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Oxford County
Growing stronger together

April 8, 2026

VIA EMAIL

RE: CAO 2026-06 Oxford County Local Climate Hazard Assessment

At its meeting held March 25, 2026, Oxford County Council adopted the recommendations contained in Report CAO 2026-06 titled "Oxford County Climate Hazard Assessment." The Report recommendations read as follows:

RECOMMENDATIONS:

1. That Oxford County Council receive the Climate Hazard Assessment completed by GEI Consultants Canada as information;
2. And further, that the Climate Hazard Assessment report be posted to the County website and shared with community partners and Area Municipalities.

Enclosed herein you will find a copy of the Council Resolution as well as the Local Climate Hazard Assessment referred to.

Should you require anything further or have questions or concerns, please do not hesitate to contact the undersigned.

Thank you,

Lindsey A. Mansbridge
County Clerk

CC: Chelsea Martin, Coordinator of Community Environmental Sustainability
Sarah Hamulecki, Manager of Strategic Initiatives and Intergovernmental Relations

Oxford County
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Municipal Council of the County of Oxford
Council Meeting - Oxford County

RESOLUTION NO. 8

Date: Wednesday, March 25, 2026

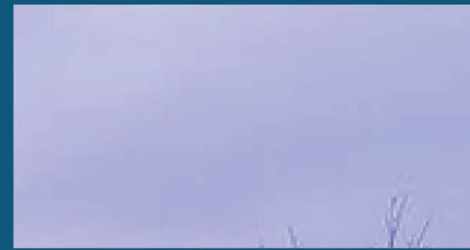
Moved By: Bernia Martin

Seconded By: Brian Petrie

Resolved that the recommendations contained in Report CAO 2026-06 titled "Climate Hazard Assessment", be adopted.

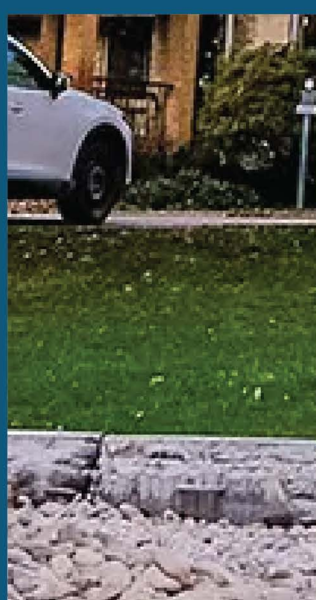
DISPOSITION: Motion Carried

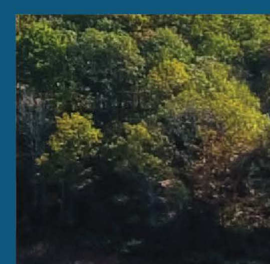





OXFORD COUNTY LOCAL CLIMATE HAZARD ASSESSMENT



2026

Oxford County

Growing stronger together

This project was carried out with assistance from the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

CONTENTS

EXECUTIVE SUMMARY

OXFORD COUNTY IS ALREADY EXPERIENCING THE IMPACTS OF A CHANGING CLIMATE.

Rising temperatures, more frequent extreme heat, heavier rainfall, shifting seasonal patterns, and increasing variability in winter conditions are affecting infrastructure performance, agricultural operations, ecosystem health, and community wellbeing. These trends are projected to intensify through the 2050s and 2080s under both moderate and high emissions scenarios.

This Local Climate Hazard Assessment (LCHA) provides a County-specific evidence base to support climate-informed planning, asset management, emergency preparedness, and long-term investment decisions. It integrates climate projections, historical event review, public health assessments, social vulnerability mapping, and provincial risk findings to identify where pressures are increasing and where impacts may be most significant. This assessment represents a screening-level analysis intended to establish a consistent evidence base for decision-making, rather than a detailed asset-specific engineering or operational vulnerability assessment.

KEY CLIMATE TRENDS FOR OXFORD COUNTY

Climate projections indicate:

- Mean annual temperature increases of approximately 3.5°C by the 2050s and up to 6°C by the 2080s under higher emissions
- More frequent and prolonged extreme heat events
- Longer growing seasons and fewer extreme cold days
- Increases in total annual precipitation
- Greater likelihood of intense rainfall events and longer wet and dry intervals
- Significant increases in cooling demand and reductions in heating demand

These changes represent a long-term shift in baseline climate conditions, not isolated weather variability.

WHAT HISTORICAL RECORDS SHOW

A review of historical events confirms that many projected future hazards are already occurring in Oxford County. Flooding has been the most frequent and persistent climate hazard, driven by short-duration, high-intensity rainfall that overwhelms stormwater systems. Severe storms, wind events, and tornadoes have caused fatalities, infrastructure damage, and extended power outages. Winter ice storms and snow events have disrupted transportation and essential services. Heat alerts have increased in recent years, with Southwestern Public Health issuing multiple advisories between 2022 and 2025.

Near-miss events in surrounding regions further demonstrate the magnitude of risk possible under similar climatic conditions, including high-cost flood seasons, catastrophic windstorms, and prolonged ice-related power outages. These events illustrate that climate change is not introducing entirely new hazards, but increasing the frequency, severity, and financial consequences of hazards the County already manages.

"CLEAR OPPORTUNITY TO PROACTIVELY INTEGRATE CLIMATE RISK INTO PLANNING AND INVESTMENT DECISIONS"

WHERE RISK IS CONCENTRATED

Climate risk is not uniform across Oxford County.

Settlement areas, particularly Woodstock, Tillsonburg, Ingersoll, and portions of Norwich, show the strongest overlap between increasing climate exposure and social vulnerability. These locations are identified as priority areas based on this convergence of factors, rather than as a formal ranking of risk.

Rural areas generally demonstrate stronger relative social resilience indicators, but remain highly exposed to sector-specific risks, particularly those affecting agriculture, groundwater-dependent water systems, transportation access, and natural ecosystems.

Natural Systems

Projected increases in heat, intense rainfall, and drought are expected to increase erosion, degrade water quality, stress aquatic habitats, reduce forest resilience, and alter species composition. Because natural systems provide flood regulation, groundwater recharge, and agricultural support, ecosystem stress has cascading implications.

Food and Agriculture

Agriculture occupies approximately 87% of the County's land base and is central to its economy. Climate pressures include saturated soils, longer dry intervals, livestock heat stress, expanded pest pressures, and greater seasonal variability. While longer growing seasons may offer limited opportunities, overall risk exposure increases.

Infrastructure

Oxford County maintains approximately $3.95 billion in infrastructure assets designed for historical climate conditions. Rising temperatures, intense rainfall, and freeze–thaw variability will accelerate deterioration, increase stormwater exceedance risk, raise peak energy demand, and compound renewal pressures alongside projected population growth. Infrastructure interdependencies increase the risk of cascading failures.

People and Communities

Extreme heat, flooding, severe storms, and air quality degradation pose increasing health risks. Impacts are shaped by age, income, housing conditions, and access to services. Climate hazards can amplify existing social inequities and strain health and emergency systems.

Business and Economy

Manufacturing, agriculture, transportation, and service sectors may experience reduced labour productivity, higher operating costs, supply chain disruptions, and increased insurance pressures. Climate impacts carry implications for competitiveness, investment confidence, and long-term economic stability.

Overall Risk Pattern

Climate risk in Oxford County is shaped by three reinforcing dynamics:

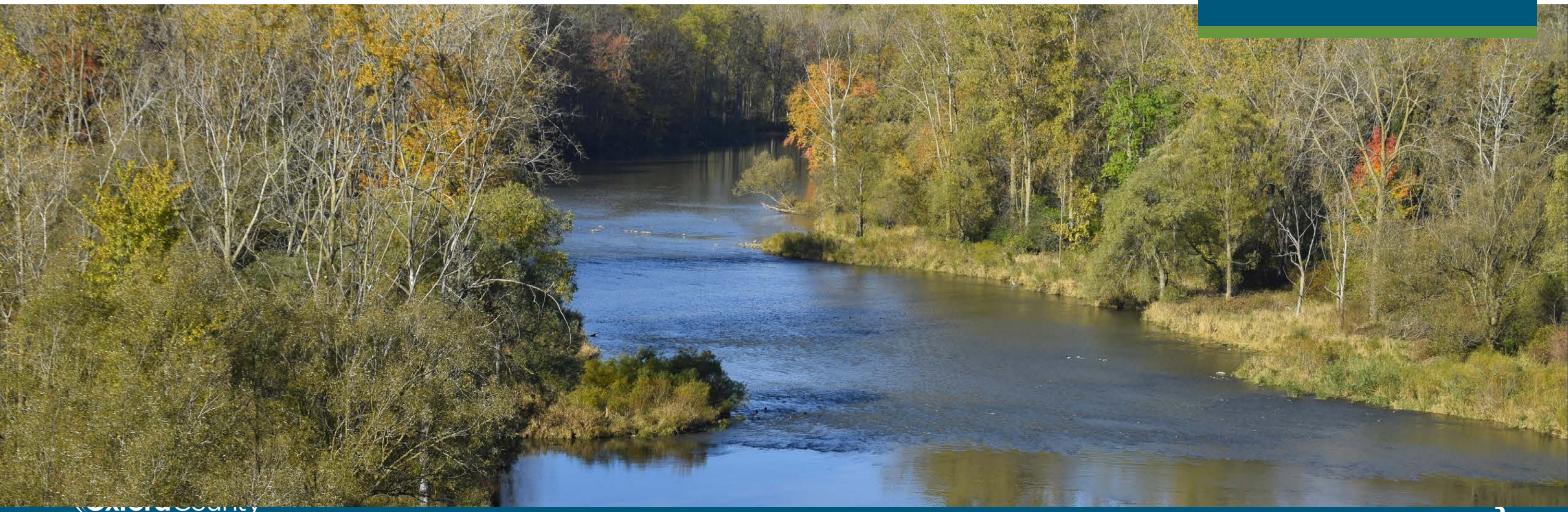
1. Increasing hazard intensity
2. Climate-sensitive sectors such as agriculture and infrastructure
3. Uneven social and geographic capacity to adapt and recover

Because infrastructure, economic systems, public health services, and natural systems are closely interconnected, disruptions in one sector can trigger cascading impacts across others, increasing overall risk. Risk is highest where hazards are intensifying and where exposure, sensitivity, and limited adaptive capacity intersect.

WHAT THIS MEANS FOR OXFORD COUNTY

Climate change represents a material, cross-cutting planning consideration for Oxford County. Projected changes will influence asset lifecycle planning, agricultural stability, ecosystem function, public health outcomes, service delivery, and economic competitiveness.

By identifying where hazards are increasing, which sectors are most sensitive, and where vulnerability is concentrated, this assessment provides a foundation for integrating climate risk into future County planning and investment decisions.



BACKGROUND & PURPOSE

Oxford County is a mixed rural-urban region in southwestern Ontario, made up of a network of communities that share services and governance. Its location, settlement patterns, and reliance on transportation, agricultural, and natural systems shape how climate-related hazards are experienced across the County. Climate impacts may vary between urban centres and rural areas, but many risks are shared across municipalities and services.

The County continues to grow, with the intercensal population estimated at 135,976 in 2024, representing a 7% increase from the 2021 estimate of 126,731 (Oxford County, 2025). This growth has already placed increasing pressure on infrastructure, services, and emergency response systems that may also be affected by climate-related hazards.

Climate change is already influencing conditions in Oxford County and is expected to intensify pressures on infrastructure, public health, ecosystems, and the local economy. Regional and County-level information indicates that extreme heat and changing precipitation patterns represent the most significant climate-related risks. These hazards have implications for various systems such as water and wastewater, emergency response services, and community well-being. Oxford County's strong reliance on agriculture further heightens climate sensitivity, as crop production, livestock operations, and agri-food supply chains are directly affected by temperature extremes, drought, intense rainfall, and severe storms (Ontario Federation of Agriculture, 2023). While some climatic shifts may offer short-term opportunities, such as longer growing seasons, the overall trajectory points toward increasing exposure to climate-related disruptions and costs (Government of Canada, 2020).

Oxford County has advanced a range of climate change mitigation and adaptation initiatives through its existing policy and planning framework. The County's Strategic Plan identifies environmental sustainability as a pillar, supported by objectives related to climate change mitigation and adaptation (Oxford County, 2023). Council reports have further identified the need to better understand local climate risks and to integrate climate considerations into County decision-making, asset management, and emergency planning processes (Oxford County, 2024).

To support this work, Oxford County is developing a comprehensive Climate Action Plan and has secured funding through the Federation of Canadian Municipalities' (FCM) Green Municipal Fund Local Leadership for Climate Adaptation program. Completion of the Local Climate Hazard Assessment (LCHA) is a required component of this process.

The purpose of the LCHA is to provide a County-wide, high-level understanding of current and projected climate-related hazards and their potential consequences for people, infrastructure, services, ecosystems, and key economic sectors. This assessment is intended to establish a consistent and evidence-based foundation for decision-making. It identifies where risks are emerging and where pressures may intensify, but it does not constitute a detailed, asset-specific engineering vulnerability assessment or a sector-level operational review.

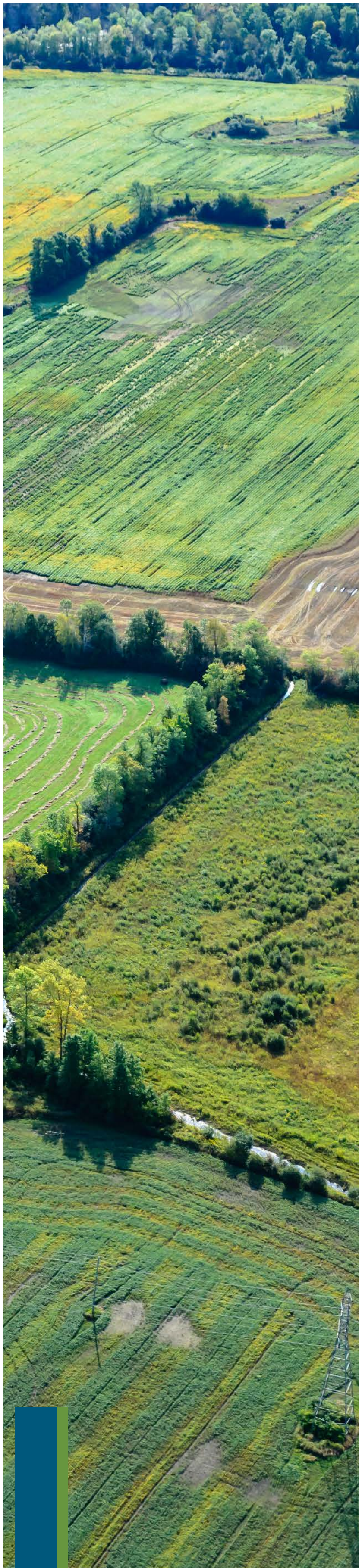
Instead, the LCHA serves as a screening-level assessment that supports integration of climate considerations into asset management, emergency planning, and future policy development. By clarifying the nature and distribution of climate-related risks across Oxford County, this report strengthens the foundation for targeted adaptation planning, future technical studies, and funding-ready resilience initiatives.

REVIEW OF EXISTING PLANS, STUDIES, AND FRAMEWORKS

To develop a locally relevant LCHA, it is important to first establish an overall understanding of Oxford County's planning, policy, and technical context. This ensures the assessment is grounded in existing priorities and focused on the systems, populations, and risks most in need of attention.

The documents reviewed include the County's key policy, planning, and technical documents, including Council reports, master plans, asset management and emergency response plans, climate and health vulnerability studies, and relevant provincial frameworks. We also reviewed climate risk and adaptation assessments completed by peer municipalities and regional agencies in Ontario. This review informed the identification of climate-sensitive systems and populations, confirmed priority climate hazards, and ensured the LCHA is aligned with existing plans, funding requirements, and best practices.

The findings from the document review were used to shape the scope, focus, and methodology of the LCHA. The consistent identification of extreme heat and extreme precipitation as priority risks across Council reports, health vulnerability assessments, and peer municipal studies have been used to confirm the core climate hazards evaluated in the LCHA. Information from County master plans and the Asset Management Plan have helped to identify critical infrastructure, services, and systems such as transportation, water and wastewater, facilities, and emergency response functions that may be exposed to these hazards. Health-focused studies informed the consideration of vulnerable populations and equity-related impacts to ensure that differential risks are reflected in the assessment. The Province's Hazard Risk Impact Assessment (HIRA) Framework and peer municipal climate risk assessments helped inform the risk identification, evaluation, and prioritization approach. This review ensures that the LCHA is methodologically consistent with best practices and aligned with the County's policy context, funding requirements, and decision-making needs.



HISTORICAL CLIMATE & EMERGENCY REVIEW

Before examining future climate projections, it is important to understand how climate-related events have historically affected Oxford County and how the County has responded to these events. This section reviews historical climate conditions, significant climate-related emergency events, and near misses relevant to Oxford County to establish a baseline understanding of how climate risks have been experienced and managed to date. This historical perspective provides important context for identifying existing vulnerabilities, understanding response capacity, and informing subsequent stages of the LCHA.

The review draws on County records, Conservation Authority information, public health reports, insurance claims, historical weather data, and other relevant sources. It summarizes the types of climate hazards experienced, the associated impacts, and the emergency response and mitigation measures implemented by the County and its partners. Together, these examples highlight recurring challenges, demonstrate response capacity, and identify lessons from past events that can inform future risk management and climate adaptation planning.

SUMMARY OF EVENTS BY HAZARD TYPE

The historical climate-related events have been organized by hazard type to support a clear and consistent understanding of how different climate hazards have affected Oxford County. For each hazard, the summary highlights key events, affected locations, documented impacts, and notable response or mitigation actions. Grouping events in this way helps identify patterns in exposure and response and supports comparison across hazard types. The primary climate hazards identified through the historical record are reviewed in the summary below. This summary is not intended to be an exhaustive inventory of all historical climate events, but rather a focused overview of notable and well-documented events and near misses that illustrate how different climate hazards have affected Oxford County and the surrounding region.

Note: Insured loss values presented in this section reflect the total damages associated with each weather event across the broader region in which it occurred and are not limited to losses within Oxford County. These events either affected Oxford County directly or occurred within the same regional weather systems that influence the County's climate risk profile. The figures are provided to illustrate the scale of financial exposure associated with these types of hazards, rather than to represent site-specific damages.

EXTREME RAINFALL AND FLOODING

HOW DOES CLIMATE CHANGE IMPACT THIS EVENT?

A warmer atmosphere can hold more moisture, which increases the likelihood of heavier rainfall events that can overwhelm drainage systems and contribute to flooding (IPCC, 2021).

Flooding is the most frequent and persistent climate hazard affecting Oxford County, with impacts ranging from chronic basement flooding to institutional and infrastructure damage. Flooding events are most often driven by extreme rainfall, where short-duration, high-intensity precipitation overwhelms aging stormwater and sanitary systems, particularly in Woodstock, Tavistock, Norwich, Ingersoll, and surrounding rural areas.

Several events stand out due to their severity, recurrence, and financial impact. Between 1992 and 2006, Tavistock experienced four (4) major flooding events, including a 1-in-250-year storm, resulting in widespread basement flooding and extensive insurance claims. More recently, extreme rainfall events, including 175 mm in May 2006 (Tavistock), 125 mm over four (4) hours in July 2010 (Norwich-Woodstock), and more than 200 mm during August 2023 storms (County-wide), caused widespread road flooding, sewer surcharging, infrastructure stress, and property damage across the County.

Chronic flooding issues have also been documented along CN rail corridors, recycling facilities, and neighbourhoods with undersized or poorly graded drainage systems. In addition to direct property damage, flooding has caused road closures, unsafe travel conditions, service disruptions, and repeated wastewater system overflows, compounding environmental and public health risks.

RESPONSE AND/OR MITIGATION EFFORTS

Oxford County and local municipalities have implemented a range of structural, programmatic, and planning-based mitigation measures in response to flooding. Following repeated flooding in Tavistock, coordinated actions included the formation of a flood prevention working group, implementation of roof weeper disconnect programs, and completion of major stormwater and sanitary infrastructure upgrades through the Municipal Class Environmental Assessment process. These investments totaled approximately $5.2 million and proved effective during the May 2006 storm, when flood-proofed properties avoided basement flooding and no insurance claims were filed.

Elsewhere, mitigation efforts have included storm sewer inspections, rear-yard catch basin modifications, local berming, drainage channel improvements, targeted Environmental Assessment studies, Closed Circuit Television investigations, and drainage grading adjustments. Emergency responses typically involved road closures, public advisories, and deployment of municipal crews. More recent facility-specific responses have included rapid isolation of failed infrastructure, engagement of restoration contractors, continuity-of-operations planning, and broader facility flood-prevention reviews and leak-detection evaluations.

THUNDERSTORMS AND SEVERE STORMS

HOW DOES CLIMATE CHANGE IMPACT THIS EVENT?

Higher temperatures and moisture create conditions that can make storm systems produce more intense rainfall and related impacts (IPCC, 2021).

Severe thunderstorm events have repeatedly affected Oxford County, often occurring alongside or independent of flooding impacts. These storms are characterized by heavy rainfall, damaging winds, large hail, and lightning, and can result in power outages, transportation disruptions, and localized infrastructure damage even where flooding does not occur.

The summer of 2023 included several severe storms designated as “catastrophes,” with insured damage estimates exceeding $30 million, highlighting the growing financial exposure associated with convective storm systems. More recent thunderstorms in May and June 2024 produced damaging winds, large hail, and downed trees across Oxford County, leading to widespread power outages and road disruptions.

RESPONSE AND/OR MITIGATION EFFORTS

Responses to thunderstorm and severe storm events have included issuance of weather warnings, road closures, emergency wastewater bypasses where required, and rapid deployment of municipal and utility crews. In areas where flood mitigation measures had previously been implemented, impacts were often reduced, demonstrating the co-benefits of flood-focused adaptation actions for severe storm resilience.

WINDSTORMS, DERECHOS, AND TORNADOES

HOW DOES CLIMATE CHANGE IMPACT THIS EVENT?

Climate change is affecting the environmental conditions in which severe storms form, which can influence their behaviour even if individual events cannot be directly linked to climate change (IPCC, 2021).

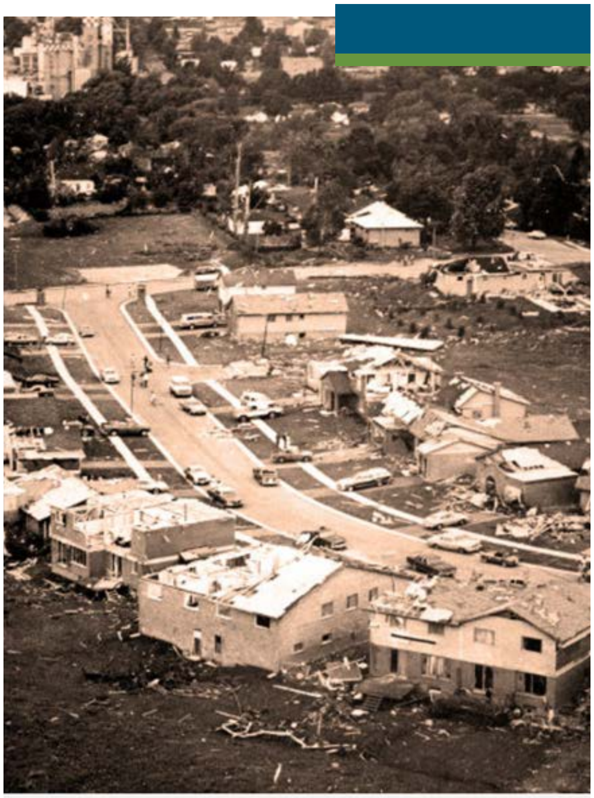
Oxford County has experienced multiple high-impact wind events, including tornadoes, downbursts, and derechos, resulting in fatalities, widespread power outages, and extensive structural and natural systems damage. **Figure 1** depicts the most catastrophic local event, which occurred in August 1979 when an F3 tornado struck Woodstock, killing two (2) people, injuring 142, and destroying more than $100 million in property, making it one of the most destructive tornadoes in the region's history.

More recent events demonstrate that severe wind remains an ongoing risk. The May 2018 windstorm caused three (3) fatalities and resulted in $680 million in insured losses, with at least $380 million in Ontario. A May 2022 derecho produced winds up to 120 km/h across Oxford County, downing trees and power lines and damaging buildings. Tornadoes and downbursts in 2020 (Beachville, Ingersoll, Zorra) caused structural and tree damage, while the January 2020 windstorm resulted in over $87 million in insured losses and power outages affecting more than one million people across Ontario and Quebec. Impacts from wind events consistently include extended power outages, downed hydro poles and lines, blocked roads, damage to homes and businesses, and risks to public safety.

RESPONSE AND/OR MITIGATION EFFORTS

Responses to severe wind events have focused primarily on emergency power restoration, debris removal, and public safety measures. Utility providers (Hydro One, municipal utilities) mobilized crews for multi-day restoration efforts, while police services managed road closures and restricted access to hazardous areas.

Following major tornado and downburst events, damage assessments were conducted, including specialized investigations by the Northern Tornadoes Project (undertaken by Western University). Community-level recovery often relied on insurance, volunteer efforts, and localized cleanup rather than formal disaster recovery programs unless damage thresholds were exceeded.



Manitoba Rd, Woodstock Aug 7, 1979

Figure 1: Aftermath damages on Manitoba Road in Woodstock after the August 1979 F3 Tornado (InstantWeather, 2019).

SNOWSTORMS, EXTREME SNOW, ICE STORMS, AND SNOW SQUALLS

HOW DOES CLIMATE CHANGE IMPACT THIS EVENT?

Warmer winters are changing how precipitation falls and when freezing conditions occur, leading to greater variability in snow and ice events rather than simply "less winter" (IPCC, 2021).

Winter storms represent a significant climate hazard in Oxford County resulting in transportation disruptions, facility and school closures, power outages, and prolonged recovery periods. Major ice storms in 2013, April 2023, and April 2025 affected hundreds of thousands to over one million households across Ontario, with impacts extending into Oxford County. These storms caused widespread tree and infrastructure damage, extended power outages lasting weeks in some areas, and significant public safety concerns.

Extreme snow and blizzard conditions in January and February 2025 resulted in unsafe roads, widespread closures, suspension of snowplow operations, and declarations of significant weather events. Snow squalls and early snowfalls have repeatedly disrupted transportation systems and institutional operations, including school and bus cancellations.

RESPONSE AND/OR MITIGATION EFFORTS

Mitigation and response measures for winter events have included activation of emergency plans, school and service closures, deployment of snowplows and salters, warming centres, public advisories, and coordination among municipalities, utilities, police, and public health units. During extreme events, travel advisories and non-essential travel restrictions have been issued to protect public safety. Long-duration ice storm recovery has required inter-provincial utility support, large-scale crew mobilization, and extended infrastructure repair efforts.

EXTREME HEAT

HOW DOES CLIMATE CHANGE IMPACT THIS EVENT?

Rising global temperatures are making heat waves more frequent, longer-lasting, and more intense, a trend that scientists attribute primarily to greenhouse gas emissions (IPCC, 2021).

Extreme heat represents a growing climate hazard in Oxford County, placing increasing stress on public health, buildings, infrastructure, and municipal operations. Recent heat events have been characterized by high daytime temperatures, elevated humidex values, and warm overnight conditions, which limit the body's ability to recover and increase the risk of heat-related illness.

Southwestern Public Health (SWPH) follows Environment and Climate Change Canada's evidence-based criteria for issuing heat warnings (see criteria summary below). These thresholds are designed to identify conditions that pose elevated health risks, particularly when high daytime temperatures are combined with warm overnight conditions that prevent recovery.

Once thresholds are met, alerts are communicated using standardized severity levels to help communities understand the degree of risk and required response. **Figure 3** outlines the new colour-coded weather alerts (e.g., Warnings, Advisories and Watches) put out by the Government of Canada. It should be noted that these are not exclusively used for heat-related events but also winter storms, rainfall events etc.

As seen in **Figure 2,** between 2022 and 2025, SWPH issued 14 separate heat alerts affecting Oxford County, which together spanned 45 cumulative days of extreme heat conditions. The duration of heat warning conditions varied by year, with 2025 experiencing the highest exposure (20 days).

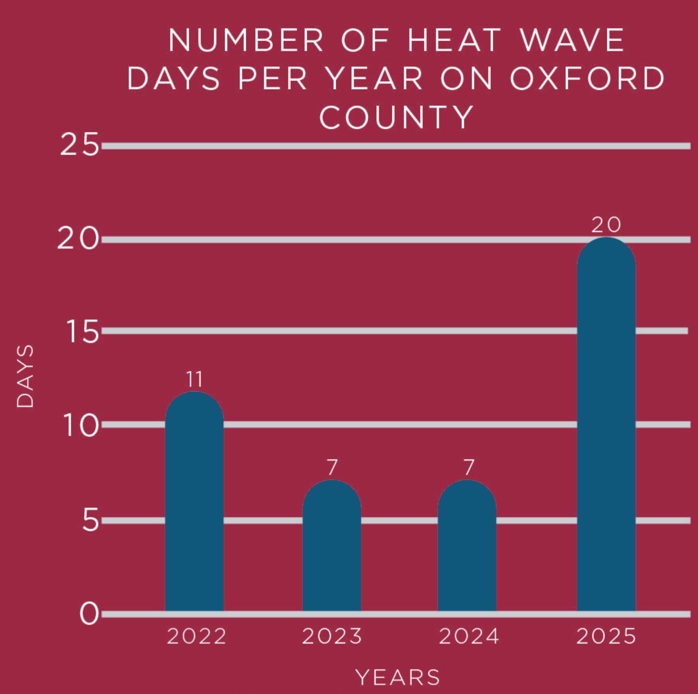


Figure 2: Number of heat wave days per year from 2022-2025 in Oxford County. Data provided by Southwestern Public Health.

Year-to-year weather variability is evident in heat wave occurrence; however, the elevated number of heat wave days in 2025 aligns with broader long-term climate trends observed across the region.

ENVIRONMENT AND CLIMATE CHANGE CANADA HEAT WARNING CRITERIA	
DAYTIME TEMPERATURE ≥ 31°C AND/OR HUMIDEX ≥ 40	✓
CONDITIONS PERSIST FOR 2 OR MORE CONSECUTIVE DAYS	✓
OVERNIGHT TEMPERATURE ≥ 20°C, LIMITING NIGHTTIME COOLING	✓

RESPONSE AND/OR MITIGATION EFFORTS

Responses have focused on public health advisories, promotion of cooling centres, hydration messaging, and targeted outreach to vulnerable populations.

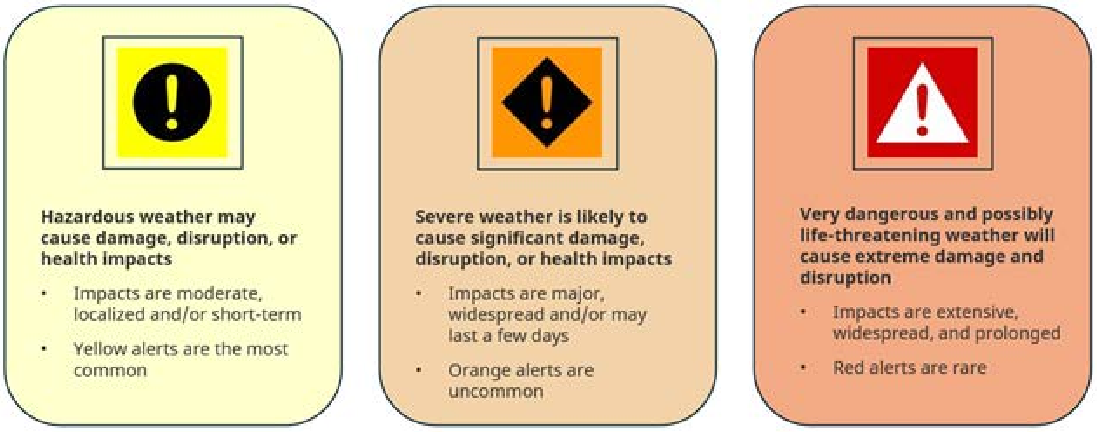


Figure 3: Description of the three colours and symbols for the weather alert system from the Government of Canada (Government of Canada, 2026).

AIR QUALITY AND WILDFIRE SMOKE

HOW DOES CLIMATE CHANGE IMPACT THIS EVENT?

Hotter, drier conditions increase the likelihood of wildfire-prone weather, which can lead to more frequent smoke events affecting air quality (IPCC, 2021).

Episodes of degraded air quality linked to wildfire smoke from Northern Ontario have increasingly affected Oxford County, often coinciding with extreme heat events. Smoke-related advisories issued in 2025 reduced outdoor air quality and posed respiratory risks, particularly for sensitive populations. These conditions disrupted outdoor activities and compounded heat-related health risks, highlighting the growing relevance of compound hazards involving heat, smoke, and humidity.

RESPONSE AND/OR MITIGATION EFFORTS

Public health responses included air quality advisories, guidance to reduce outdoor exposure, and coordination with Environment Canada to communicate evolving conditions.

DROUGHT

HOW DOES CLIMATE CHANGE IMPACT THIS EVENT?

Higher temperatures increase evaporation and dry out soils faster, which can intensify drought conditions even when rainfall changes are small (IPCC, 2021).

Prolonged periods of hot and dry weather have led to drought conditions and the issuance of fire bans in Oxford County and surrounding regions. These conditions increase wildfire risk, reduce soil moisture, and place stress on agricultural operations and natural ecosystems. Drought-related fire bans in August 2025, seen in **Figure 5**, demonstrate emerging climate pressures that extend beyond flooding and storms, particularly in rural and agricultural landscapes.

RESPONSE AND/OR MITIGATION EFFORTS

Drought conditions present a particular risk for Oxford County due to the County's primary reliance on groundwater as a drinking water source. Prolonged periods of low precipitation and reduced groundwater recharge can place direct pressure on municipal well systems, potentially affecting water availability and long-term aquifer sustainability. During past dry periods, the County has implemented water use restrictions in addition to fire bans, highlighting the sensitivity of local water resources to drought conditions and the importance of proactive water conservation and drought preparedness. Oxford County also promotes seasonal water conservation through its Water Conservation Program (May 1 to September 30), as seen in **Figure 4.** This program encourages residents and businesses to reduce non-essential outdoor water use, helping balance demand with available groundwater resources and support long-term water sustainability during periods of limited rainfall.

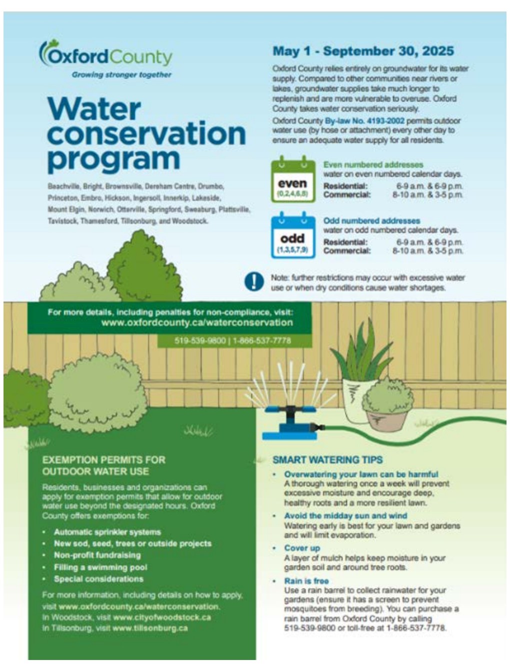


Figure 4: Oxford County Water Conservation Program infographic for 2025 (Oxford County, 2025).

Figure 5: City of Woodstock post on X (formerly Twitter) advising the public on the Fire Ban due to ongoing hot and dry conditions (X, 2025).

NEAR MISSES

An inventory of regional near-miss climate events was compiled to illustrate the magnitude and impacts of hazards affecting southern and southwestern Ontario. While these events did not result in major documented impacts within Oxford County, they occurred within comparable climatic and infrastructure contexts and represent credible future risk scenarios. A summary of near-miss event types and implications is provided in **Table 1** below.

Table 1: Near-Miss Event Types and Implications

Hazard Type	Representative Near-Miss Events	Typical Impacts Observed	Key Implications for Oxford County
SEVERE WIND, TORNADOES & DERECHOS	• May 1953 Port Huron-Sarnia Tornado • August 2005 Southern Ontario Tornado • August 2009 Southern Ontario Tornado • August 2011 Goderich Tornado • July 2013 Greater Toronto Area Thunderstorm • May 2018 Southwestern Ontario Thunderstorm • June 2020 London Tornado • August 2021 Severe Thunderstorm • May 2022 Northwestern Ontario Derecho • August 2024 North Dumfries Tornado	Fatalities and injuries; destruction of buildings; widespread power and gas outages; mass displacement; long-term recovery	Demonstrates upper-bound wind risk in Southwestern Ontario and the need for wind-resilient infrastructure, emergency preparedness, and effective warning systems
EXTREME RAINFALL AND FLOODING	• June 2014 Toronto Flash Flood • June 2017 Grand River Watershed Extreme Rainfall Event • August 2017 Windsor Flooding • February 2018 Grand River Watershed Flooding • April 2018 Southwestern Ontario Freezing/Extreme Rain Event • February 2019 Grand River Watershed Flooding • June 2023 Southwestern Ontario Extreme Rainfall Event • July 2024 Southern Ontario Extreme Rainfall Event • July 2025 Sarnia Extreme Rainfall Event	Basement flooding; overwhelmed stormwater systems; transit and roadway closures; hospital disruptions; insured losses in the hundreds of millions.	Highly relevant to stormwater capacity, flood forecasting, emergency response, and land-use planning in flood-prone areas

Hazard Type	Representative Near-Miss Events	Typical Impacts Observed	Key Implications for Oxford County
WINTER STORMS & ICE-RELATED FLOODING	• March 2025 Southern Ontario Ice Storm • August 2021 Southwestern Ontario Hail Storm • February 2025 Southwestern Ontario Snowstorm	Evacuations; prolonged power outages; infrastructure damage; transportation disruptions; fatalities	Highlights vulnerability to compound winter hazards and the importance of integrated winter emergency management and infrastructure resilience
SEASONAL VARIABILITY & TRANSITION-SEASON EXTREMES	• April 2016 Southern Ontario Seasonal Shifts • August 2021 Southwestern Ontario Hail Storm	Agricultural disruption; extended winter maintenance demands; infrastructure stress during shoulder seasons	Challenges assumptions about seasonal timing and underscores the need for flexible operational and planning approaches

Severe Windstorms, Derechos, and Tornadoes

Southern Ontario has experienced several high-consequence tornado outbreaks that narrowly missed Oxford County but illustrate the potential severity of wind hazards in the region. The 1953 Sarnia-Port Huron F4 tornado remains one of the most destructive tornadoes in Canadian history, killing seven (7) people, injuring dozens, leaving approximately 500 people homeless, and causing an estimated US$17.6 million in damages in 1953 (equivalent to ~CAD $18.5 million). While emergency response capacity was limited at the time, the event demonstrates the upper bound of tornado risk in Southwestern Ontario.

More recent outbreaks further underscore this risk. The Southern Ontario tornado outbreak of August 2005 (**Figure 6**) caused more than $500 million in damages, while the August 2009 outbreak, the largest single-day tornado outbreak in Canadian history, involved 19 confirmed tornadoes and affected nearly ten (10) million people through widespread warnings. The 2011 Goderich F3 tornado caused one fatality, injured 37 people, destroyed 54 buildings, and resulted in approximately $150 million in damages, despite occurring with some advance warning.

Figure 6: Damages from the August 2005 tornado in Southern Ontario (The Weather Network, 2021).

Extreme Rainfall and Flooding

Several near-miss events demonstrate the severe consequences of short-duration, high-intensity rainfall, a hazard highly relevant to Oxford County. The July 2013 Greater Toronto Area storm produced more than 100 mm of rain in a single day, overwhelming drainage systems during peak commuting hours. Impacts included widespread flash flooding, stranded vehicles, major transit shutdowns, evacuation of a GO Transit train carrying 1,400 passengers, and extensive power outages affecting hundreds of thousands of residents.

Additional flash flood events in 2014, 2017 (Grand River watershed), 2017 (Windsor–Essex), 2023, 2024, and 2025 produced rainfall totals exceeding 100 to 200 mm in short periods. Seen in **Figure 7**, the August 2017 Windsor event alone resulted in more than $124 million in insured damages, flooded over 1,000 basements, disrupted hospital operations, and caused widespread sewer backups. Province-wide extreme rainfall events in 2023 and 2024 resulted in insured losses exceeding $750 million and $1 billion, respectively, making them among the costliest flood seasons in Ontario history.

Figure 7: Flooding impacts from the August 2017 flood in Windsor, Ontario (CBC News, 2019).

Winter Storms, Ice Storms, and Seasonal Extremes

Near-miss winter events illustrate the vulnerability of Southern Ontario to compound cold-season hazards, including freezing rain, heavy snowfall, ice jams, and rain-on-snow events. The February 2018 Grand River watershed flooding combined extreme cold, ice formation, rainfall, and rapid snowmelt, resulting in widespread evacuations affecting up to 4,900 residents, damage to municipal infrastructure, and a fatality.

More recently, the February 2025 series of winter storms and the March 2025 ice storm (**Figure 8)** caused widespread power outages affecting hundreds of thousands of customers, school and service closures, transportation disruptions, and emergency declarations across multiple municipalities. These events demonstrate the potential for prolonged service interruptions, infrastructure damage, and public safety risks during extreme winter conditions.

Figure 8: Damages to a Barrie home from the March 2025 Ice Storm that caused power outages, school and road closures and many more impacts all across Southern Ontario (CTV News, 2025).

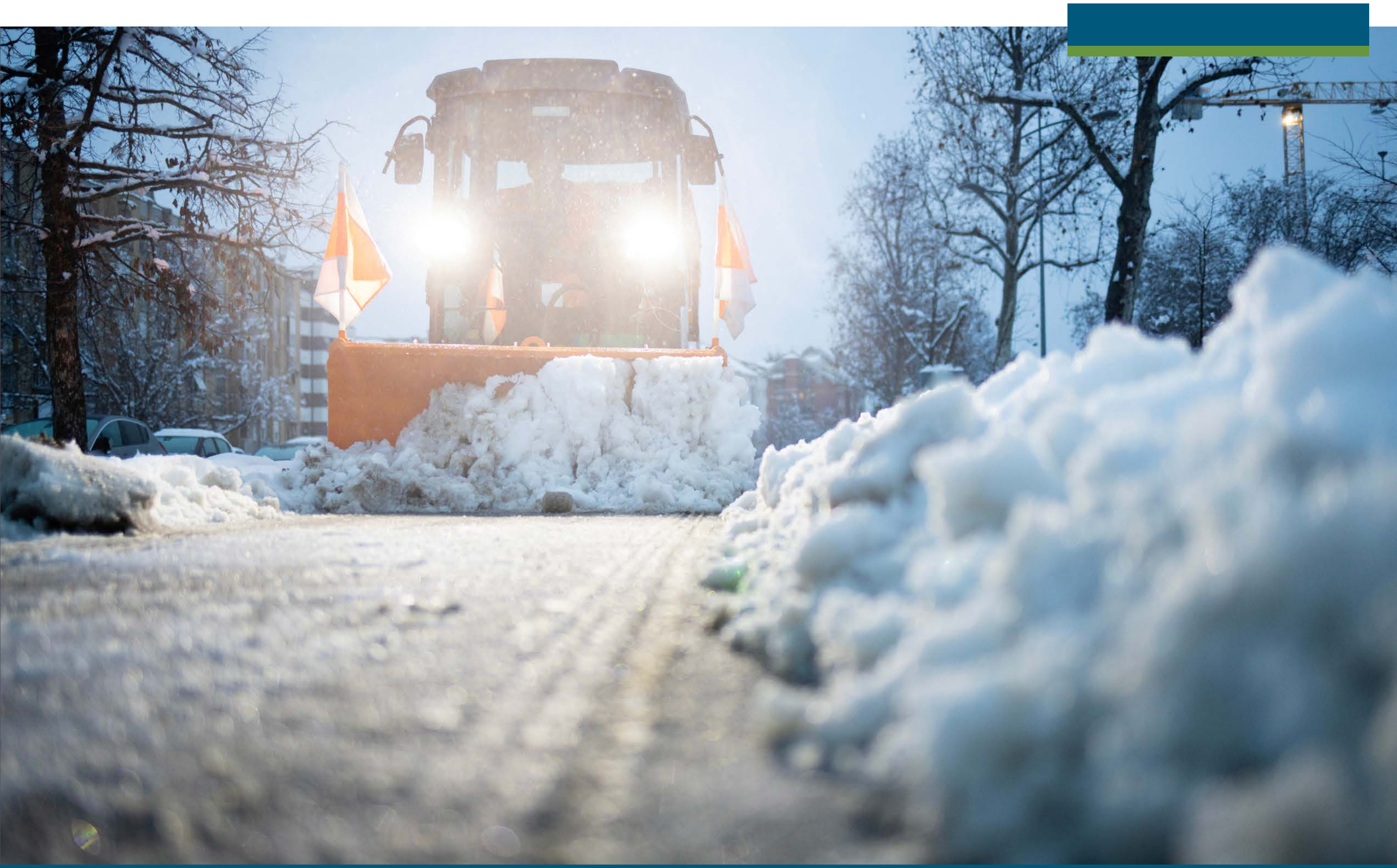
Seasonal Variability and Climate Extremes

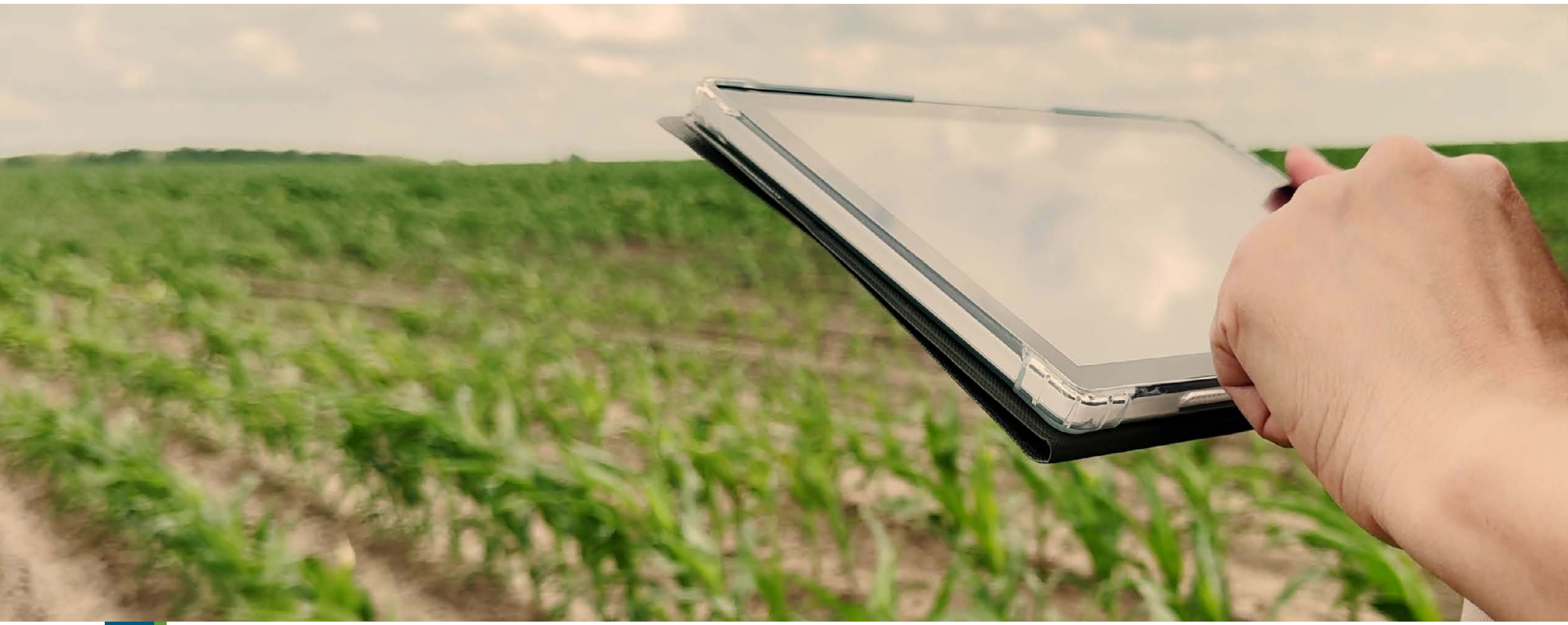
Near-miss events also illustrate increasing seasonal variability, including unusually late cold conditions in April 2016, extended winter impacts into the spring transition period, and rapid shifts between heat and severe storms. These events disrupted agricultural planning, extended winter maintenance demands, and challenged assumptions about seasonal preparedness. Documented response efforts to this category were limited.

GAP IDENTIFICATION

Review of documented climate-related events identifies gaps that limit a comprehensive understanding of climate-related risks and responses in Oxford County. These gaps relate primarily to the documentation of impact response actions, rather than the absence of response mechanisms themselves.

Event records often lack detailed asset-level impact information, clear timelines, quantified costs, and documentation of operational outcomes. Spatial and temporal details, such as the extent and duration of service disruptions, are inconsistently recorded, and event descriptions rarely reference specific meteorological thresholds. While emergency response procedures are generally in place, limited documentation of how these measures are implemented and perform during extreme events constrains learning and future planning. Improved documentation will be important to ensure response mechanisms remain effective and viable as climate conditions continue to change.





CLIMATE DATA ANALYSIS & FUTURE PROJECTIONS

This section presents the climate data analysis used to support the LCHA for Oxford County, providing a forward-looking understanding of projected changes in temperature, precipitation patterns, and extreme rainfall characteristics. The analysis supports the identification of priority climate hazards, assessment of risks to infrastructure and services, and the development of informed adaptation and resilience planning.

CLIMATE DATA ANALYSIS

Climate projections were analyzed to summarize expected long-term changes in key temperature and precipitation-related indicators for Oxford County. The data was acquired from ClimateData.ca, a Government of Canada supported platform that provides downscaled climate projections based on the Coupled Model Intercomparison Project Phase 6 (CMIP6). CMIP6 represents the latest generation of internationally peer-reviewed climate models used by the Intergovernmental Panel on Climate Change and is the current scientific standard applied by governments, researchers, insurers, and infrastructure planners worldwide (ClimateData.ca, 2025).

While the underlying models are global, the data used in this assessment are downscaled to reflect regional climate patterns specific to southwestern Ontario. Downscaling translates global model output to a finer spatial resolution and incorporates historical observations to better represent local conditions. This ensures that the projections reflect trends relevant to Oxford County rather than broad global averages.

These projections are not intended to predict specific daily weather events. Instead, they identify long-term shifts in temperature and precipitation patterns that influence infrastructure performance, agricultural conditions, emergency preparedness, and long-term asset management decisions. This approach is consistent with how engineers evaluate design standards and how insurers assess long-term risk exposure.

ClimateData.ca was developed in partnership with leading Canadian climate science institutions, including the Pacific Climate Impacts Consortium and Environment and Climate Change Canada, and is widely used by municipalities and provincial agencies across Canada. Applying downscaled CMIP6 projections through this platform represents current best practice in municipal climate risk and infrastructure planning.

Two (2) emissions scenarios were selected to represent: Shared Socio-economic Pathway (SSP) 2-4.5 (moderate emissions) and SSP5-8.5 (high emissions). SSPs represent standardized future development pathways that account for differences in population growth, economic development, energy use, and climate policy, and are commonly used to assess a range of plausible future climate conditions (ClimateData.ca, 2025). For all variables, the 50th percentile (median) value was used to represent typical future conditions and to reduce the influence of extreme projections.

Climate conditions were summarized using three standard 30-year periods:

- Historical baseline (1980–2010)
- 2050s (2041–2070)
- 2080s (2071–2100)

For each variable and emissions scenario, annual values were averaged across each 30-year period to produce a single representative value for that time horizon. **Table 2** below summarizes projected changes in key climate variables for Oxford County under moderate (SSP2-4.5) and high (SSP5-8.5) emissions scenarios. Values are presented for historical conditions and future time horizons to illustrate the direction and magnitude of change over time. Definitions of each climate variable can be found in **Appendix A**.

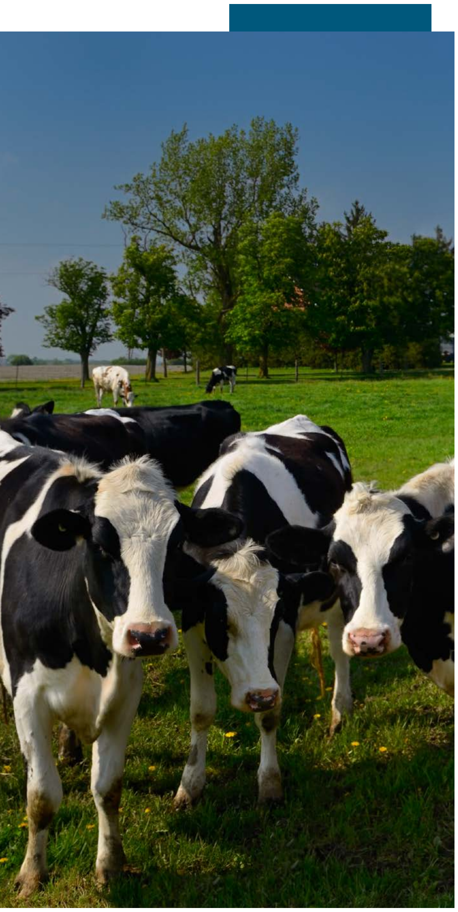


Table 2: Future Climate Projections for Oxford County Across Key Variables, Comparing SSP2-4.5 and SSP5-8.5 with Historical, 2050s, and 2080s Conditions.

Future Projected Climate Variables for Oxford County

Variables	Historical	SSP2-4.5				SSP5-8.5			
		2050s	2080s	Trendlines		2050s	2080s	Trendlines	
Mean Temperature	8.49	11.27	12.14	↑		12.08	14.43	↑	
Days Above Tmax (35°C)	0	1.66	3.37	↑		3.52	20	↑	
Days Below Tmin (-15°C)	11.92	1.41	0.14	↓		0.36	0	↓	
Last Spring Frost	2-May	19-Apr	13-Apr	↓		14-Apr	2-Apr	↓	
First Fall Frost	13-Oct	27-Oct	1-Nov	↑		31-Oct	17-Nov	↑	
Frost-Free Season	~5.5 months	~6.5 months	~6.8 months	→		~6.8 months	~7.8 months	→	
Frost Days	134.23	99.7	88.23	↓		88.98	58.45	↓	
Freeze–Thaw Cycles	80.53	68.86	63.57	↓		64.57	49.31	↓	
Total Precipitation (mm)	1021.75	1103.97	1117.99	↑		1109.05	1155.67	↑	
Max Consecutive Dry Days	13.55	13.59	14.43	↑		14.10	14.71	↑	
Max Consecutive Wet Days	7.23	7.64	7.74	↑		7.57	7.67	↑	
Cooling Degree Days (Above 18°C)	286.56	553.32	655.97	↑		634.84	1002.25	↑	
Heating Degree Days (Below 18°C)	3799.54	3052.92	2844.47	↓		2856.61	2335.41	↓	
Growing Degree Days (Above 5°C)	2319.04	2921.51	3127.72	↑		3097.95	3752.64	↑	

IDENTIFICATION OF VULNERABLE POPULATIONS

Climate change does not affect all people or communities equally. The impacts of extreme heat, flooding, severe storms, power outages, and other climate-related hazards are often felt most acutely by populations who already face social, economic, health, or housing-related challenges. Limited financial resources, pre-existing health conditions, language barriers, inadequate housing, and reduced access to services can all constrain a household's ability to prepare for, withstand, and recover from climate-related events. As climate hazards increase in frequency and severity, these existing inequities can compound, resulting in disproportionate impacts on certain populations and neighbourhoods.

In Oxford County, understanding who is most at risk and why is critical for effective and equitable climate adaptation planning. To support this analysis, the Canadian Index of Social Vulnerability (CISV) and the Canadian Index of Social Resilience (CISR) were utilized for this analysis. Both datasets are derived from Statistics Canada census data, reported as quintile-based scores at the dissemination area level and capture key socio-economic factors influencing sensitivity and adaptive capacity.

The Climate Insight Tool was used to spatially integrate these indices with climate exposure variables, including maximum 1-day precipitation, freeze-thaw days, and the frequency of maximum temperatures exceeding 30°C. This integrated approach identifies areas where high social vulnerability coincides with elevated climate exposure, supporting the prioritization of needs-based adaptation actions across Oxford County.

The CISV, CISR, and Climate Insight analyses are intended to answer three related questions:

- Where might people be more affected by climate events? (CISV – Social Vulnerability
- Where may communities have stronger or weaker capacity to cope and recover? (CISR – Social Resilience)
- Where do changing climate hazards overlap with those conditions? (Climate Insight – Compounded Risk)

These tools do not measure climate hazards alone. Instead, they show how local social conditions, such as housing, income, age, mobility, and community stability, can influence how strongly climate impacts are felt and how easily recovery can occur.

THE CANADIAN INDEX OF SOCIAL VULNERABILITY (CISV)

The CISV reflects the extent to which social and economic conditions may increase the severity of climate-related impacts on populations. It captures characteristics that can constrain a community's ability to respond during emergencies or recover following disruptive events.

The CISV is expressed using quintiles ranging from 1 to 5, where:

- **Quintile 1** represents the lowest social vulnerability
- **Quintile 3** represents moderate social vulnerability
- **Quintile 5** represents the highest social vulnerability

These quintiles are relative measures, meaning they compare conditions across geographic areas rather than defining absolute thresholds of risk. As such, they are best interpreted as indicators of where social vulnerability is higher or lower within the study area.

Higher CISV scores indicate areas with relatively greater social vulnerability, where climate-related hazards may result in disproportionate impacts or longer recovery times. These areas may face barriers such as limited financial capacity, health-related constraints, or reduced access to information and services during extreme events (Statistics Canada, 2025).

RESULTS

Figure 9 presents the spatial distribution of social vulnerability across Oxford County based on the Canadian Index of Social Vulnerability (CISV). These results illustrate how underlying social and economic conditions vary geographically and provide context for identifying areas where climate-related impacts may be more pronounced. Enlarged maps of each regional municipality are presented in **Appendix B.**

"IDENTIFY OPPORTUNITIES TO STRENGTHEN COMMUNITY RESILIENCE TO CLIMATE-RELATED IMPACTS"

CISV INDICATORS

- Population in low income
- Median household income (lower values)
- Median dwelling value (lower values)
- Unemployment rate
- Population not in the labour force
- Population receiving social assistance as main source of income
- Population receiving employment insurance benefits
- Population receiving government pension benefits as main source of income
- Population without a high school diploma (or equivalent)
- Population aged 65 years or older
- Older adults (65+) living alone
- One-parent families with more than three children
- Population reporting persistent physical activity limitations
- Population reporting persistent psychological activity limitations
- Dwellings deemed not acceptable
- Dwellings with five or more storeys
- Recent movers (within the last five years)
- Population identifying as racialized
- Recent immigrants (within the last five years)
- Population with no working knowledge of English or French
- Population identifying as Indigenous
- Geographic remoteness

The CISV map for Oxford County (**Figure 9**) indicates higher levels of social vulnerability in Woodstock, Tillsonburg, Ingersoll, and portions of Norwich, as shown in red, orange, and yellow. These areas exhibit greater sensitivity to climate related impacts and may face additional barriers to preparing for, responding to, and recovering from disruptive events.

Higher social vulnerability is observed in several of Oxford County's urban centres; however, this pattern is not driven by population size alone. The CISV reflects the concentration of socio economic and demographic characteristics associated with increased sensitivity and reduced adaptive capacity. Urban areas such as Woodstock, Tillsonburg, and Ingersoll tend to have higher proportions of renters, lower income households, seniors, and individuals with mobility or access constraints, which contributes to relatively higher vulnerability scores.

In some cases, areas within smaller municipalities or rural communities may also appear in higher CISV quintiles, as observed in portions of Norwich. This does not necessarily indicate higher levels of deprivation in the traditional sense. Rather, it reflects the combined influence of several demographic and socio economic indicators used in the CISV methodology. Rural areas may score higher on certain indicators such as older age distributions, lower labour force participation, smaller household incomes relative to regional averages, or greater geographic distance from services and supports.

It is therefore important to interpret the CISV as an indicator of relative sensitivity and adaptive capacity, rather than a measure of absolute risk or hardship. In the context of climate resilience planning, these results help identify where additional consideration may support inclusive emergency planning, communication strategies, and service delivery across the County.

KEY CONSIDERATIONS

Higher CISV scores in Oxford County's settlement areas reflect the concentration of socio-economic and built-environment characteristics associated with increased sensitivity to climate impacts. These areas tend to include:

- Greater proportions of lower-income households, renters, seniors, and residents with mobility or access constraints
- More impervious surfaces and older housing stock, which can increase exposure to heat and localized flooding
- Reliance on shared infrastructure and services that may be disrupted during extreme events

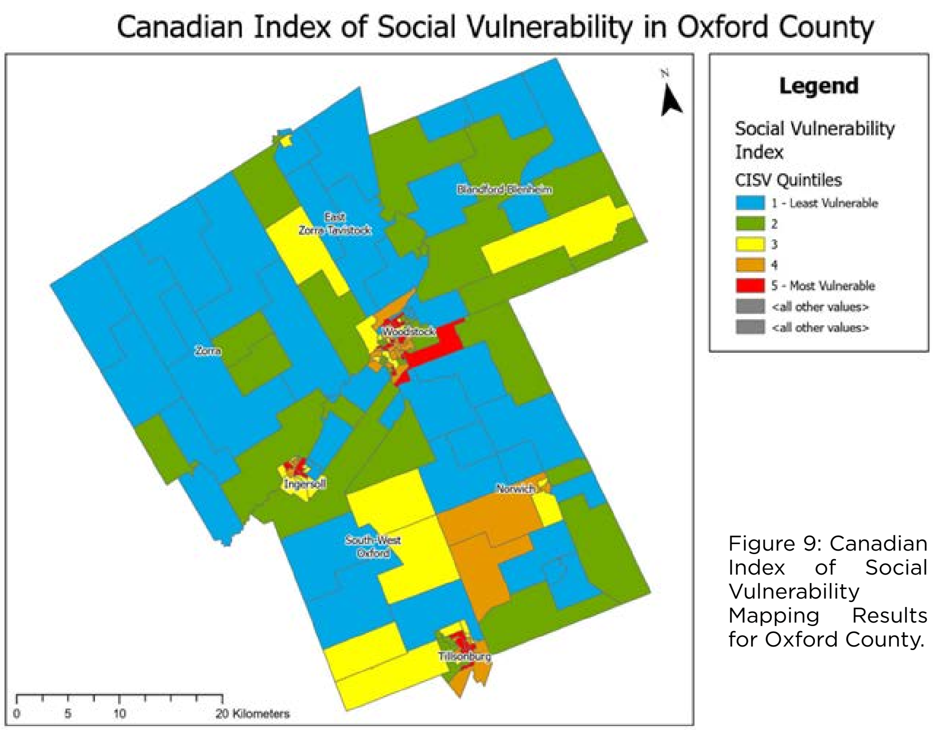


Figure 9: Canadian Index of Social Vulnerability Mapping Results for Oxford County.

Lower CISV scores in rural areas generally reflect higher home ownership, residential stability, and fewer indicators of socio-economic deprivation. This does not indicate lower climate risk, but rather different vulnerability pathways, as CISV measures social conditions rather than hazard exposure.

THE CANADIAN INDEX OF SOCIAL RESILIENCE (CISR)

The CISR captures community-level characteristics that support adaptive capacity and recovery from climate-related hazards. Rather than focusing on susceptibility, the CISR highlights strengths that can help buffer climate impacts and support effective response.

The CISR is expressed using quintiles ranging from 1 to 5, where:

- **Quintile 1** represents the lowest social resilience
- **Quintile 3** represents moderate social resilience
- **Quintile 5** represents the highest social resilience

Once again, these are relative measures, meaning they compare conditions across geographic areas rather than defining absolute thresholds of adaptive capacity. They should therefore be interpreted as indicators of where social resilience is stronger or weaker within the study area.

Higher CISR scores indicate greater relative social resilience, suggesting communities may be better positioned to cope with disruptions and recover more quickly following climate impacts. Lower CISR scores point to reduced adaptive capacity, where even moderate hazards may result in outsized social or economic consequences (Statistics Canada, 2025).

CISR INDICATORS

- Population with a high school diploma (or equivalent) or higher
- Population with a bachelor's degree or higher
- Employment in creative class occupations
- Labour force employment rate
- Workforce not concentrated in a single employment sector
- Population that has not moved in the last five years
- Median household income
- Population not in low income
- Median value of dwellings
- Proportion of permanent dwellings
- Dwellings built after 1980
- Population under 65 years of age
- Population without persistent difficulties in activities of daily living

RESULTS

Figure 10 presents the spatial distribution of social resilience across Oxford County based on CISR data. These results highlight geographic patterns in adaptive capacity and provide context for understanding where communities may be better positioned to respond to and recover from climate-related impacts. Enlarged maps of each regional municipality are presented in **Appendix B.**

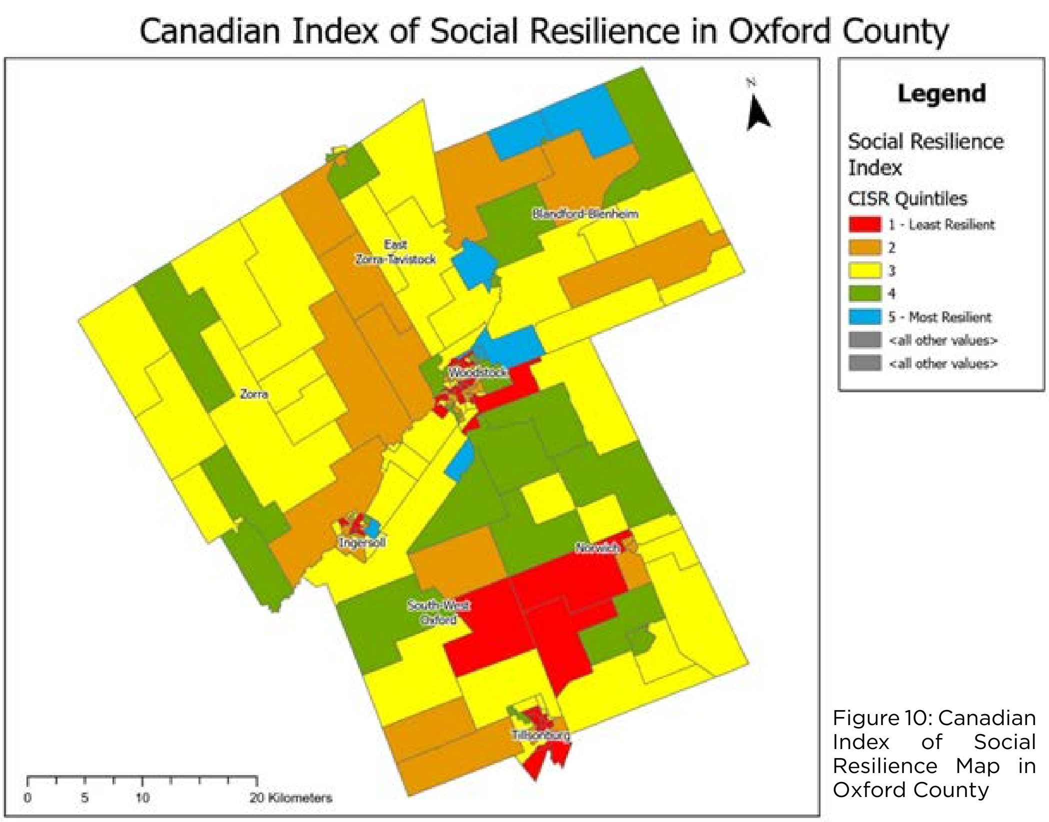


Figure 10: Canadian Index of Social Resilience Map in Oxford County

The CISR map for Oxford County (**Figure 10**) indicates lower levels of social resilience in Woodstock, Tillsonburg, Norwich, parts of South-West Oxford, and Ingersoll, as shown in red, orange, and yellow.

These areas exhibit reduced adaptive capacity, suggesting greater sensitivity to climate-related impacts and more limited ability to prepare for, respond to, and recover from climate stressors. In contrast, the remaining areas display higher relative levels of social resilience, indicating stronger capacity to cope with and recover from changing climate conditions.

KEY CONSIDERATIONS

Areas with higher CISR scores demonstrate characteristics associated with adaptive capacity and recovery, including:

- Housing stability and longer-term residency
- Indicators of economic security
- Strong social networks and informal support systems

These factors can support community response and recovery during climate disruptions. Lower CISR scores in some settlement areas reflect greater socio-economic diversity and household constraints that may limit flexibility to adapt, even where services are nearby.

CLIMATE INSIGHT TOOL

To further integrate social vulnerability and climate exposure, the Climate Insight Tool was used. This spatial analysis platform overlays climate hazard projections with socio-economic indicators to identify areas of compounded climate risk. The tool supports place-based climate risk assessment by combining projected changes in key climate variables with social vulnerability metrics at a fine spatial scale.

For this assessment, social vulnerability was combined with three priority climate exposure variables:

- Maximum 1-day precipitation
- Freeze-thaw days
- Maximum temperature exceeding 30°C

These variables were selected to represent major climate stressors affecting Oxford County, including extreme rainfall and flooding risk, infrastructure stress and surface degradation, and extreme heat exposure with implications for public health and infrastructure performance.

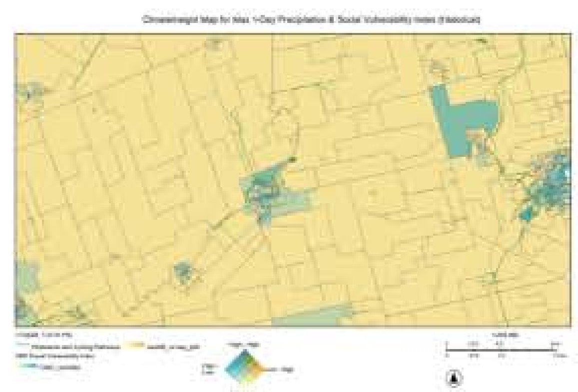
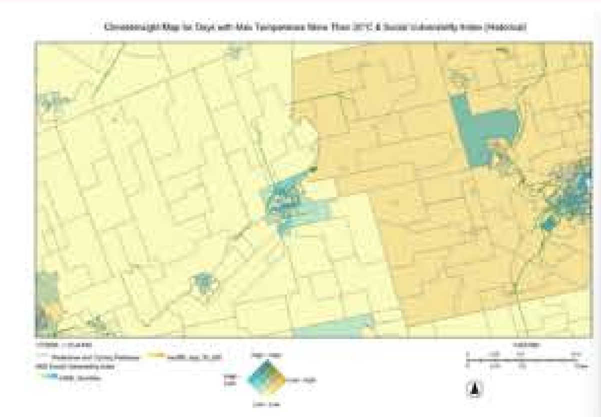
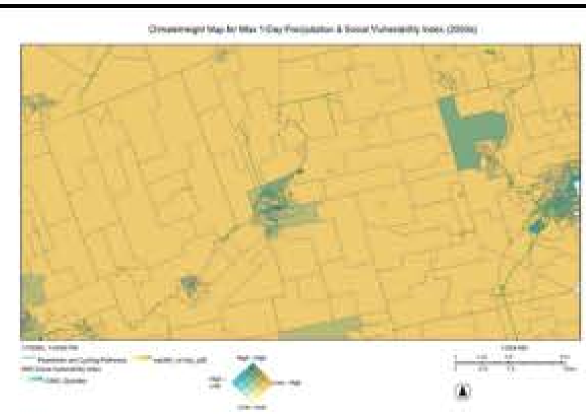
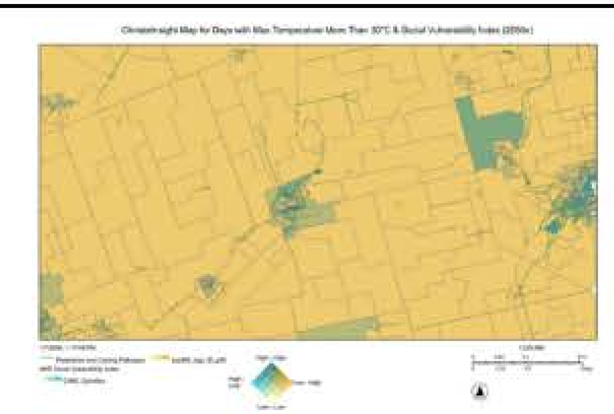
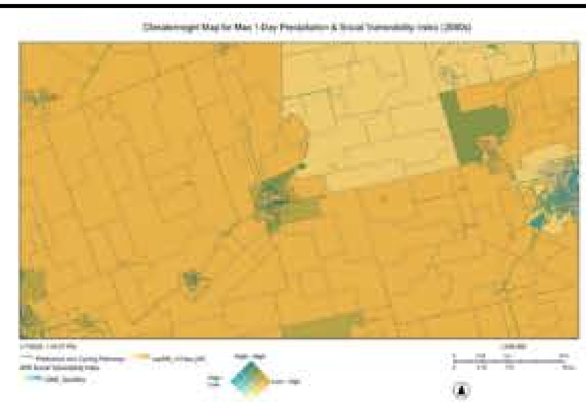
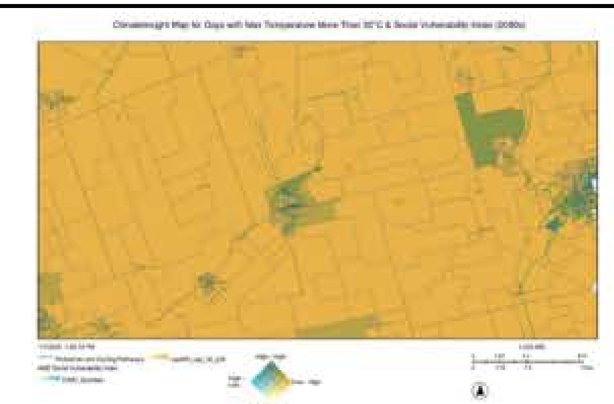
Climate Insight maps were generated for three (3) time horizons: historical baseline conditions, 2050s, and 2080s under a high emissions scenario (SSP5-8.5). Each map displays the spatial coincidence of climate exposure and social vulnerability, highlighting areas where high CISV values intersect with elevated climate hazard intensity.

RESULTS

The results illustrate how projected climate exposure interacts with underlying social vulnerability across Oxford County. By comparing historical conditions with the 2050s and 2080s under a high emissions scenario (SSP5-8.5), the maps demonstrate both the spatial concentration of compounded risk and how that risk is expected to change over time.

Across all three variables, areas of highest compounded exposure generally align with the County's primary settlement areas, particularly Woodstock, Tillsonburg, and Ingersoll, where higher population density and elevated social vulnerability coincide with increasing climate stress. The maps for each variable are presented in Table 3 below, with enlarged versions provided in **Appendix C**.

TABLE 3: SPATIAL OVERLAP OF SOCIAL VULNERABILITY AND PROJECTED CLIMATE HAZARDS IN OXFORD COUNTY UNDER HISTORICAL, 2050S, AND 2080S CONDITIONS (SSP5-8.5)

Timeline	Maximum 1-day precipitation	Freeze-thaw days	Maximum temperature exceeding 30°C
Historical			
2050s			
2080s			

Maximum 1-Day Precipitation

Historically, elevated exposure to intense rainfall is already evident in urban areas where drainage systems, transportation routes, and higher-density housing increase sensitivity to flooding. By the 2050s and more prominently by the 2080s, these areas expand and intensify, indicating a growing likelihood of stormwater exceedance, localized flooding, and service disruption occurring where populations may face greater recovery challenges.

Freeze–Thaw Days

Although the overall number of freeze–thaw cycles is projected to decline with warming temperatures, the maps indicate that winter-related risks remain relevant. Transitional winter conditions, including mid-season thaws, ice events, and rain-on-snow, continue to intersect with vulnerable areas, maintaining the potential for infrastructure stress, surface deterioration, and transportation disruption.

Maximum Temperature Exceeding 30°C

Extreme heat shows the most significant projected change. While historically limited, exposure increases substantially by the 2050s and becomes widespread by the 2080s. The strongest compounded risk remains focused in settlement areas, where higher concentrations of sensitive populations and built environments amplify heat-related health and infrastructure impacts.

KEY CONSIDERATIONS

The Climate Insight analysis identifies where projected climate changes intersect with underlying social vulnerability, highlighting areas of compounded risk rather than areas of high exposure alone. In Oxford County, these overlaps are most evident in Woodstock, Tillsonburg, and Ingersoll, where:

- Built form and land cover intensify heat and runoff effects
- Infrastructure and population characteristics increase sensitivity to disruption
- Climate stressors are projected to intensify through the 2050s and 2080s

Rural areas may experience significant climate hazards but show lower compounded risk where high exposure does not coincide with elevated social vulnerability.

"SUPPORTING THE PRIORITIZATION OF EQUITY-FOCUSED ADAPTATION ACTIONS ACROSS OXFORD COUNTY"

CROSS CUTTING FACTORS INFLUENCING VULNERABILITY AND RESILIENCE

Several common factors help explain the patterns observed across the CISV, CISR, and Climate Insight analyses. These factors reflect how social conditions, settlement form, and infrastructure interact with climate hazards to shape local risk.

Settlement structure and population characteristics

Settlement areas often contain higher concentrations of diverse socio-economic conditions, including lower-income households, renters, seniors, and residents facing mobility or access challenges. These characteristics can influence how strongly climate disruptions are experienced and how easily households can respond.

Built environment and infrastructure exposure

Urban areas concentrate impervious surfaces, transportation networks, and older building stock, which can intensify heat retention, increase runoff during extreme rainfall, and heighten sensitivity to service disruptions during climate events.

Access to services versus ability to use them

Proximity to services does not always translate into adaptive capacity. Barriers such as mobility, awareness, housing tenure, or financial flexibility may limit the ability of some residents to access cooling centres, emergency information, or property-level adaptation measures.

Different expressions of risk in rural areas

Lower measured social vulnerability in rural areas often reflects housing stability, home ownership, and strong community cohesion. This does not imply lower climate risk; rather, rural impacts may occur through different pathways, including agricultural stress, transportation disruption, or limited access to centralized services.

Together, these shared dynamics provide context for understanding how climate exposure and community characteristics combine to influence where impacts may be felt most acutely across Oxford County.

HOW DOES CLIMATE CHANGE AFFECT NATURAL SYSTEMS IN OXFORD COUNTY?

OXFORD COUNTY'S NATURAL SYSTEMS

Oxford County's landscape is defined by its agricultural lands, river systems, and scattered natural features that support ecological and community health across the region. The County spans portions of four Conservation Authority watersheds, including the Upper Thames River, Grand River, Catfish Creek, and Long Point Region. Together, these watersheds contain woodlands, wetlands, watercourses, meadows, thickets, water features, and connected vegetation features distributed across the County.

While these natural features are present throughout the County, they occupy a relatively small share of the overall land base. Woodlands and wetlands occur as individual patches of varying size and condition, often separated by agricultural land uses or infrastructure. In many areas, natural features are not continuous but instead function as fragmented systems connected primarily along valleylands and watercourses

Landscape characteristics relevant to natural systems in Oxford County include the presence of fragmented vegetation patches, areas of altered drainage associated with agricultural land use, and varying degrees of spatial separation between natural features. Valleylands, riparian areas, and associated vegetation form prominent components of the County's natural landscape framework (Oxford County, 2023).

Figure 11: Ontario Ecozones displaying Southern and Southwestern Ontario in the Mixedwood Plains Ecozone.

Oxford County lies within the Mixedwood Plains Ecozone, the smallest terrestrial ecozone in Canada. Despite its limited size, this region is one of the country's most productive and populated ecological areas, with fertile soils, a generally mild climate, and an extensive network of rivers and wetlands shaped by past glacial activity. Historically dominated by mixed forests, much of the land has been converted to agriculture and settlement, making the remaining natural areas important for biodiversity and ecological function (Government of Ontario, 2026).

CLIMATE IMPACTS ON ECOSYSTEM SERVICES

Natural systems provide critical ecosystem services that support communities, agriculture, and economic activity in Oxford County. These services include:

- Flood regulation and erosion control
- Water filtration and groundwater recharge
- Carbon storage and climate regulation
- Habitat provision and biodiversity support
- Pollination
- Recreational and cultural benefits

Forests, wetlands, rivers, and groundwater systems collectively support these functions. When natural systems are healthy and connected, they help buffer the County from climate variability. When they are stressed or degraded, the services they provide can decline.

Climate change is expected to increase pressure on these systems. Rising temperatures, more frequent heat waves, shifting precipitation patterns, prolonged dry periods, and more intense rainfall events are projected to compound existing pressures related to agriculture, land use change, drainage alterations, and habitat fragmentation. As climate-driven disturbances intensify, the ability of natural systems to function effectively and recover from stress is increasingly compromised (Climate Risk Institute, 2023).

ECOSYSTEM SERVICES FROM NATURAL SYSTEMS

Provisioning services such as food and timber.

Regulating services such as flood protection and carbon sequestration.

Cultural services such as places to play and discover.

Supporting Services such as soil formation, habitat connectivity, and nutrient cycling.

The Provincial Climate Change Impact Assessment identifies fauna, aquatic ecosystems, and ecosystem services, particularly regulating and provisioning services, as areas experiencing elevated climate risk in Southwestern Ontario under both mid-century (2050s) and late century (2080s) scenarios. Within the Southwestern region, risk levels are projected to increase over time, with several natural environment categories shifting from moderate risk under current conditions to high risk by the 2080s.

SUMMARY OF CLIMATE CHANGE IMPACTS ON NATURAL SYSTEMS

Hazard	Impacts	Secondary Impacts (Consequences)
Extreme Rainfall	Altered soil structure, infiltration, and runoff dynamics	Increased overland flow, erosion, and sediment transport; higher vulnerability of landscapes to damage
	Vegetation damage, mortality, and canopy loss	Uprooting and loss of established vegetation; reduced habitat structure and ecosystem services
	Water quality degradation and aquatic habitat stress	Increased sediment and nutrient loading; algal blooms; degradation of fish and aquatic habit
Shifting Precipitation Patterns	Hydrologic regime alteration and water availability changes	Changes in timing and magnitude of seasonal flows; flooding or drying of sensitive habitats; reduced spawning success

Hazard	Impacts	Secondary Impacts (Consequences)
Drought	Hydrologic regime alteration and water availability changes	Drying of wetlands; reduced aquatic habitat; thermal stress on fish; lower streamflow for spawning
Extreme Heat	Vegetation damage, mortality, and canopy loss	Reduced tree growth; increased forest mortality; declining carbon storage and shading capacity
	Species redistribution, invasive species expansion, and biodiversity loss	Loss of cold-adapted species; shifts in species ranges; long-term restructuring of ecosystems
	Ecosystem stress, reduced resilience, and functional degradation	Reduced ecosystem productivity; increased vulnerability to compounding climate stressors
Increased Wildfire Risk	Vegetation damage, mortality, and canopy loss	Loss of forest habitat; reduced carbon sequestration capacity
	Altered soil structure, infiltration, and runoff dynamics	Soil instability; increased erosion and runoff following fire
	Water quality degradation and aquatic habitat stress	Ash and sediment deposition in watercourses; increased phosphorus and nitrogen concentrations
Warmer Water Temperatures	Water quality degradation and aquatic habitat stress	Reduced dissolved oxygen; stress and mortality for cold-water fish; increased harmful algal blooms and microorganisms
Freeze–Thaw Changes	Altered soil structure, infiltration, and runoff dynamics	Reduced soil infiltration capacity; increased erosion during heavy precipitation or rapid snowmelt
Multiple Climate Stressors	Ecosystem stress, reduced resilience, and functional degradation	Increased susceptibility to pests, disease, wildfire, and extreme events; declining ecosystem resilience and adaptive capacity
	Species redistribution, invasive species expansion, and biodiversity loss	Replacement of native species with climate-favoured and invasive species; long-term loss of regional biodiversity
	Habitat fragmentation and connectivity loss	Reduced wildlife movement and breeding success; reduced genetic diversity and long-term ecosystem stability

POSSIBLE FUTURES UNDER CLIMATE CHANGE

Natural systems in Oxford County are shaped by both climate and land use. As climate conditions shift, increasing heat, altered precipitation, and seasonal variability are expected to influence ecosystem structure and function across the County. In areas where natural features are already limited and fragmented, these changes may reduce resilience and increase sensitivity to disturbance.

Extreme Rainfall and Changing Precipitation Patterns

Projected Climate Trend

More frequent heavy rainfall events and seasonal shifts in the timing and intensity of precipitation events.

Site and Landscape Implications

- More localized flooding and ponding
- Higher runoff when soils cannot absorb water fast enough
- Increased erosion and sediment movement
- Greater risk of tree uprooting in saturated soils, especially along riparian corridors

Implications for Natural Systems

- Sediment and nutrients can wash into streams and wetlands, reducing water quality
- Aquatic habitats may become stressed, with higher risk of algal growth
- Seasonal flow changes can flood or dry sensitive habitats and disrupt spawning and other life-cycle processes

Drought and Low Water Conditions

Projected Climate Trend

Longer periods of drought and reduced water availability affecting wetlands, streams, and shallow groundwater-dependent ecosystems.

Site and Landscape Implications

- Lower water levels in wetlands and streams
- Reduced streamflow and drying of smaller watercourses
- Soil moisture deficits that stress vegetation
- Reduced connectivity within river systems

SUMMARY OF FUTURE CLIMATE TRENDS IN OXFORD COUNTY

Based on the projected future trend, under a high emissions scenario, the following long-term changes are indicated for Oxford County.

BY 2050s:

- Annual mean temperature will increase by ~3.5°C
- The number of extreme heat days (over 35°C) will more than triple
- The intensity of extreme storms will increase by 16%
- The growing season will be The growing season will be ~34% longer

BY 2080s:

- Annual mean temperature will increase by ~6°C
- The number of extreme heat days (over 35°C) will occur 20 times more frequently
- The intensity of extreme storms will increase by 30%
- The growing season will be ~62% longer

Implications for Natural Systems

- Loss of aquatic habitat and increased thermal stress on fish and other aquatic species
- Limited species movement and reduced reproductive success
- Stress on terrestrial vegetation, particularly in wetlands and low-lying woodlands
- Reduced overall ecosystem resilience

Extreme Heat and Rising Temperatures

Projected Climate Trend

Increasing average temperatures and more frequent extreme heat events, including warmer air and water temperatures.

Site and Landscape Implications

- Sustained thermal stress on forests and vegetation
- Reduced forest growth and increased tree mortality
- Greater vulnerability to pests and disease
- Increased wildfire risk during extended dry periods
- Warmer rivers, streams, lakes, and wetlands

Implications for Natural Systems

- Species may exceed thermal tolerance thresholds, leading to range shifts and population decline
- Long-term changes in species composition and ecosystem structure
- Reduced dissolved oxygen in water bodies, increasing stress and mortality for cold-water and temperature-sensitive species
- Increased likelihood of harmful algal blooms and microbial growth
- Loss of forest habitat, release of stored carbon, and impacts to soil stability and nearby watercourses following wildfire

Freeze-Thaw Changes

Projected Climate Trend

Warming winter temperatures and more frequent freeze-thaw cycles.

Site and Landscape Implications

- Reduced soil infiltration capacity
- Increased susceptibility to soil erosion
- Greater runoff during heavy precipitation or rapid snowmelt
- Soil instability and damage to root systems
- Altered nutrient cycling

Implications for Natural Systems

- Reduced vegetation health
- Increased erosion affecting nearby watercourses
- Disruption of soil structure and moisture balance
- Impacts to overall ecosystem function

Multiple Climate Stressors

Projected Climate Trend

The combined and interacting effects of heat, drought, extreme rainfall, and seasonal shifts over time.

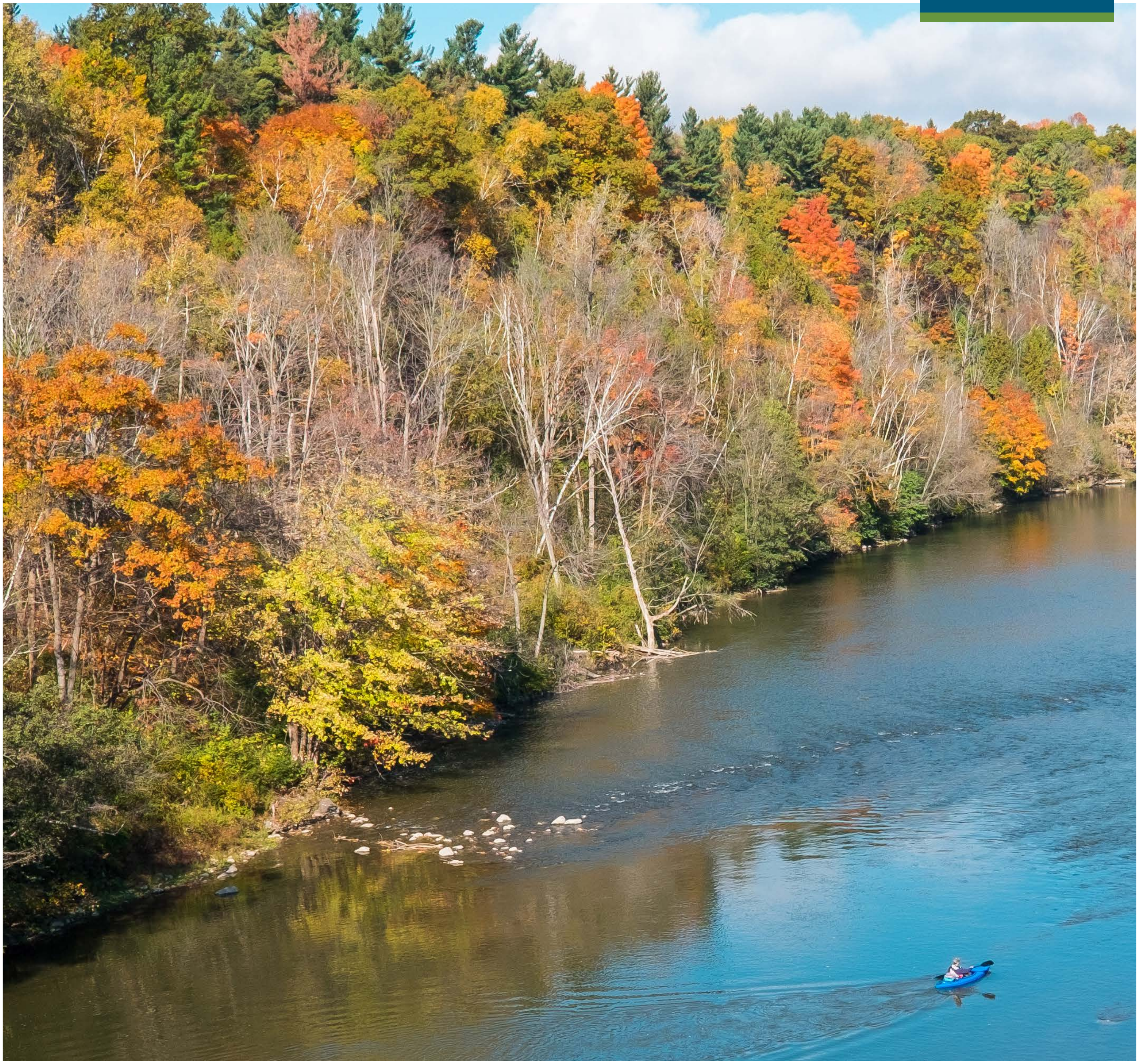
Site and Landscape Implications

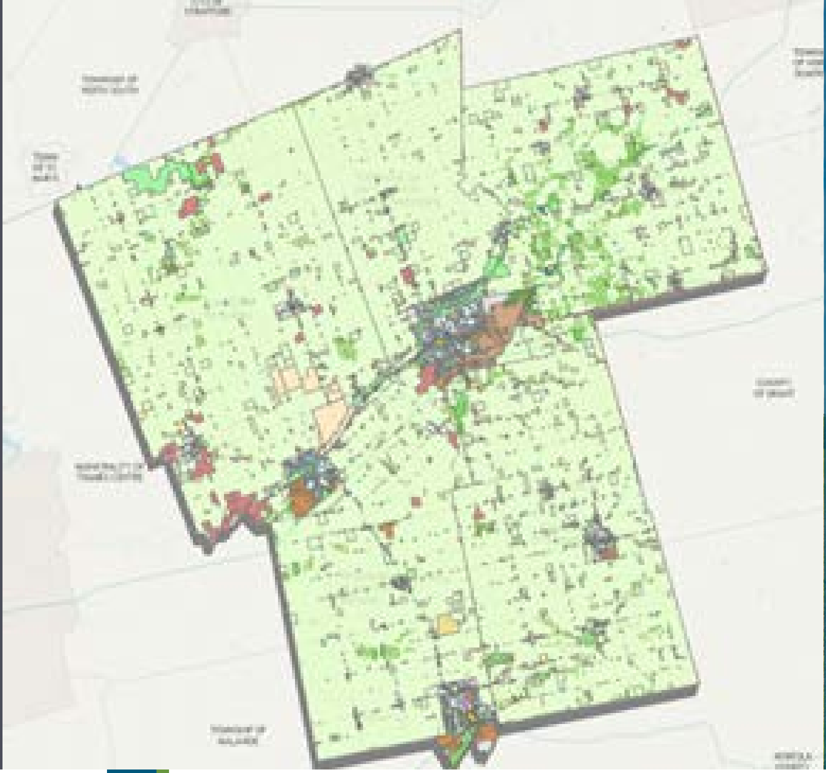
- Increased cumulative stress on natural systems
- Greater fragmentation impacts where habitats are already degraded
- Increased disturbance pressure
- Implications for Natural Systems
- Reduced biodiversity and greater advantage for invasive species
- Limited ability for species to migrate between fragmented habitats
- Increased vulnerability to pests, disease, and disturbance
- Long-term alteration of ecosystem structure and function
- Reduced adaptive capacity where natural systems are already stressed

WHAT THIS MEANS FOR OXFORD COUNTY

Oxford County's natural systems provide essential services that support agriculture, communities, and infrastructure. However, limited natural cover and landscape fragmentation may increase sensitivity to climate change.

Climate-driven changes in temperature, precipitation, and seasonal conditions are expected to interact with existing land use pressures. Protecting and restoring wetlands, forests, and riparian corridors, and improving connectivity between them, will be important strategies for maintaining ecological resilience and sustaining ecosystem services over the long-term.





AGRICULTURAL LAND IN OXFORD COUNTY

Figure 12: Land use map of Oxford County with the light green (the majority of the map) being agricultural. Map screenshot from Oxford County's Geographic Land Information & Mapping Resource (GLIMR) website: https://webmap.oxfordcounty.ca/Html5/?viewer=GLIMRCounty.

HOW DOES CLIMATE CHANGE IMPACT FOOD & AGRICULTURE SYSTEMS IN OXFORD COUNTY?

Oxford County's landscape is defined not only by its natural features, but also by its extensive agricultural lands. Lands outside of designated settlements (villages, towns, and the City of Woodstock) comprise approximately 87% of the County's total land area, as seen in **Figure 12** (Oxford County, 2022).

Farming is a dominant land use across the County, with thousands of acres in active crop production, pasture, and livestock operations. Agricultural properties are distributed throughout both rural and peri-urban areas, forming a continuous working landscape that shapes the County's economy and identity.

The County supports a diverse mix of agricultural activities, including dairy production, field crops, livestock operations, and agri-food processing. Dairy remains a leading commodity, and agricultural production in Oxford County contributes significantly to regional and provincial food supply chains. Many farms are long-established and owner-operated, reflecting sustained investment in land stewardship and production capacity. Agricultural lands in Oxford County are supported by drainage systems, soil resources, seasonal climate patterns, and access to transportation infrastructure. The sector includes primary production as well as value-added processing, local markets, and distribution networks that connect producers to broader domestic and export markets.

In several commodity categories, agricultural production exceeds local consumption needs, contributing to broader food systems beyond the County's boundaries. As a result, the food and agricultural system plays an important role not only in land use patterns, but also in employment, supply chains, and regional economic stability (OMAFRA, 2021).

CLIMATE IMPACTS ON AGRICULTURAL SERVICES AND PRODUCTION

Food and agricultural systems in Oxford County depend on stable seasonal conditions, soil resources, water availability, livestock health, and functioning supply chains. Agricultural production is closely tied to regional climate patterns, with temperature and precipitation directly influencing crop yields, planting and harvest timing, and livestock productivity.

Ontario's agriculture and food sector is recognized as climate-sensitive. While changing climate conditions may present some potential opportunities, such as longer growing and grazing seasons, these potential benefits are expected to be uneven and, in many cases, offset by increasing risks. Rising temperatures, shifting precipitation patterns, and more frequent extreme weather events are projected to amplify existing production challenges and introduce new operational pressures (Climate Risk Institute, 2023).

ECOSYSTEM SERVICES FROM AGRICULTURAL PRACTICES

Habitat services such as breeding and feeding areas for wildlife within agricultural landscapes.

Regulating services such as soil conservation, water purification, and carbon sequestration.

Cultural services such as scenic value, recreation, agri-tourism, and local food connections.

Primary agricultural production is also interconnected with infrastructure, natural systems, and broader economic networks. As a result, climate-related impacts on farms may extend to food processing, distribution, and market stability. Indirect impacts, including supply chain disruptions and input cost volatility, may further influence sector performance over time.

While agricultural producers routinely manage variability and uncertainty, climate change is expected to increase the frequency and magnitude of these stressors. Adaptation measures, including improved water management, soil conservation practices, and climate-informed decision-making, may help reduce risk exposure and support continued productivity (Climate Risk Institute, 2023).

SUMMARY OF CLIMATE CHANGE IMPACTS ON FOOD AND AGRICULTURE SYSTEMS

Hazard	Impacts	Secondary Impacts (Consequences)
Extreme Rainfall and Flooding	Saturated soils and delayed field operations	Later planting and harvest; reduced yields; increased labour and equipment costs
	Soil erosion and nutrient loss	Degraded soil quality; increased runoff to waterways
	Crop damage and infrastructure strain	Production losses; repair and recovery costs
Drought and Prolonged Dry Periods	Soil moisture deficits and plant water stress	Reduced crop productivity; increased irrigation demand
	Reduced forage and pasture	Livestock water stress; reduced grazing stability
Severe Storms, Hail, and Freeze-thaw Events	Crop damage and livestock injury	Short-term production losses; insurance claims; localized supply disruption

Hazard	Impacts	Secondary Impacts (Consequences)
Extreme Heat	Heat stress in livestock	Reduced milk, meat, and egg production; increased cooling costs; mortality risk during extreme events
	Heat stress in crops	Declining yields; increased risk of crop failure across multiple commodities
Shifting Seasonal Temperatures	Longer growing seasons and increased frost-free days	Potential for new crop varieties; altered crop suitability
	Increased spring and fall variability	Late frost damage; stress on perennial crops; disrupted planting and harvest timing
	Expanded survival and reproduction of pests and pathogens	More frequent outbreaks; crop and livestock losses; higher management costs
Multiple Climate Stressors	Production system stress and reduced operational resilience	Increased financial risk; higher input and operating costs; reduced adaptive capacity
	Land use pressure and agricultural land conversion	Reduced available farmland; intensified production on remaining lands
	Supply chain and market instability	Transportation disruptions; price volatility; reduced market stability
	Food access pressures	Increased food insecurity; reduced affordability for vulnerable populations

POSSIBLE FUTURES UNDER CLIMATE CHANGE

Food and agricultural systems in Oxford County are shaped by climate conditions, water availability, and land use patterns. As temperatures rise, precipitation patterns shift, and seasonal variability increases, these changes are expected to influence crop production, livestock operations, and overall farm management across the County. In a region where agriculture occupies the majority of the land base and plays a central economic role, changes in temperature and moisture conditions may alter both production opportunities and operational risks over time.

Extreme Rainfall and Flooding

Projected Climate Trend

Total annual precipitation is projected to increase under both emissions scenarios. The number of consecutive wet days is also projected to increase slightly, indicating a greater likelihood of sustained wet periods.

Site and Landscape Implications

- Saturated soils and delayed field access in spring
- Increased soil erosion and nutrient runoff
- Localized flooding of fields and farm infrastructure
- Reduced ability to complete planting and harvest within optimal windows

Implications for Agricultural Systems

- Lower yields due to shortened or disrupted growing periods
- Increased labour and equipment costs
- Degradation of soil quality over time
- Repair and recovery costs following flood damage

Drought and Prolonged Dry Periods

Projected Climate Trend

Although total precipitation is projected to increase overall, maximum consecutive dry days are also projected to increase, indicating longer dry intervals between rainfall events.

Site and Landscape Implications

- Reduced surface water availability and groundwater recharge
- Soil moisture deficits during critical crop development stages
- Reduced forage and pasture productivity
- Greater irrigation demand

Implications for Agricultural Systems

- Reduced crop productivity in dry years
- Increased operating costs for water management
- Livestock water stress and reduced grazing stability

Extreme Heat

Projected Climate Trend

Mean annual temperatures are projected to increase substantially. Days above 35 degrees Celsius are projected to increase from near zero historically to multiple days per year by the 2050s and significantly more by the 2080s under higher emissions scenarios.

Site and Landscape Implications

- Heat stress in livestock
- Reduced feed intake and productivity
- Heat stress in crops during flowering and grain fill stages

Implications for Agricultural Systems

- Reduced milk, meat, and egg production
- Increased cooling and ventilation costs
- Greater risk of yield decline or crop failure during extreme events

Shifting Seasonal Temperatures

Projected Climate Trend

The frost-free season is projected to lengthen by approximately one to two months by late century. The last spring frost is projected to occur earlier, and the first fall frost later. Days below minus 15 degrees Celsius are projected to decline substantially.

Site and Landscape Implications

- Longer growing seasons and expanded crop suitability
- Potential for new crop varieties
- Increased variability in spring and fall conditions
- Greater survival of pests and pathogens

Implications for Agricultural Systems

- Opportunity for diversified cropping systems
- Risk of late frost damage during earlier planting
- Increased pest and disease management costs
- Greater uncertainty in planting and harvest timing

Severe Storms, Hail, and Freeze-Thaw Events

Projected Climate Trend

While very cold days and freeze-thaw cycles are projected to decline overall, temperature variability and severe storm activity remain important risk factors.

Site and Landscape Implications

- Crop damage from hail and wind
- Livestock injury during severe weather
- Damage to barns, storage facilities, and drainage systems

Implications for Agricultural Systems

- Short-term production losses
- Insurance and recovery costs
- Localized disruptions to supply and distribution

Multiple Climate Stressors

Projected Climate Trend

Temperature increases, altered precipitation patterns, extreme heat, and land use pressures are occurring simultaneously. Population growth and development continue to influence the agricultural land base.

Site and Landscape Implications

- Increased cumulative stress on farms and production systems
- Conversion of agricultural land and intensified production on remaining farmland
- Greater exposure to supply chain and market disruptions

Implications for Agricultural Systems

- Increased financial risk and operating costs
- Reduced adaptive capacity for smaller operations
- Price volatility and market instability
- Increased food access pressures for vulnerable populations

WHAT THIS MEANS FOR OXFORD COUNTY

Agriculture is a defining feature of Oxford County's landscape and economy. As climate conditions shift, changes in temperature, precipitation, and seasonal patterns are expected to influence crop production, livestock management, and operational planning across the County.

Projected increases in extreme heat, longer growing seasons, greater precipitation variability, and longer dry intervals may create both new opportunities and additional risks. These changes will interact with existing pressures such as land use change, input costs, and market volatility.

Supporting soil health, water management, climate-informed farm practices, and long-term protection of agricultural lands will be important for maintaining productivity and economic stability. Integrating forward-looking climate information into agricultural planning and land use policy can help ensure the sector remains resilient and competitive over time.

HOW DOES CLIMATE CHANGE IMPACT INFRASTRUCTURE IN OXFORD COUNTY?

OXFORD COUNTY'S INFRASTRUCTURE

Oxford County's infrastructure system represents a substantial and diverse portfolio of municipal assets that enable service delivery across the region. As documented in the 2025 Asset Management Plan, the County maintains water and wastewater systems, bridges and structural culverts, a transportation network, stormwater infrastructure, corporate facilities, fleet and equipment, information technology systems, waste management facilities, community housing, long-term care facilities, paramedic services, the library, and natural assets

Collectively, these assets have an estimated replacement value of approximately $3.95 billion. The scale of this portfolio reflects both the breadth of services provided and the long-term financial responsibility associated with maintaining infrastructure in a state of good repair.

Infrastructure planning in Oxford County is shaped by projected growth and climate-related pressures. As seen in **Figure 13**, population is expected to increase by approximately 36% between 2026 and 2046, placing additional demand on existing systems and requiring both renewal of aging assets and expansion to accommodate future service needs. At the same time, extreme heat and extreme precipitation are identified as increasing threats in southwestern Ontario, with implications for infrastructure durability, service reliability, and lifecycle management. Together, these pressures require the County to balance renewal, growth, and climate resilience within a structured long-term financial framework (Oxford County, 2025b).

Overall, Oxford County's infrastructure system is characterized by its scale, diversity of asset classes, long service lives, and the need to balance lifecycle renewal, growth-related expansion, and climate-related risk within a structured long-term financial framework.

GROWTH PROJECTIONS IN OXFORD COUNTY

Table 2.8.1 Oxford County Growth Projections

	2026	2031	2036	2041	2046
Population	140,700	154,900	168,100	180,200	191,600
Households	53,615	59,365	64,980	70,265	75,350
Employment	70,015	77,615	84,320	89,020	94,500

Figure 13: Oxford County Growth Projections from the County's 2025 Asset Management Plan (Oxford County, 2025b).

Projected population growth will expand service demand and the scale of Oxford County's infrastructure portfolio. Concurrently, increasing extreme heat and precipitation are placing additional stress on assets, shortening service life and raising maintenance and replacement costs. These compounding pressures require climate-informed asset management planning to balance growth-related expansion with resilience investments and long-term financial sustainability (Oxford County, 2025b).

IMPACTS ON INFRASTRUCTURE SYSTEMS AND SERVICE DELIVERY

Infrastructure systems in Oxford County underpin the delivery of essential services, including transportation, water and wastewater management, stormwater systems, buildings, utilities, waste management, and telecommunications. These systems support daily economic activity, public health and safety, and community wellbeing. Infrastructure performance is closely linked to climate conditions, with temperature extremes, precipitation patterns, and severe weather events directly influencing asset durability, service reliability, and lifecycle costs (Oxford County, 2025b).

MAIN CLIMATE DRIVERS OF INFRASTRUCTURE RISK

- Extreme precipitation events
- Extreme heat
- Wildfire

Ontario's infrastructure sector is recognized as climate-exposed. The Ontario Provincial Climate Change Impact Assessment (PCCIA) concludes that all infrastructure assets across Ontario face at least a medium level of climate risk under current conditions, with risk projected to increase in many regions over time. Extreme precipitation events, extreme heat, and wildfire are identified as the primary climate drivers of infrastructure risk, accounting for a substantial proportion of assessed risk scenarios. In southwestern Ontario, where much of the province's infrastructure is concentrated, risks are projected to rise as these hazards intensify.

Infrastructure systems are highly interconnected. Failures in one system can trigger cascading impacts across others. For example, power outages can disrupt water and wastewater treatment operations, telecommunications, and transportation networks. Similarly, flooding can impair road access, delay emergency response, and interrupt supply chains. These interdependencies introduce additional layers of risk beyond the direct physical damage to assets.

SUMMARY OF CLIMATE CHANGE IMPACTS ON INFRASTRUCTURE SYSTEMS

Hazard	Impacts	Secondary Impacts (Consequences)
Changing Winter Conditions and Shifts in	Reduced ice thickness; altered water availability	Reliability loss for winter roads; disrupted supply delivery; impacts to hydroelectric generation
Extreme Weather Events	Physical damage from high winds, hail, and ice	Downed power lines; electrical outages; damage to homes and buildings; telecommunications disruption
	Reduced visibility and hazardous travel conditions	Increased accidents; travel delays; disruption of essential goods movement
High Water Temperatures	Reduced cooling efficiency in thermoelectric and nuclear facilities	Operational constraints; reduced generation efficiency
Freeze-Thaw Cycles	Pavement cracking; potholing; bridge deck deterioration	Reduced service life; increased maintenance and rehabilitation costs

Hazard	Impacts	Secondary Impacts (Consequences)
Extreme Rainfall and Flooding	Flooding of roads, railways, bridges, and culverts	Road and rail washouts; bridge scour; loss of community access; supply chain disruptions
	Overloaded stormwater, sewer, and drainage systems	Sewer backups; basement flooding; localized flooding; increased bypass events; discharge of partially treated wastewater
	Damage to water and wastewater treatment infrastructure	Service interruption; contamination risk; reduced treatment or pumping capacity
	Damage to buildings and public facilities	Structural damage; property loss; displacement; increased insurance and recovery costs
	Erosion, landslides, and embankment instability	Destruction of transportation corridors; dam and tailings pond failure; downstream infrastructure damage
	Flooding of airports and critical transport hubs	Runway damage; operational disruptions; delays in goods and passenger movement
Extreme Heat	Thermal deformation of pavement, bridges, and building materials	Asphalt rutting; cracking; bridge joint expansion; reduced structural performance; higher maintenance costs
	Reduced efficiency of electricity transmission and generation systems	Increased outage risk; reduced reliability during peak demand
	Increased cooling demand in buildings	Strain on HVAC systems; higher energy demand; potential service interruptions
Wildfire Conditions	Damage to power lines, substations, and buildings	Service outages; property loss; displacement of residents
	Post-fire hydrological changes	Increased sediment loads; damage to intakes, storage systems, and turbines
Ground Instability and Subsidence	Damage to buried pipes, cables, and foundations	Infrastructure settlement; pipe failures; rail track distortion; damage to telecommunications conduits
	Instability affecting dams, mines, and airport infrastructure	Structural stress; damage to facilities; ecosystem impacts
Multiple Climate Stressors	Cumulative damage to built infrastructure and interdependent systems	Increased repair frequency; rising replacement costs; shortened asset lifespan; higher maintenance needs; more frequent service disruptions; increased risk of partial or full asset failure
	Interdependencies across electricity, water, transportation, and telecommunications systems	Cascading failures across utilities; delayed emergency response; disruptions to essential services

POSSIBLE FUTURES UNDER CLIMATE CHANGE

Infrastructure systems in Oxford County support transportation, water and wastewater services, stormwater management, utilities, buildings, telecommunications, and community facilities. These systems were largely designed for historical climate conditions. As temperatures rise and precipitation patterns shift, infrastructure assets are expected to experience new performance stresses, increased deterioration, and greater service disruption risk over time.

Extreme Rainfall and Flooding

Projected Trend

Total annual precipitation and consecutive wet days are projected to increase, raising the likelihood of sustained rainfall and high-intensity storm events.

Infrastructure System Implications

- Flooding of roads, bridges, rail corridors, and culverts
- Overloading of stormwater and sewer systems
- Increased erosion and embankment instability
- Damage to water and wastewater treatment facilities
- Flooding of buildings and transport hubs
- Service and Operational Implications
- Road and rail washouts and loss of access
- Sewer backups and localized flooding
- Service interruption and contamination risks
- Structural damage and increased recovery costs
- Higher capital and maintenance expenditures
- Increased reliance on backup generation and emergency power

Extreme Heat

Projected Trend

Mean annual temperatures and the number of extreme hot days are projected to increase substantially under both emissions scenarios.

Infrastructure System Implications

- Thermal deformation of pavement, bridges, and building materials
- Reduced efficiency of electricity transmission and generation
- Increased cooling demand in buildings
- Higher peak energy loads
- Rail track expansion and buckling risk

Service and Operational Implications

- Accelerated asset deterioration and shortened service life
- Increased outage risk during peak demand
- Higher maintenance and operational costs
- Increased likelihood of assets operating beyond original design thresholds

Changing Winter Conditions and Seasonal Shifts

Projected Trend

Very cold days and freeze-thaw cycles are projected to decline overall, while winter precipitation patterns and seasonal timing continue to shift.

Infrastructure System Implications

- Reduced reliability of winter roads
- Altered water availability affecting hydroelectric generation
- Pavement cracking and bridge deck deterioration
- Variable snow and ice loading on infrastructure

Service and Operational Implications

- Disrupted winter access and supply delivery
- Reduced service life of transportation assets
- Increased inspection and rehabilitation needs

Severe Storms and High-Impact Weather

Projected Trend

Extreme precipitation events and severe storms remain primary climate drivers of infrastructure risk and are projected to intensify over time.

Infrastructure System Implications

- Physical damage to buildings, electrical systems, and telecommunications
- Downed power lines and substations
- Flooding of airports and transport hubs
- Hazardous travel conditions

Service and Operational Implications

- Electrical outages and service disruption
- Cascading failures across interconnected systems
- Disruption to essential goods movement and emergency response

Multiple Climate Stressors

Projected Trend

Rising temperatures, altered precipitation, extreme events, infrastructure aging, and growth are occurring simultaneously.

Infrastructure System Implications

- Cumulative damage across interconnected systems
- Compounding maintenance and renewal pressures
- Increased strain on electricity, water, and transportation networks
- Increased vulnerability of digital and communications infrastructure
- Soil instability and subsidence affecting foundations and buried infrastructure

Service and Operational Implications

- Shortened asset lifespan and rising replacement costs
- More frequent service disruptions
- Greater long-term financial exposure in asset management planning
- Accelerated capital replacement timelines
- Pipe failures and transportation safety risks due to ground movement

WHAT THIS MEANS FOR OXFORD COUNTY

Infrastructure is essential in supporting Oxford County's communities, economy, and projected growth. As climate conditions shift, changes in temperature, precipitation, and extreme weather are expected to affect asset performance, service reliability, and lifecycle costs across the County.

Projected increases in extreme heat, heavier rainfall events, and seasonal variability may accelerate deterioration, increase maintenance demands, and heighten the risk of service disruption. These pressures will interact with existing challenges, including aging infrastructure and growth-related expansion of the asset base.

Integrating forward-looking climate projections into asset management planning, capital investment decisions, and infrastructure design will be important to maintain reliable services and manage long-term financial risk.

HOW DOES CLIMATE CHANGE IMPACT PEOPLE & COMMUNITIES IN OXFORD COUNTY?

OXFORD COUNTY'S PEOPLE AND COMMUNITIES

Oxford County's people and communities reflect a diverse and growing population distributed across urban centres, small towns, and rural townships. Settlement patterns are concentrated in Woodstock and other fully serviced urban areas, while rural communities feature lower population density and varying levels of service access. Since 2001, the County has experienced sustained growth, driven primarily by net in-migration, with forecasts projecting continued expansion through 2046. Housing growth has outpaced population growth due to declining household sizes (Hemson Consulting Ltd., 2020).

HEAT VULNERABILITY FACTORS

Figure 14: Community and individual risk factors that can impact vulnerability to heat-related illnesses (Health Canada, 2020).

The County and surrounding area include residents who are more susceptible to climate-related health risks, including older adults, individuals living with chronic health conditions, and socially vulnerable populations. SWPH identifies these groups as being at elevated risk of heat related illness, poor air quality impacts, and complications during emergency events. Sensitivity to extreme heat, smoke exposure, flooding, and service disruptions varies across age, health status, income, and housing conditions.

Exposure also differs geographically. Urban areas, as displayed in **Figure 14**, may experience higher heat exposure due to built form and limited tree canopy, while rural and partially serviced communities face different risks related to transportation access, reliance on private wells and septic systems, agricultural land use, and longer distances to health and emergency services. These structural differences influence both hazard exposure and recovery capacity following extreme weather events. As population growth continues, integrating public health, equity, and emergency preparedness considerations into long-term climate resilience planning will be critical to supporting community wellbeing (Southwestern Public Health, 2023).

IMPACTS ON PEOPLE AND COMMUNITIES

Climate change is already affecting the health, safety, and wellbeing of people and communities across Ontario, with risks projected to increase over time. The PCCIA identifies people and communities as one of the highest climate risk areas in the province, with risks expected to rise under future climate scenarios, particularly in the Southwest region. Extreme temperature events and extreme precipitation are identified as the primary climate drivers influencing this risk profile. Extreme heat and extreme cold account for a substantial proportion of risk scenarios, while extreme precipitation events represent an additional major contributor. These hazards directly affect human health and also disrupt the systems that people rely on for daily living (Climate Risk Institute, 2023).

Within Oxford County and the broader Southwestern Public Health region, certain populations face heightened risk, including older adults, Indigenous communities, people experiencing homelessness, and individuals facing social or material deprivation. Climate risks are found to exacerbate existing inequities, particularly where adaptive capacity is constrained by housing insecurity, income limitations, underlying health conditions, or reduced access to health and social services. As climate hazards intensify, these intersecting vulnerabilities increase the likelihood of adverse health outcomes and strain on community support systems (Southwestern Public Health, 2023).

The PCCIA emphasizes that risks to people and communities are not only the result of direct exposure to climate hazards but also reflect underlying social determinants of health. Access to health care, availability of social services, population density, and levels of socio-economic inequality all influence vulnerability and recovery capacity. As climate hazards intensify through mid-century and beyond, risks to population, health care systems, and social services are projected to increase, with some risk categories rising to high or very high levels by the 2080s under high emissions scenarios (Climate Risk Institute, 2023).

SUMMARY OF CLIMATE CHANGE IMPACTS ON PEOPLE AND COMMUNITY SYSTEMS

Hazard	Impacts	Secondary Impacts (Consequences)
Extreme Rainfall and Flooding	Increased precipitation intensity and flooding	Drowning; trauma; hypothermia; displacement; mold-related respiratory illness; cardiovascular stress; mental stress
	Water contamination and runoff	Gastrointestinal illness; exposure to pathogens; risks to private wells and rural systems; foodborne and waterborne outbreaks
	Winter flooding and freeze–thaw conditions	Slippery conditions; flash freezes; traffic collisions; injuries; infrastructure strain
Extreme Weather Events	Physical damage to built and natural infrastructure	Injuries; evacuation; displacement; service disruption; communication outages; loss of heating or cooling during power failures
	Disruption to health and emergency systems	Increased emergency calls; delays in care; risk to individuals dependent on medical devices
	Direct health impacts from severe events	Respiratory and cardiovascular illness; injury; mortality; increased risk of disease outbreaks following extreme events

Hazard	Impacts	Secondary Impacts (Consequences)
Extreme Heat	Physiological heat stress	Heat exhaustion; heat stroke; dehydration; kidney strain; worsening cardiovascular, respiratory, and chronic disease; increased mortality risk
	Increased exposure in urban and vulnerable populations	Urban heat island amplification; disproportionate impacts on older adults, low-income residents, and people experiencing homelessness
	Health system and mental health impacts	Higher emergency visits and hospitalizations; irritability; anxiety; depression; increased aggression; community stress
	Compounding environmental effects	Increased fire weather conditions; smoke exposure; rising ozone formation; worsened respiratory illness
Shifting Seasonal Conditions	Expansion of disease vectors	Increased risk of Lyme disease and other vector-borne illnesses; emergence of new diseases
	Impacts to natural systems and food security	Crop failure; reduced productivity; livestock impacts; loss of traditional foods and medicines; cultural and livelihood impacts
Changing Winter Conditions and Extreme Cold	Declining extreme cold days and altered freeze–thaw cycles	Reduced cold-related injury over time; increased tick survival and longer vector transmission seasons
	Cold exposure events	Frostbite; hypothermia; aggravated cardiovascular and respiratory disease; increased mortality among vulnerable populations
Air Quality Degradation	Elevated air pollutants, smog, wildfire smoke, and pollen shifts	Increased asthma attacks; worsening pulmonary and cardiovascular disease; allergic illness; premature mortality with chronic exposure
Multiple Climate Stressors	Damage to housing, infrastructure, utilities, and essential services	Unsafe housing; displacement; economic losses; reduced access to health care, transportation, food, and utilities
	Social and economic vulnerability	Higher exposure and fewer adaptive resources for marginalized groups; worsened poverty, housing instability, and food insecurity
	Cumulative psychosocial stress	Climate anxiety; depression; PTSD; ecoanxiety; trauma; long-term uncertainty; disproportionate impacts on youth, Indigenous communities, low-income residents, and people

POSSIBLE FUTURES UNDER CLIMATE CHANGE

People and communities in Oxford County are directly affected by changes in temperature, precipitation, seasonal patterns, and extreme weather events. Future climate projections indicate substantial increases in average temperature, extreme heat days, total precipitation, and consecutive wet days, alongside declines in extreme cold days and freeze–thaw cycles. These changes will influence health outcomes, housing stability, access to services, and overall community wellbeing. As climate hazards intensify under both emissions scenarios, impacts to vulnerable populations and essential systems are expected to increase.

Extreme Rainfall and Flooding

Projected Trend

Total annual precipitation and maximum consecutive wet days are projected to increase. High intensity rainfall events are expected to become more frequent.

Implications for People and Communities

- Flooding of homes and neighbourhoods
- Water contamination from runoff
- Winter flooding and slippery conditions
- Service disruption and displacement
- Temporary loss of access to facilities (e.g., schools, community facilities, workplaces)

Health Outcomes and System Implications

- Drowning, trauma, hypothermia
- Mold related respiratory illness
- Gastrointestinal illness from contaminated water
- Mental stress and displacement

Extreme Heat

Projected Trend

Average temperatures will increase, extreme heat days will become more common, cooling degree days will rise sharply, and heating degree days will decline.

Implications for People and Communities

- Increased physiological heat stress
- Greater exposure to urban and vulnerable populations
- Increased cooling demand and energy dependence
- Higher ozone formation and smoke exposure during hot periods
- Reduced outdoor work and recreation activity
- Increased health risk during power outages in extreme heat

Health Outcomes and System Implications

- Heat exhaustion, heat stroke, dehydration, kidney strain
- Worsening cardiovascular, respiratory, and chronic disease
- Increased emergency visits and hospitalizations
- Higher mortality risk among older adults, low-income residents, and people experiencing homelessness
- Increased anxiety, irritability, and community stress

Shifting Seasonal and Ecological Conditions

Projected Trend

Growing degree days increase substantially. Frost free season lengthens. Seasonal timing shifts.

Implications for People and Communities

- Expansion of disease vectors
- Impacts on natural systems and food production
- Crop and livestock stress
- Loss of traditional foods and medicines
- Cultural and livelihood impacts

Health Outcomes and System Implications

- Increased risk of Lyme disease and emerging infectious diseases
- Increased seasonal allergies and asthma related illness due to longer pollen seasons
- Increased risk of food borne illness during extended warm seasons
- Increased demand for public health surveillance and vector control programs
- Increased food insecurity

Changing Winter Conditions and Extreme Cold

Projected Trend

Days below -15°C decline sharply. Frost days and freeze-thaw cycles decrease, while frost-free season length increases.

Implications for People and Communities

- Reduced cold exposure overall
- Altered seasonal patterns affecting vector survival
- Variable winter conditions and travel hazards

Health Outcomes and System Implications

- Lower cold related injury over time
- Increased tick survival and longer transmission seasons
- Increased risk of Lyme disease and other vector borne illnesses
- Ongoing risk of frostbite and hypothermia during extreme cold events

Air Quality Degradation and Fire Conditions

Projected Trend

Higher temperatures and longer dry periods increase fire weather conditions and ozone formation.

Implications for People and Communities

- Increased wildfire smoke exposure
- Elevated air pollutants and pollen shifts
- Reduced outdoor activity during smoke advisories

Health Outcomes and System Implications

- Increased asthma attacks and allergic illness
- Worsening pulmonary and cardiovascular disease
- Increased hospital visits and premature mortality with chronic exposure

Multiple Climate Stressors

Projected Trend

Rising temperatures, heavier precipitation, longer warm seasons, and demographic pressures occur simultaneously.

Implications for People and Communities

- Cumulative damage to housing and essential services
- Increased strain on vulnerable households

Health Outcomes and System Implications

- Compounded stress on health and emergency systems
- Unsafe housing and displacement
- Reduced access to health care, food, transportation, and utilities
- Worsening poverty, housing instability, and inequities
- Increased psychosocial stress including anxiety, depression, and trauma

WHAT THIS MEANS FOR OXFORD COUNTY

People and communities in Oxford County will experience climate change through rising temperatures, heavier rainfall events, shifting seasonal patterns, and more frequent extreme weather. Projected increases in extreme heat days, total precipitation, and longer warm seasons will directly affect health, housing stability, access to services, and overall community wellbeing.

More frequent heat events may increase risks for older adults, individuals with chronic health conditions, and residents without reliable access to cooling. Heavier rainfall and consecutive wet days raise the likelihood of flooding, water contamination, and temporary displacement, particularly in areas with aging infrastructure or reliance on private water systems. Longer growing seasons and milder winters may also extend vector activity, increasing exposure to tick-borne illness.

These climate shifts will interact with population growth, housing pressures, and existing social and health system constraints. Integrating climate projections into public health planning, emergency preparedness, housing policy, and community services will be important to reduce risk and support long-term resilience across Oxford County.

HOW DOES CLIMATE CHANGE IMPACT BUSINESS & ECONOMY IN OXFORD COUNTY?

OXFORD COUNTY'S BUSINESS AND ECONOMIC SYSTEMS

Oxford County's business and economic system is characterized by a diverse labour force and strong goods producing and service-based economy. In 2021, approximately 62,975 residents participated in the labour force, with 56,450 employed across a range of industries (Statistics Canada, 2021). The workforce is supported by a skilled labour base, with more than 46,000 residents holding postsecondary credentials and notable concentrations in engineering, construction trades, business, health, and agriculture related fields Manufacturing represents the largest employment sector in the County, employing more than 13,000 workers, followed by health care and social assistance, retail trade, and trades and construction. Agriculture, forestry, fishing and hunting employs approximately 3,900 workers and remains an important component of the local economy within this broader and integrated economic structure (Statistics Canada, 2021).

TOP INDUSTRIES IN OXFORD COUNTY

1. Manufacturing
2. Health care and social assistance
3. Retail
4. Trades/construction
5. Agriculture, forestry, fishing and hunting

Agriculture and agri-food production continue to play a significant strategic role in the County's economy. Although Oxford represents approximately 5% of Southern Ontario's population, it contributes roughly 14% of the region's farm cash receipts and agri-food GDP, and 6% of agri-food employment. With more than 432,000 acres of farmland across over 2,000 farms, and key commodities including dairy, hogs, and poultry, the sector generates approximately 1.2 billion dollars in annual farm cash receipts and supports employment across farming, processing, distribution, and related services (OMAFRA, 2021).

Economic stability in Oxford County is supported by relatively strong household incomes, with a median after tax household income of $76,500 in 2020 and a median employment income of approximately $60,000 for full year fulltime workers. However, more than 8,000 households spend 30% or more of their income on shelter costs, highlighting housing affordability pressures. At the same time, the County's economy is closely integrated with the broader Southwestern Ontario region, as a substantial share of residents commute beyond their local municipality and more than 42,000 workers rely on private vehicles, underscoring dependence on transportation infrastructure, regional market access, and goods movement systems (Statistics Canada, 2021).

IMPACTS ON BUSINESS AND ECONOMIC SYSTEMS

Climate change is already influencing economic performance across Ontario, with risks to businesses projected to increase under future climate scenarios. The PCCIA identifies Business and Economy as an Area of Focus where most industries are expected to face elevated risk, primarily driven by extreme precipitation, extreme heat, and wildfire. Extreme precipitation accounts for nearly half of assessed business risk scenarios. These hazards affect physical assets, service delivery, infrastructure systems, and supply chains, with risks varying by industry type, geographic location, and adaptive capacity (Climate Risk Institute, 2023).

The PCCIA finds that risks are not distributed evenly across industries or regions. Businesses dependent on natural production systems, such as forestry, fishing, and recreation, face some of the largest projected increases in risk. Industries reliant on infrastructure systems, including transportation and utilities, are also expected to experience heightened risk as climate hazards intensify. The ability to recover from disruptions varies by firm size, financial reserves, geographic location, and supply chain complexity, meaning that smaller firms or those operating with limited adaptive capacity may face disproportionate impacts (Climate Risk Institute, 2023).

Business and economic risk reflect both direct climate impacts and indirect effects through infrastructure, energy, transportation, and supply chains. Many economic impacts are indirect, occurring through disruptions to infrastructure systems, utilities, transportation networks, and supply chains rather than through direct physical damage alone. As shown in **Figure 15**, climate change is projected to reduce GDP, exports, investment, and household income, while increasing job losses under both low and high emissions scenarios, with greater impacts under higher emissions pathways (Canadian Climate Institute, 2022).

CLIMATE CHANGE IMPACTS ON CANADIAN ECONOMY

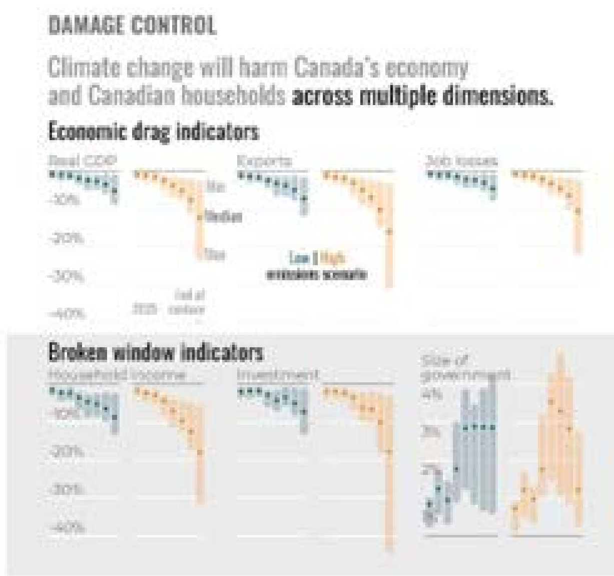


Figure 15: Economic impacts from climate change on Canada's economy under low and high emissions scenarios (Canadian Climate Institute, 2022)

SUMMARY OF CLIMATE CHANGE IMPACTS ON BUSINESS AND ECONOMIC SYSTEMS

Hazard	Impacts	Secondary Impacts (Consequences)
Extreme Weather Events	Physical damage to buildings, infrastructure, and natural systems	Business closures; asset loss; erosion of household wealth; diversion of public funds toward disaster recovery; sustained drag on economic growth
	Damage to power and communications infrastructure	Power outages affecting commercial and industrial operations; equipment failure; increased insurance claims and premiums
Extreme Rainfall and Flooding	Inundation of infrastructure and commercial properties	Restricted transportation access; supply chain disruption; business interruption; inventory loss; property damage
	Surface flooding and saturated ground conditions	Reduced access to industrial sites; transportation delays; damage to rail corridors and logistics infrastructure
Changing Snow and Ice Conditions	Altered snow and ice cover; more variable freeze conditions	Impacts to winter recreation industries; variability in seasonal economic activity
Extreme Heat	Higher frequency and intensity of very hot days	Reduced labour productivity in outdoor and climate-sensitive sectors; decreased household income and workforce capacity; increased cooling costs; heat-related labour interruptions; long-term drag on economic competitiveness
	Increased demand for cooling and HVAC services	Operational downtime for heat-sensitive industries; strain on commercial systems; damage to temperature-sensitive goods
	Warmer average conditions year-round	Reduced winter tourism revenue; impacts to forestry operations due to pest pressures, wildfire activity, and heat stress
Wildfire Smoke and Air Quality Degradation	Degraded air quality and visibility	Reduced outdoor productivity; business interruptions during air quality advisories; increased respiratory illness within the workforce
Seasonal Shifts	Warmer seasonal conditions	Modest tourism gains in some regions; overall limited economic benefit relative to broader climate risks

Hazard	Impacts	Secondary Impacts (Consequences)
Multiple Climate Stressors	Increasing frequency and severity of climate-related disasters	Weakened investor confidence; slower innovation; reduced long-term productivity and growth potential; amplified macroeconomic drag
	Accumulated climate damages across sectors and regions	Lower GDP; higher unemployment; slower business investment; reduced competitiveness; increased public spending and taxation pressures
	Damage to assets, infrastructure, and operations	Increased operational costs; reduced economic output; financial losses concentrated in resource-dependent and rural regions
	Insurance and financial pressures	Increased insurance costs; reduced insurability of high-risk assets; greater strain on small businesses
	Supply chain and market instability	Delayed shipping; reduced market access; disruptions to global supply chains; price volatility; downstream impacts on manufacturing and retail

POSSIBLE FUTURES UNDER CLIMATE CHANGE

Business and economic systems in Oxford County are closely tied to climate conditions, infrastructure reliability, supply chains, labour productivity, and market stability. As temperatures rise and precipitation patterns shift, increasing heat, more intense rainfall, and seasonal variability are expected to influence production, transportation, energy demand, and overall economic performance across the County.

Extreme Rainfall and Flooding

Projected Trend

Total precipitation and consecutive wet days are projected to increase, raising the likelihood of high intensity rainfall events and sustained wet periods.

Business and Operational Implications

- Flooding of commercial and industrial properties
- Damage to transportation corridors and logistics routes
- Restricted access to industrial and agricultural sites
- Inventory loss and supply chain delays
- Disruption to utilities and communications
- Increased maintenance requirements for drainage and site infrastructure

Economic and Competitiveness Implications

- Business interruption and revenue loss
- Delayed shipping and reduced market access
- Increased insurance claims, higher premiums, and potential coverage constraints in high risk areas
- Diversion of public funds toward recovery and repair

Extreme Heat and Rising Temperatures

Projected Trend

Average temperatures are projected to increase, with very hot days becoming more frequent over time. Longer and more intense heat events are expected, while extremely cold days become less common.

Business and Operational Implications

- Reduced labour productivity in outdoor and climate sensitive sectors
- Reduced workforce capacity during extreme heat

- Increased cooling and energy demand for commercial and industrial facilities
- Greater strain on HVAC and refrigeration systems
- Heat related interruptions to construction and transportation operations
- Increased risk of grid constraints or localized power disruptions during peak demand periods

Economic and Competitiveness Implications

- Higher operating costs and reduced output
- Increased risk of equipment failure and downtime
- Increased wildfire risk affecting regional supply chains
- Increased capital expenditure for cooling retrofits and facility upgrades
- Competitive pressures where climate related costs rise faster than adaptation

Seasonal Shifts and Changing Winter Conditions

Projected Trend

Fewer very cold days, longer frost-free seasons, declining frost days, and fewer freeze-thaw cycles are projected. Seasonal timing continues to shift.

Business and Operational Implications

- Changes to agricultural production cycles
- Variability in winter recreation activity
- Altered transportation conditions
- Shifts in energy demand patterns
- Increased wear on transportation infrastructure due to variable freeze-thaw conditions

Economic and Competitiveness Implications

- Operational uncertainty for climate sensitive industries
- Variability in seasonal employment and revenue streams
- Changing maintenance and infrastructure requirements
- Reduced reliability of winter dependent industries and seasonal markets

Wildfire Smoke and Air Quality Degradation

Projected Trend

Rising temperatures and longer dry periods increase the likelihood of wildfire conditions and smoke events that affect air quality.

Business and Operational Implications

- Reduced outdoor productivity
- Business interruptions during air quality advisories
- Temporary closure of outdoor worksites or events
- Increased strain on commercial ventilation systems

Economic and Competitiveness Implications

- Reduced labour availability and efficiency
- Increased health related absenteeism
- Disruptions to construction, agriculture, and transportation sectors
- Revenue volatility in tourism, recreation, and hospitality sectors

Multiple Climate Stressors

Projected Trend

Heat, extreme rainfall, seasonal shifts, infrastructure aging, and economic pressures are occurring simultaneously and interacting over time.

Business and Operational Implications

- Accumulated damage across sectors
- Greater supply chain instability
- Reduced redundancy where infrastructure systems experience simultaneous stress

Economic and Competitiveness Implications

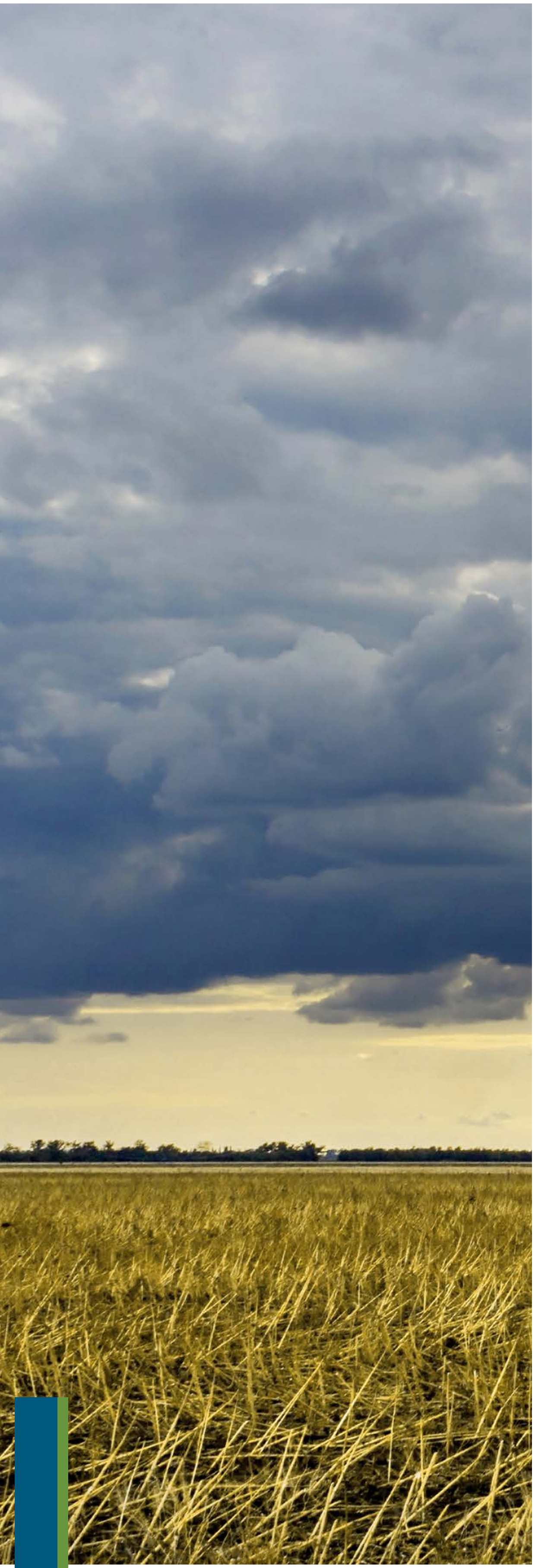
- Increased operational costs
- Insurance and financing pressures
- Compounding risks in rural and resource dependent areas
- Lower long-term productivity and competitiveness
- Slower business investment and innovation
- Increased public spending and taxation pressures
- Greater vulnerability for small and medium sized enterprises
- Increased borrowing and financing costs where risk exposure is elevated

WHAT THIS MEANS FOR OXFORD COUNTY

Businesses and economic systems in Oxford County will experience climate change through rising temperatures, heavier rainfall, shifting seasonal patterns, and more frequent extreme weather. Projected increases in extreme heat days and total precipitation will influence agricultural production, labour productivity, infrastructure performance, and supply chain reliability.

More frequent heat events may reduce outdoor work capacity and increase cooling costs for commercial and industrial facilities. Heavier rainfall and sustained wet periods raise the risk of flooding, transportation disruption, and operational downtime, particularly for sectors dependent on reliable infrastructure and market access. Seasonal shifts may also alter production cycles and energy demand patterns.

These climate pressures will interact with workforce availability, infrastructure condition and broader market conditions. Integrating climate projections into economic development, infrastructure planning, and business continuity strategies will be important to protect competitiveness and support long-term economic resilience across Oxford County.



RISK SUMMARY

The sections above outline the key climate hazards facing Oxford County, the projected changes in temperature and precipitation, and the populations and systems that may be most affected. This section brings that information together to describe how these changes translate into practical risks for the County and what that means for future planning and decision-making.

Evidence from historical events, regional health assessments, and climate projections indicates that Oxford County is already experiencing the types of environmental changes expected to intensify in the future. Increasing temperatures, more frequent extreme heat events, shifting precipitation patterns, and a growing likelihood of intense rainfall are contributing to pressures on infrastructure, agriculture, ecosystems, and community health. Regional health assessments identify extreme heat, extreme weather, and air quality impacts as key pathways through which climate change is affecting human well-being in Southwestern Ontario (Southwestern Public Health, 2024). These findings confirm that climate change is not introducing entirely new hazards, but is increasing the frequency, severity, and consequences of hazards that the County already manages.

SECTOR-LEVEL RISK CONTEXT

To understand what climate change means for Oxford County specifically, this project looked to the PCCIA to identify which systems across Southwestern Ontario are most likely to experience increasing stress over time. The PCCIA evaluates both the likelihood of climate impacts and their consequences to highlight where municipalities can expect growing pressures that may require planning or investment.

For Oxford County, this matters because the sectors identified as higher risk regionally such as agriculture, infrastructure, and the natural environment are the same systems that support the County's economy, services, and day-to-day operations. The PCCIA therefore provides a regional evidence base that helps explain why certain local risks are expected to intensify through the 2050s and 2080s, particularly in areas already sensitive to temperature variability, heavy rainfall, and severe weather (Climate Risk Institute, 2023).

Table 4 summarizes the sectors identified as having the highest climate-related risk across Southwestern Ontario and illustrates how these broader trends connect to the types of challenges already being observed locally, including repeated flooding, increased heat exposure, and pressures on agricultural production and water resources.

Table 4: Top moderate to high risks areas for Southwestern Ontario from the PCCIA report.

PCCIA Sector	Highest-Risk Areas Identified for SW Ontario	Risk Characterization
Food and Agriculture	• Field crops • Fruit and vegetable production • Livestock systems	Moderate risk to high due to heat stress, moisture variability, and changing growing conditions
Business and Economy	• Transportation-dependent industries • Recreation and tourism sectors • Financial and Insurance • Forestry, hunting and fishing economies	Moderate risk associated with operational disruptions, supply-chain instability, and increased maintenance costs
People and Communities	• Population-wide health impacts • Indigenous Communities • Increasing demand on health care and emergency services	Moderate to high risk linked to extreme heat, air quality, and severe weather exposure
Infrastructure	• Buildings • Stormwater systems • Transportation networks • Utilities and waste services	Sustained moderate risk with increasing stress from intense rainfall, freeze–thaw cycles, and heat
Natural Environment	• Species and habitats (fauna and flora) • Terrestrial ecosystems • Provisioning ecosystem services	Moderate to high risk as ecosystems shift beyond historical climate conditions

These sector-level risks align with observed local trends, including repeated flooding, growing heat exposure, and pressures on agricultural and water resources.

WHERE RISK IS CONCENTRATED LOCALLY

While the PCCIA provides a regional understanding of which sectors are most sensitive to climate change, the CISR, CISV, and Climate Insight Tool help translate those findings to the local scale by identifying where climate impacts may result in the greatest consequences for people and services within Oxford County.

These indices show that social vulnerability and adaptive capacity are not evenly distributed across the County. Instead, areas with higher population density, older housing stock, greater reliance on municipal services, and a higher proportion of residents facing socioeconomic or health-related challenges tend to cluster within the County's urban settlement areas. In these locations, even moderate climate events can lead to disproportionate impacts because more people, infrastructure, and critical services are concentrated within a smaller geographic area.

This pattern aligns with the historical events described in Section 2, where flooding, severe storms, and extreme heat have repeatedly produced the most disruptive effects in built-up areas such as Woodstock, Ingersoll, Norwich, and Tillsonburg. It also reflects projected climate trends discussed in Section 3, which indicate increasing temperatures, more intense rainfall, and longer periods of heat exposure that can place added stress on infrastructure, housing conditions, and public health systems.

"FOCUS CLIMATE ADAPTATION WHERE IT DELIVERS THE GREATEST BENEFIT."

Top Areas Identified

The following locations are priority areas based on the overlap of social conditions and climate exposure, rather than a formal ranking.

Woodstock (Central and South Woodstock)

This area represents the County's most significant convergence of lower resilience and higher vulnerability. As the largest urban centre and service hub, Woodstock contains critical infrastructure, healthcare facilities, transportation corridors, and higher-density residential areas. Climate-related disruptions here have the potential to affect a large share of the population and to strain emergency response and municipal operations.

Woodstock (North and East Urban Areas)

Neighbourhoods surrounding the core show consistently lower resilience relative to the County average, forming a broader zone where climate stressors such as basement flooding, heat exposure, or power outages may have cumulative impacts across residential communities.

Tillsonburg Urban Core

Tillsonburg functions as an important regional centre with concentrated residential, commercial, and healthcare services. Localized vulnerability in this area suggests heightened sensitivity to extreme heat, infrastructure disruptions, and storm-related impacts that could affect both residents and surrounding rural populations who rely on its services.

Ingersoll Settlement Area

Ingersoll demonstrates moderate-to-lower resilience combined with localized vulnerability. Its role as a transportation and employment node means that climate impacts affecting infrastructure or mobility may have broader economic and service-related consequences.

Norwich Area (Emerging Moderate Vulnerability)

Although more rural in character, portions of Norwich display moderate vulnerability levels that, when combined with exposure to flooding and severe weather, indicate a need for continued monitoring and targeted adaptation planning.

Taken together, these locations illustrate that climate risk is influenced not only by the hazard itself, but also by the concentration of people, services, and infrastructure that may be affected when events occur.

Outside of these settlement areas, rural townships generally demonstrate stronger relative resilience based on CISR indicators such as housing stability and workforce participation. However, rural areas remain highly exposed to sectoral climate risks identified through the PCCIA, particularly those affecting agriculture, groundwater-dependent water supplies, transportation access, and natural systems. Lower population density may reduce immediate social impacts, but greater distances between services and infrastructure can lengthen recovery times following extreme events.

This urban–rural contrast highlights the importance of tailoring adaptation approaches to local context: strengthening infrastructure and public health preparedness in settlement areas while supporting agricultural resilience, water resource management, and emergency accessibility across the broader rural landscape.

"IMPORTANCE OF TAILORING ADAPTATION APPROACHES TO OXFORD COUNTY"

OVERALL CLIMATE RISK PATTERN

The combined findings from the climate analysis, historical event review, Southwestern Public Health Report, PCCIA sector assessment, and CISV/CISR mapping indicate that climate change will not affect all parts of Oxford County equally, nor will it impact all systems in the same way. Risk is highest where hazards are increasing and where people, infrastructure, or services are more exposed, more sensitive, or have less capacity to adapt and recover. In addition, the interdependence of infrastructure, economic systems, public health services, and natural systems means that disruptions in one sector can amplify impacts across others.

For Oxford County, this means that climate adaptation planning should focus not only on reducing exposure to hazards, but also on strengthening the ability of communities and systems to cope with and recover from those hazards over time. Because future climate conditions contain uncertainty, priority actions should be those that perform well across a range of plausible futures and provide near-term co-benefits. Areas identified as having lower resilience and higher vulnerability, particularly Woodstock, Tillsonburg, Ingersoll, and portions of Norwich, represent priority locations where adaptation actions can have the greatest benefit. Investments in these areas can help reduce disproportionate impacts on residents while also protecting critical services that support the broader region. At the same time, sector-specific risks identified through the PCCIA highlight the importance of integrating climate considerations into long-term planning and operations across the County's core systems.

KEY CONSIDERATIONS FOR ADAPTATION PLANNING INCLUDE

Key considerations for adaptation planning emerging from this assessment include the following areas of focus. These considerations reflect where projected climate pressures intersect most directly with County systems, services, and community well-being.

Infrastructure Planning and Asset Management: Design, renewal, and maintenance of infrastructure should account for more intense rainfall, higher temperatures, and increased freeze–thaw variability to ensure continued service reliability and avoid escalating lifecycle costs.

Agricultural Resilience: As a County strongly dependent on agriculture, supporting adaptive practices such as soil management, water conservation, and climate-informed crop planning will be critical to sustaining productivity and protecting the local economy.

Public Health and Community Preparedness: Increasing heat events, air quality concerns, and severe weather underscore the need for preparedness measures such as cooling strategies, emergency response coordination, and targeted outreach to vulnerable populations.

Natural Systems Protection and Enhancement: Maintaining and restoring wetlands, woodlands, and riparian corridors can help buffer flooding, regulate temperatures, support biodiversity, and sustain ecosystem services that underpin both agriculture and community well-being.

Service Continuity and Emergency Management: Strengthening continuity plans for power, water, communications, and transportation systems can reduce cascading impacts during extreme events and support faster recovery across sectors.

Looking ahead, climate change is expected to gradually reshape environmental conditions, operational demands, and service delivery expectations across Oxford County. Proactive adaptation that considers both sector-level risks and localized social capacity can help reduce long-term costs, improve resilience to future disruptions, and support sustainable growth. Because infrastructure, economic systems, public health services, and natural systems are closely interconnected, strengthening resilience in one area can reduce risk across others and limit cascading impacts during extreme events.

By aligning adaptation strategies with the areas and systems identified as most at risk, and by integrating climate considerations across planning, asset management, emergency preparedness, and land use decision-making, Oxford County can move from reacting to individual events toward building a coordinated, forward-looking approach to climate resilience.

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APPENDIX A - KEY CLIMATE VARIABLES DEFINITIONS

Mean Temperature

Mean temperature represents the average air temperature over a 24-hour period and is reported in degrees Celsius (°C). Higher values indicate warmer overall climate conditions. Mean temperature is relevant to the project as it influences ecosystem conditions, agricultural suitability, pest and invasive species presence, and long-term shifts in baseline climate conditions that affect multiple sectors.

Days Above Maximum Temperature (Tmax > 35 °C)

Days Above Maximum Temperature (Tmax) quantify the number of days per year when daily maximum temperatures exceed 35 °C and are reported in days per year. Higher values indicate more frequent extreme heat events. This variable is relevant as high-temperature days increase risks to human health, particularly heat exhaustion and heat stroke, place stress on infrastructure and energy systems, and can limit outdoor work and recreation.

Days Below Minimum Temperature (Tmin < −15 °C)

Days Below Minimum Temperature (Tmin) measure the number of days per year when daily minimum temperatures fall below −15 °C and are reported in days per year. Higher values indicate more frequent extreme cold conditions. This variable is relevant for understanding winter severity, impacts on human health and safety, energy demand, transportation reliability, and ecological constraints. Changes in extreme cold days also affect winter road maintenance and building performance.

Last Spring Frost

The last spring frost represents the approximate start of the frost-free growing season and is reported as the day of year (converted to approximate date or month). It is defined as the last occurrence of a minimum daily temperature below 0 °C before July 15. Lower values indicate an earlier last frost. This indicator is relevant for agriculture and natural systems, as it affects planting timing, crop viability, and ecosystem phenology. Shifts in last spring frost dates also have implications for maple syrup production due to changes in freeze–thaw timing.

First Fall Frost

The first fall frost marks the approximate end of the growing season and is reported as the day of year (converted to approximate date or month). It is defined as the first occurrence of a minimum daily temperature below 0 °C after July 15. Higher values indicate a later onset of fall frost. This variable is relevant for understanding growing season length, crop harvesting timelines, and frost-related risks to sensitive vegetation. Later fall frost dates generally indicate an extended growing season.

Frost-Free Season

The frost-free season represents the length of time between the last spring frost and the first fall frost and is reported in days (converted to approximate length in months). Higher values indicate a longer growing season. This variable is relevant to agriculture through its influence on crop suitability and yields, and to health by indicating potential extensions of allergy seasons and vector-borne disease risks associated with longer warm periods.

Frost Days

Frost days describe the number of days per year when minimum temperatures fall below 0 °C and are reported in days per year. Higher values indicate longer or more severe winter conditions. This variable is relevant as an indicator of winter length and severity, influencing agricultural growing seasons, natural ecosystems, and infrastructure durability. A reduction in frost days may signal shorter winters and longer growing seasons.

Freeze–Thaw Cycles

Freeze–thaw cycles count the number of days per year when temperatures fluctuate above and below 0 °C within the same day and are reported in days per year. Higher values indicate more frequent freeze–thaw conditions. This indicator is particularly relevant for infrastructure, as repeated freeze–thaw cycles accelerate deterioration of roads, bridges, sidewalks, and railways. It is also relevant for agriculture (e.g., maple syrup production) and public safety due to increased slipping and tripping hazards.

Total Precipitation

Total precipitation represents the combined amount of rainfall and snowfall accumulated over a year and is reported in millimetres (mm). Higher values indicate wetter conditions. This variable is relevant for assessing water availability, drought and flood risk, agricultural productivity, and infrastructure design requirements. Changes in total precipitation can affect drainage capacity, construction timelines, and health outcomes related to moisture extremes.

Maximum Consecutive Dry Days

Maximum consecutive dry days measure the longest continuous period without measurable precipitation (1 mm) in a year and are reported in days. Higher values indicate longer dry spells and increased drought potential. This indicator is relevant for identifying agricultural stress, soil shrinkage, water availability challenges, and potential impacts on infrastructure stability and air quality.

Maximum Consecutive Wet Days

Maximum consecutive wet days represent the longest continuous period with measurable precipitation (above 0 mm) and are reported in days. Higher values indicate prolonged wet conditions. This variable is relevant for assessing flood risk, soil saturation, crop disease potential, and increased strain on stormwater and transportation infrastructure.

Cooling Degree Days (CDD, base 18 °C)

Cooling Degree Days estimate the demand for space cooling by accumulating daily temperatures that exceed a base threshold of 18 °C. Values are reported in K·days (equivalent to °C·days) and represent the total amount of excess heat over time. Higher values indicate greater cumulative heat and increased demand for air conditioning. This variable is relevant for understanding future energy demand, building design requirements, and heat-related health risks.

Heating Degree Days (HDD, base 18 °C)

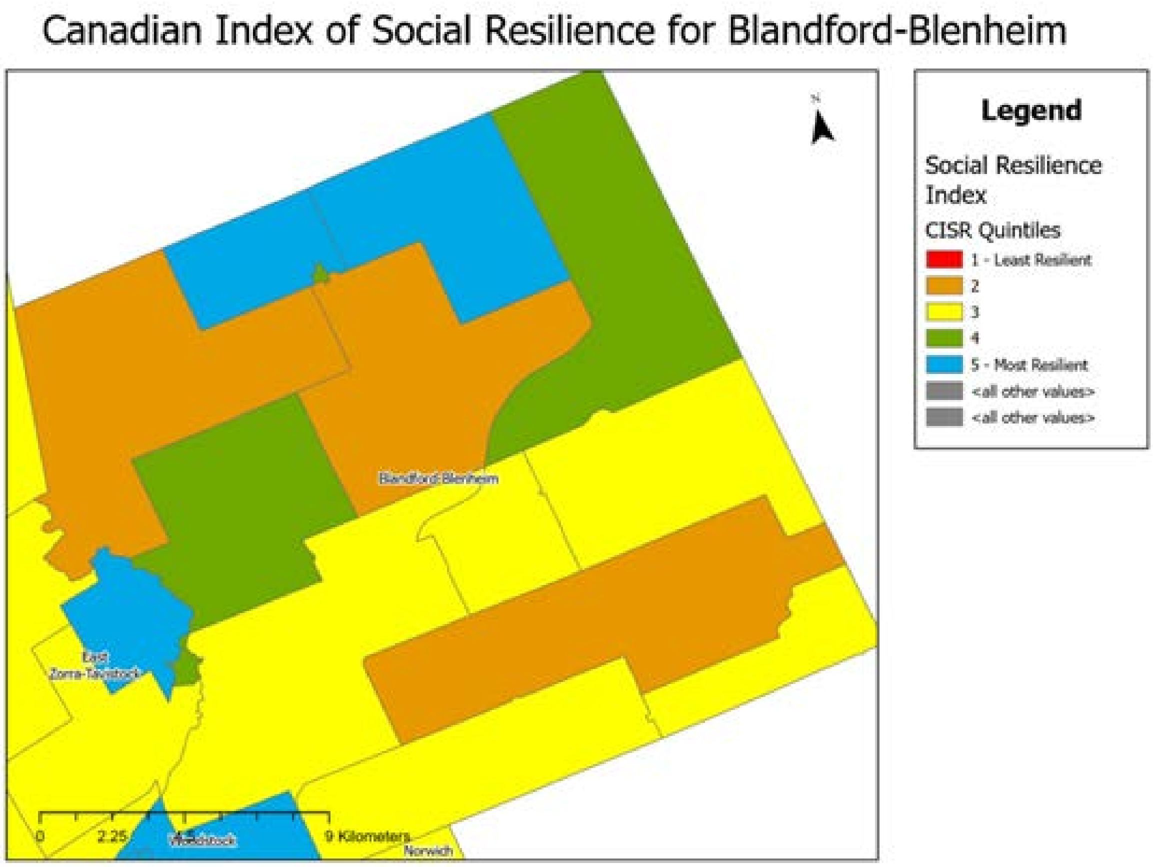
Heating degree days estimate the demand for space heating based on daily temperatures below a base threshold of 18 °C and are reported in K·days (equivalent to °C·days). Higher values indicate greater heating demand, while lower values reflect warmer winter conditions. This variable is relevant for assessing energy demand, infrastructure planning, and winter heating needs.

Growing Degree Days (GDD, base 5 °C)

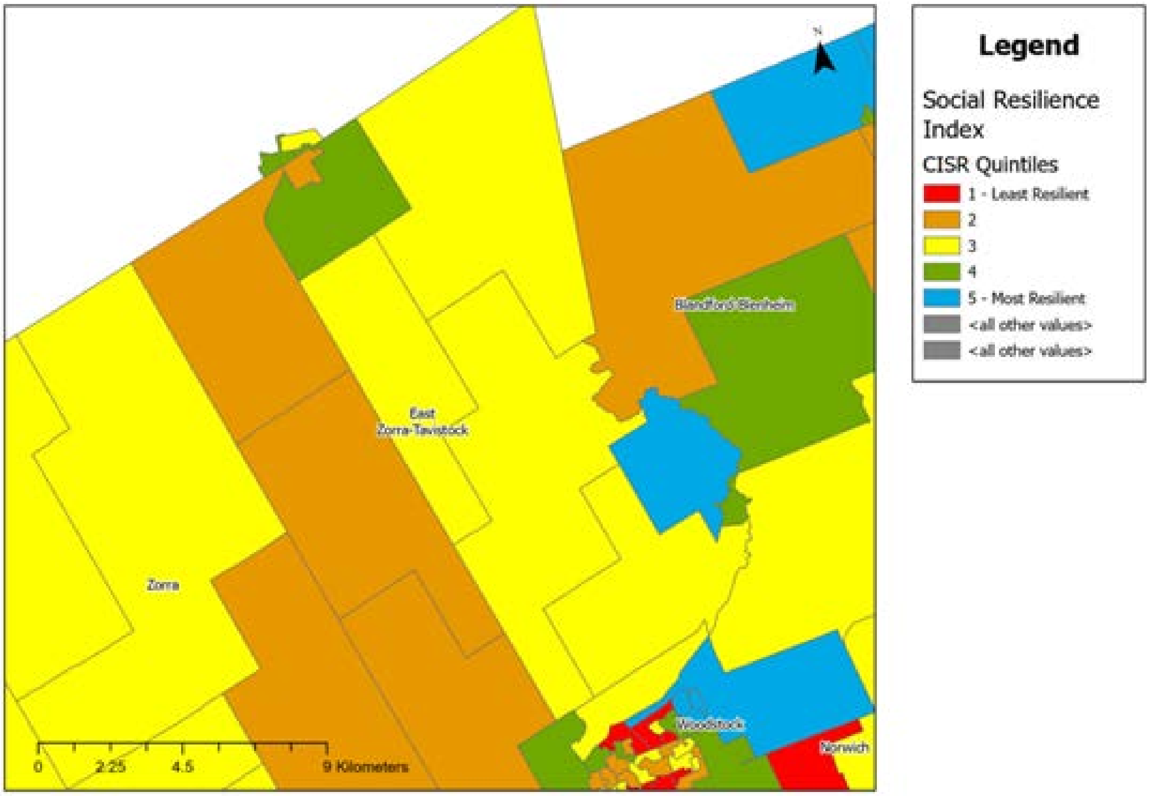
Growing degree days measure accumulated heat above a base temperature of 5 °C and are reported in K·days (equivalent to °C·days). Higher values indicate greater heat availability for plant and insect growth. This variable is relevant for agriculture by indicating crop growth potential, maturity timing, and pest development, and for health due to its association with longer pollen seasons and allergenic exposure.

APPENDIX B - SOCIAL VULNERABILITY MAPPING

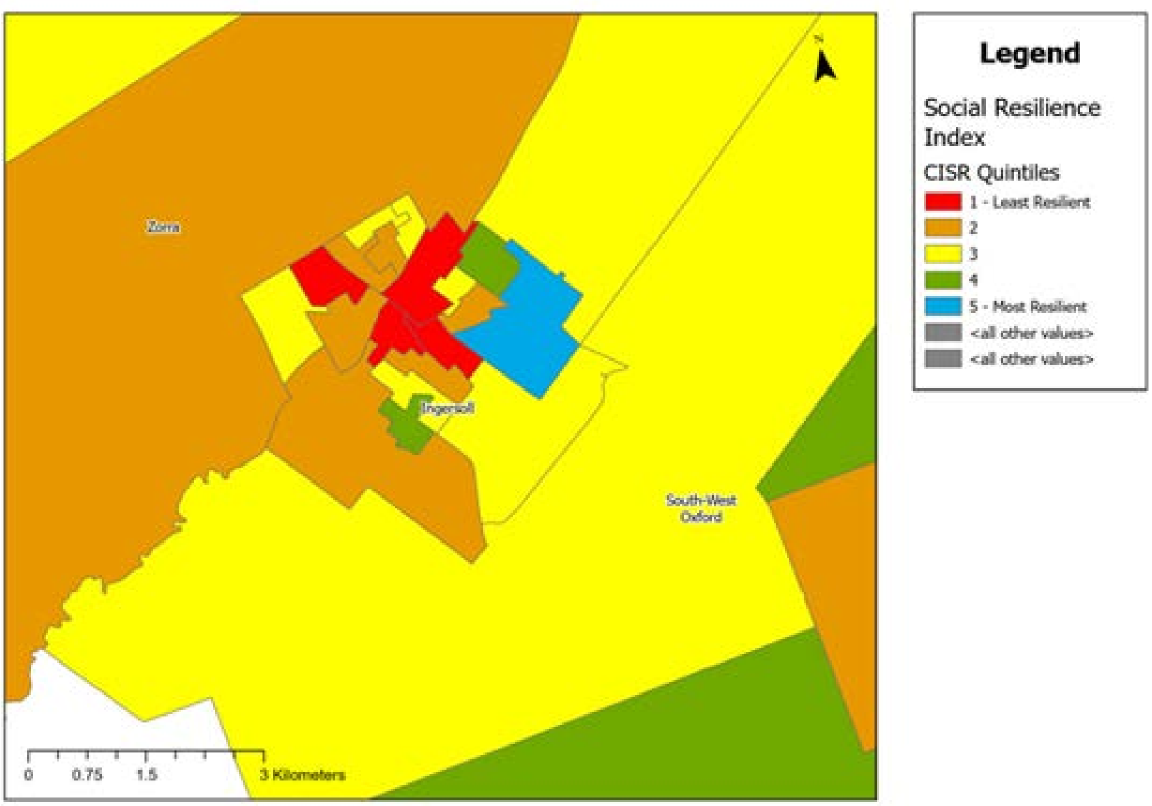
C.1. CISR Maps for Lower-Tier Municipalities within Oxford County



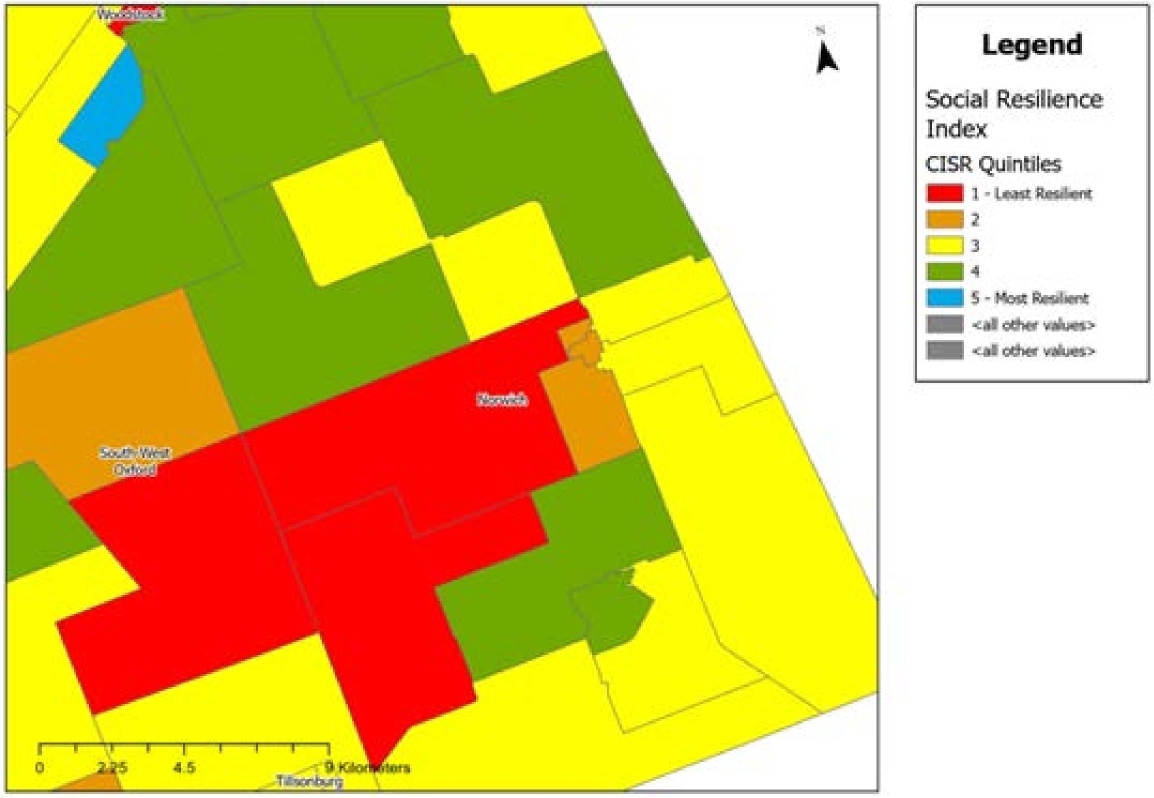
Canadian Index of Social Resilience for East Zorra-Tavistock



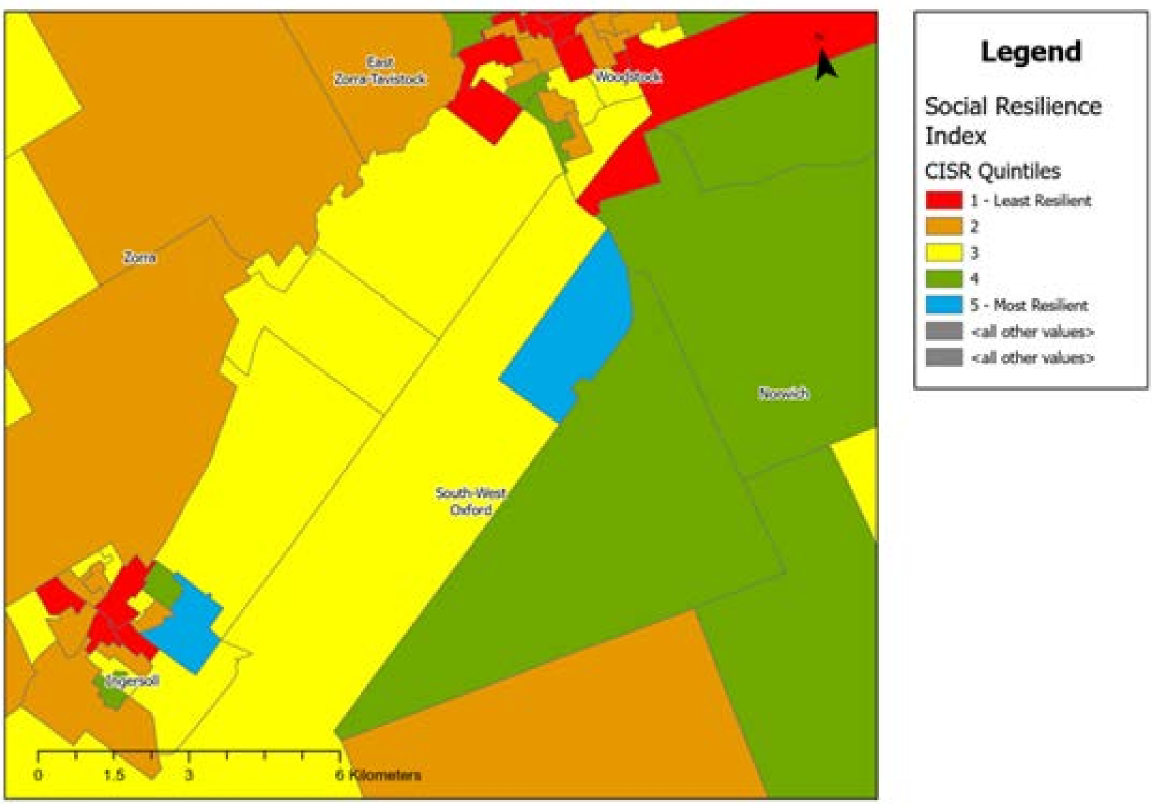
Canadian Index of Social Resilience for Ingersoll



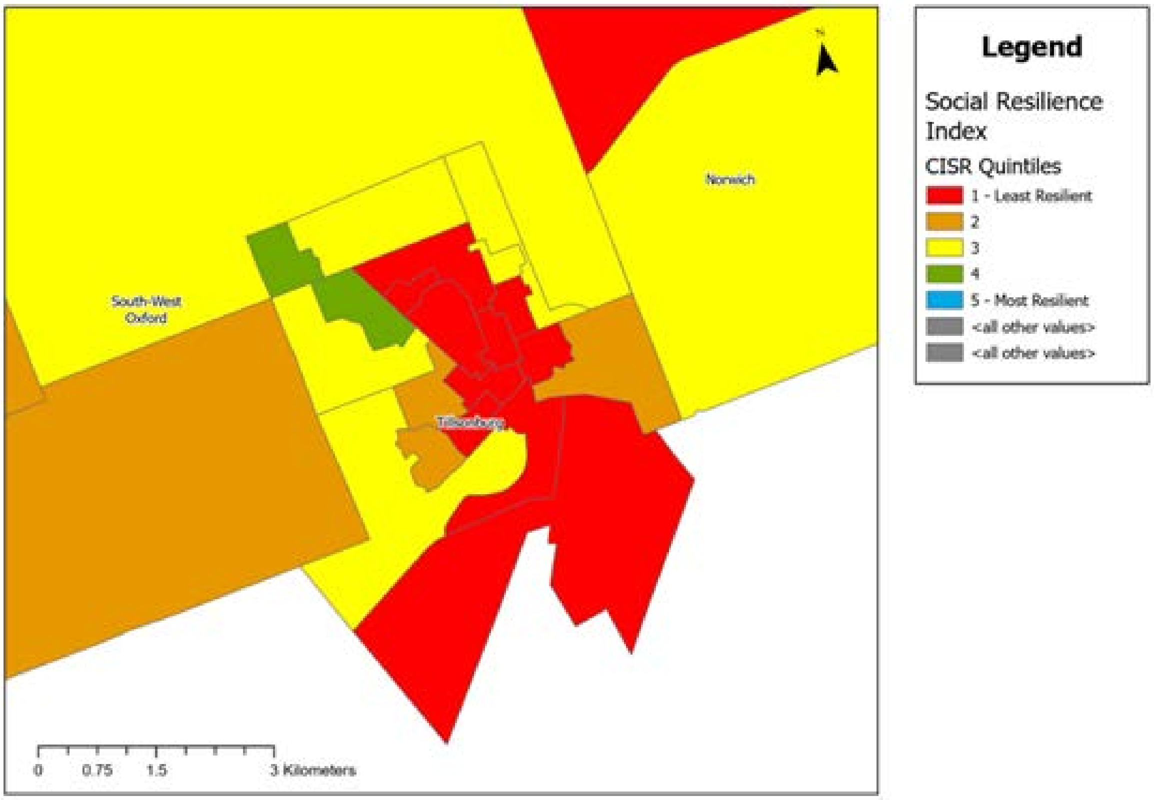
Canadian Index of Social Resilience for Norwich



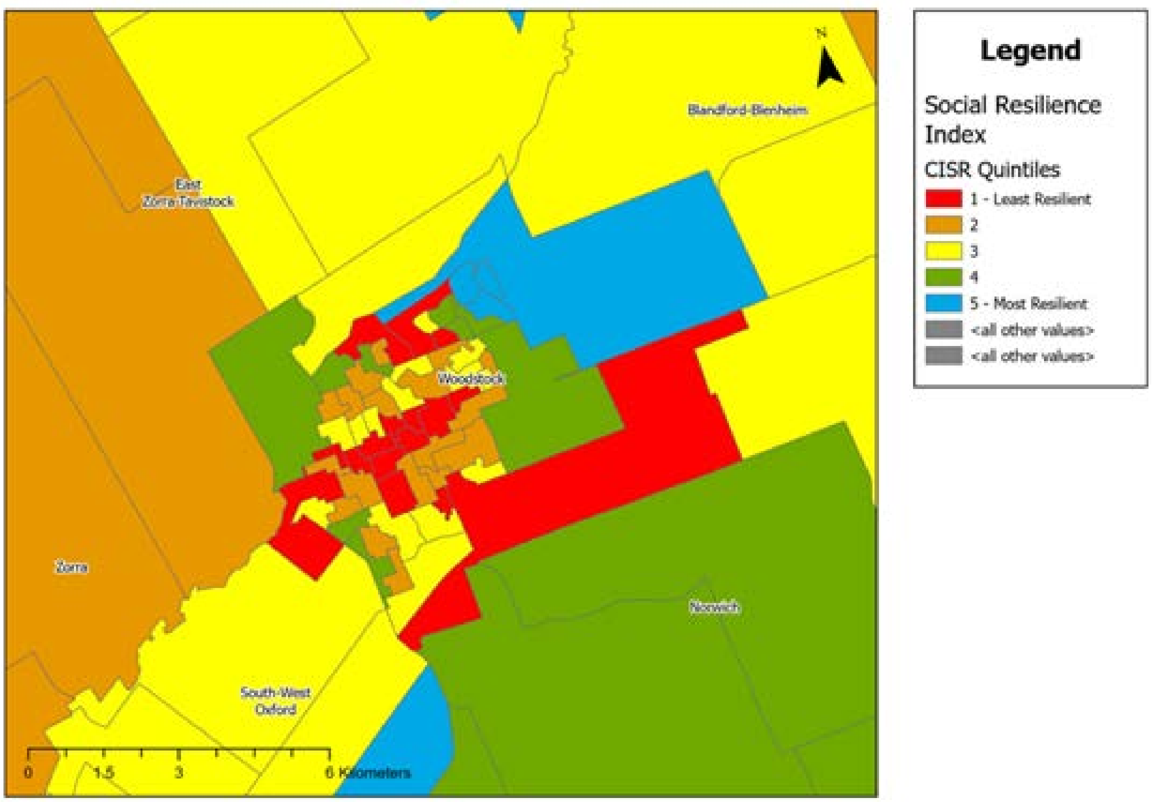
Canadian Index of Social Resilience for South-West Oxford



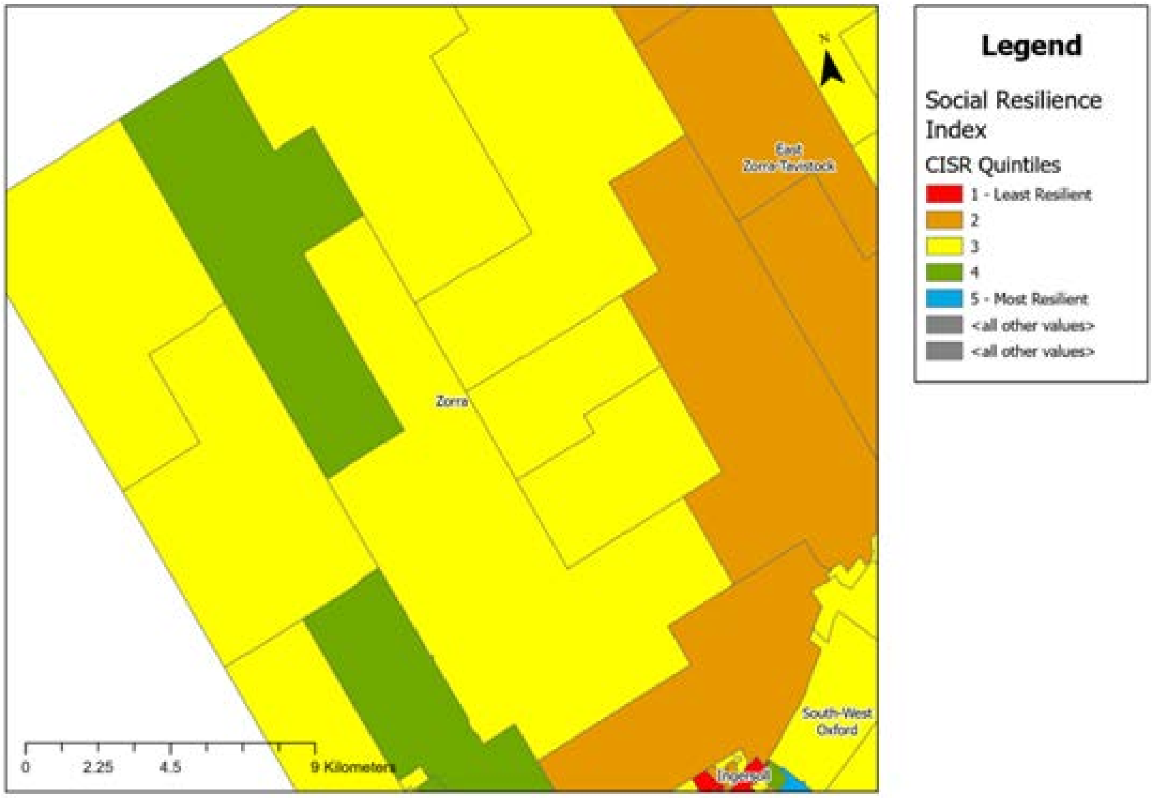
Canadian Index of Social Resilience for Tillsonburg



Canadian Index of Social Resilience for Woodstock

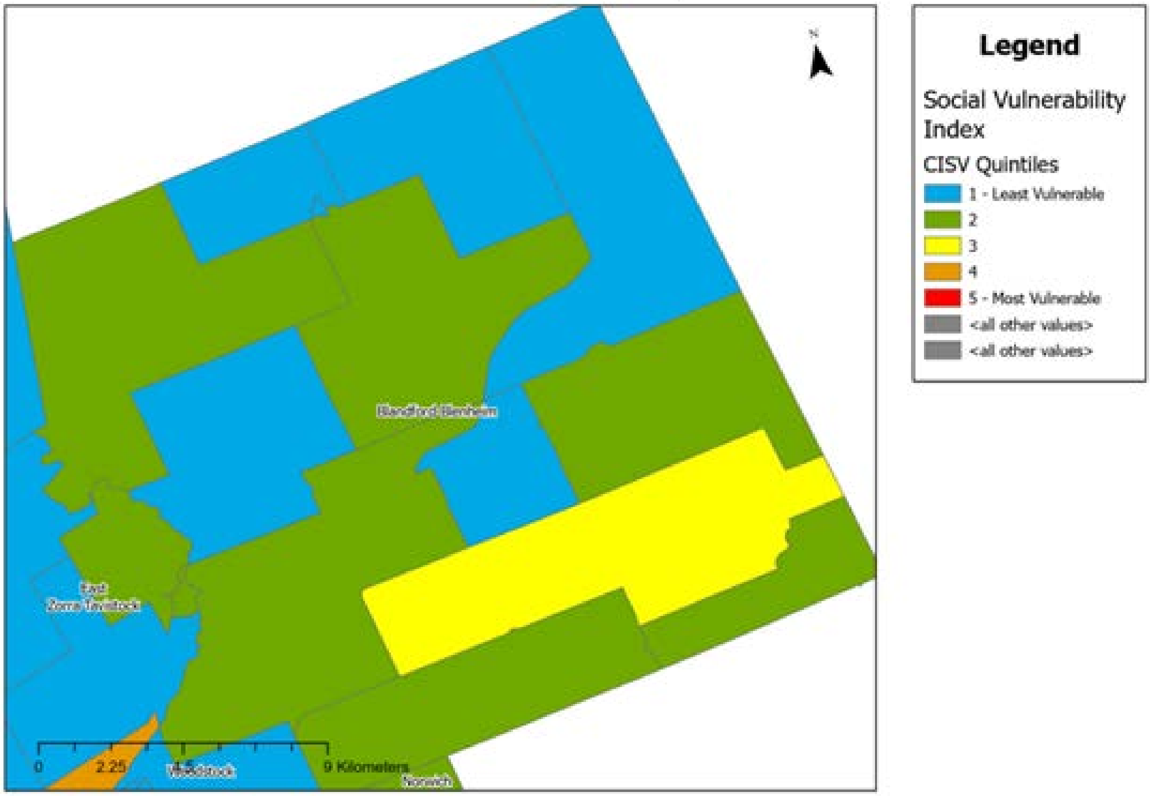


Canadian Index of Social Resilience for Zorra

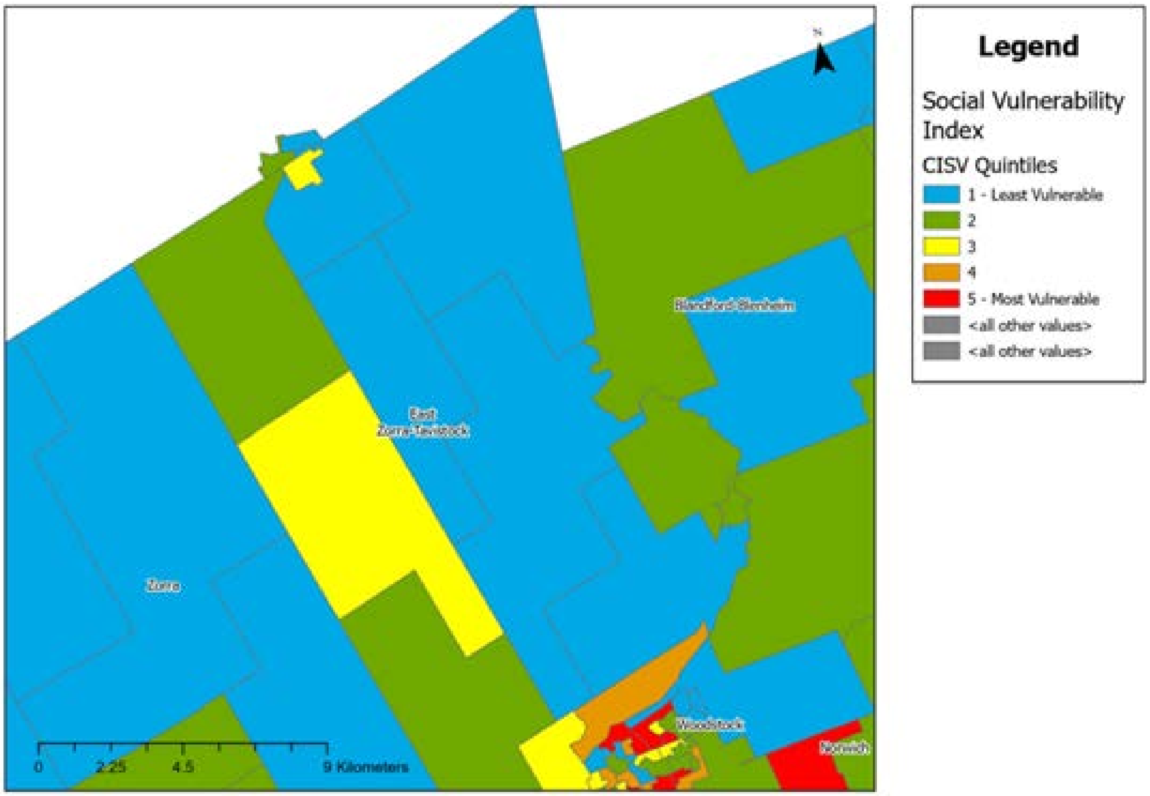


C.2. CISV Maps for Lower-Tier Municipalities within Oxford County

Canadian Index of Social Vulnerability for Blandford-Blenheim

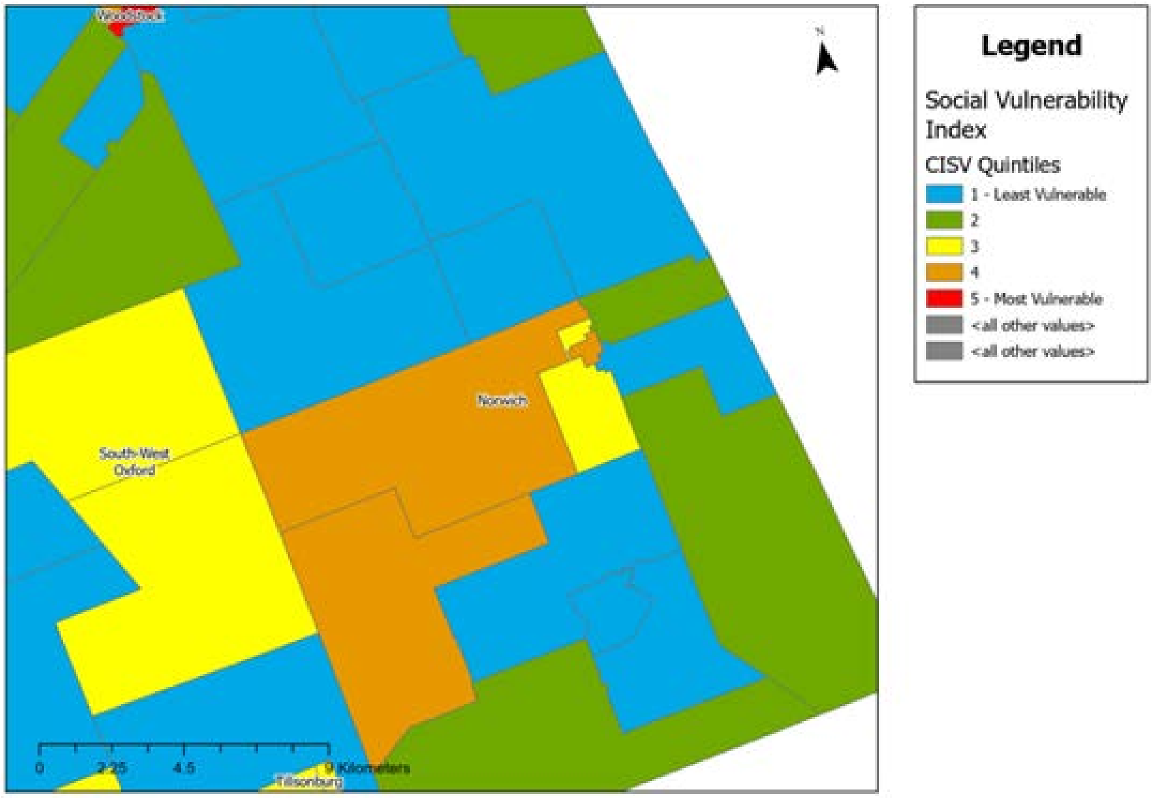


Canadian Index of Social Vulnerability for East Zorra-Tavistock

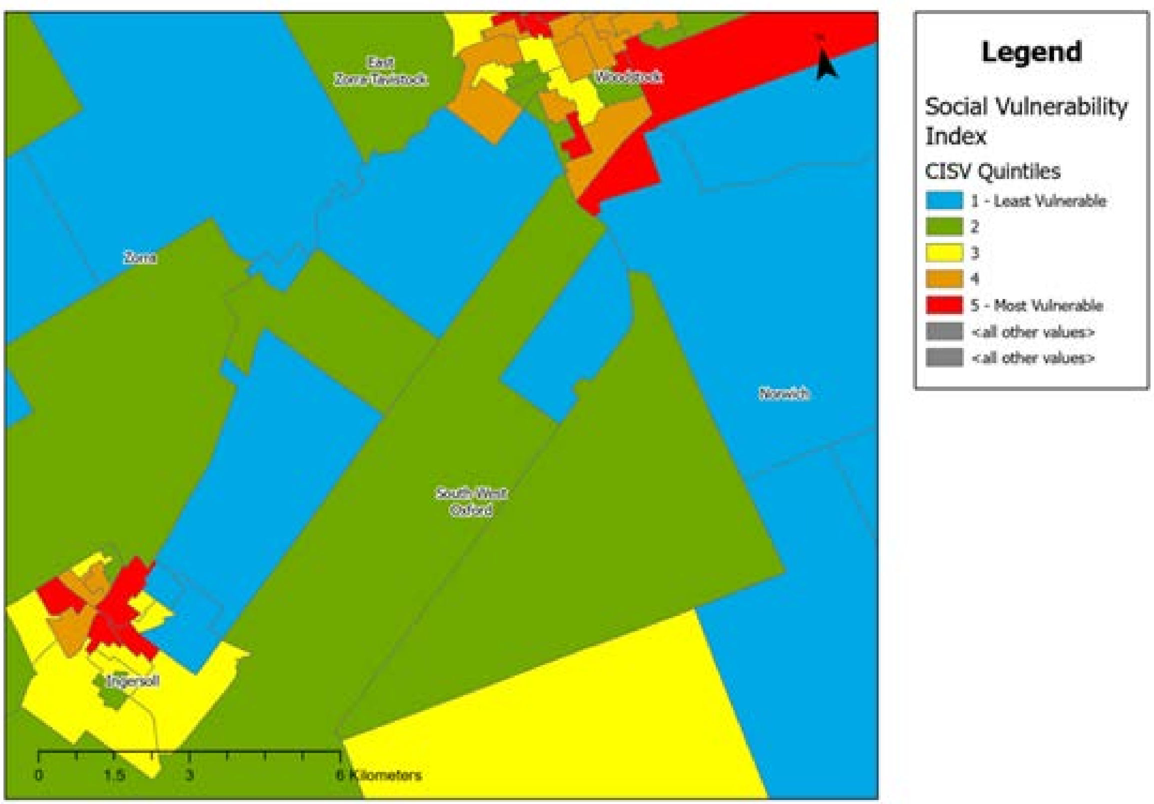


Canadian Index of Social Vulnerability for Ingersoll

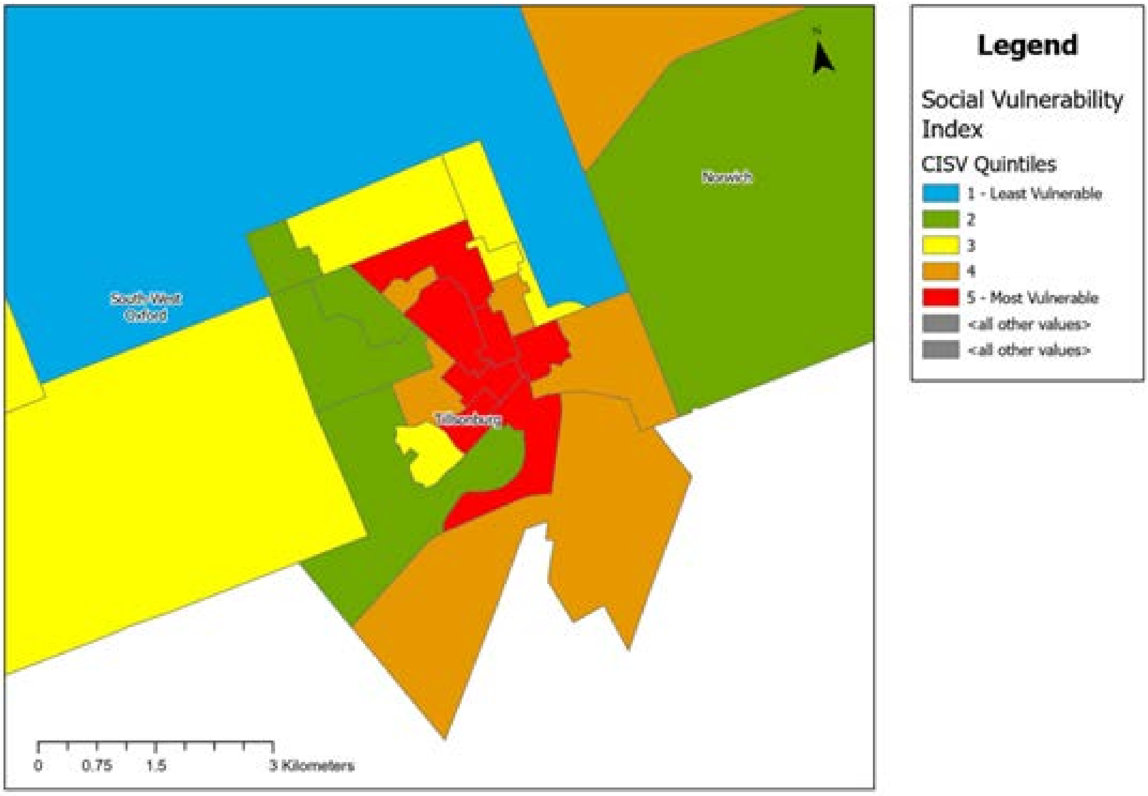
Canadian Index of Social Vulnerability for Norwich



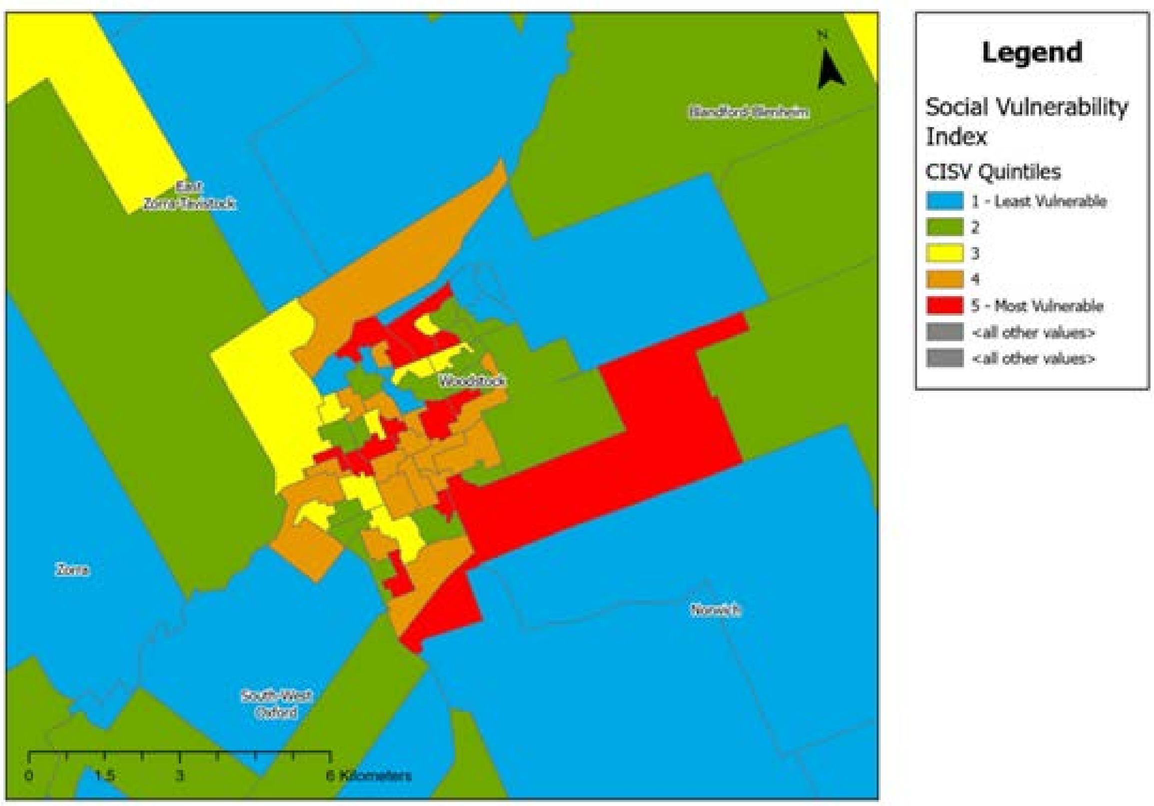
Canadian Index of Social Vulnerability for South-West Oxford



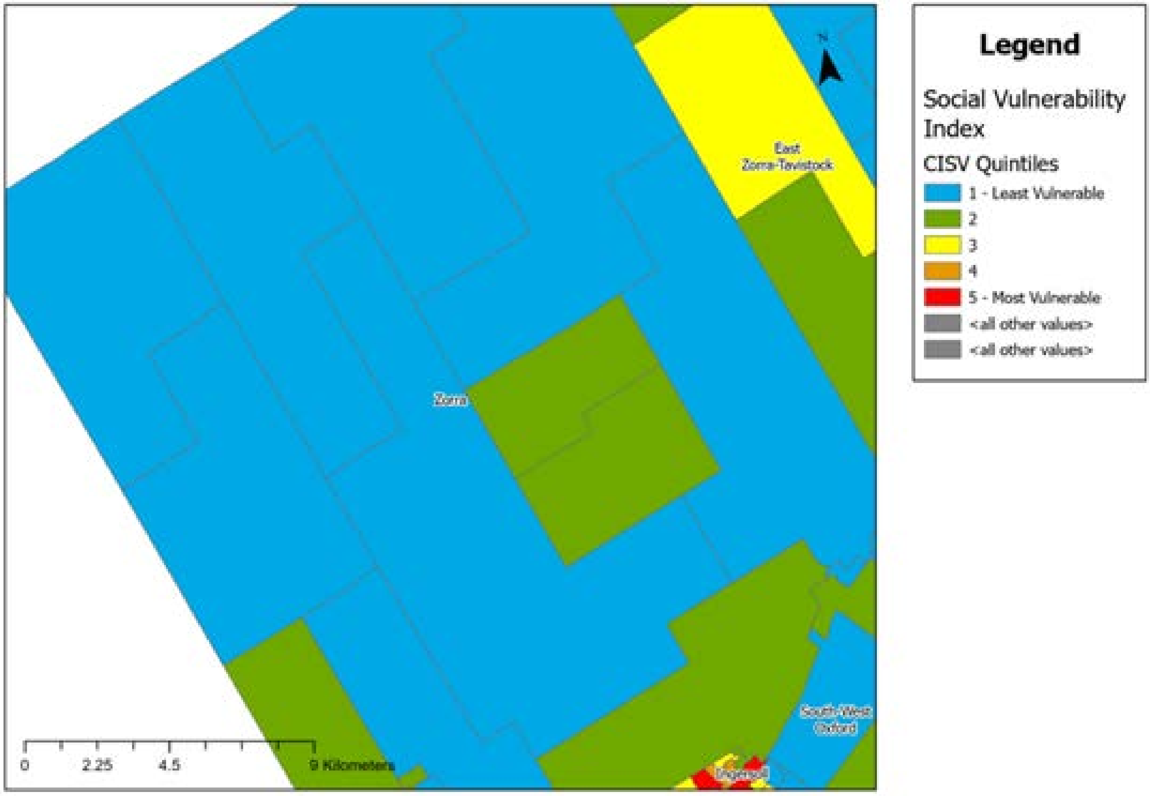
Canadian Index of Social Vulnerability for Tillsonburg



Canadian Index of Social Vulnerability for Woodstock



Canadian Index of Social Vulnerability for Zorra

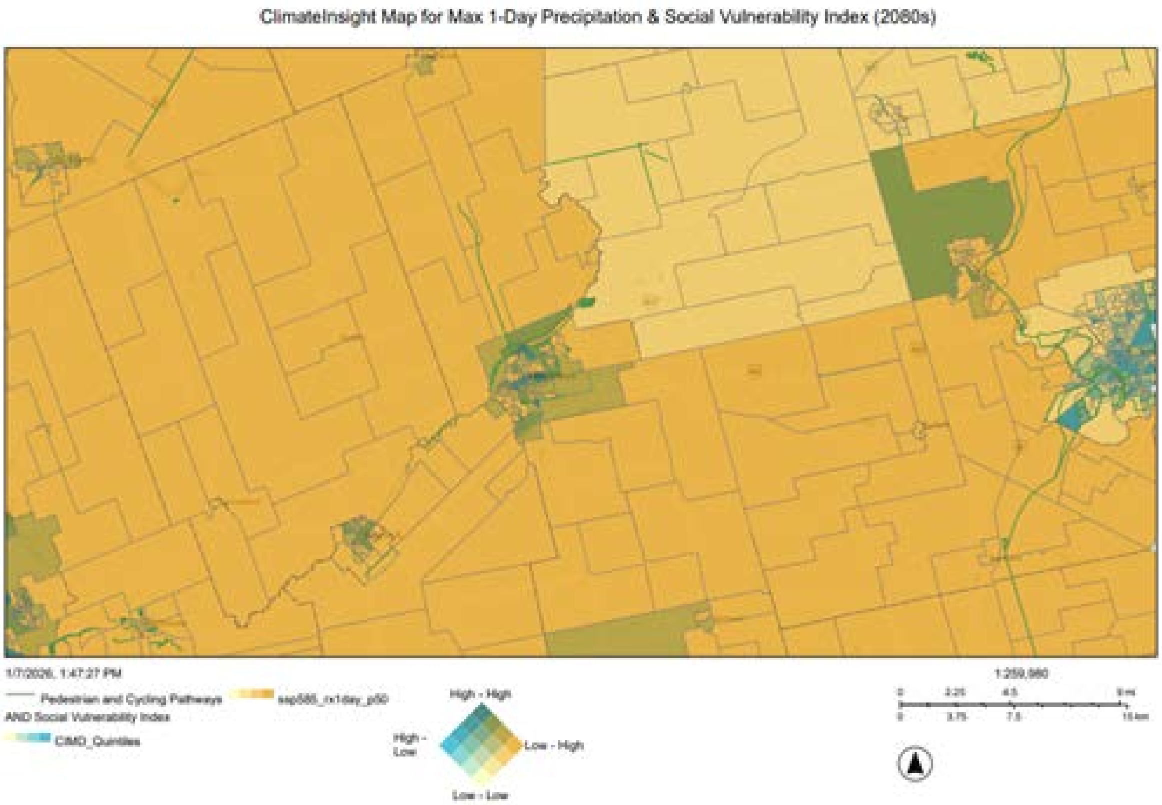


APPENDIX C - CLIMATE INSIGHT MAPS

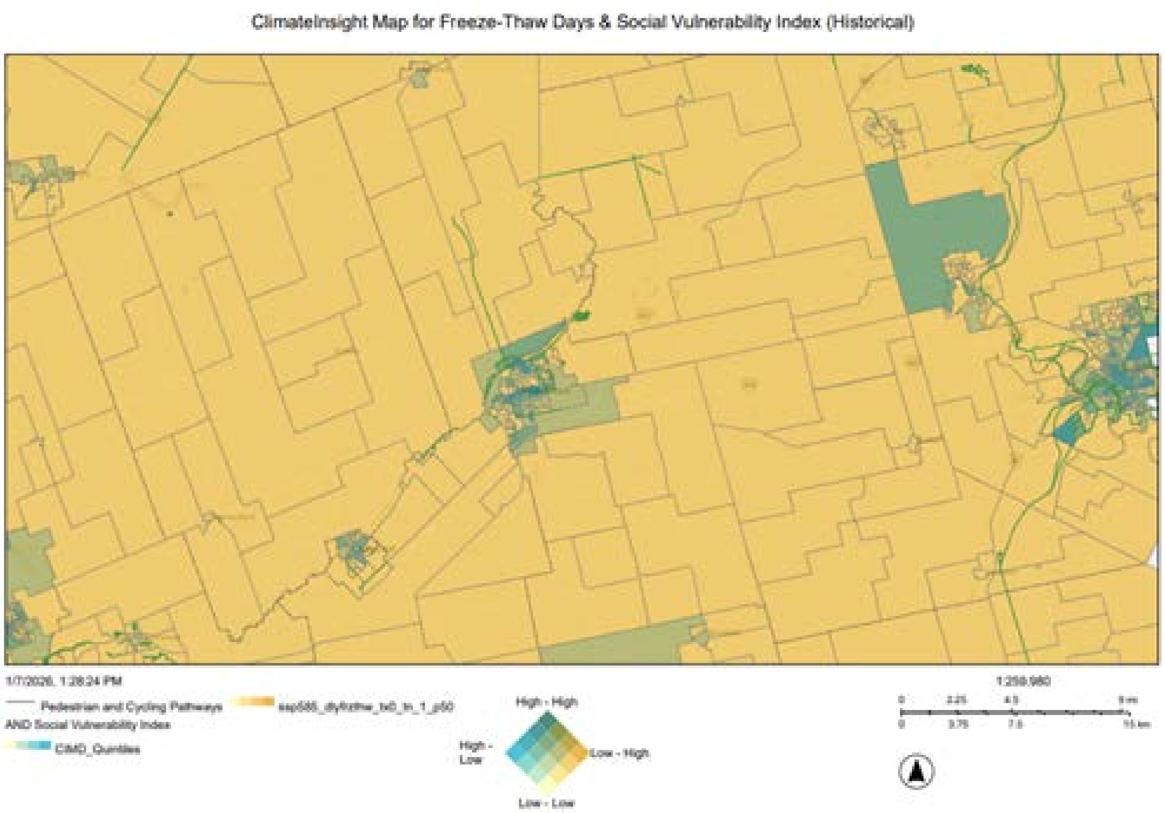
D.1. Maximum 1-Day Precipitation and Social Vulnerability Index

ClimateInsight Map for Max 1-Day Precipitation & Social Vulnerability Index (Historical)

ClimateInsight Map for Max 1-Day Precipitation & Social Vulnerability Index (2050s)



D.2. Freeze-Thaw Days and Social Vulnerability Index



ClimateInsight Map for Freeze-Thaw Days & Social Vulnerability Index (2050s)

ClimateInsight Map for Freeze-Thaw Days & Social Vulnerability Index (2080s)

D.3. Maximum Temperature More Than 30°C and Social Vulnerability Index

ClimateInsight Map for Days with Max Temperature More Than 30°C & Social Vulnerability Index (Historical)

ClimateInsight Map for Days with Max Temperature More Than 30°C & Social Vulnerability Index (2050s)

ClimateInsight Map for Days with Max Temperature More Than 30°C & Social Vulnerability Index (2080s)