



# Hennepin County Climate Vulnerability Assessment



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This guidance document was created by Barr Engineering Co. for Hennepin County.



# Executive Summary

## Purpose

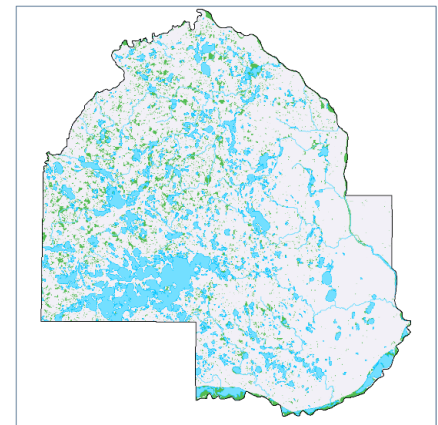
This vulnerability assessment presents the risks posed by existing and projected climate trends in Hennepin County and identifies the people and operations within the county that are most vulnerable to the impacts of our changing climate. Its purpose is to provide Hennepin County staff with data that identifies climate change vulnerabilities within the county's water, transportation, and natural systems, as well as risks to public health, public services, and the built environment. The document is intended to serve as a foundation and technical reference for the Hennepin County Climate Action Plan, where the county intends to present strategies, initiatives, and actions aimed at building resilience to these risks. It can also serve as a useful reference for Hennepin County's 45 municipalities, 11 watershed management entities, and two park districts.

Vulnerability to the impacts of climate change in Hennepin County varies by location and by social, jurisdictional, and economic factors. There are many ways to define the term vulnerability as it relates to climate change. For the purposes of this assessment, climate change vulnerability is a function of exposure to climate hazards and associated impacts, sensitivity to these hazards, and capacity of a system or community to adapt or cope with the adverse effects. Existing health, social, economic, and racial disparities reduce a community's ability to leverage resources for adapting to and overcoming the adverse effects of climate change hazards.

When climate-driven events unfold, the impacts disproportionately affect vulnerable populations and place additional strain on the County's budget, its operation, and its personnel. Those impacts are communicated in this document through a series of over 40 maps depicting flood susceptibility, susceptible infrastructure and natural resources, vulnerable populations, and much more.

The primary existing and projected climate change trends in Hennepin County include increased warming, heat, and humidity; warmer winters; extreme precipitation; and drought. The prevalence of surface water and the density of development throughout Hennepin County, as well as existing disparities, increase the

vulnerability of the county's population and operations to the impacts of many of these climate trends. Hennepin County, encompassing 611 square miles, is bordered by three major river systems (Crow River, Mississippi River, and Minnesota River) and includes 200 lakes larger than 10 acres, 640 miles of streams, and 45,000 acres of wetlands. Close proximity to surface waters increases exposure to the risk of flooding resulting from extreme precipitation.



*The many lakes, river, streams (shown in blue) and wetlands (shown in green) in Hennepin County improve our quality of life, but also increase our vulnerability to climate change.*

The primary climate change hazards in Hennepin County (warmer winters; increased extreme precipitation; warming, heat, and humidity; drought) and the associated impacts are detailed in this vulnerability assessment and summarized below.



### Warming, Heat, and Humidity

Yearly average maximum temperatures in Hennepin County are slowly increasing at a rate of 0.09°F per decade, and projected climate scenarios show that the frequency and magnitude of hot days, warm nights, and heat waves are likely to increase by mid-century. Humidity, or dew-point temperature (a measure of water vapor in the air), is also increasing. And, increased heat and humidity are favorable conditions for severe storms with high wind, hail, or tornados—severe weather events that are projected to increase beyond mid-century. Some specific anticipated impacts include:

- Increased frequency and severity of heat-induced illness.
- Exacerbated physical and mental health issues due to periods of high heat and humidity.
- Increased air pollution and reduced air quality, exacerbating existing health conditions such as asthma or chronic obstructive pulmonary disease (COPD).
- Increased frequency and severity of non-local wildfires, reducing local air quality.
- Warming surface waters, which can result in algal blooms and fish kills.
- Forest die-offs of plant species that can no longer tolerate warmer, more humid growing conditions.
- Greater demand for air conditioning and community cooling options.

- Increased energy use, causing:
  - Rising energy costs for cooling, which puts additional strain on county operations and economically disadvantaged renters/owners.
  - Increased air pollution.
- Disruption and damage to the transportation system, including:
  - Pavement buckling caused by excess heat and humidity and subsequent traffic interruptions and emergency repair costs.
  - Increased electrical system malfunctions and signal interruptions caused by storm events and subsequent traffic interruptions.
- More frequent power outages resulting from severe storms or high energy demand.



### Warming Winters

A distinct climate change trend occurring in Hennepin County is warmer winters. Based on data collected at the Minneapolis-St. Paul airport, winter temperatures since 1969 have increased at a surprising rate of approximately 2.2°F per decade. With increased winter temperatures come more freeze-thaw cycling and less consistent lake ice cover. Although average annual snowfall is steady or increasing, warmer winter temperatures result in less snow cover, shorter snow-cover season, and decreased snowpack thickness. Other impacts include:

- Increased freeze-thaw cycling, causing:
  - Hazardous walking and driving conditions.

- Increased use of salt and sand to mitigate icy conditions, which negatively impacts downstream waterbodies and habitat.
- Decline in pavement life cycle and increased costs for maintenance and replacement.
- Increased occurrence of winter flooding resulting from rainfall on frozen ground and waterway ice dams that cause an unpredictable rise in spring flood stages.
- Increased power outages from ice events, causing economic and social disruption from the loss of electricity, heating, and communication systems.
- Increased risk of human illness resulting from over-wintering survival of insects that carry pathogens like Lyme disease, West Nile virus, and human anaplasmosis, now found locally.
- Increased survival of existing invasive species and arrival of new invasive species, causing much loss of habitat and additional expense to manage or control the invasive species.
- Increased survival of destructive tree pests such as emerald ash borer and the pine bark beetle.

Disruptions to winter recreational activities and associated economic impacts.



### Extreme Precipitation

Hennepin County has and will continue to experience more wet conditions caused by increased precipitation. Precipitation increases are occurring in each season of the year, with the largest increases in spring and summer. Not only has total precipitation increased, but

the intensity and frequency of large events have also increased, with significant potential impacts on Hennepin County residents and operations, including:

- Increased frequency and severity of localized and large-scale regional flooding along streams or river systems, adjacent to lakes, and near wetlands or other low-lying areas, causing:
  - Increased safety risks from moving or deep water on roadways, roadway failure, unstable slopes, disrupted emergency access, and contaminated water.
  - More frequent and extreme property damage to public and private property, including Hennepin County owned or leased facilities, roadways, and infrastructure.
  - More construction and flood clean-up debris generated and needing disposal.
  - More frequent disruption of traffic corridors, including roadways, sidewalks, and trails.
  - Increases in the cost of future roadway design and construction to adapt to impacts of increased flood risk and to retrofit existing under-designed roads and infrastructure.
- Fluctuations in groundwater levels and more prolonged groundwater rise, causing:
  - More flooding of public and private property in areas that previously have not experienced flooding.

- More flooded or wet basements and associated property damage, mold and bacteria issues, and stress.
- Impacts to underground infrastructure and building foundations, including potential to mobilize historic contamination, plumes, and vapors, and the formation of sinkholes.
- Saturated soils on steep slopes, causing slope failures and landslides.



## Drought

Several historic droughts have occurred across Hennepin County dating back to 1863, including the Dust Bowl period in the 1930s. An increase in drought conditions has not been observed in recent data, and projected scenarios only show a slight possibility of increasing drought conditions by the mid-century. However, it is important to remember that severe drought, such as the Dust Bowl period, is part of normal climate fluctuation and should be expected. Increased drought conditions will have negative impacts on Hennepin County residents and operations, including:

- Increased demand for water for public and private use (including agriculture), resulting in drawdown of aquifers and additional water supply costs for public utilities and water users.
- Limitations on availability or allowable use of water for personal use and property irrigation.
- Stress to crops and vegetation, causing:
  - Lower productivity in agricultural crops.

- Additional costs for maintaining, watering, or replacing landscaping.
- Increased stress on roadside vegetation.
- Stress to wetlands and lake ecosystems, including:
  - Warming surface waters, which can result in algal blooms and fish kills.
- Increased risk of wildfires, flash flooding, and erosion.
- Drought in areas outside of Hennepin County. This may increase demand to ship local water supplies out of Minnesota, disrupt the fuel and food supply system, and increase costs. Drought-driven wildfires, local or distant, will adversely impact air quality.

## Population Vulnerability

Vulnerability to climate change throughout Hennepin County will be exacerbated by existing health, social, economic, and racial disparities that affect exposure and sensitivity to climate hazards. Disparities partly determine a community's ability to respond to impactful events, overcome the adverse effects of climate change hazards, and proactively adapt for similar, or worse, future occurrences. A composite population vulnerability map was developed using 14 demographic variables to help assess the influence of these factors on climate change vulnerability and

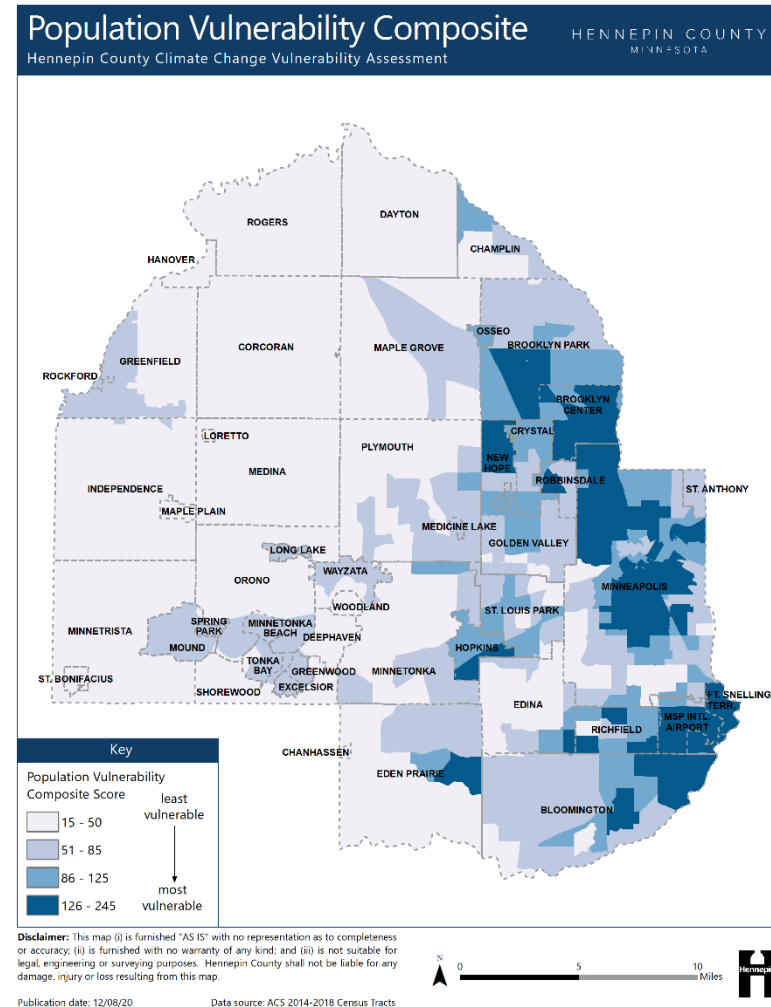
vulnerability scores were assigned to census tracts for each equally considered variable. A composite score was then computed for each census tract: the higher the value, the greater the population's vulnerability to climate change. This composite population vulnerability map can be used as a tool by local government to prioritize climate change response actions.

## Hennepin County Climate Adaptation Work Groups

As part of its climate resiliency and adaptation planning, Hennepin County developed five work groups, organized by county core functions. Discussion of key climate change impacts and vulnerability is organized in this document by these work groups, which include: (1) people, health, and disparities; (2) natural resources, agriculture, and land use; (3) buildings and energy; (4) transportation infrastructure; and (5) waste and materials.

## Conclusions

Hennepin County is getting warmer and wetter. These trends are projected to continue with heavy precipitation and warmer winter temperatures occurring more frequently. Other climate change manifestations such as an increase in drought and severe weather (tornadoes and high-wind events) have not, yet, been documented, but still have the possibility to increase by mid-century. Local severe-weather events create uncertainty and will disproportionately impact businesses, county operations, and residents. Residents already experiencing health, social, economic, and racial disparities are placed at greater risk of experiencing negative consequences in their daily lives.



*The composite population vulnerability map includes 14 demographic variables that influence vulnerability to climate change impacts. Areas of greater vulnerability, based on social, political, and economic indicators, are shown in darker blue.*

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A challenge that Hennepin County faces is that the dramatic climate change images seen in the news (wildfires, extreme heat waves, rising ocean levels) don't match up with how we are experiencing climate change in Minnesota. Because of this mismatch, it can be harder for people to grasp the county's current and potential vulnerabilities. However, as noted above, there are many local impacts from changing climate conditions. Events elsewhere do eventually impact Hennepin County and its residents when far-away wildfires diminish local air quality, or supply chains for food, fuel, and resources are impacted and higher costs are passed on to local consumers and businesses.

### **Next Steps**

This vulnerability assessment is intended to serve as a foundation and technical reference for the Hennepin County Climate Action Plan, where the county work groups intend to present strategies, initiatives, and actions aimed at building resilience to the risks posed by climate change