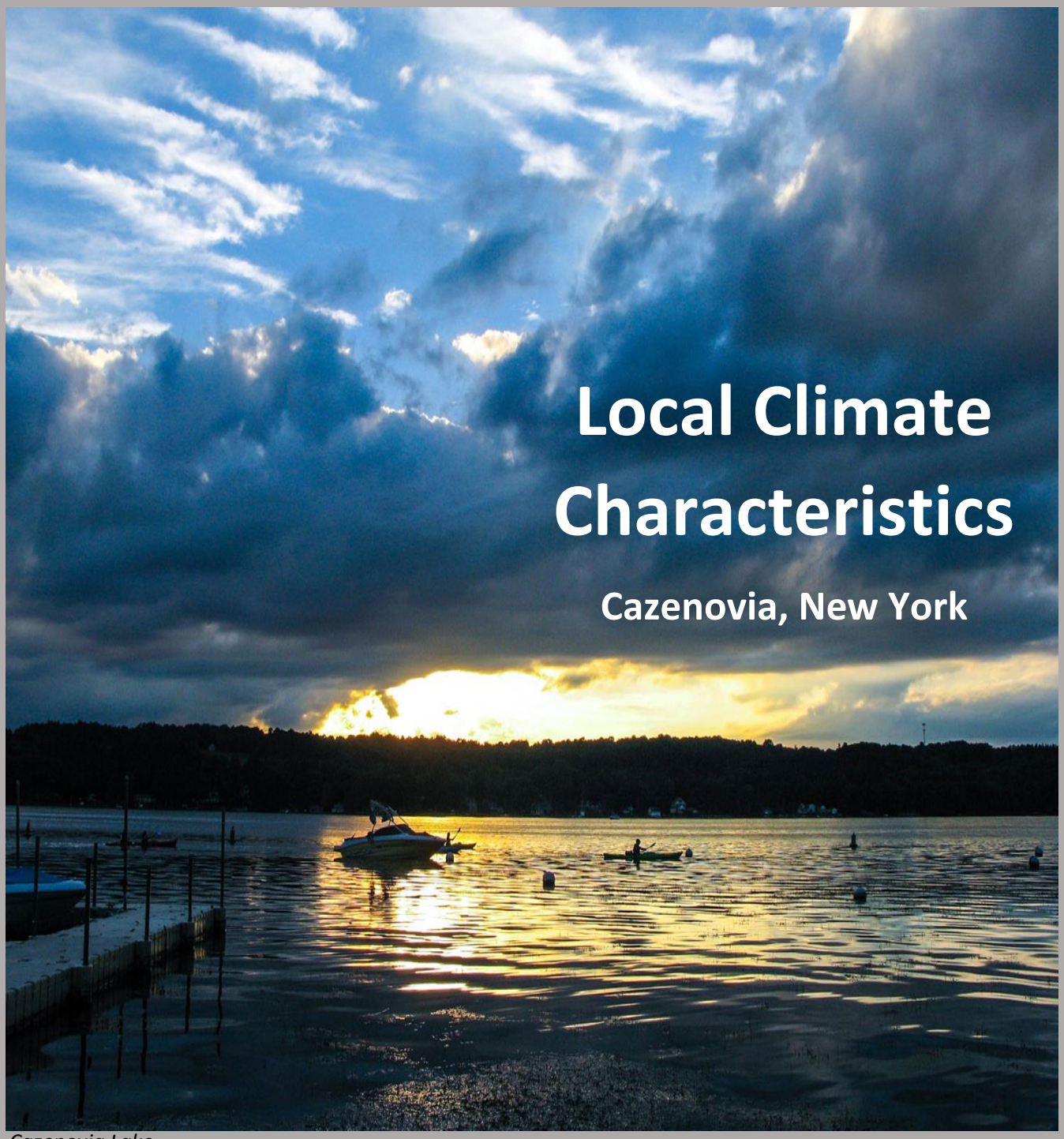

# Local Climate Characteristics

## Cazenovia, New York

*Cazenovia Lake*

# Local Climate Characteristics

# Cazenovia, New York

Anne Saltman

Updated July 2021

For the past several months, a team of dedicated and enthusiastic partners assisted with the collection and display of climate data. My appreciation and thanks go to the following groups and individuals that provided information, support, and encouragement:

- Kristi Andersen, Town of Cazenovia
- Greg Boyer, SUNY ESF
- Karin Bump, Cornell Cooperative Extension of Madison County
- Elisha Davies, Cazenovia Public Library
- Jim Cunningham, Nelson Supervisor
- Alexis Ellis, Urban Forestry Ecosystem Services
- Jimmy Golub, Town of Cazenovia
- Stephanie June, NYSDEC/CSLAP
- Lauren Lines, CACDA
- Al Marshall, Willow Bank Yacht Club
- Dave Miller and Bob Crichton, Cazenovia Lake Association
- Liz Moran, EcoLogic
- Geoffrey Navias, U-CAN
- Molli Rainbow, Toggenburg Mountain Resort
- Jackie Roshia, Lorenzo State Historic Site
- Pelle Rudstam, SUNY ESF and Chittenango High School
- Dwight (Tad) Webster, Cazenovia Lake Association
- Stacia Nourse, Cazenovia High School
- Mathew Webber, Izaak Walton League of America

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**APPENDICES**

# Introduction

The Town of Cazenovia has made significant progress with mitigation and adaptation initiatives that address our changing climate. However, our community lacks comprehensive documentation of long-term environmental trends. This report is designed to fill that gap by providing a summary of local conditions over several decades.

Climate data is readily available at the global, national, and statewide levels but information for Cazenovia and Central New York is relatively limited. Without data to display local conditions, how will the public know the extent by which climate change is impacting us here in Cazenovia? To address this issue, information for several priority areas was compiled that were thought to be indicative of climate variation. Historic data was collected by a team of local and statewide partners in order to show long-term trends of climate conditions in and around Cazenovia. This research is designed to help our community prepare for future changes in climate patterns, to help municipal representatives as they determine what projects to prioritize, and to be used as an educational tool for school students and adults.

**Weather vs. Climate**

People often confuse the terms weather and climate. Weather refers to conditions during a short period of time that can change within minutes or hours. It is often referenced in terms of temperature, humidity, precipitation, cloudiness, brightness, visibility, wind, and atmospheric pressure. Climate, on the other hand, refers to conditions over extended periods of time and is reported as the long-term average of the weather in a specific location. Weather can change in a short period of time, but climate change develops over longer periods, covering decades or centuries.

Field research was not conducted for this report. Instead, information was collected that had already been compiled by agencies, organizations, and individuals. The initial goal was to collect data for Cazenovia but when local statistics weren't available, information from the town of Morrisville (snowfall) and from Syracuse (precipitation) was used. The NYSDEC was consulted for water temperature trends in Cazenovia Lake, and the Toggenburg Ski Resort provided annual trends in ski season duration. Long-term trends on the following pages are presented in a visual format that the public can easily understand. A template for each category was developed with the hope that annual updates for the coming years will be relatively simple to incorporate.

# Project Goals

President Biden recently proposed that the United States cut emissions by 50% by the year 2030. This is considered an "all-hands-on-deck" effort for our government and across our nation. This ambitious target will also require profound changes at the local level. In order to set community goals for the future, it's important to see where we came from. Taking a look back and documenting historical trends will help us to define our path as we move forward. The following goals were developed for this report:

- Research the availability of local weather information
- Identify priority indicators needed to track changes in our local climate
- Gather data and graphically display long-term trends
- Provide a template that can serve as a foundation for data collection in the future
- Use this information for educational purposes

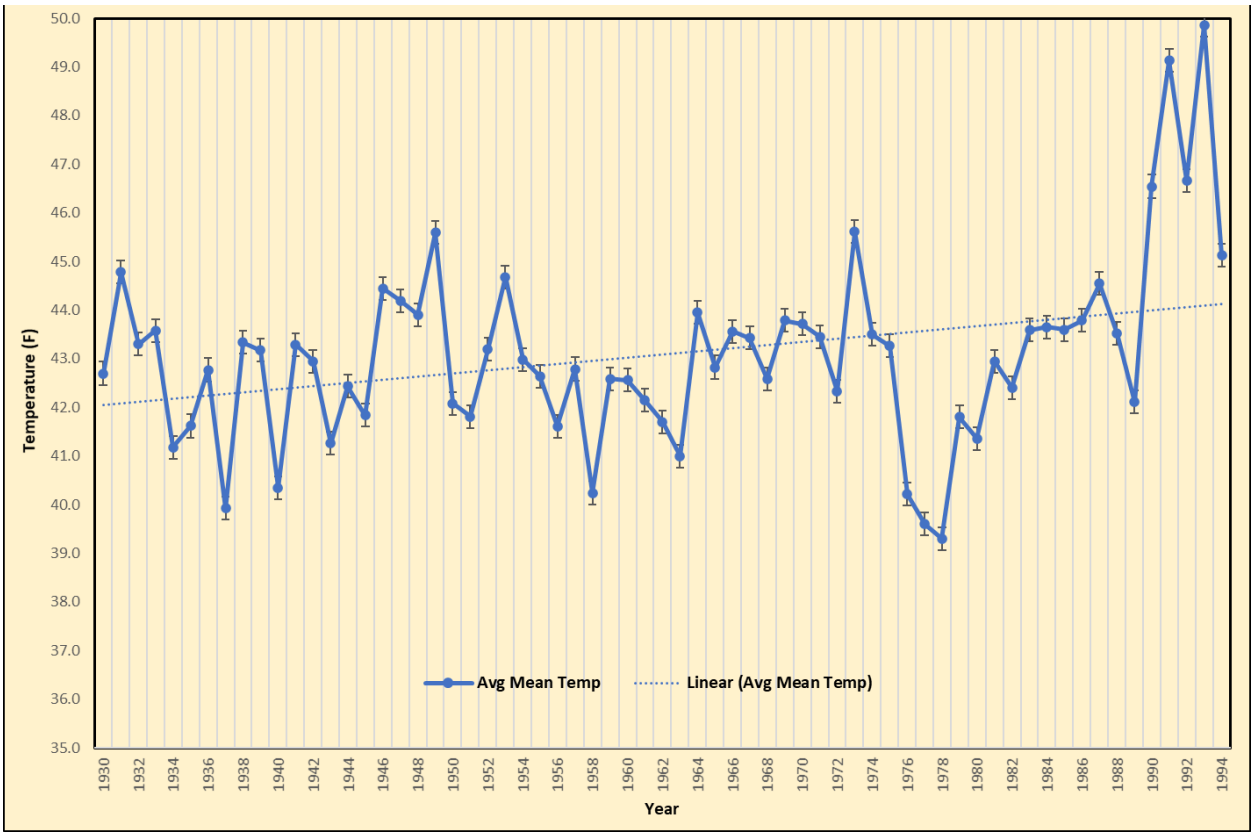
This report contains information on the following climate indicators: air temperature, lake water temperature, precipitation, snowfall, ice duration on Cazenovia Lake, extreme storm events, periods of drought, duration of the Toggenburg ski season, and harmful algal blooms. Information sources and data collection methodology are summarized in Appendices A and F.

## Air Temperature, Cazenovia NY

The following graph shows average temperature per year in Cazenovia from 1930 to 1994. Monthly values were originally recorded by Cazenovia resident, Donald Hart. His information was collected from archived copies of the *Cazenovia Republican.* Annual totals were then calculated (Appendix B), and the following graph was developed. The dotted trend line shows a gradual increase in temperature of approximately 2° during this time period. Predictable temperature patterns can be seen from 1930 to 1974. This is followed by a period of greater fluctuation in annual values from 1974 to 1997 which is an indication of climate change.

Increasing air temperatures impact conditions such as human and animal health, the northern migration of invasive species, and agricultural productivity. Increasing temperatures also impact the amount of precipitation and frequency of storm events. Increased water temperatures in Cazenovia Lake will continue to contribute to the frequency and extent of algal blooms which will, in turn, affect the local economy when access to the lake is limited.

**Average Temperature (°F) per Year in Cazenovia, NY 1930-1994**

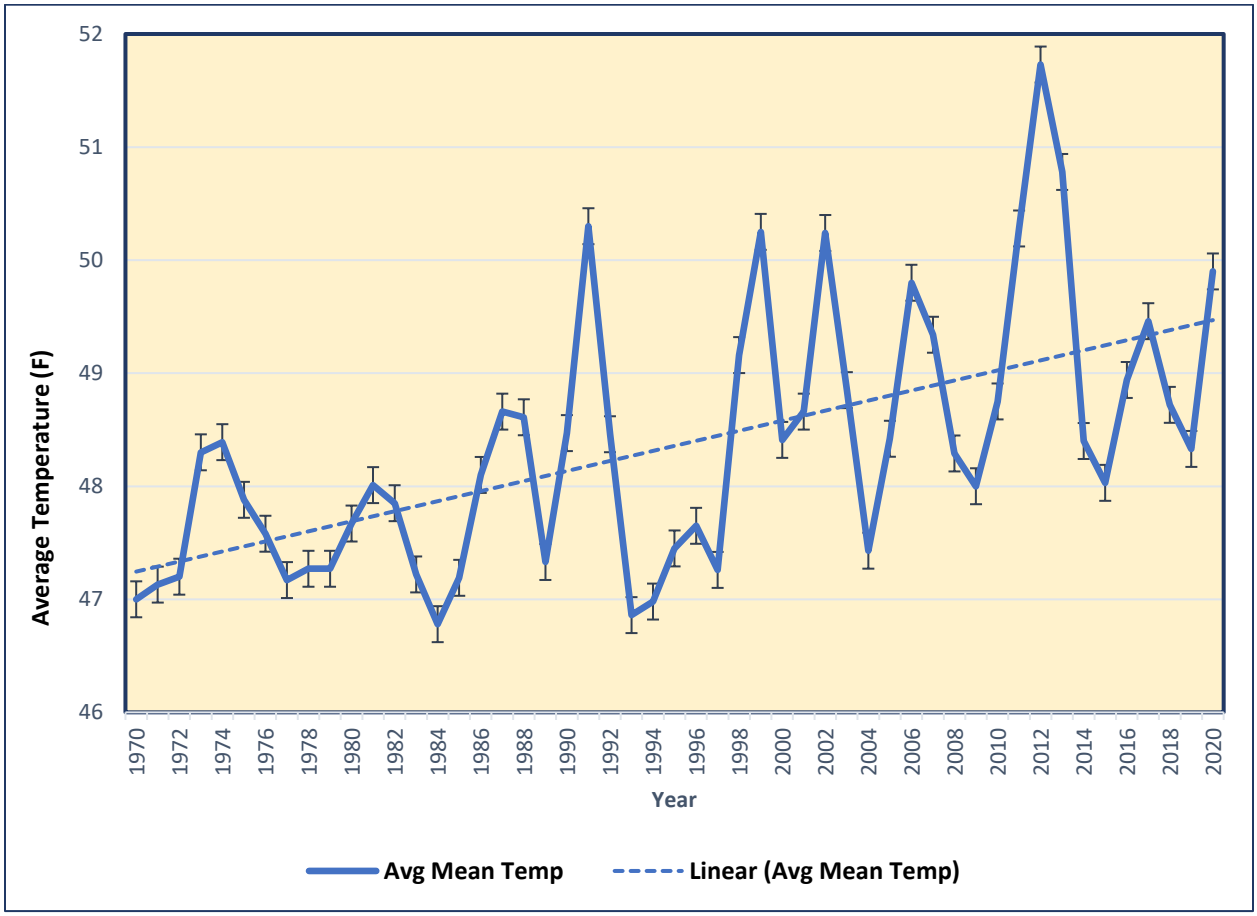



Source: Temperature values reported by Donald Hart and printed in the *Cazenovia Republican*

# Air Temperature, Syracuse NY

Temperature data for Syracuse was collected from the NOAA weather station at the Hancock International Airport in order to compare it with the Cazenovia data compiled by Don Hart. The average mean temperature was calculated for each year from 1970 to 2020 (Appendix C) and was used to generate the following graph. The trend line shows a gradual increase in temperature of approximately 2° (F), which is similar to the increase observed in Cazenovia. Differences of approximately five degrees between the two locations (Syracuse and Cazenovia) were noted and can be attributed to a change in altitude and topography. Syracuse is located at a lower altitude of the Erie Ontario Lowlands and Cazenovia is located at a higher altitude of the Appalachian Uplands. Hilly topography in Cazenovia also creates localized weather conditions.

**Average Temperature (°F) per Year, Syracuse NY 1970 to 2020**

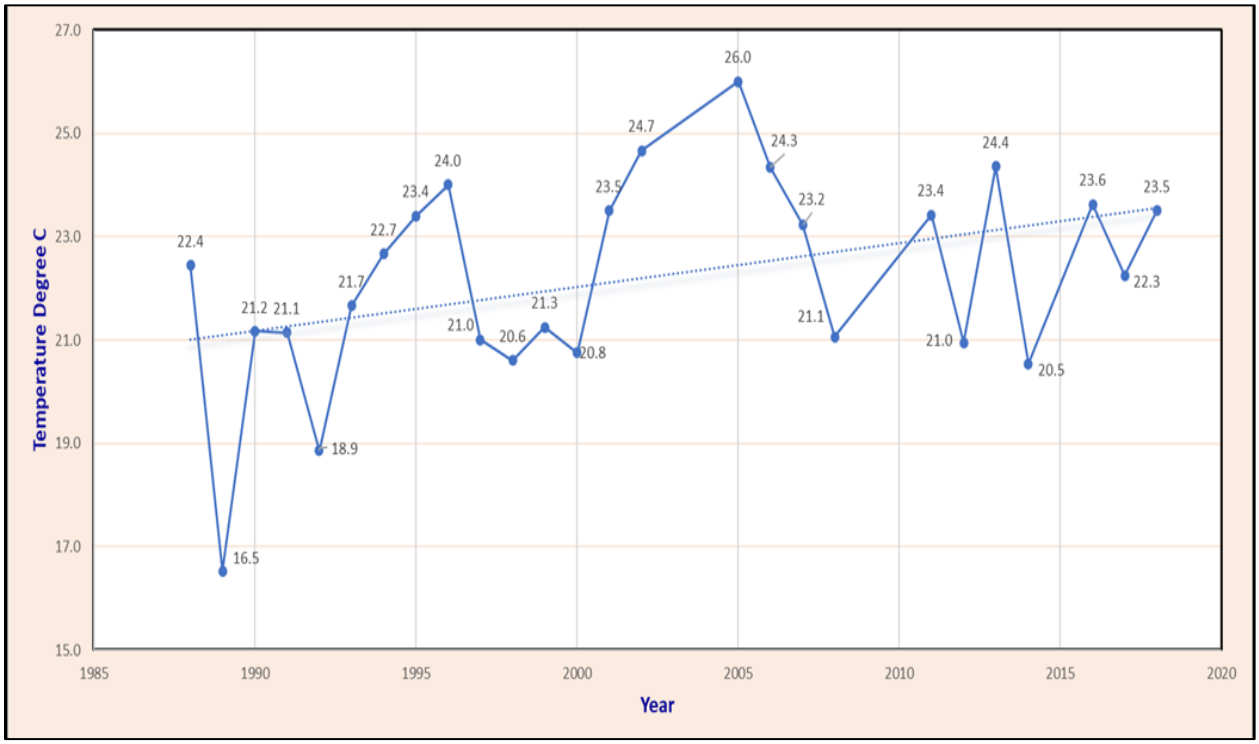



Source: Syracuse Hancock International Airport

## Summer Water Temperature, Cazenovia Lake

The following graph shows summer surface water temperatures in Cazenovia Lake. It was developed using raw data that was provided by the NYS Department of Environmental Conservation. The temperature readings were recorded by local volunteers working with the Citizens Statewide Lake Assessment Program (Appendix G.) The trend line shows a gradual increase in water temperature by approximately 2.5°C (4.5°F). Increasing lake water temperature is important to monitor because it impacts fisheries, plant growth, and other aquatic life.

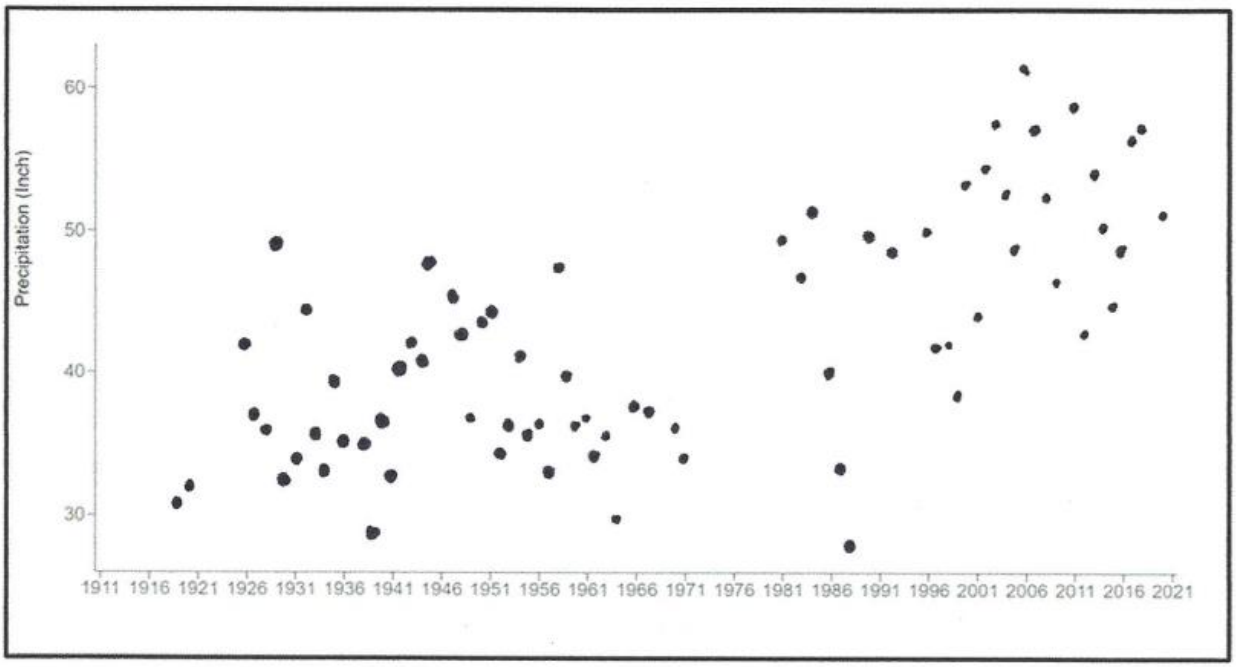
**Cazenovia Lake Summer Surface Water Temperatures, 1988 to 2018**



## Precipitation, Morrisville NY

Long-term precipitation data for Cazenovia wasn't available so a graph of data collected in the nearby town of Morrisville was used for this report. The annual precipitation totals (recorded in inches) were compiled by the New York Climate Change Science Clearinghouse. The graph displays significant variability in annual precipitation totals, with a gradual increase observed from 1918 to 2020.

**Annual Precipitation, Morrisville NY 1918 to 2020**



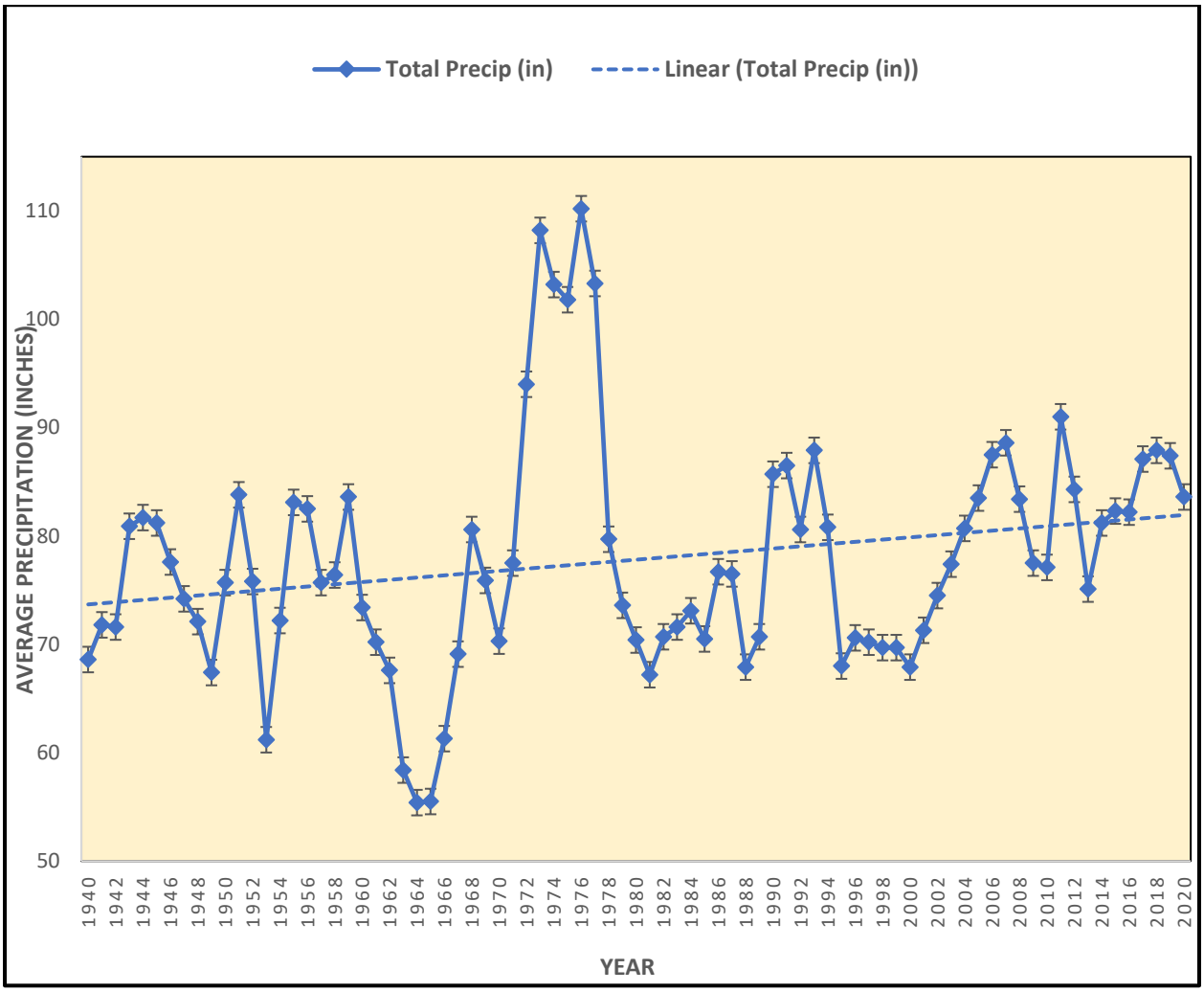

Source: https://d2ln813o5uvqrd.cloudfront.net/?c=Temp/stn/pcpn/ANN/USH00305512/

## Precipitation, Syracuse NY

Precipitation data for Syracuse was collected from the Hancock International Airport in order to compare the results with the data from Morrisville. The following graph shows annual precipitation in inches from 1940 to 2020. The trend line displays a gradual increase in annual precipitation of approximately four inches during this time period.

Researchers at the EPA are analyzing precipitation data collected during the past century and are using models to predict what rainfall events might look like in the future. This work will help communities such as Cazenovia better prepare for increases in precipitation and reduce the potential public health and environmental impacts of climate change.

**Average Total Precipitation per Year, Syracuse NY 1940 to 2020**



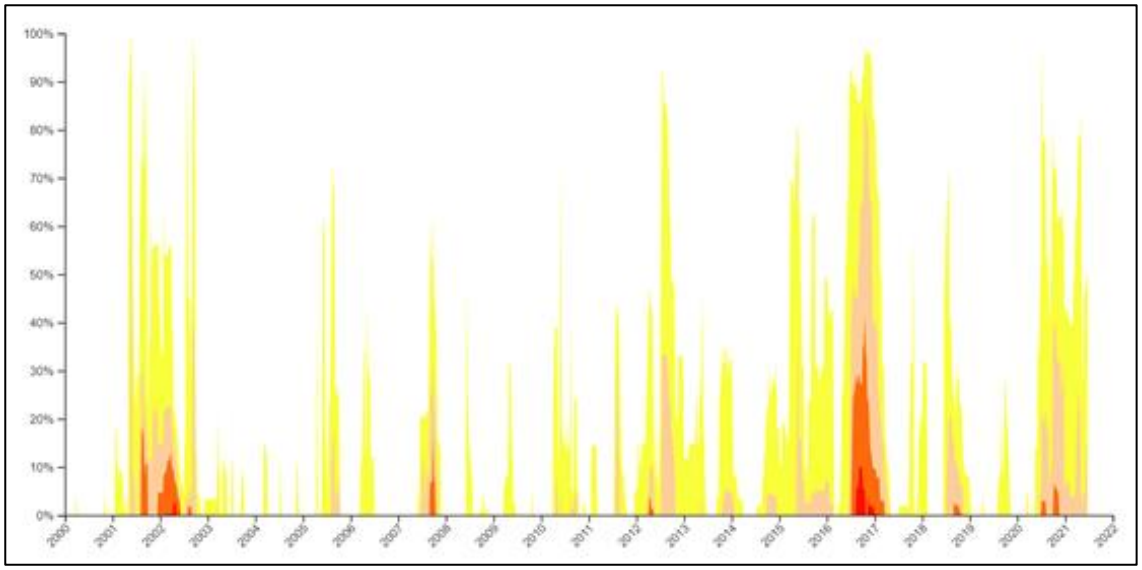

Source: Syracuse Hancock International Airport

## Periods of Drought

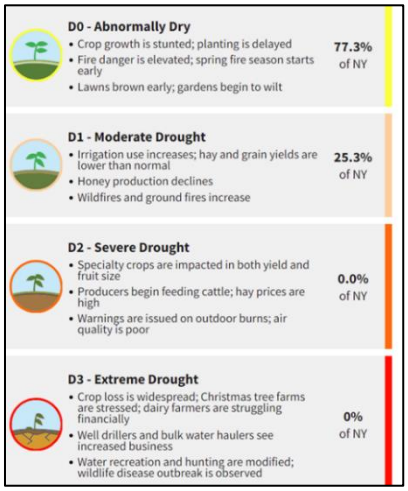
In order to better understand and prepare for the impacts of climate change, NYSERDA developed a comprehensive report (known as the ClimAID Report) that contains climate projections, impacts and vulnerabilities, and potential adaptation strategies for several areas of New York State. According to the report, altered patterns of precipitation result in more rain falling in heavy events, often with longer dry periods in between. Drought conditions are important to monitor because they impact crop growth (rates and yield,) planting dates, fire danger, wildlife, and the health of lawns and gardens.

A five-category system, typically used to explain the status of droughts, shows a range from “abnormally dry” conditions to “extreme drought.” The following graph shows drought conditions for Madison County NY from 2000 to 2022. Most of the county was in the yellow “abnormally dry” category when

crop growth was delayed, fire danger was elevated, and lawns and gardens were dry. The tan shading reflects areas with “moderate drought.” Under these conditions, fire danger is elevated. The graph shows a high level of variability from one year to the next but with no discernable trend. Extreme drought conditions were recorded in 2002 and 2017.




Source: NOAA and the National Integrated Drought Information System https://www.drought.gov/states/new-york/county/madison




## Ice Duration, Cazenovia Lake

Ice duration on Cazenovia Lake is important to monitor because of its influence on recreation, fisheries, and other characteristics of the aquatic ecosystem. Ice duration was the subject of a research report written by Pelle Rudstam titled, “Ice cover in Central New York and its effects on Phytoplankton, Daphnia and yellow perch (*Perca flavescens*)” (Appendix D). The graph on the next page and the following information about ice cover on Cazenovia Lake were collected from Rudstam’s report. Members of the Cazenovia-based Ledyard family had recorded detailed information about ice freeze and melting dates which Rudstam used to calculate ice duration on the lake. He filled occasional data

gaps using information collected from the National Snow and Ice Data Center. The results show that Cazenovia Lake exhibited a decreasing trend of ice duration by nineteen days from 1843 to 2005. Additional information can be found in a report titled, *Ice Cover data for Oneida and Cazenovia Lakes, New York, 1826-2011,* by Lars Rudstam and James Jackson.

**Cazenovia Lake Ice Duration 1843 - 2005**

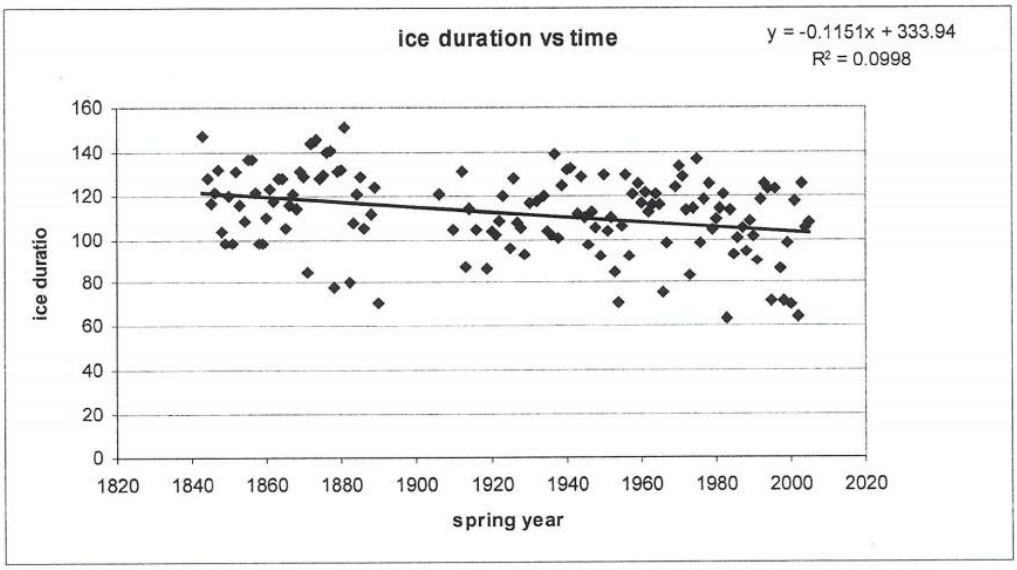



Fig 2: Ice duration for Cazenovia Lake graphed over spring year. The trend is significant (p= 0.00019) toward decreasing ice duration over time.

At the recommendation of Dave Miller (President of the Cazenovia Lake Association), Dwight (Tad) Webster was recruited to monitor ice duration on the lake in the coming years. He is an excellent resource because he lives on West Lake Road and observes the lake on a daily basis. He provided the following information on how he plans to record ice formation and melting:

**Ice In**

The date of ice in will be the first date in a given winter season (approximately Nov 1-April 31) where ice forms across Cazenovia Lake from Beckwith Bay on the west side to the Notleymere dock on the east side. Mr. Webster will indicate if ice is located at both the north and south ends of the lake.

**Intermittent Thaws**

When intermittent thaws occur during the winter season, Mr. Webster will report the dates and locations including areas kept open artificially by geese.

**Ice Out**

Mr. Webster will record the date when the ice is fully melted between Beckwith Bay and the Notleymere dock and doesn't reappear during that winter season. He will also note the date when ice is melted from the north and south ends.

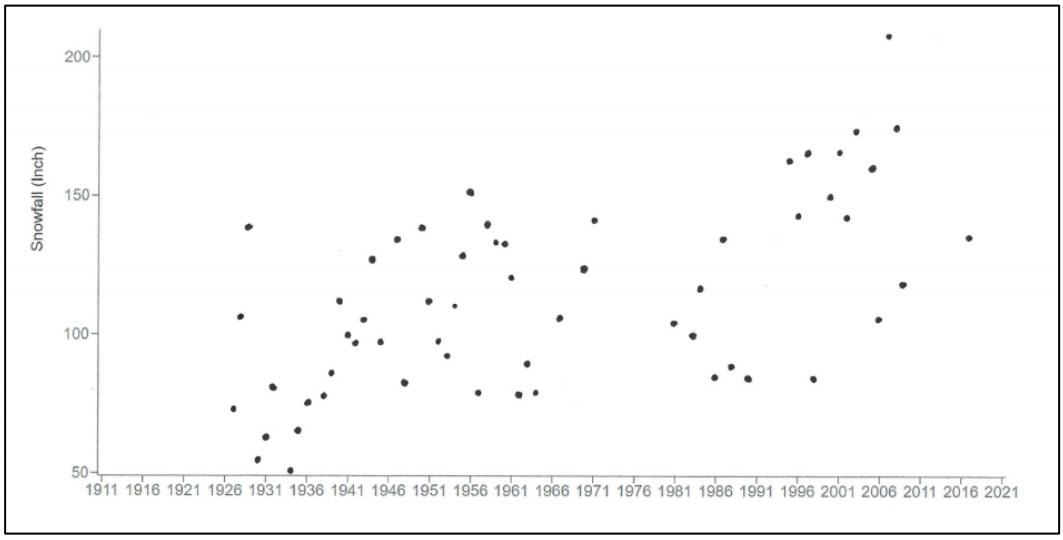
| Year | Date of Ice-In | Date of Ice-Out | Ice Duration |
|---|---|---|---|
| 2021 | January 15 | The ice melted in the middle section and south end of the lake on March 26, and the north end on March 27. | 70 days |

## Snowfall

The Town of Cazenovia and neighboring municipalities are influenced by lake effect snowfall which is caused by a differential between cold air temperatures and warmer water temperatures in Lake Ontario. As cold air flows over the warm water, the bottom layer of air over the surface of the water is heated from below. Since warm air is lighter and less dense than cold air, the heated air rises and cools. As it cools, the moisture from the lake condenses and forms clouds. When enough moisture condenses, snow bands develop over the region downwind of Lake Ontario. The greater the temperature contrast between the cold air and the warm water, the heavier the resulting lake effect snow fall will be. Because of the increased water temperature and reduced duration of ice cover on Lake Ontario, Cazenovia and other areas to the east and south will likely continue to experience heavier and more frequent lake-effect snowfall events. (Source: Cazenovia Climate Action Plan)

Long-term snow cover trends for Cazenovia aren't available so a graph showing results from the nearby municipality of Morrisville was used for this report. The graph, covering a period from 1925 to 2020, shows a gradual increase in snow cover over time.

**Annual Snowfall, Morrisville NY 1925 - 2020**




Source: New York Climate Change Science Clearinghouse
https://d2ln813o5uvqrd.cloudfront.net/?c=Temp/stn/snow/ANN/USH00305512/

# Extreme Weather Events

According to the ClimAID report, heavy downpours in New York State have increased over the past 50 years and this trend is projected to continue, causing an increase in localized flash flooding in urban areas and hilly regions. Flooding frequency is important to monitor because it can increase pollution loading to surface and groundwater resources and can overwhelm the wastewater treatment plant. Flooding and the increased frequency of storm events are greater concerns in areas where new development creates impervious surfaces. According to the Madison County Assessment office records, the Town of Cazenovia has 444 parcels with at least some land in the 100-year flood plain, not including parcels in the Village of Cazenovia. There are 17 parcels with houses in the flood plain in the immediate vicinity of Cazenovia Lake.

**ClimAid Report**

The New York State Energy Research and Development Authority (NYSERDA) helps the public understand and prepare for the impacts of climate change. NYSERDA's ClimAID Report contains climate projections, impacts and vulnerabilities, and potential adaptation strategies for a wide collection of areas throughout New York State. Because greenhouse gas emissions from energy production are the primary cause of climate change, NYSERDA works to help New Yorkers use less energy while collecting the energy they need from clean, renewable sources.

The ClimAID report states that rising air temperatures intensify the water cycle by causing increased evaporation and precipitation. The altered patterns of precipitation that result include more rain falling in heavy events, often with longer dry periods in between. Increased air temperatures also cause higher levels of oceanic evaporation which intensifies the water cycle. As a result, storm events around the globe are gradually becoming more extreme with stronger wind and higher amounts of rainfall.

Meteorologists report that the total annual amount of precipitation is changing, as well as the distribution and intensity of storm events. The ClimAID report states that New York State experienced a 64% increase in extreme storm frequency between 1948 and 2011. The increased number of severe storms is expected to gradually continue, with 100-year storms likely to occur every 80 years by the end of the century.

Strong storm events contribute to localized flooding, soil erosion, and stormwater runoff that can damage roads, bridges, and other infrastructure in Cazenovia. The role of agencies such as the Madison County Soil and Water Conservation District and the Natural Resource Conservation Service will become increasingly important in the coming years because of their work with stream bank stabilization, erosion and sediment control, and stormwater management. Incorporating green infrastructure and enhancing stormwater management will help Cazenovia to reduce the threat of flooding and erosion during storm events while improving the water quality in Cazenovia Lake and its tributaries.

Jim Cunningham (Nelson Town Supervisor) provided the following: "Precipitation intensity can have a large impact on erosion of soils such that a 2-inch rain event over one hour will be eroding soils fast, however a 2-inch rain event over 24 hours is less damaging, but most rain data typically only shows up as a daily (24hr) event. The daily larger rain events are useful to trend but would not help focus on the level of damage and soil loss aspect. Existing groundwater levels also have an impact on erosion. If it has been a dry period with no rain a 2-inch rain event will soak in then run off once saturated. If the ground is already saturated from previous rain then the same 2-inch rain event will run off much faster and

erode soils immediately. So, intensity and soil saturation levels are big factors that we would not be able to plot, but something for you can qualify as you present your data."

**The 2016 Madison County Mitigation Plan listed the following storm events for Cazenovia**:

April 3 and 4, 2005 – This was a spring runoff event that was accompanied by a rainstorm. Washouts occurred on several roads in the Town of Cazenovia.

August 2003 - The Madison County Sewer District recorded 4.5 inches of rain in a 1-hour period during this thunderstorm event that affected the western part of Madison County. Damage was particularly severe to road culverts under Pompey Hollow Road on the western edge of the Township.

April 2001 - This was a spring melt event and was not associated with rainfall.

Spring 2000 – This was presidential disaster FEMA 1335 DR-NY for storms that occurred between May 3 and June 30.

January 1996 Flood – This was presidential disaster FEMA 1095 DR. This run-off event caused by rain and melting snow resulted in widespread flooding in the Town of Cazenovia.

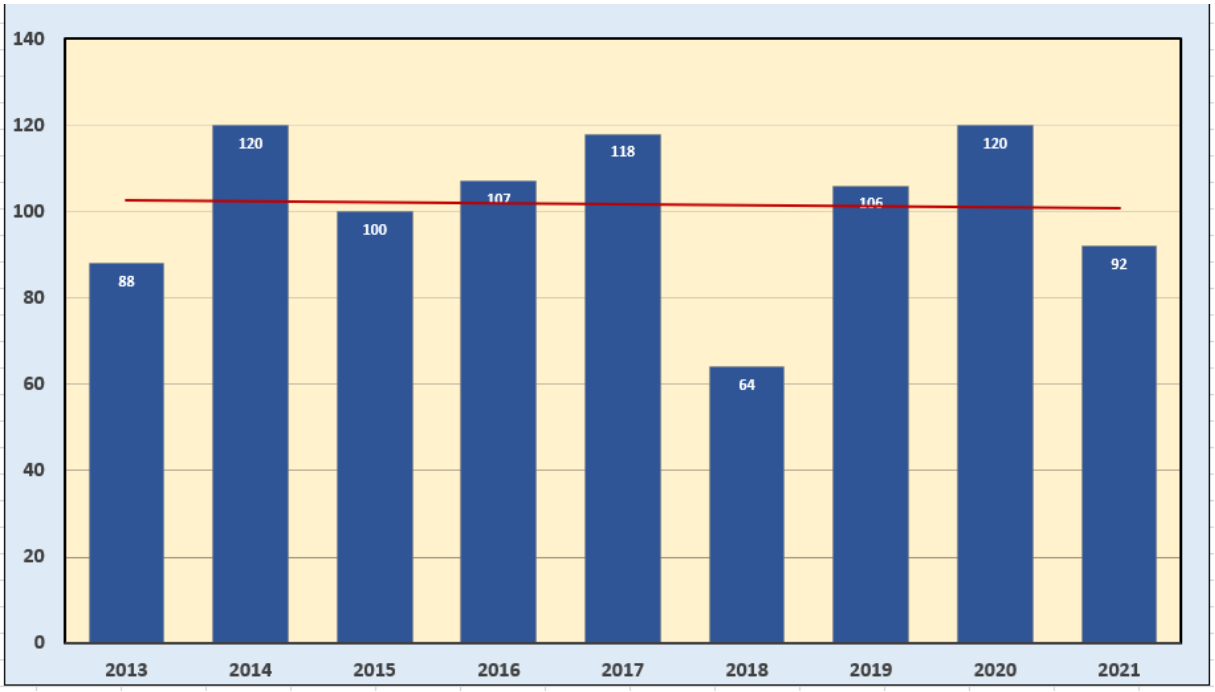
**100-Year Storm**

According to the Natural Resource Conservation Service (NRCS) a 100-year storm refers to rainfall totals that have a one percent probability of occurring at that location in that year. Encountering a "100-year storm" on one day does not decrease the chance of a second 100-year storm occurring in that same year or any year to follow. In other words, there is a 1 in 100 or 1% chance that a storm will reach this intensity in any given year. Each locality has its own criteria for how much rain must fall within 24 hours to classify as a particular rain event.

# Ski Season Duration

The duration of annual ski seasons at a local resort was initially thought to be a good indicator of climate change, based on the assumption that warmer temperatures would decrease the snow coverage. Toggenburg provided data for the season durations from 2013 to 2021 and the following bar graph was developed. The red trend line for this time period shows a slight decrease. Local ski resorts have adapted to a warming climate by developing year-round activities such as mountain biking, zip lines, ropes courses, and music festivals. Most are also using renewable resources such as solar, wind and hydropower to improve their efficiency. Toggenburg, like most ski resorts, uses snow making technology to extend the duration of their ski season. For that reason, this is no longer considered to be a valid climate indicator.

**Toggenburg Ski Season Duration 2013 - 2021**




Source: Sales and Office Manager, Toggenburg Mountain info@skitog.com

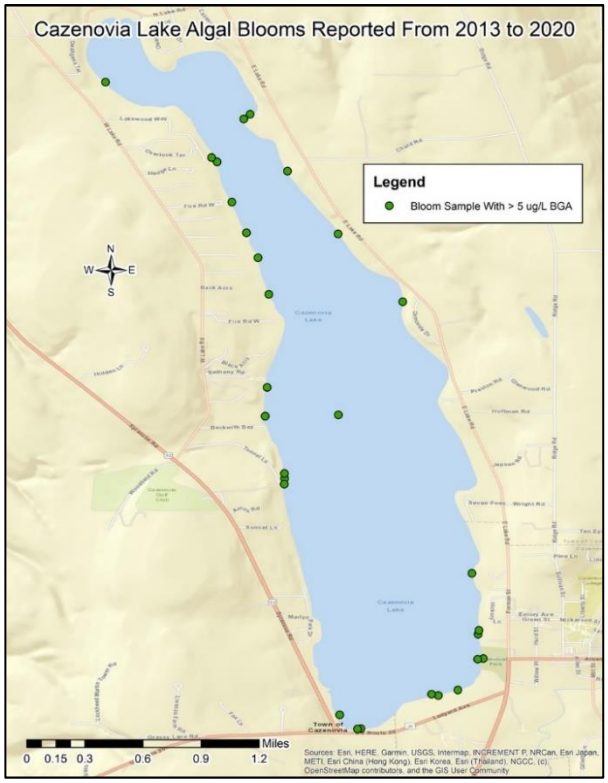
# Harmful Algal Blooms (HAB)

Warm temperatures, nutrients (primarily phosphorus and nitrogen), and calm weather contribute to the growth of algal blooms in lake environments. Many types of algae are harmless and serve an important role in the aquatic environment. During the past several years however, Cazenovia Lake and lakes throughout New York State have experienced blooms that can be harmful to people and animals. Algal blooms that produce toxins are referred to as harmful algal blooms, or HABs.

It can be difficult to differentiate HABs from non-harmful algal blooms so the Cazenovia Lake Association is partnering with researchers at the SUNY College of Environmental Science and Forestry to conduct laboratory analyses to confirm the presence of HABs. The following map (produced by SUNY ESF) shows the blooms that were reported from 2013 to 2020. When HABs are detected, restrictions on drinking and recreation use are set into place.

According to the NYS DEC, people, pets and livestock should avoid contact with any floating mats, scums, or discolored water. The public is warned to never drink, prepare food, cook, or make ice with untreated surface water, whether or not algal blooms are present. People should not drink surface water during an algal bloom, even if it is treated. Treatment such as boiling, disinfecting water with chlorine or ultraviolet (UV), and water filtration units do not protect people from HABs toxins.

The Cazenovia Lake Association will continue to monitor the frequency and location of HABs each summer. This will be important, especially as water temperatures continue to rise.



# Results Summary

- In general, climate data for Cazenovia was either difficult to locate or was not available.
- According to information collected by Don Hart, air temperature in Cazenovia exhibited a gradual increase of approximately 2° during a period of 64 years. The increased fluctuation in annual values seen from 1974 to 1997, is most likely influenced by climate change.
- According to the NASA weather station, air temperature in Syracuse showed a gradual increase of approximately 2° in the past 50 years.
- The difference between the air temperature in Syracuse and Cazenovia was approximately 5°.
- Between 1987 and 2019, the surface water temperature in Cazenovia Lake gradually increased by approximately 2.5°C (4.5°F).
- Long-term precipitation and snowfall rates in Morrisville showed increasing trends.
- In the past 78 years, annual precipitation in Syracuse showed a gradual increase of about 6 inches.
- There were no significant trends in drought conditions in Madison County.
- Long-term statistics for ice duration on Cazenovia Lake showed a decreasing trend. A Cazenovia resident has volunteered to record ice duration in the coming years.
- Long-term trends for flooding and storm events in Cazenovia aren't available but the treatment plant is currently compiling flow data that will be added to this report. Statewide predictions indicate that storm events will become stronger and more frequent.
- The duration of the ski season at Toggenburg was not a good indicator due to snow making capabilities.
- The Cazenovia Lake Association and SUNY ESF have monitored Harmful Algal Blooms (HABs) in Cazenovia Lake since 2013. Continued monitoring is expected to continue.

Appendix E shows how these local results compare to climate conditions in New York State and throughout the United States.

# The Big Picture: Impacts of Climate Change in New York State

Source: https://www.dec.ny.gov/energy/94702.html

New York's ClimAID report (2011, 2014), the National Climate Assessment (2014), and other research shows that a variety of climate change impacts have already been observed in New York and across the northeastern United States:

### Warmer Temperatures

Skeptical Science - Indicators of a Warming World

The annual average temperature statewide has risen about 2.4°F since 1970.

Annual average temperatures have increased in all regions of the state.

More warming will occur, mostly in the northern parts of New York.

### More Rain and Snow

Overall, average annual precipitation has increased across New York State since 1900.

New York is getting more rain and snow in the winter and less in the summer.

Increased precipitation is expected to continue, with more frequent storm events and heavier downpours.

### Sea-level Rise

Sea levels along New York's coast have already risen more than a foot since 1900.

New York's coastal counties are home to more than half of New Yorkers.

By 2100, sea levels will be 18 to 50 inches higher than today along New York's coastlines.

Sea-level rise is locked in for centuries, by heat-trapping greenhouse gases already in the atmosphere. Continuing or increasing emissions will speed up the rise to higher levels.

Energy, land use, and infrastructure decisions made now will determine how vulnerable our children and grandchildren will be to rising sea-levels.

### Natural Resources

Spring begins a week earlier than it did a few decades ago; in many areas of New York, the first leaf date is more than 8 days earlier and the first bloom date is more than 4 days earlier than in the 1950s.

Winter snow cover is decreasing.

Pollinating bees in the northeastern United States arrive about 10 days earlier than they did in the 1880s.

New York's breeding bird and oceanic fish population ranges have shifted northward over the last several decades.

Signs depicting sea level rise

Photo courtesy of Julie G. via Flickr

## Health Risks

Certain people are more vulnerable to emerging climate change impacts. Climate change raises health risks for people with existing physical or mental illness, children and older adults, those who work outdoors, and those living along the coast or in areas prone to flooding. Climate change can lead to weather events and conditions that are associated with health hazards, such as:

Heat waves, which can cause heat-related illnesses, heat stroke, and other serious health problems. Heat waves also can make it more likely that people who already have heart, lung, or other chronic conditions might get sick.

Warmer temperatures, which can expand ranges for disease-carrying insects, and also can increase pollen production and air pollution. Pollen and pollution raise risks for people who suffer from asthma; infectious diseases transmitted by mosquito and tick bites (such as Lyme disease or West Nile Virus) may appear in previously unaffected locations when the insects' range expands.

Changing precipitation patterns such as drought and flooding may take the form of extreme events that directly cause human injury or death. Less extreme changes may affect public health in other ways - for example, by reducing the availability of water for drinking and other human needs, or by creating damp conditions in homes, schools, and workplaces that promote mold and other pests.

Disruptions to agriculture from frequent drought, flooding, and unseasonal heat or frost events can interfere with successful food production. Altered growing and storage conditions could require changes in crop and livestock species or food production practices, promote emerging pathogens or affect the movement of environmental contaminants into food supplies.

# Recommendations

**Climate Action Plan**

Cazenovia should continue projects that will help us to reach local goals to reduce greenhouse gas emissions. This will reduce the degree and magnitude of climate change in the coming years. Several years ago, community leaders throughout the town and village worked together to develop a Climate Action Plan. The report contains recommendations for transportation, energy conservation, waste management, natural resources, and agriculture. It was written in 2015 and now needs to be updated with current information and goals. Updates should be developed as a community-wide, grass roots initiative. Report updates should be an ongoing effort so that new ideas are incorporated and strategies are modified as technologies evolve.

**Climate Smart Communities**

The Town and Village of Cazenovia are registered Climate Smart Communities and have reached the bronze level, showing that our community is committed to reducing greenhouse gas emissions and improving climate resilience. Efforts should be continued to reach the silver level of the CSC program in order to increase energy efficiency, reduce GHG emissions, save taxpayers money, and promote renewable energy.

**Weather Monitoring Station**

In order for Cazenovia to record future climate data for temperature and precipitation, a reliable weather monitoring system will be needed. Staff time should also be allocated to record annual updates for all of the variables included in this report. Installing a monitoring system and strengthening our climate science capabilities will help our community to better understand and respond to future climate change.

**Education**

- Continue to engage with community members on a regular basis as part of an outreach and education strategy. Inform and inspire local families by hosting speakers and organizing events that will educate citizens about climate change.
- Teach environmental education and climate change at all levels of our school system.
- Continue to use social media to publicize Cazenovia's role as a Climate Smart Community and our commitment to reducing GHG emissions.
- Continue to promote success stories and report on progress toward achieving local goals for energy conservation.

# Conclusion

Cazenovia continues to be a leader in the areas of energy efficiency and environmental stewardship and the community should be proud of these accomplishments. Our continued success with program implementation will depend on how well we develop ongoing proactive management and policy initiatives throughout the town and village. Continued monitoring of weather patterns will help to define priority goals for the community and justify actions taken in the coming years.

# Appendix A Methodology

An initial task with this project was to identify information sources for climate information. Statistics were compiled from organizations such as the NYSDEC's CSLAP program, the NOAA National Weather Service, the National Centers for Environmental Information, the New York Climate Change Science Clearinghouse, NYSERDA's ClimAID report, the USDA/U.S. Forest Service Climate Change Resource Center, the Northeast Regional Climate Center, and the Syracuse Hancock Weather Station. The following information provides additional details about the data collection process.

**Temperature and Precipitation**

Temperature and precipitation data was collected from the following sources: the NOAA weather station at the Syracuse Hancock International Airport, weather journals maintained by Cazenovia resident Don Hart, the Willow Bank Yacht Club weather station, and the New York Climate Change Science Clearinghouse.

I encountered several obstacles during my search for this data. After learning about a weather station located on the roof of the Cazenovia High School, I contacted Village Mayor, Kurt Wheeler, who referred me to Dr. Stacia Nourse, Chair of the Science Department. The school purchased a weather station in 1998 but unfortunately, it was damaged during a strong storm on Labor Day. The maintenance staff tried to repair it but it never worked correctly after that event. Dr. Nourse decided against buying a new station because websites were able to provide the weather data she uses in her class.

I also checked the weather station at Willow Bank Yacht Club with the help of Al Marshall. It had been set up to record information from the Wunderground dashboard. I accessed as much data as possible, collected monthly figures, and then calculated annual temperature and precipitation averages for 2015 to 2019. Unfortunately, much of the information was either not available or not reliable. Mr. Marshall provided the following explanation:

> *The weather station was installed just before the season started in 2014, so there is no data for the first 5 months of that year. We started having intermittent outages at the station in 2019 and don't think it has worked at all since the fall of 2020. In addition, the connection from the station to Wunderground has had some outages. The rain gauge clogged at some point before the spring of 2019 and I removed the clog during one of the work parties that spring. We don't have any data to fill in the gaps.*

Because only a limited amount of information was available at Willow Bank, I decided to focus my efforts on collecting weather information from Don Hart's journals which are more comprehensive. Elisha Davies (Cazenovia Public Library) provided historical references from the *Cazenovia Republican* pertaining to his weather journals. I also reviewed Mr. Hart's journals that are maintained at the Lorenzo State Historic Site but the information in the *Cazenovia Republican* was easier to access. Don Hart and his family lived on Hickory Lane in Cazenovia and worked for the electric company. He was Sparky Christakos' grandfather. He kept meticulous records of the weather and his everyday activities. According to Patty Christakos, additional information about Hart may be available in Peter Hugill's book called "Upstate Arcadia."

I collected temperature averages for each month and then calculated the average mean temperature for each year from 1930 to 1994 (Appendix B). I then worked with my son, Jonathan Saltman, on developing the graphs and we experimented with various ways to present the information. The final graph shows the average mean temperature from 1930 to 1994 (the full duration of Hart's information.) The vertical lines for each year show standard deviation and the dotted line shows the trend.

I collected temperature and precipitation data from the Hancock Airport in Syracuse. I wasn't able to locate precipitation data for Cazenovia. Instead, I used a graph showing annual precipitation for Morrisville that I collected from the New York Climate Change Science Clearinghouse.

**Cazenovia Lake Temperature**

Jonathan Saltman developed the graph for surface lake water temperatures using the raw data that I had collected from the DEC.

The two Cazenovia Lake graphs showing epilimnion and hypolimnion temperatures were compiled by Stephanie June, Research Scientist with the NYS Department of Environmental Conservation. This information is from Citizens Statewide Lake Assessment Program (CSLAP). The CSLAP volunteers that worked on Cazenovia Lake in 2018 were Margot Giblin, Theresa Parke, and Barbara Settel. The CSLAP report from 2018 is available at the following link:
http://www.dec.ny.gov/docs/water_pdf/cslrpt18cazenovial.pdf

**Ice Duration on Cazenovia Lake**

I met with Jackie Roshia, Interpretive Programs Assistant, during a mid-January visit to the Lorenzo State Historic Site. She allowed me to review detailed journals of weather and daily life that were kept by members of the Ledyard family.

When she learned of my interest in ice formation on the lake, Jackie provided a research report that had been written by Pelle Rudstam titled, "Ice cover in Central New York and its effects on Phytoplankton, Daphnia and yellow perch (Perca flavescens)". The report (Appendix D) was written in 2006 for Global Environment EFB 120 at SUNY ESF and for a class at Chittenango High School. The graph included in my report and the information about ice cover on Cazenovia Lake came from Rudstam's report. The Ledyard family members had recorded detailed information about ice freeze and melting dates and Rudstam had used these dates to calculate ice duration on the lake. He filled occasional data gaps using information collected from the National Snow and Ice Data Center.

According to Rudstam, "The ice freeze and breakup dates were compiled into a spreadsheet in Excel. Ice duration was calculated by converting the ice freeze and breakup dates into days of the year (doy) measurements, which are a numerical equivalent of the date (ex: January 1st is doy 1). The freeze data was next subtracted from the breakup date to give numerical ice duration in days for every year that there was a record. This was then plotted compared to the spring year for Oneida, Cazenovia and Otsego Lakes. A regression was performed on the available data in order to test if there was a significant trend."

**Strom Events**

The storm event information for Cazenovia is from USA.com. The information is based on the global volcano database, the U.S. earthquake database of 1638-1985, and the U.S. Tornado and Weather Extremes database of 1950-2010. Additional storm information is available at https://www.spc.noaa.gov/climo/online/monthly/newm.html

Additional storm event information was collected from the Madison County Mitigation Plan ( https://www.madisoncounty.ny.gov/DocumentCenter/View/1144/Town-of-Cazenovia) Mitigation Plans are normally updated every five years. The mitigation goals stated in the report are to minimize the loss of property, risk of injury, damage to the environment, and loss of infrastructure from 500-year flooding events.

I am currently working with Jim Cunningham on the collection of Chittenango Creek flow data at the Cazenovia Treatment Plant. We are hopeful that this will help to determine storm event frequency.

**Ski Season Duration**

Information about Toggenburg is from https://www.skicentral.com/toggenburgmountain.html My primary contact was Molli Rainbow, Sales and Office Manager, Toggenburg Mountain info@skitog.com, www.skitog.com, (315) 683.5842 X 13.

**Drought**

Drought conditions for Cazenovia aren't available so I collected information for Madison County from NOAA and the National Integrated Drought Information System https://www.drought.gov/states/new-york/county/madison.

**Snowfall**

Snowfall information isn't available in Cazenovia so I used information from Morrisville that I collected from the New York Climate Change Science Clearinghouse https://d2ln813o5uvqrd.cloudfront.net/?c=Temp/stn/snow/ANN/USH00305512/.

**Harmful Algal Blooms (HAB)**

The Cazenovia Lake Association is working on HAB identification in cooperation with Dr. Greg Boyer from SUNY ESF. The HAB map was compiled by Dr. Boyer.

The remaining appendices (B through G) are located in another file