,000 population. In general, incidence of this disease has shown to increase with age. Campylobacter enteritis was marginally more common among males compared to females (54.4% vs. 45.6%) between 2016 and 2018. The top three risk factors indicated by WEC campylobacter enteritis cases between 2016 and 2018 were consumption of chicken/chicken products (73.7%), consumption of raw fruits (69.1%) and consumption of beef (57.7%).

Figure 21. Campylobacter enteritis case counts and average rate by age group in Windsor and Essex County, 2016-2018



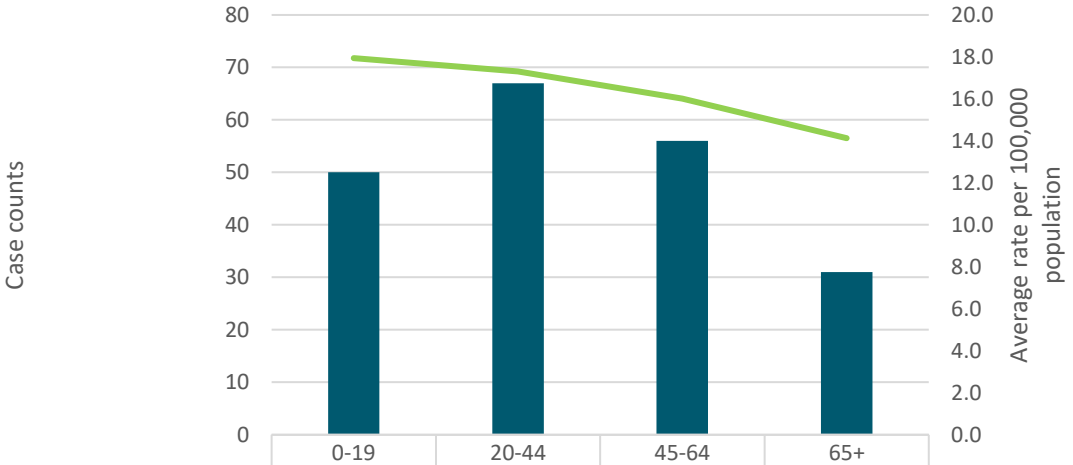
	0-19	20-44	45-64	65+
Total cases	35	68	61	43
3-year average rate	12.6	17.5	17.4	19.5

Source: Ontario Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [2016-2018];
Public Health Ontario. Infectious Disease (ID) Query Tool [2016-2018].

Salmonellosis

There were 204 cases of salmonellosis from 2016 to 2018 in WEC. The rate of salmonellosis was highest in the younger age groups (0 to 19 and 20 to 44 years) with an average of over 17.0 cases per 100,000 population compared to an overall rate of 16.5 cases per 100,000 (**Figure 22**). One-third (32.8%) of cases were between the ages of 20 to 44 years and almost another one-third (27.5%) of cases were in the 45 to 64 years age group. The proportion of salmonellosis cases impacting female WEC residents was slightly higher than their male counterparts (54.9% vs. 45.1%). The top three risk factors reported by WEC salmonellosis cases between 2016 and 2018 were consumption of raw chicken/chicken products (61.3%), raw fruits (51.6%) and consumption of eggs or food containing eggs (45.7%).

Figure 22. Salmonellosis case counts and average rate by age group in Windsor and Essex County, 2016-2018



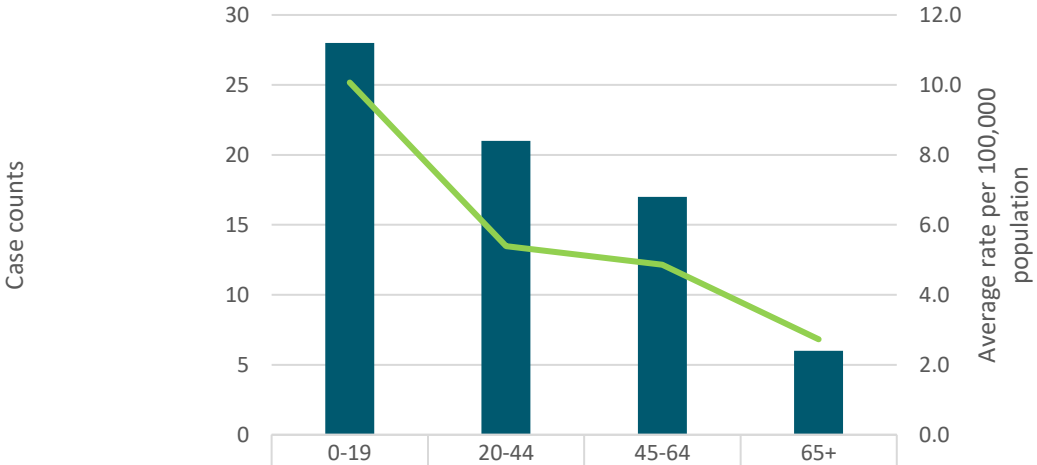
	0-19	20-44	45-64	65+
Total cases	50	67	56	31
3-year average rate	17.9	17.3	16.0	14.1

Source: Ontario Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [2016-2018].
Public Health Ontario. Infectious Disease (ID) Query Tool [2016-2018].

Giardiasis

Giardiasis resulted in 72 cases between 2016 and 2018 in WEC where children ages 0 to 9 years accounted for 38.9% of cases at a rate of 10.1 cases per 100,000 population on average compared to the overall rate of 5.8 cases per 100,000 population (**Figure 23**). Although almost one-third (29.2%) of cases were between the age 20 to 44, the age-specific rate between 2016 and 2018 was low at 5.4 cases per 100,000 population. Over two-thirds (70.8%) of giardiasis cases were males in WEC between 2014 and 2018. The top three risk factors reported by WEC giardiasis cases between 2014 and 2018 were consumption of raw fruits (58.2%), consumption of raw vegetables (50.0%) and travel outside province in the last 3-25 days prior to illness (43.9%).

Figure 23. Giardiasis case counts and average rate by age group in Windsor and Essex County, 2016-2018



Source: Ontario Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [2016-2018].
Public Health Ontario. Infectious Disease (ID) Query Tool [2016-2018].

From 2016 to 2019, there have been 23 beach closures due to high E.coli levels. High levels of phosphorous run off into Lake Erie, situated south of WEC, resulted in a large algae bloom leading to a Drinking Water Advisory impacting 500,000 people in northwestern Ohio (Michalak, AM., Anderson, E., Beletsky, D., et al., 2013). On August 26, 2014, WECHU closed the Pelee Island beaches and issued a Drinking Water Advisory for the residents of Pelee Island due to blue green algae toxin levels. Furthermore, these algae blooms impact recreational water and local tourism economy.

High Risk Groups

Food-borne and waterborne illnesses can affect anyone however, vulnerable populations such as the elderly, children, pregnant women, immunocompromised individuals and individuals with pre-existing conditions are at higher risk when exposed to contaminated food and water sources (Government of Canada, 2019). During pregnancy, both women and the unborn baby are at increased risk of foodborne illnesses because of all the changes happening to the body (Government of Canada, 2019). Seniors and people with weakened immune systems have a harder time fighting off harmful bacteria and may take longer to recover (Government of Canada, 2019).

Adaptive Capacity to Food and Water Contamination

Current Actions taken by WECHU

1. Identification of populations and communities at risk (Community Needs Assessment, 2019).
2. Conducting outbreak investigations to identify sources of food-borne or water-borne illness.
3. Conducting required routine food safety investigations/inspections under the Ontario Regulation 493/17: Food Premises.
4. Conducting required routine small drinking water system inspections under the Ontario Regulation 319/08.
5. Working with operators of municipal water systems under the Ontario Regulation 319/08.
6. Providing education to aid homeowners on private well water systems understand their test results and well maintenance.
7. Issuing boil and drinking water advisories.
8. Public beach surveillance and monitoring.
9. Posting public beach advisories.
10. Monitoring occurrence of Blue-green algae blooms.
11. Participate in Source Water Protection.

Future Recommendations

Activities	Key Partners
Education and research on the impact of climate change on food systems and access.	Essex County Federation of Agriculture Municipal partners ERCA Local Businesses Schools
Advocate for policy statements related to local foods systems, food access protection of agricultural lands and source water protection into municipal official plans.	Ontario Federation of Agriculture Essex County Federation of Agriculture Municipal partners ERCA
Support local policy development related to strengthening local food systems (i.e., production, support for local food, food share).	Ontario Federation of Agriculture Essex County Federation of Agriculture Municipal partners ERCA
Advocate for policy development related to reduction in nutrient loading in surface waters.	Ontario Federation of Agriculture Essex County Federation of Agriculture Municipal partners

5. Vector-Borne Diseases

Vector-borne diseases are caused by transmission of parasites, viruses and bacteria in humans by vectors. Most common vectors are mosquitoes and ticks, and can transfer the pathogen from one host to another (USGCRP, 2016). The WECHU conducts vector-borne surveillance to monitor trends for current and emerging diseases including factors that influence their occurrence. Some of the factors that can impact the presence of vectors are: temperature, precipitation, reservoir hosts, and available habitat. As we see changes in the climate, there has been an increase of vectors found that are known to carry novel vector-borne diseases (Ng et al, 2019). Climate change is just one of several factors that can have impact on vector-borne diseases. Other factors like travel and trade (Windsor-Detroit Gateway is Canada's busiest land border crossing), population movement, migratory birds, deforestation, and urbanization can also lead to emergence and re-emergence of vector-borne diseases (WHO, 2014). Point Pelee is a prominent site for over 390 species of migratory birds moving through in spring and fall (Parks Canada, 2019). Birds are central to the epidemiology of a number of viruses spread by mosquitoes because they are the main amplifying host of the virus in nature (Reed et al., 2003).

An increase in annual average temperature will lead to more hot days, record-breaking hot days, warmer nights, and milder winters (City of Windsor, 2012b). Rising temperatures combined with stagnant water from flooding will facilitate the survival of invasive species and a greater presence of insect vectors that can carry disease (Kovats et al., 2003). Climate and seasonal trends influence the viability of infectious pathogens by constraining the rates of transmission and reproduction. The projected temperature and precipitation rises are likely to further increase infectious disease risk in Ontario (Xu et al., 2016). The favourable climatic conditions for West Nile virus and Lyme disease present in Southwest Ontario, especially WEC, have and will continue to expand to a wider geographical area by the 2050s and 2080s (Gough et al., 2016).

Vector-Borne Disease Trends

Mosquito-Borne Diseases

West Nile Virus (WNV)

West Nile Virus (WNV) was first identified in North America in 1999. WEC was the first area to discover WNV in Canada in 2002. Ontario has had human cases every year since then (Wijayasri et al, 2019). WNV can, albeit rarely, be spread through blood transfusion, organ or tissue transplants, during pregnancy, through breastmilk or laboratory exposure. While the majority of WNV cases are asymptomatic, almost 20% of people will develop West Nile fever, which consists of fever, headache, body aches, swollen lymph nodes, and mild rash. These symptoms can last for as short as a few days to as long as several weeks. It is possible to develop severe symptoms or neuroinvasive disease which may lead to death (CDC, 2018).

Zika Virus

Zika Virus is a mosquito-borne flavivirus that was discovered in Uganda in 1947 and reached Latin America and the Caribbean between 2013 and 2015. More recently, in 2016, it was detected in North America (Boyer et al, 2018). While many Zika virus infections are asymptomatic or have mild symptoms, more severe symptoms, such as neurological disorders and microcephaly in newborns.

Aedes aegypti and *Aedes albopictus*, typically found in tropical regions, are known vectors of the Zika virus, as well as for chikungunya virus, dengue virus, WNV, and yellow fever virus (Giordano et al, 2019). The *Aedes aegypti* mosquito, the main vector for Zika virus, likely originated in Africa, but has been transported through shipping and trade (Zettel and Kaufman, 2013).

The virus can be spread from a person, to a mosquito, to another person. Zika virus can also be spread via sexual intercourse before symptoms start, while a person has symptoms, and after their symptoms end. The virus can also be spread from a pregnant mother to her fetus, causing severe neurological disorders and microcephaly. The most common symptoms of Zika virus in adults are fairly mild and can include fever, rash, headache, joint pain, conjunctivitis (red eyes), and muscle pain.

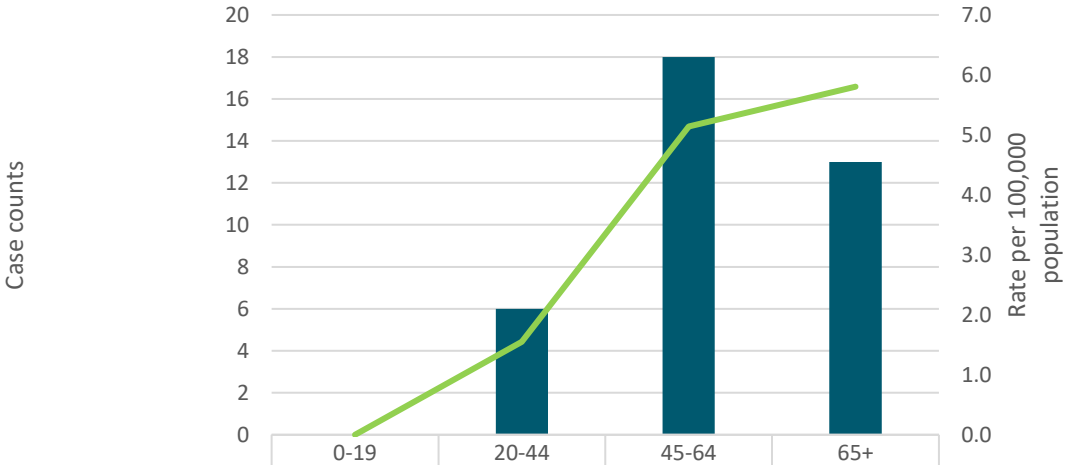
Eastern Equine Encephalitis Virus (EEEV)

Eastern equine encephalitis virus (EEEV) is a mosquito-borne alphavirus that is considered to be the most severe arboviral disease in North America. It is spread between birds and mosquitos. It requires a bridge vector, typically *Aedes, Culex* or *Coquillettidiea* mosquito species, to transfer the disease to mammals. Humans and horses are considered dead-end hosts which means the virus cannot be spread after they have contracted the disease (Lindsey et al, 2018).

Signs and symptoms of EEEV include fever, chills, malaise, and muscle and joint pain. EEEV can also become neuroinvasive and cause altered mental status, seizures, meningitis or encephalitis. If EEEV becomes neuroinvasive, the case fatality rate is 30%. From 1997 through 2007, eight cases of neuroinvasive disease were reported in the United States. As of October 2019, there have been 10 confirmed cases of EEEV and five deaths across Michigan. Also in October 2019, the WECHU discovered a positive mosquito pool for EEEV.

Between 2016 and 2018, WEC encountered 37 human cases (confirmed and probable) of WNV (**Figure 24**). Almost one-half (48.6%) of cases were of ages 45 to 64 years with another one-third of cases within the elderly WEC population (65+ years). The proportion of male WNV cases were higher than their female counterparts in WEC (59.5% vs. 40.5%). The top three risk factors reported by WNV cases in WEC between 2016 and 2018 were no insect repellant when outdoors (75.7%), inadequate clothing protection when exposed to mosquitoes (i.e. long sleeves, long pants, covered shoes) (73.0%) and outdoor activities (i.e. camping, hiking, working) (70.3%).

Figure 24. West Nile virus case counts and average rate by age group in Windsor and Essex County, 2016-2018

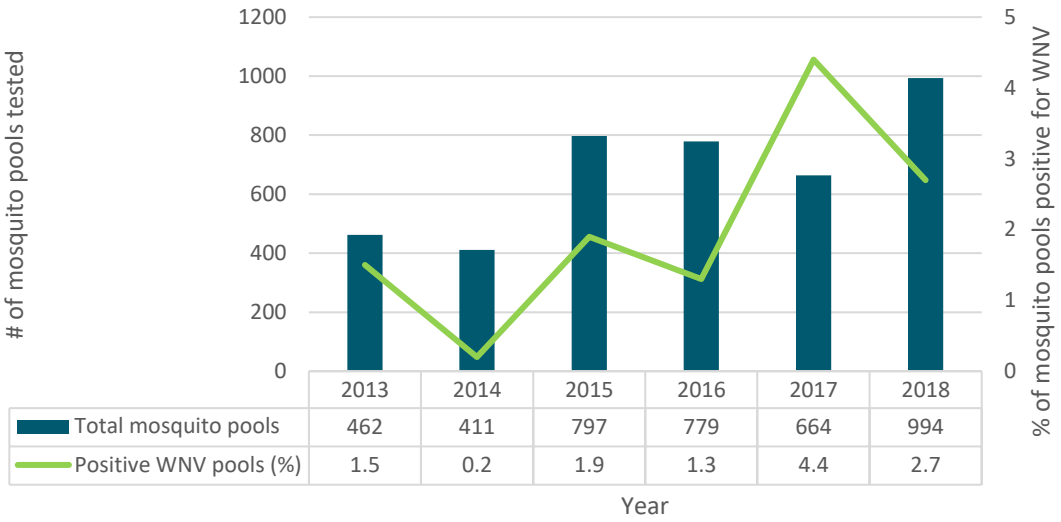


	0-19	20-44	45-64	65+
Total cases	0	6	18	13
3-year average rate	0.0	1.5	5.1	5.8

Source: Ontario Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [2016-2018].
Public Health Ontario. Infectious Disease (ID) Query Tool [2016-2018].

Since 2017, the percentage of mosquito pools that tested positive for WNV has increased in WEC (**Figure 25**). During the surveillance period spanning from May to October of 2018, 26 (2.7%) positive pools of WNV were detected in mosquito traps, which is almost double than the percentage of pools that tested positive in 2013. Furthermore, exotic species, such as *Ae. aegypti* and *Ae. albopictus which* are vectors of Zika virus, have been discovered in the region since 2016. Responding to this emergence of invasive mosquito species, in 2017, the WECHU initiated an annual Enhanced Mosquito Surveillance Program. The traps deployed in 2018 first identified Ae. albopictus mosquitos in the month of May and eventually captured a total of 1,129 adult mosquitos and 314 eggs of this invasive species throughout the season (WECHU, 2018). WEC is now considered an established habitat of *Ae. albopictus* due to the recent and consistent identification of this invasive mosquito species (Giordano et al., 2019).

Figure 25. Mosquitoes tested for West Nile virus in Windsor and Essex County, 2013-2018



Source: Environmental Health Department, Windsor-Essex County Health Unit [2013-2018].

Tick Borne Diseases

Ticks are a relative to the spider and are a crawling, non-flying insect. They vary in size and colour. Ticks are very small (1 to 5 mm) when unfed and female ticks get larger and change colour when feeding (Government of Canada, 2015). Ticks can spread diseases such as Lyme Disease, Rocky Mountain Spotted Fever, Powassan Virus Disease, and tularemia. Blacklegged ticks (*Ixodes scapularis*, formerly called deer ticks), found in WEC can spread the bacteria that cause Lyme disease. Lone star ticks (*Amblyomma americanum*) which have also been found in WEC can transmit Rocky Mountain spotted fever and tularemia, as well as potentially cause red meat (alpha-gal) allergy (Telford et al, 2019).

The WECHU conducts active tick surveillance and supports passive surveillance initiatives in the community. **Passive surveillance** activities are used to detect and monitor the presence of ticks found by residents in the community. **Active tick surveillance** is the act of "tick dragging" which involves the dragging of a white cloth through grassy areas whereby ticks attach themselves to the cloth and can be easily spotted. Ticks collected on the cloth are sent to an accredited lab for testing. Tick dragging is performed twice yearly to identify areas in WEC that have populations of blacklegged ticks, which is the main vector for Lyme disease (WECHU, 2018)

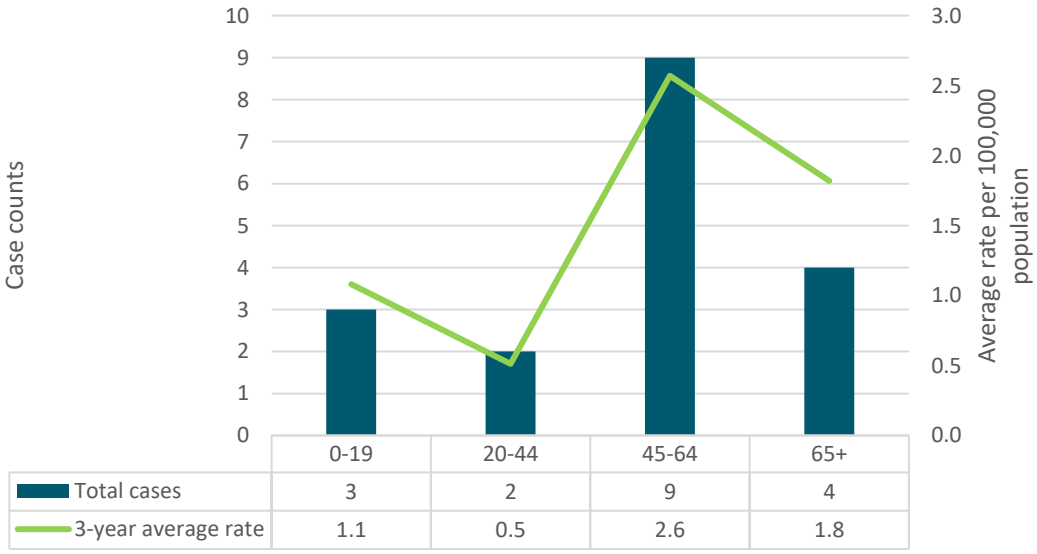
Lyme disease is a bacterial infection spread through the bite of a blacklegged tick. The bacteria (*Borrelia burgdorferi*) is most likely to be transmitted after the tick has been attached to you for 24 hours or more (Government of Canada, 2019). South Western Ontario is an established area for Lyme disease. Early symptoms of Lyme disease usually occur within one to two weeks, but can occur as soon as three days or as long as a month, after being bitten by an infected tick. Symptoms may include fever, headache, muscle and joint pains, fatigue, bull's eye rash, numbness or tingling, and swollen lymph nodes (Government of Canada, 2019).

There were 18 cases of Lyme disease in WEC between 2016 and 2018 (**Figure 26**). One-half (50.0%) of the cases were in the 45 to 64 year age group resulting in a 3-year average rate of 2.6 cases per 100,000 population. The top three risk factors reported by WEC Lyme disease cases between 2016 and 2018

were: 1) inadequate clothing protection when exposed to ticks (i.e. long sleeves, long pants, covered shoes) (76.5%); 2) no use of insect repellant when outdoors (76.5%); and 3) activities in wooded or tall grass areas.

Point Pelee National Park, a popular site for outdoor activities in WEC, is one of the known endemic locations for Lyme disease, most commonly carried by blacklegged ticks, within Ontario (Government of Canada, 2018). As of 2019, most of WEC is considered a risk area and not just Point Pelee due to the identification of black-legged ticks throughout the region. The number of ticks submitted to the WECHU in 2018 from the public was 335 with 27 (8.1%) ticks identified as the blacklegged species. One tick tested positive for the Lyme disease infectious agent. In the previous three years, the WECHU received fewer tick submissions (42 to 169) from residents. Lyme disease active surveillance performed by the WECHU on May 17th, 2018 identified 2 blacklegged ticks at each of the sampling sites (4 total) and 8 adult blacklegged ticks on October 30th, 2018. This recent finding was alarming since in the previous 3 years (2015-2017), no blacklegged ticks were captured and no ticks in general were captured after the month of May. Lone star tick, whose bite can lead to alpha-gal meat allergy, was also found during active surveillance in 2017. These have also found consistently in the region with 14 captured through public tick submissions from 2015 to 2018.

Figure 26. Lyme disease case counts and average rate by age group in Windsor and Essex County, 2016-2018



Source: Ontario Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [2016-2018].
Public Health Ontario. Infectious Disease (ID) Query Tool [2016-2018].

High Risk Groups

While any person bit by an infected vector has the potential to contract a vector-borne disease, certain populations are more sensitive to the health impacts than others. These are:

- People that work outside, camp, hike, and garden
- Children, elderly and those with chronic diseases or weakened immune systems
- Pregnant women have the greatest health consequences if they contract Zika virus due to the severe effects the virus can cause on their developing fetus

Adaptive Capacity to Vector borne Diseases

Current Actions taken by WECHU

1. Identification of populations most at risk for VBD (Community Needs Assessment, 2019).
2. Case investigation and monitoring of reported cases of VBD.
3. Adult mosquito and larval monitoring.
4. Viral testing of adult mosquito pools.
5. Larviciding.
6. Active tick surveillance.Enhanced mosquito surveillance to monitor invasive species *Aedes aegypti and Aedes albopictus.*

7. Support policy development related to property standard by-laws and storm water infrastructure related to standing water .
8. Public education and awareness activities to decrease the risks of exposure of VBD.
9. Development of VBD Response Plan for adulticiding.

Future Recommendations

Activities	Key partners
Support local policy development related to the protection outdoor workers.	Municipal partners Local workplaces
Advocate and support development of policies regarding standing for workplaces and private businesses.	Local workplaces Local businesses
Explore opportunities to advocate for larviciding on non-municipal lands.	VIA rail Essex Terminal Railway Company CN rail
Implement increased mosquito surveillance and monitoring activities in Leamington, Ontario (received a federal grant from the Public Health Agency of Canada).	Public Health Agency of Canada Parks Canada Municipality of Leamington

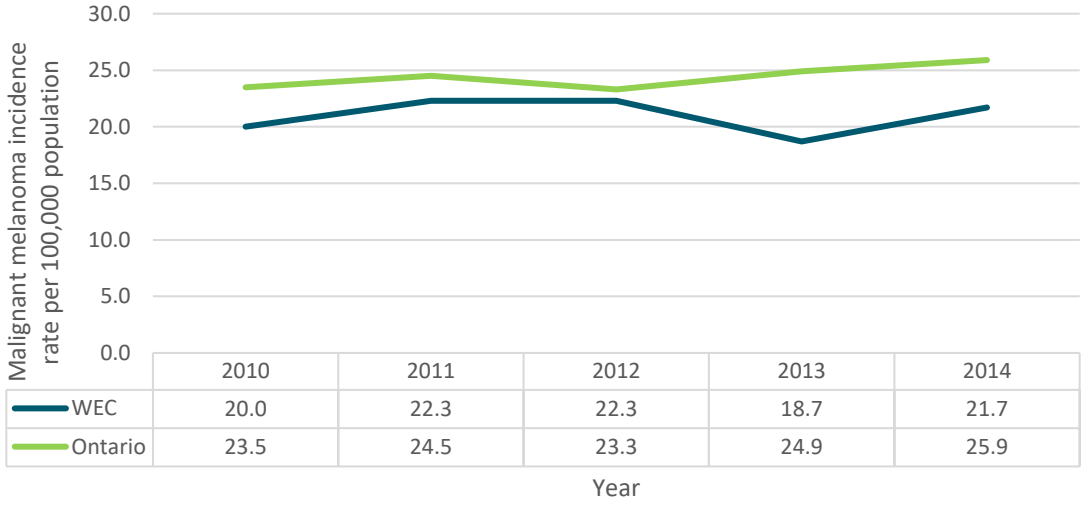
6. Ultraviolet Radiation Exposure

Ultraviolet (UV) radiation can come from both natural and artificial sources (Government of Canada, 2017). The sun is a natural source of a UV radiation whereas black lights, lasers and tanning beds are all examples of artificial UV radiation (Government of Canada, 2017). Depending on the wavelength of the UV radiation, it may be able to pass through the ozone layer and impact our health in different ways (Government of Canada, 2017). The two main types of UV radiation is Ultraviolet A (UVA) and Ultraviolet B (UVB) (Government of Canada, 2017). Approximately 95% of UVA that is passed through the ozone layer is able to penetrate deep into the dermis and is often linked to long-term skin damage whereas only 5% of UVB passes through the ozone layer and reaches the earth's surface (Government of Canada, 2017). UBV only penetrates the outer protective layer of the skin but is the main cause of sunburns and most skin cancers (Government of Canada, 2017).

Health impacts

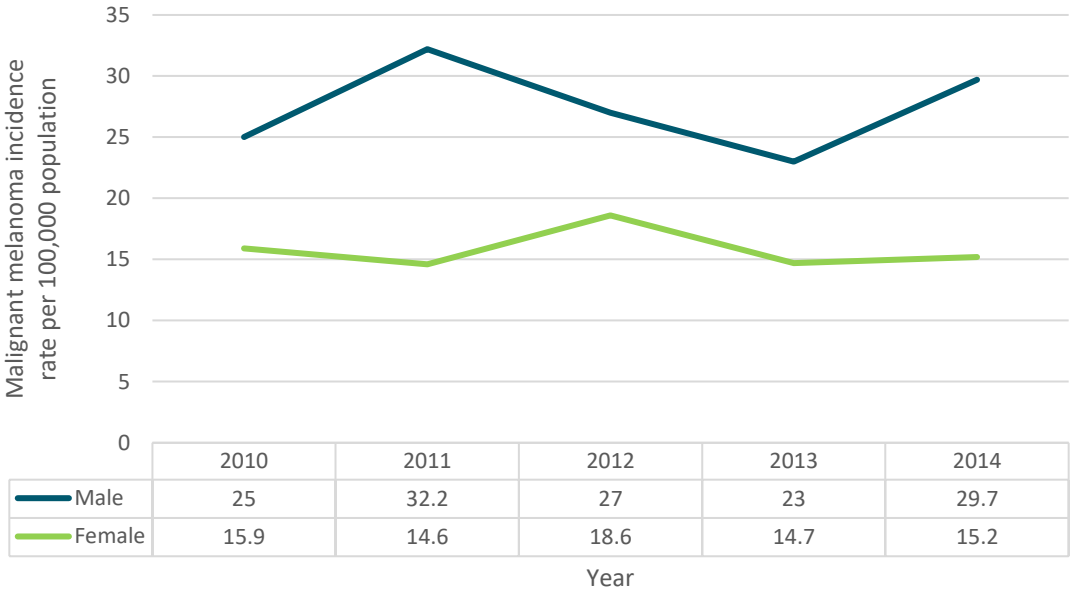
The age-standardized incidence rates of malignant melanoma, which is a type of cancer forming form the pigment-containing cells called melanocytes, in WEC and Ontario from 2010 to 2014 are displayed in **Figure 27**. The rate of new cases of malignant melanoma in WEC during this period was approximately 20 new cases per 100,000 population. From 2010 to 2014, WEC and Ontario residents experienced similar rates of malignant melanoma with the exception of 2013 where rates in WEC were 33.2% lower than the provincial rate. Male WEC residents experience on average a 75.0% greater rate of malignant melanoma compared to female WEC residents between 2010 and 2014 (**Figure 28**). The 5-year average age-specific incidence rates of malignant melanoma are displayed in (**Figure 29**). Between 2010 and 2014, there were no new cases of malignant melanoma among WEC residents below the age of 29 years. The incidence of malignant melanoma in WEC was on average highest among residents above 80 years.

Figure 27. Age-standardized incidence rate of malignant melanoma in Windsor and Essex County and Ontario, 2010-2014



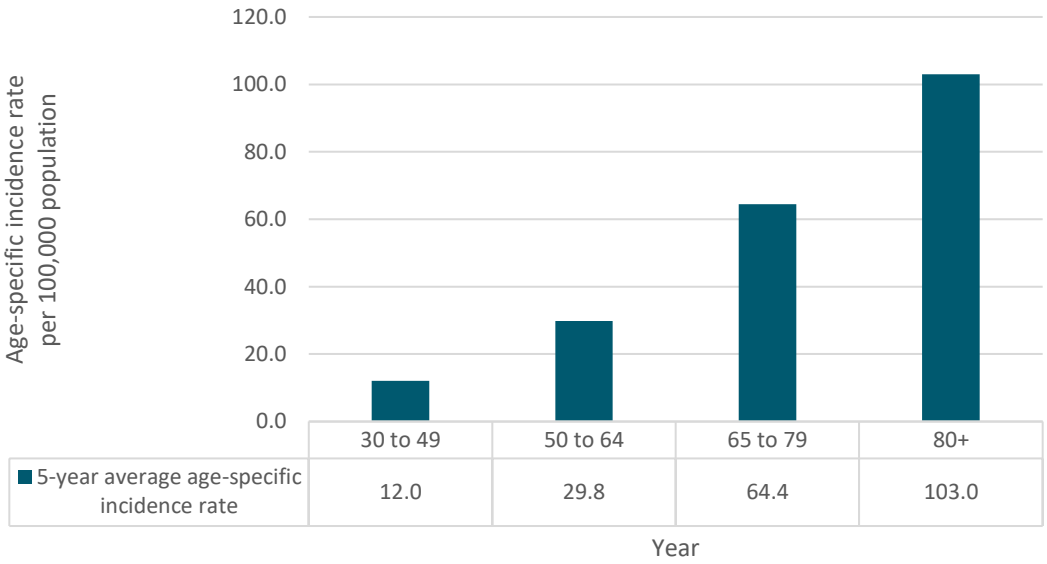
Source: Cancer Care Ontario. Ontario Cancer Registry [2010-2014].

Figure 28. Age-standardized incidence rate of malignant melanoma by sex in Windsor and Essex County, 2010-2014



Source: Cancer Care Ontario. Ontario Cancer Registry [2010-2014].

Figure 29. Five-year average age-specific incidence rate of malignant melanoma by age group in Windsor and Essex County, 2010-2014



Source: Cancer Care Ontario. Ontario Cancer Registry [2010-2014].

Stratospheric Ozone Depletion

The connection between ozone depletion in the stratosphere and increased UVB has implications on current and future non-melanoma cancer rates. Compared to the 1971-2000 baseline, during the 2050s and 2080s, basal cell carcinoma is projected to increase by 7.8% and 12.8% while squamous cell carcinoma is estimated to rise by 14.8% and 24.3% in WEC (Gough et al., 2016).

High Risk Groups

Children are more impacted by the health effects of UV radiation than adults in particular because their skin is thinner and more sensitive (WHO, 2009). Children spend more time exposed to the sun and are less aware of the harmful effects of UV radiation (WHO, 2009).

Adaptive Capacity to UV Radiation

Current Actions taken by WECHU

1. Collaborating with community partners to promote sun safe behaviors within populations most at risk for UV Radiation exposure.

Future Recommendations

Activities	Key Partners
Engagement with municipalities and workplaces providing consultation for reduction of UV Radiation exposure	Municipal partners Local workplaces
Supporting policies that limit the use of ozone-depleting chemicals	Municipal partners

Next Steps

This assessment has provided us with information on health impacts resulting from climate change in WEC, regions and populations in our community that are more vulnerable to these health impacts, interventions and programs that are already in place and recommendations for additional programs and policies necessary to respond to climate change and strengthen our adaptive capacity. The data from this report will be used to create a final climate change action plan with our partners. The action plan will help the WECHU to support adaptive capacity actions that will decrease exposure and sensitivity to impacts on health due to climate change and to engage community partners in increasing resiliency to climate change impacts in WEC.

Next steps for the WECHU's climate change program are:

- Share the results of this assessment with local municipalities and other community partners and continue to collaborate in the planning processes
- Develop and implement a stakeholder and community education and engagement plan
- Develop resources to support individuals in making personal choices to help reduce their impact on climate change
- Develop resources to promote awareness of the health effects from climate change

Continue to access the health impacts of climate change in our region. We will also continue to work with the Windsor Essex Climate Change Collaborative (a partnership between ERCA, municipalities, the County of Essex, the Windsor-Essex Health Unit, the University of Windsor) to develop the Regional climate change strategy. The strategy will address regional issues and the multitude of climate change vulnerabilities and risks facing different sectors.

Glossary:

Air Quality Health Index (AQHI): The AQHI is a measure of adverse health event risk in the population due to air pollutant concentrations. A high-risk AQHI alert is issued to inform residents of the elevated health risk with exposure to air pollution levels.

Climate normals: They refer to arithmetic calculations based on observed climate values for a given location over a specified time period (usually 30 years).

Infrastructure: The infrastructure of a country, society, or organization consists of the basic facilities such as transport, communications, power supplies, and buildings, which enable it to function.

Intensity Duration Frequency curves: An Intensity-Duration-Frequency curve (IDF Curve) is a graphical representation of the probability that a given average rainfall intensity will occur.

Migratory bird: Migratory bird is a bird that travels from one place to another at regular times often over long distances.

Outbreak: An unexpected increase of disease occurring within a specific population at a given time and place.

Public health: Promote the health of populations by preventing morbidity and mortality through a broad range of research, programming and policy activities

Resilience: The capacity of a system, community or society exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure.

Stakeholders: Stakeholders are groups or individual who can affect or are affected by an issue.

Stratosphere: The stratosphere the second layer of the Earth's atmosphere as you go upward.

Surface Water: Surface water is the water that flows on the surface of the earth including lakes, rivers and ponds.

Tropical nights: Annual count of days when daily minimum temperature is > 22 C

UV Index: The Ultraviolet Index (UV Index) is a measurement of the intensity of the sun’s rays.

Weather: The day-to-day state of the atmosphere, and its short-term variation in minutes to weeks.

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Appendix A

Categorization of health outcomes by international classification of disease, Tenth Revision, (ICD-10) codes

CATEGORY	ICD10-CA Codes	Definition
Asthma	J45-46	Asthma-related conditions which includes intermittent or persistent and severity (e.g., mild, moderate and severe).
Cold-related illness	T33-35, T68-T69, X31	Cold-related illness due to frostbites, hypothermia, other effects of reduced temperature, and exposure to excessive natural cold
Heat-related illness	T67, X30	Heat-related illness due to effects of heat and light, and exposure to excessive natural heat
Mental health-related illness	F20-29, F30-34, F38.0, F38.1, F38.8, F39, F53.0, F40, F41, F42, F43.0, F43.1, F43.8, F43.9, F93.0, F93.1, F93.2, F60-62, F68, F69	Mental health-related illness which includes schizophrenia, delusional and non-organic psychotic disorders, mood/affective disorders, anxiety disorders and select disorders of adults

WINDSOR-ESSEX COUNTY
HEALTH UNIT

1005 Ouellette Avenue
Windsor, Ontario N9A 4J8

www.wechu.org

519-258-2146

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