January 2021

# Climate Vulnerability and Adaptation Report

For the City of Schenectady


**Prepared for Mayor Gary R. McCarthy**

by Avi Epstein & Heather Ipsen

with the assistance of the

Climate Smart Communities Task Force & Climate Action Associates

# Table of Contents

# Executive Summary

A. The **purpose** of this document is to provide an outline of the challenges the City of Schenectady will face in the wake of climate change, as well as the best ways in which we can respond to these challenges.
B. The **Climate Smart Communities (CSC) Task Force** was established in Spring 2019 in order to complete a series of tasks outlined by the New York State Department of Environmental Conservation (DEC) and to help the City of Schenectady become a certified Climate Smart Community.
    a. **Mission Statement:** The City of Schenectady's Climate Smart Communities (CSC) Task Force serves as a resource and catalyst to promote and provide guidance on environmental, social and economic sustainability. The group serves as a bridge between ideas and their practical implementation by advising the City Council, fostering local partnerships, and engaging our local communities to develop goals, policies, and practices that will improve the well-being of our city and ensure a vibrant and resilient future for all.
C. **Document Organization**/Section Summaries
    a. Section I: Vulnerable Systems
        i. This section discusses how the City of Schenectady's infrastructure, ecological systems, and socioeconomic health may be vulnerable to the predicted regional effects of climate change.
    b. Section II: Recommendations and Adaptation Strategies
        i. Section II explains how we can respond to the City of Schenectady's vulnerabilities. A matrix of adaptation strategies is provided to help prioritize and rank the strategies within the broader infrastructure, ecological, and socioeconomic categories.
D. **Take Home**: What are the main conclusions of this report?
    a. The City of Schenectady is at risk for flooding, severe storms, and other climate-related hazards as a result of climate change.
    b. Infrastructure in the city is vulnerable to these hazards, particularly due to possible higher energy and water demands, energy price fluctuations, transformer failures, decreases in water quality, and location within the 100-year floodplain.
    c. Ecosystems in the city are vulnerable due to potential ice jams, flooding, lower diversity of species, and a decline in native species' habitat leading to an increase in invasive species.
    d. Socially, the city is vulnerable due to disproportionate risks of heat-related death or illness, food deserts, vector-borne disease, poor air quality, low socioeconomic status, limited access to green spaces, and proximity to industrial sites and brownfields.
    e. Concrete actions must be taken to adapt to and mitigate the effects of local climate change. To build climate resilience in the City, the entire community must be involved in creating a plan of action. Suggested actions are listed at the conclusion of this report.

# Introduction

## Definitions

1. *Adaptive capacity* - the ability of an asset or system to adjust to actual or expected climate stresses or to cope with the consequences.

2. *Exposure* - the degree to which elements of a climate-sensitive asset or system are in direct contact with climate hazards or sensitive to climate variability and the degree to which the climate hazard may change over time.

3. *Resilience* - the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning; the capacity for self-organization and the capacity to adapt to stress and change.

4. *Risk* - the likelihood of an event happening and the consequences of that event taking place.

5. *Sensitivity* - the degree to which an asset or system will be affected by a change in climate, either to its benefit or its detriment.

6. *System* - related parts that are organized into a complex whole. Urban environments include social, infrastructure, and natural systems.

7. *Vulnerability Assessment* - identifying, analyzing, and prioritizing the effects of climate hazards; this may also include a *risk assessment* or *risk criteria* that helps prioritize impacts based on their magnitude and their likelihood of occurrence. In assessing the magnitude and likelihood of the events, the local government must consider both future and current projections.

## Climate Change, Vulnerability, Risk, and Adaptation

In 1988, leading climate scientists came together to form the Intergovernmental Panel on Climate Change (IPCC) with a mission to “provide governments at all levels with scientific information that they can use to develop climate policies.” Their latest report, released in 2014, explicitly states that “human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems” (IPCC, 2014).The question is then not whether or not humans are causing climate change, but rather what communities can do to lessen its negative impact. Even the

local effects of global climate change are becoming increasingly difficult to ignore. New York State has already begun to see increased annual temperatures and extreme heat events, intense precipitation events and flooding, and rising sea level in coastal areas at levels beyond what the state has experienced in the past (NYSERDA, 2014).

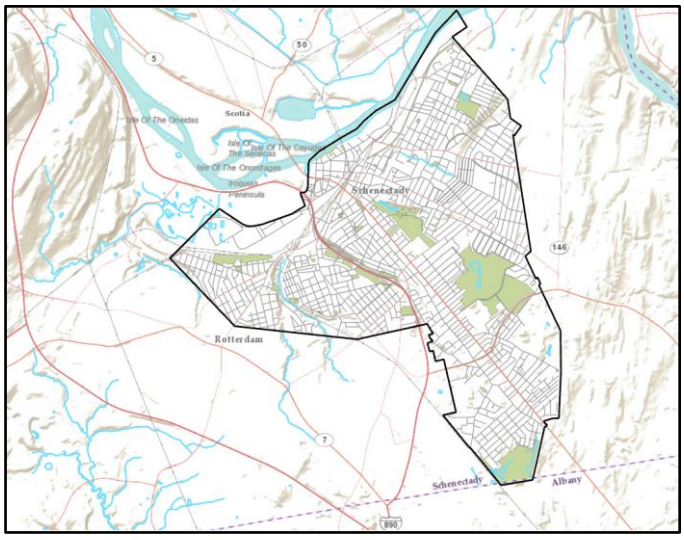
It is, therefore, crucial that local vulnerabilities and risks are identified so that plans of action can be developed. Vulnerability, for the purposes of this report, is defined as the tendency for humans, their livelihoods, and/or physical assets to experience harm or damage due to climate hazards. Many studies have also highlighted the fact that mitigation (i.e., decreasing activities that contribute to climate change) alone will not be enough. Adaptation (i.e., making changes to live with the inevitable effects of climate change) must also be taken into consideration (Rosenzweig & Solecki, 2010). In an ideal world, hazard levels would remain constant, and adaptations would necessarily result in reduced vulnerability; however, since climate hazards are worsening and may continue to do so, adaptation alone may not reduce vulnerability (Brooks, 2003). Overall climate resiliency must therefore be created by a plan that highlights strategies for both mitigation and adaptation to reduce vulnerability to climate hazards. Simply put, resiliency is the ability for a system or community to adjust to actual or expected stresses. By identifying what vulnerabilities and risks exist at the local level now, a comprehensive plan of action can be developed to foster climate resiliency.

This report will focus on vulnerability and adaptation in the City of Schenectady. It is written in hopes of spurring public and institutional action to create a more resilient community.

## Study Area: The City of Schenectady

### History, Geography, and Natural Systems

The City of Schenectady is located in the Mohawk Valley region of New York State. Founded by Dutch colonists in the 17th century, the City began rapid transformation from a small trading and manufacturing community to a bustling city in the early 1900s, home to important industrial leaders General Electric (GE) and American Locomotive Company (ALCO). These industrial leaders provided an influx of jobs, which encouraged many new immigrants to move to the City. After the national economic downturn in the mid- to late-1900s, Schenectady began to slowly decline; however, due to the efforts of many local organizations and city officials, Schenectady is currently in the midst of economic renewal. Over $1 billion has been invested in the City by public and private entities. The thriving downtown area features numerous restaurants, new hotels, a movie theater, Mohawk Harbor Rivers Casino and Resort, and Proctors Theater (CNA, 2017).




The City of Schenectady's borders include about 2.5 miles of riverfront along the Mohawk River. The majority of parcels in that stretch of land are City park land, two industrial/technology parks, and the City's wastewater treatment plant. Residential development in this area is primarily in the historic Stockade District neighborhood. Flooding has been increasingly problematic in both the Woodlawn neighborhood and the historic Stockade District neighborhood. A mitigation project to ameliorate flooding in the Stockade neighborhood, funded by the Federal Emergency Management Association (FEMA) Hazard Mitigation Grant Program (HMGP) through the New York Department of Homeland Security and Emergency Services (DHSES), is currently underway. Despite the damages caused by its flooding, the Mohawk River provides a crucial connection between transportation and recreation waterways in the region. It also forms the City's northwest boundary. The river is now generally used for recreation rather than transportation or cargo. Commercial and business development are concentrated south of Union Street and west of Erie Boulevard, and industrial land use primarily occurs along Erie Boulevard and Maxon Road.

The City also includes approximately 700 acres of park, recreation, and open-space land. Most of this acreage is contained within three locations: Central Park, Schenectady Municipal Golf Course, and the Woodlawn Preserve. Several areas in the City are within the 100 and 500-year floodplains and are thus potentially at risk of flooding due to increasingly severe storms in the region. The 100-year floodplain has a base flood elevation of 232 feet in the Stockade District and 226 feet for the wastewater treatment plant. The average river elevation in the City is 211 feet. Class I freshwater wetlands, located in the Lisha Kill forest and the adjacent land in the Woodlawn Preserve, are also in a 500-year floodplain. The Woodlawn Preserve is an undeveloped wetland with a unique ecosystem that provides habitat for several rare species.

## Infrastructure & Transportation

The City's public water system supplies water for not only the entire City, but also the surrounding towns of Rotterdam and Niskayuna. This distribution system is well-

maintained and water quality is constantly monitored. The City also houses a wastewater treatment plant, which was first established in 1973. The treatment plant is located near the Mohawk River, along the border between Schenectady and Niskayuna. Because the age of the equipment became a growing concern in recent years, the City has begun to revitalize the plant by updating pumps and working with a local company to convert solid waste into energy through a process known as pyrolysis. This process is saving the City thousands of dollars in disposal fees each month and may even generate gas to power City operations. National Grid provides electricity and gas service to the City. Telecommunication possibilities are expanding within the City, as projects are underway to provide free public Wi-Fi to the entire City in coming years.

The City of Schenectady is connected to other communities by a network of Interstate highways, state highways, and local streets. Schenectady has multiple bridges with a total of 41 roadways that meet the NYSDOT definition. Six bridges are owned by the city, 13 are primarily owned by NYSDOT and the remaining 22 are owned by the railroad companies. Capital District Transportation Authority (CDTA) has continued work on their Transit Development Plan (TDP) to improve local residents' ability to travel in and out of the City. Since the TDP's approval in 2008, CDTA has successfully launched the BusPlus program, which provides limited stop service on NY Route 5 between Schenectady and Albany. The City is also now home to an Amtrak Schenectady Intermodal Station, making it a key stopping point for travelers going to and from New York City, Boston, and other cities.

Socioeconomics – General Demographics

As outlined in Table 1 below, Schenectady's population is approximately 65,500 individuals. Despite a decline in population that began in the 1950s as a result of economic downturn, the total population in the City grew 7% between 2000 and 2010 and has only dropped slightly since then according to predictions by the U.S. Census Bureau. The population sex and age distribution in the City closely matches national numbers. That said, Schenectady has a relatively diverse population, made up of 51.3% White, Non-Hispanic or Latino individuals and 48.7 % Non-White individuals. In terms of education, the City ranks below the national rates for graduation from a bachelor's program or higher. Only 21.9% of residents over the age of 25 have a bachelor's degree or higher, compared to 31.5% nationwide. The vast majority (84.2%), however, have graduated from high school. Median household income in the U.S. is also 25.6% higher than in the City, where median income is less than $45,000. There is also a larger proportion of persons in poverty (18.4%) in Schenectady than there are nationwide (11.8%).

*Table 1. Demographic data for the City of Schenectady. Source: U.S. Census Bureau, 2018.*

| Demographic | 2018 Estimate |
|---|---|
| Population | 65,482 |
| Area (sq mi) | 11.0 |
| Population (per sq mi) | 6,135.5 |
| >65 Years Old | 9,063.5 |
| Percent Non-White Individuals | 43.5% |
| Median Household Income (USD) | $44,826 |
| Percent Below Poverty Line | 18.4% |
| Unemployment Rate | 5.6% |
| Percent Without Health Insurance | 7.7% |

The City of Schenectady has created a Community Needs Assessment (CNA) in order to set forth a plan to address potential social vulnerabilities in the community. The CNA outlines six main goals: increase economic activity, expand employment opportunities, raise educational achievement, promote health, wellness, and public safety, expand housing opportunities, and enhance community, cultural, and recreational opportunities. The City already has several ongoing initiatives in place that are aligned with these goals, and more are in development.

## Methodology

CSC Task Force

The Climate Smart Communities (CSC) Task Force took the lead on generating this report. This group consists of City of Schenectady staff members, local residents, and community members who specialize in various fields of sustainability. Working in small groups, the CSC Task Force gathered existing data and reports to analyze the vulnerable areas of the community, as well as to provide guidelines that will allow for the development of local adaptation strategies as the global climate continues to change.

Vulnerability Assessment

Local governments need to know where to focus their resources and staff in order to improve climate resilience on the municipal scale. Climate change will have unequal impacts on community assets and systems, so it is important to understand how to best foster community resilience through an in-depth assessment of local vulnerability and risk. A Vulnerability Assessment achieves this task through identifying, analyzing, and prioritizing the effects of physical trends or events that could affect ecosystems, human populations, assets, industries, or communities (DEC CSC Action Guide). The list below outlines the steps the City took in order to complete this assessment.

a) Step 1: Research related studies on climate change and climate change projections.
b) Step 2: Identify impacts to local systems and/or assets
c) Step 3: Prioritize assets and systems deemed most vulnerable based on their sensitivity and adaptive capacity in the face of climate hazards
d) Step 4: Report results and develop a timeline for action and re-assessment

Resiliency Planning

Local governments often have various plans in place to handle emergencies and protect the community's systems and assets from harm. As climate change is now causing more severe weather events, it is crucial for municipalities to reexamine existing plans and create new ones to address any possible impacts of climate change that may be unaccounted for. Exposing gaps in current plans, projects, and policies can help a community reduce its vulnerability and help them better prepare for localized impacts. The list below outlines the steps the City took in order to complete the Climate Smart Resiliency Planning (CSRP) process.

e) Step 1: Review existing planning documents from various City departments and complete the DEC's CSRP tool
f) Step 2: Analyze the CSRP tool and notice deficiencies or gaps in existing planning documents
g) Step 3: Report results and discuss recommendations with City officials and staff

Adaptation and Mitigation Strategies

Once a local government has evaluated its community's vulnerability to climate hazards, as well as reviewed its existing planning documents for gaps, it is crucial to

take the next step and collaborate with community members to develop a definitive plan of action. The effectiveness and quality of this plan is greatly enhanced by making its development an inclusive, collaborative, and transparent process. The steps the City took to complete the Climate Adaptation Strategies included in this report are outlined below.

a) Step 1: Research potential actions to take based on climate hazards identified in the Vulnerability Assessment and gaps identified in the CSRP process
b) Step 2: Develop strategies and projects that will achieve climate adaptation and mitigation goals with public input via outreach efforts by the CSC Task Force
c) Step 3: Assign appropriate entities to strategies and projects and plan how to achieve the agreed upon goals
d) Step 4: Collect ideas into a report and publish for public release
e) Step 5: Create a timeline for updates and tracking progress on the report and associated plans

# Climate Profile

The State of New York is characterized by a fairly humid climate which is broadly representative of a majority of states within the northeast. Its geographical position creates a unique environment, impacted by its proximity to water bodies, mountains and two atmospheric circulation systems that bring a dry and humid season along with it. Large pockets of cold, dry air generally arrive from the northern interior of the continent. Winds from the southwesterly areas of the country, transport warm, humid air, which often develop by the Gulf of Mexico and nearby subtropical waters. These two wind streams provide the dominant continental characteristics of the climate. A third air mass flows inland from the Atlantic Ocean and produces cool and damp weather conditions. This maritime weather pattern is important to New York's climatic regime and largely shapes the regional climate (ncdc.noaa.gov).

## Schenectady's Climate

The City of Schenectady currently has an annual average temperature of approximately 80 degrees F in the summer months, 55 degrees F in spring, 59 degrees F in autumn, and 33 degrees F in the winter months. On average, July is the hottest month, with an average temperature of 82 degrees F, while January is the coldest month with an average of 30 degrees F (NOAA). Figure 1 shows annual average temperature for the region from January to December.

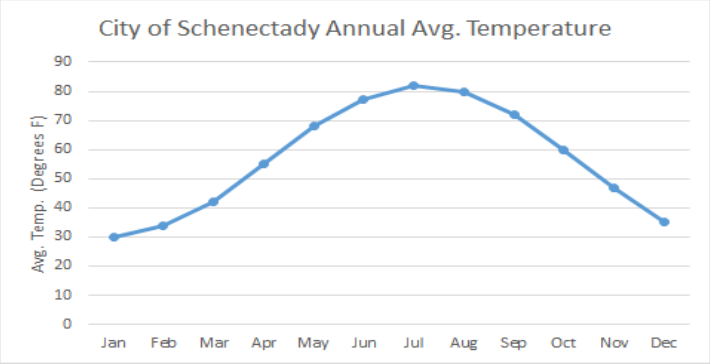



*Figure 1. City of Schenectady annual average temperature. Weather data obtained from NOAA.*

In most years, the coldest temperature ranges from -5 degrees F to -15 degrees F. Summers are warm with temperatures of 90 degrees F or higher occurring on an average of 8 to 12 days per year, mostly between early June and late August. Average daytime temperatures in summer range from the upper 70's to mid 80's. The freeze-free season is approximately 165 days long. The last freezing temperature in spring generally occurs between May 10th and 15th, and the first freeze in autumn occurs around October 10th. Annual precipitation averages 35 to 38 inches throughout most of the City. Rainfall during the May to September growing season varies from 17 to 19 inches. Average annual snowfall is 60 inches.

Schenectady County, like many others in the Capital Region, has faced a variety of climate related disasters over the years. Records from FEMA indicate there have been approximately 24 natural disaster declarations within the County, where data is available. This information is shown below in Figure 2.


*Figure 2. Climate-related disasters in Schenectady County. Source: FEMA/Data-Visualization.*

The information provided by FEMA also shows a dramatic increase in disaster events related to storms and other sources over the years. Figure 2 displays the number of disasters that have occurred each year since record keeping began.

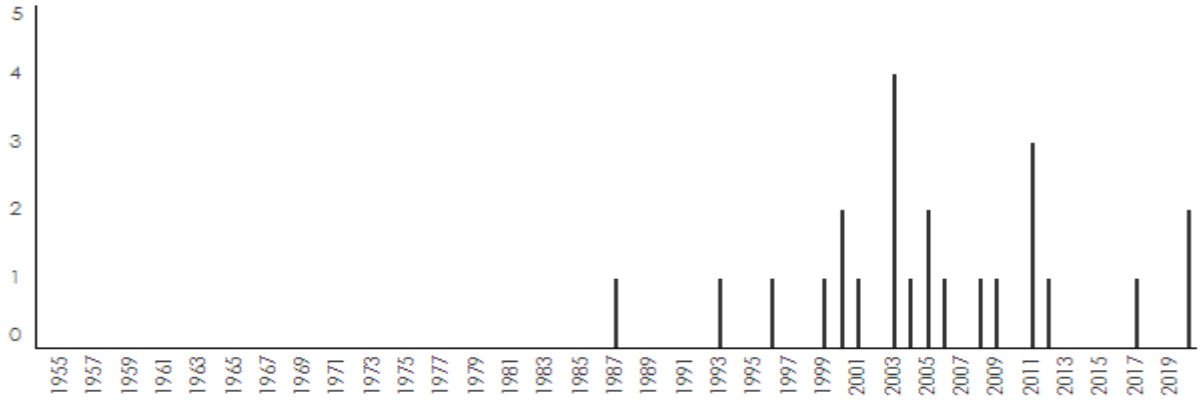



*Figure 3. Disaster events related to storms and other sources. Source: FEMA/Data-Visualization.*

Schenectady has also been subject to an increase in temperature and precipitation over the past several years. Data collected by stations around the 7 NYS regions confirms this trend (Figure 4).

**a.** Annual Temperature (1901 – 2012)

| Observed Weather Station | Temperature Trend (°F/decade) |
|---|---|
| Region 1 – Rochester | 0.32** |
| Region 2 – Port Jervis | 0.35** |
| Region 3 – Elmira | 0.09* |
| Region 4 – New York City | 0.33** |
| Region 5 – Albany | 0.22** |
| Region 6 – Watertown | 0.22** |
| Region 7 – Indian Lake | 0.21** |

**b.** Annual Precipitation (1901 – 2012)

| Observed Weather Station | Precipitation Trend (in/decade) |
|---|---|
| Region 1 – Rochester | 0.34** |
| Region 2 – Port Jervis | 0.35 |
| Region 3 – Elmira | 0.58** |
| Region 4 – New York City | 0.76** |
| Region 5 – Albany | 0.90** |
| Region 6 – Watertown | 0.54** |
| Region 7 – Indian Lake | 0.19 |

* Trend is significant at the 95% significance level
** Trend is significant at the 99% significance level
All data are from NOAA NCDC USHCN V2.5 dataset.

*Figure 4. Annual temperature and precipitation trends for the ClimAID regions of New York State. Source: NYSERDA ClimAID report, 2011.*

Given the City's location in upstate New York, roughly 150 miles from the Atlantic Ocean, coastal erosion, coastal storms and tsunamis are not relevant risks. The City is also not susceptible to avalanches, due to its location in Mohawk River Valley, where it is surrounded by gently sloped hills with relatively low elevation above sea level. Additionally, Schenectady does not have a history of any volcanic activity, nor is there evidence to suggest that there will be any future volcanic activity. Similarly, the City and County as a whole do not have any limestone bedrock or Karst geology that would be indicative of potential for land subsidence. Therefore, an in-depth analysis of these natural hazard types is not included in this report.

# Vulnerable Systems

## Infrastructure

### Energy & Utilities

Energy Overview

New York State consists of 11 electricity load zones, which were created by the New York State Research and Development Authority (NYSERDA) based on physical location as opposed to geographic characteristics. The New York Independent System Operator (NYISO) manages these 11 zones. The City of Schenectady is located in Zone F where peak load for the entire zone averages about 2,381 MWp as of 2008. For reference, New York City's peak load is about 11,347 MWp (Figure 5).

| NYISO Load Zone | Average Annual Load (2002–2008) (GWh) | Annual Load (2008) (GWh) | Percent of State Annual Load (2008) | Average Peak Load (2002–2008) (MWp) | Peak Load (2008) (MWp) | Percent Load Growth Change (2002–2008) | Percent Average Annual Change |
|---|---|---|---|---|---|---|---|
| Zone A (Buffalo) | 16,129 | 15,833 | 10% | 3,113 | 2,611 | -3.8% | -0.59% |
| Zone B (Rochester) | 10,002 | 10,088 | 6% | 2,143 | 2,001 | 1.72% | 0.31% |
| Zone C (Syracuse) | 16,863 | 16,719 | 10% | 3,153 | 2,939 | 2.4% | 0.45% |
| Zone D (Plattsburgh) | 6,336 | 6,733 | 4% | 1,493 | 949 | 4.22% | 1% |
| Zone E (Utica, Watertown) | 7,393 | 7,855 | 5% | 1,569 | 1,388 | 9.45% | 1.75% |
| Zone F (Albany) | 11,452 | 11,594 | 7% | 2,381 | 2,302 | 2.59% | 0.51% |
| Zone G (Hudson Valley) | 10,594 | 10,607 | 6% | 2,496 | 2,344 | 3.77% | 0.7% |
| Zone H (Upper Westchester) | 2,467 | 2,935 | 2% | 2,204 | 665 | 26.36% | 5.55% |
| Zone I (Lower Westchester) | 6,186 | 5,944 | 4% | 1,641 | 1,440 | -0.24% | 0.02% |
| Zone J (New York City) | 30,344 | 54,830 | 33% | 11,347 | 11,262 | 3.1% | 1.6% |
| Zone K (Long Island) | 12,642 | 22,459 | 14% | 5,748 | 5,281 | 1.33% | 0.69% |
| Total | 130,407 | 165,595 | 100% | 37,288 | 33,181 | | |

Note that prior to February 2005, Zone J and Zone K were a single, combined load zone.
Source: NYISO 2009a

*Figure 5. Electricity loads in New York State by ClimAID Region. Source: NYSERDA ClimAID report, 2011.*

The City is also located in ClimAID Region 5, which houses a large proportion of the nuclear and renewable energy production sites in the state (Figure 6). In 2018, New York State generated a total of 132,521 thousand Megawatt hours of electricity and sold 149,930 thousand Megawatt hours. According to the EIA, both net generation and sale of electricity have increased in recent years. The energy mix in Upstate New York consists of fossil fuels, hydroelectric, and nuclear power in roughly equal proportions (about 30% each), with the remaining 7 to 10% coming from renewables other than hydroelectric (Figure 6). The primary source of heating fuel in the state is natural gas, which is imported from a national distribution system due to a lack of in-state production.

Energy prices vary region by region, but prices tend to be highest in New York City and Long Island.

| ClimAID Region | Number of Power Plants (by fuel type) and Peak Generation Capacity (MWp) | | | |
|---|---|---|---|---|
| | Fossil fuel | Nuclear power | Renewables | Total |
| Region 1 | 19<br>2,761 MWp | 1<br>517 MWp | 14<br>2,628 MWp | 34<br>5,905 MWp |
| Region 2 | 11<br>3,548 MWp | | 13<br>1,106 MWp | 24<br>4,654 MWp |
| Region 3 | 10<br>775 MWp | | 4<br>11 MWp | 14<br>786 MWp |
| Region 4 | 49<br>12,996 MWp | | 7<br>137 MWp | 56<br>MWp |
| Region 5 | 14<br>1,350 MWp | 2<br>2,339 MWp | 50<br>594 MWp | 66<br>4,283 MWp |
| Region 6 | 13<br>3,968 MWp | 2<br>2,784 MWp | 42<br>304 MWp | 57<br>7,056 MWp |
| Region 7 | 6<br>566 MWp | | 52<br>1,263 MWp | 58<br>1,829 MWp |
| New York State | 122<br>25,964 MWp | 5<br>5,640 MWp | 182<br>6,043 MWp | 309<br>37,647 MWp |

*Figure 6. NYS power plant data in each ClimAID Region. Source: NYSERDA ClimAID report, 2011.*

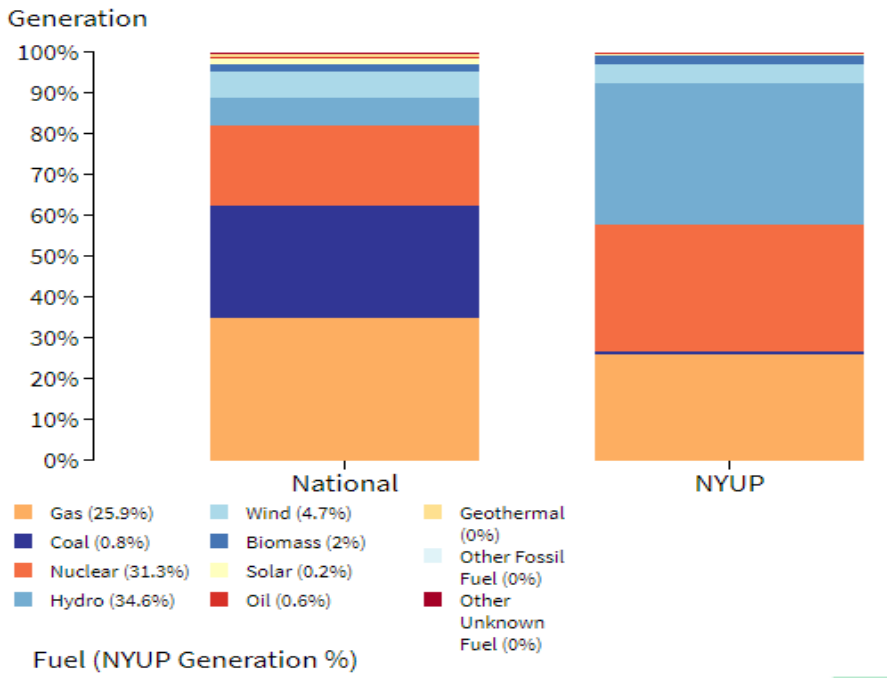



*Figure 7. Upstate NY electricity mix by fuel type as compared to the national averages. Source: NYSERDA ClimAID report, 2011.*

Energy-Related Vulnerabilities

As a result of climate change, there may be several general vulnerabilities the City could face in the energy sector, particularly with regards to energy supply. According to the 2014 ClimAID report, vulnerabilities pertaining directly to the northern portions of the state include:

- Changes in wind speed and direction, as well as temperature and precipitation may limit the availability and reduce the predictability of renewable energy sources
- Higher water temperatures could make cooling some nuclear power plants more difficult
- Increasing frequency and severity of extreme weather events, particularly in the summer and winter seasons, may cause transformer failures and more widespread outages

Supply and demand for energy are also affected by the number of heating and cooling degree days a region has. In the Mid Atlantic Region as a whole, the number of Heating Degree Days (HDD) has decreased, while the number of Cooling Degree Days (CDD) has increased. Thus, while the demand for energy in the winter could potentially decline, the demand in summer may rise, causing a net increase in annual energy use. Since the source of energy for winter warming (e.g., natural gas, fuel oil) often differs from that of summer cooling (e.g., electricity), this shift in energy use poses additional stresses on energy supplies.

Furthermore, demand for electricity generally rises as population increases, which could pose a threat to energy supply, as the region's aging infrastructure would need to take on this extra burden. Demand will also rise as residents purchase more electronic devices and air conditioning units for their homes. An overall increase in energy demand, along with a possible decrease in supply, may cause energy prices to rise substantially. Policies and technologies relating to the energy market are continually changing, and the City will need to be prepared to adapt quickly to keep up.

## Transportation

The transportation system in the City of Schenectady is composed of local streets, interstate highways, state highways, bus routes, railroads, and a bike path. Many City residents rely on the public transportation network for commuting to and from work, so it is important that the infrastructure that supports this network is protected from the impacts of climate change. Flooding, coastal erosion, and the intensity and frequency of extreme weather events all pose a threat to transportation infrastructure.

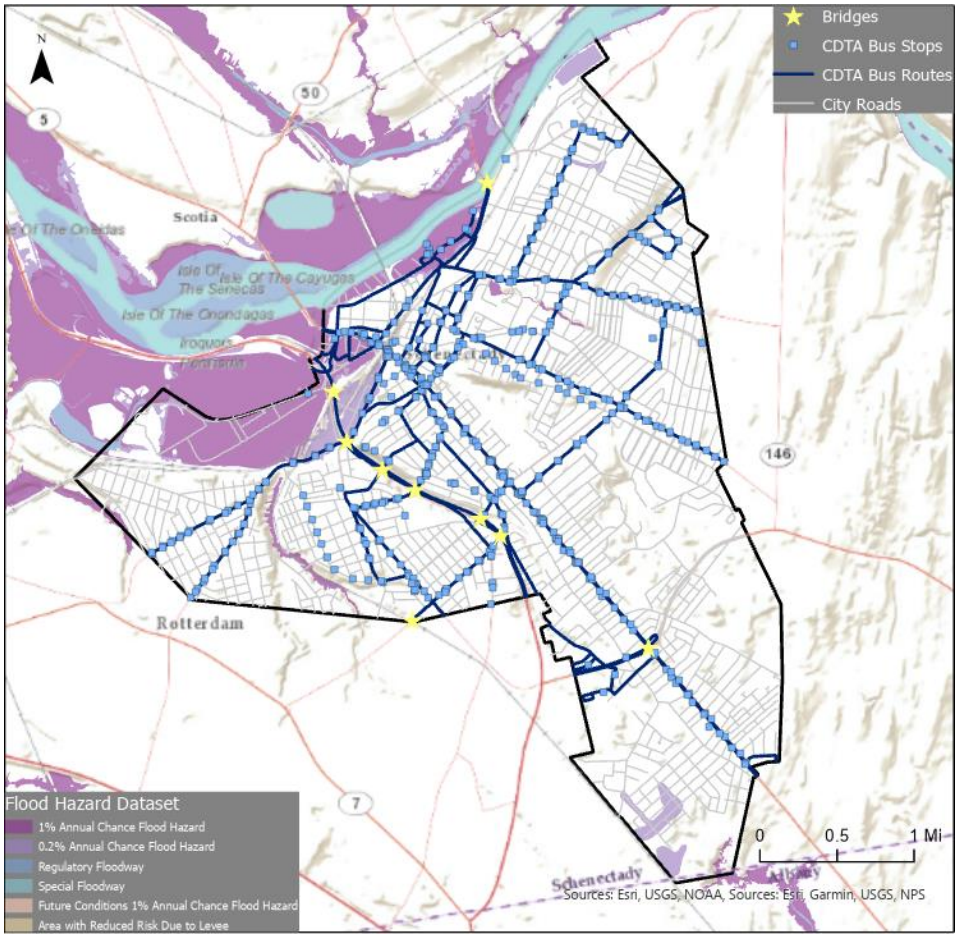



*Figure 8. Transportation infrastructure relative to the 100- and 500-year floodplain.*

In the City specifically, public transportation networks may be at risk (Figure 8). Approximately 26 bus routes and 23 bus stops within city boundaries are currently located within the 100-year floodplain. Portions of Interstate 890 (I-890) and over 60 City streets also may be at risk for flooding in the near future, especially with increased frequency and severity of storms. Heavy rainfall could also cause landslides and mud hazards in areas near steeper slopes. Road surfaces are important considerations as well, since temperature extremes will impact the stability of roadbeds, as well as increase the need for using heat-resistant material to pave roads.

Schenectady also has two railroad bridges, and several vehicle traffic bridges. Bridges may be vulnerable to climate change in several ways, including a higher risk of scouring, particularly for those nearest to waterways. The railroad tracks that run through the City are within the 100-year floodplain and adjacent to low-lying areas that will be increasingly likely to flood in coming years. Erosion of surrounding land areas could also be a concern. Additionally, extreme heat may pose a threat to railroad operations, since it can cause rail buckling, particularly if trains are travelling at higher rates of speed. If power outages occur during these extreme weather events it may also lead to communication or signal failures.

## Water & Sewer

Although the City of Schenectady's water and sewer systems have, to date, been historically reliable, these systems may be particularly vulnerable to climate change. Extreme weather events pose a particular risk.

Water Supply

The City of Schenectady draws water from the Great Flats Aquifer, which covers approximately 25 square miles in the Mohawk River Valley in Schenectady County, New York. The City dug the first municipal well field in 1897 and has since expanded to six well fields that serve five municipalities in Schenectady County. The allowable daily withdrawal is 65 million gallons, as permitted by New York State Department of Health; however, the average daily withdrawal is generally around 25 million gallons, and water shortages are historically rare (Schenectady County). It is unlikely that Schenectady will face extreme shortages in the near future, as demand is currently balanced with aquifer recharge (Figure 9). Groundwater sources are also typically less vulnerable to drought and/or precipitation changes than are other water supply sources (e.g., surface water and reservoirs) because of their geologic structure. That said, as global climate continues to change, there may be changes in the timing of aquifer recharge. These changes could reduce water supply by a small amount - although studies on the impact of climate change on groundwater sources are limited (NYSERDA, 2011).

| System | Daily Demand (million gallons/day) | Daily Recharge (million gallons/day) | Well Field Storage (million gallons) | Days of Supply with No Inflow |
|---|---|---|---|---|
| Jamestown – Cassadaga Creek (Crain 1966) | 4.8 | 30.1 | 3,000 | 625 |
| Schenectady – Mohawk River (Winslow et al. 1965) | 26 | 15 (plus Mohawk River infiltration) | 500 | 19 |
| Endicott/Johnson City – Susquehanna River (Randall 1977) | 16 | 41 | 1,700 | 106 |
| Cortland Homer Preble – Tioughnioga River (Miller 2004) | 6.5 | 24 | >1,000 | ~150 |

*Figure 9. Major aquifer systems in New York State. Source: NYSERDA ClimAID report, 2011.*

A more probable threat to water supply in the face of a changing climate is the potential increase in demand for water for both residential and industrial purposes. According to NYSERDA's 2011 ClimAID report, it is highly likely that people living in the southwestern portions of the United States will begin to migrate east. The Southwest faces imminent water shortages, as climate change has manifested in declines in water flow and decreased runoff. Furthermore, people living in low-lying coastal cities, such as New York City, may be forced to relocate as sea level continues to rise. Due to its geographic location and economic growth potential, the Capital Region, including the City of Schenectady, could be an attractive option for those who chose to relocate (Albany Climate Change Report, 2013). Subsequent increases in population could strain water resources.

Demand for water from industrial users is less likely to pose a threat in the City of Schenectady, primarily because the City does not include agricultural land or power generation sites that require intensive water withdrawal. Moreover, most of these uses do not require drinking water for their operations. However, it is possible that both newly constructed and existing sites near to the City, such as natural gas wells or agricultural operations, may tap into Schenectady's water resources as their primary sources of water are drawn down. If they do so, it could reduce the City's water supply.

Sewage Treatment & Stormwater Management

The sewer system in Schenectady is separate from the stormwater system, which lessens the chance of stormwater overflow during and after severe storms. That said, the Wastewater Treatment Plant (WWTP) in the City is located along the Mohawk River, which is more likely to flood with increased precipitation and severe storms. A summary of general vulnerabilities is provided in the table below, from the Water Environment Research Foundation's (WERF) 2009 report.

| | Increased Flood Risk to Plants & Other Facilities | Increased Risk of Impaired Coastal Outfall Operations | Altered Receiving Water Quality | Challenges to Collection & Conveyance System Operations | Challenges to Treatment Processes, Biosolids Facilities & Reuse Plants |
|---|---|---|---|---|---|
| Sea Level Rise | ● | ● | ● | | |
| Warmer & Shorter Winters | | | ● | | |
| Warmer & Drier Summers | | | ● | ● | ● |
| More Intense Rainfall Events | ● | | ● | ● | ● |

Another potential concern with flooding is a potential for decline in water quality. WWTPs are generally designed to process a certain range of intake flows and loadings. With increased high precipitation events, it is more likely that the inflows will fall outside of the design specifications, which are generally based on historical hydrological and meteorological records for a given area (WERF, 2009). If incoming water is unable to be treated by the WWTP, it is possible that bacteria such as *E. coli* could end up in water bodies nearby, or sewage backups could occur in residents' homes. However, the City's WWTP has not had any issues with this to date and with coming upgrades to the WWTP facility -- none are predicted for the future.

## Critical Facilities

Critical facilities, as defined by the Federal Emergency Management Agency (FEMA) include fire/police stations, schools, public libraries, and health services facilities. The City of Schenectady is home to 28 schools, 18 health service facilities, four fire stations, two public libraries, two recycling centers, one wastewater treatment plant (WWTP), and one police station. Fortunately, the majority of these facilities are located outside of the 100-year flood plain, with the exception of the WWTP on Anthony Street and the recycling plants near I-890, where there is a 0.2% annual chance of flood hazard, as well as Schenectady ARC, where there is a 0.1% annual chance of flood hazard. There are also three pump stations that are located within the 500-year flood plain, on North Ferry Street, South Ferry Street, and Delaware Avenue. All three pump stations were damaged by the 2011 Hurricane Irene floods. As such, the City's primary pump station on North Ferry Street is currently undergoing multi-million dollar upgrades to make the station flood-proof. There are currently no plans to relocate or improve the other two pumps (Figure 10).

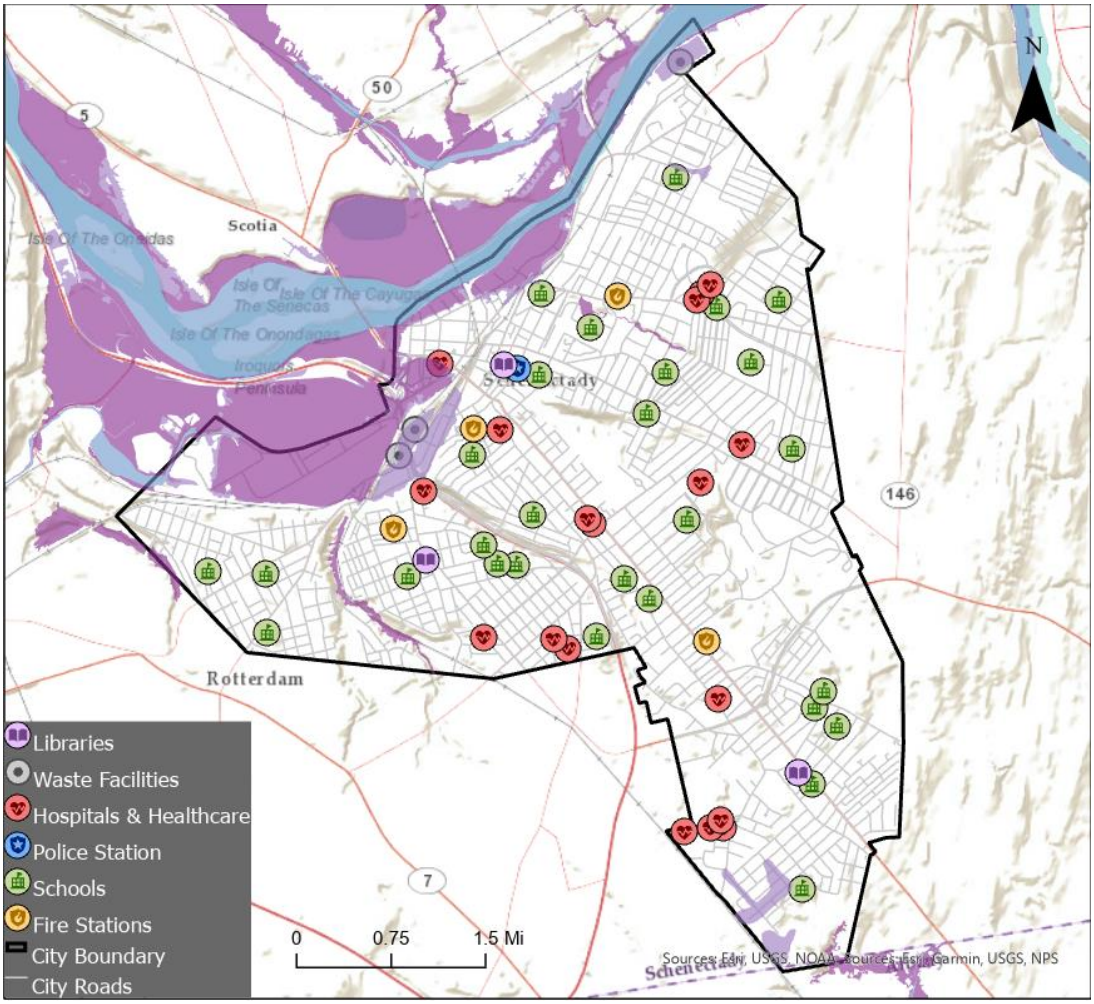



*Figure 10. Critical facilities in the City of Schenectady.*

# Ecological

## Waterways

Mohawk River

Schenectady is located adjacent to the Mohawk River, the largest tributary to the Hudson River. Its 3,460 square mile watershed drains the southern Adirondacks and much of the Catskills and makes up approximately 25% of the Hudson River watershed. Controls on water flow operated by the NYS Barge Canal System are located just upstream (Lock 8, Rotterdam) and downstream (Lock 7, Niskayuna) of Schenectady. Floodplains on either side of the Mohawk River (including the Stockade neighborhood) accommodate flood conditions while steep cuts further downstream maintain water in the river channel.

Heavy rainfall (e.g., Hurricane Irene in 2011) in the watershed can result in significant flooding, particularly in the Stockade neighborhood. Such catastrophic flooding has led to Hazard Mitigation Programs under the Department of Homeland and Emergency Services (DHSES) and Federal Emergency and Management Agency (FEMA). In the last 50 years, the City has recorded 21 flood events. In addition, ice jams during spring runoff frequently result in water backing up in the Mohawk River and flooding the Stockade neighborhood. Increased frequency of severe rainfall and fluctuating temperatures during spring runoff are potential hazards to this portion of the City. A 2019-2020 Stockade Resiliency Study determined that the previously established base flood elevation (BFE) was too low and that when calculating ice jamming into the equation the BFE has a net increase of nearly 1.24’ feet. (Stockade Resilience, 2019)

Various Creeks and Ponds in Schenectady

Several small tributaries to the Mohawk River historically flowed through Schenectady but most have been piped and covered over (Buell, 2003). The four largest were Hans Groot’s Kill, Cowhorn Creek, Brandywine Creek, and Schermerhorn Kill. Hans Groot’s Kill is still visible running through the GE Realty Plot and Jackson’s Garden on the Union College Campus before being piped to discharge to the Mohawk River (originally a half-mile west of Freeman’s Bridge). Recent studies of the Hans Groot’s Kill have shown that during significant rain events, stream concentrations of fecal-indicating bacteria rise to levels that are more than 35 times EPA guidelines. The other three originally flowed into Mill Creek and discharged to the river near the Western Gateway Bridge. A portion of Cowhorn Creek is visible in Central Park and Vale Cemetery while a portion of Schermerhorn Creek can be seen in the ravine near Cheltingham Avenue. Pipes

carrying these creeks beneath the City date back to the early 1900s. Elevated precipitation events could lead to water backing up where the creeks daylight and may impact buried stormwater or sewer pipes in the vicinity.

Ponds in Central Park (Iroquois Lake and the Duck Pond), Steinmetz Park, and Vale Cemetery are subject to flooding during heavy precipitation. Impacts tend to be localized, but in some cases (e.g., if flows are backed up by buildup of silt or fallen limbs), need to be managed proactively.

## Urban Forest, Natural Habitat, and Invasive Insect Species

### Urban Forest

Urban forests play an important role in mitigating climate change by providing shade (i.e., cooling) and windbreaks, and controlling soil erosion and stormwater runoff. According to the City's Tree Master Plan (Davey Resource Group 2003), the size and composition of Schenectady's urban forest is about average compared to New York State communities with similar populations. However, low diversity (i.e., Norway maple species compose approximately 60 percent of the tree population), poor health (i.e., only half of the trees in the right-of-way are in good health), and low stocking rates (i.e., removal rates exceed planting rates) jeopardize the health of the forest and make it more vulnerable to climate change. Planting more trees and a greater diversity of species would help make the urban forest more resilient in the face of higher temperatures and extremes in precipitation associated with climate change.

### Natural Habitat

Schenectady has several hundred acres of natural and managed parkland with the largest contiguous areas in Central Park and the Woodlawn Preserve. These areas provide important habitat for birds, mammals, insects, reptiles, and amphibians, as well as offering solace to city dwellers. Climate change impacts are likely to alter the mix of native species and could exacerbate the occurrence of invasive plant species. For example, milder winters may result in higher survival rates for seedlings of Japanese knotweed (*Polygonum cuspidatum*) (NYSERDA 2011), an invasive species already present in Schenectady parks.

The Woodlawn Preserve is an extension of the Albany Pine Bush Preserve, with its unusual inland pitch pine-scrub oak barrens ecology. According to the Albany Pine Bush 2017 Management Plan Update, increased weather variability associated with climate change is likely to impact rare plant and animal species because extreme conditions

(e.g., high temperatures, severe precipitation) would be outside the natural range of variability for this biota. The Albany Pine Bush Commission, The Nature Conservancy, and the federal Karner Blue Butterfly Recovery Team are researching the potential impact of altered weather conditions on the endangered Karner blue butterfly.

Invasive Insect Species

Several insects that can adversely impact the urban forest and parkland have been identified in or near Schenectady. NYSDEC has identified the following species as invasive:

- Asian long horned beetle
- Emerald ash borer
- Hemlock woolly adelgid
- Sirex wood wasp
- Spotted lanternfly

The occurrence of these species may be impacted by climate change. In at least one case, the hemlock woolly adelgid, warmer winters have expanded its range in the Northeast resulting in decimation of hemlock populations (NYSERDA 2011). HWA is prevalent in residential areas of the City where hemlocks are a common landscaping plant. It has also been identified on several trees in Vale Park and Central Park.

# Socioeconomic

## Public Health

One of the major issues posed by climate change is the potentially devastating impacts it will have on public health. As noted in the NYS ClimAid Report, the consequences of climate change, both current impacts and future ones, are likely to be dramatic, particularly for the most vulnerable populations. The most relevant impacts facing New York State specifically, include the following:

- Increase of heat-related deaths
- Negative consequences as a result of more intense rainfall and large flooding events
- Deteriorating air quality (primarily due to increasing smog, wildfires, pollens, and molds) and related respiratory health impacts
- Changing patterns of vector-borne and other infectious diseases
- Risks to water supply, recreational water quality, and food production due to shifting precipitation patterns

Air Quality

The growing concern over air quality is linked to the increasing number of high-heat days. Even in a city with a relatively mild summer climate, like Schenectady, high-heat days result in faster chemical reactions that lead to ozone and secondary particle formation which worsen overall air quality. The volatile organic compounds (VOCs) that are the precursors of smog may also increase as rising temperatures and CO2 concentrations could also fuel greater plant growth.

Worsening air quality poses a threat to everyone, but its impacts often fall disproportionately on lower socio-economic neighborhoods. As of 2014, Schenectady County had the highest rate of Medicaid recipients diagnosed with asthma in New York with 131.3 people per 1,000 enrollees. A 2017 Health Equity Report revealed an analysis that shows the Hamilton Hill neighborhood, an area of statistically low socio-economic status, sees emergency department visit rates for asthma that are 11 to 14 times higher than high socio-economic status areas within the Capital Region. (DiNapoli, 2014; HCDINY, 2017)

High Heat Vulnerability

High-heat days have the potential to lead to many heat-related illnesses such as heat exhaustion and heat stroke. Extreme heat can also lead to indirect impacts to health such as the spread of disease or the financial strain it may cause to provide cooling. As temperatures continue to rise and high heat days become more prevalent, the risks associated with heat-related illness will impact public health at far greater rates than previously seen in Schenectady. The Department of Health currently tracks this information and produces a High Heat Vulnerability Index (HVI) to assist local officials and provide services to the populations in greatest need. A map of Schenectady County's HVI can be found in Figure 11 below.

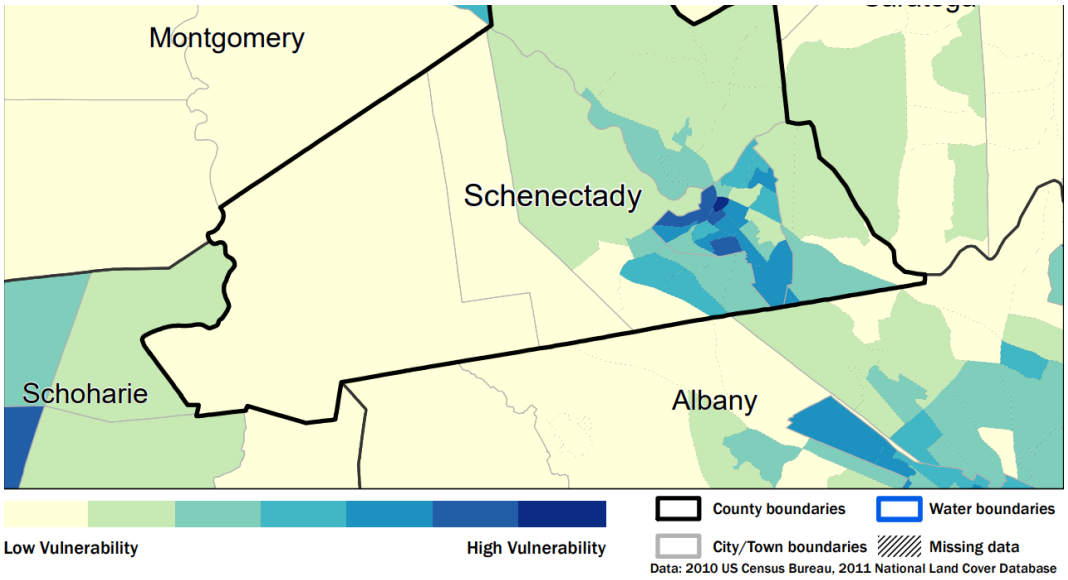



*Figure 11. Schenectady County's HVI. Source: NYS Department of Health.*

Vector-Borne Disease

Increasing the amount of high heat days also leads to longer breeding seasons for many pests that carry potentially harmful diseases that spread easily to humans.

## Economic Vulnerability

Economic vulnerability can come in different forms, but for the purposes of this report, the focus is on low-income indicators. Low-income families and individuals are not as likely to be able to allocate their financial resources toward preventative measures such as disaster recovery. Furthermore, because low-income families tend not to have additional financial resources or strong social networks to aid amidst times of trouble, they may find it more difficult to rebound from extreme weather events. If coupled with other stressors such as unexpected unemployment or the death of a loved one, economic vulnerability only further increases (Albany Climate Change Report, 2013).

The City of Schenectady's unemployment rate has declined steadily over the past five years; however, nearly 40% of the population over 16 years old is not in the labor force (U.S. Census Bureau, 2018). Median household income as of 2018 is $44,826 for all races (see Table 2 below for a breakdown by race), and the poverty rate is 18.4% (U.S. Census Bureau, 2018).

*Table 2. Median household income in Schenectady by race. Source: U.S. Census Bureau, 2018.*

| Race | Median Household Income |
|---|---|
| Black | $30,643 |
| Hispanic or Latino | $31,625 |
| Asian | $51,488 |
| White | $50,625 |

As compared to New York State overall, Schenectady has a median household income nearly 46% lower and a poverty rate about 26% higher. Table 3 below highlights the heightened economic vulnerability of Schenectady residents.

*Table 3. Economic vulnerability metrics in Schenectady. Source: U.S. Census Bureau, 2018.*

| Indicator | City of Schenectady | New York State | % Difference |
|---|---|---|---|
| Median Household Income | $44,826 | $65,323 | -45.72 |
| Poverty Rate | 18.4% | 13.6% | +26.1 |

## Social Vulnerability

According to the Center for Disease Control (CDC), social vulnerability is “the resilience of communities when confronted by external stresses on human health,” including natural and human-caused disasters. CDC has developed a Social Vulnerability Index (SVI) to help local officials determine where to best focus resources to support the most vulnerable communities before, during, and after a disaster occurs. The SVI is based on 15 U.S. census variables at census tract level to pinpoint these communities (Table 4). As indicated in the table below, the City of Schenectady is most vulnerable in terms of socioeconomic variables.

*Table 4. Categories used by CDC in their Social Vulnerability Index (SVI) calculations (2018) and the associated value of each variable for the City of Schenectady. Values are based on the average of all census tracts within City borders.*

| SVI Group | Variable | Schenectady Metric (Avg.) |
|---|---|---|
| Socioeconomic Status | Below Poverty | 21.7% |
| | Unemployed | 9.7% |
| | Income (per capita) | $22,971 |
| | No High School Diploma | 16.7% |
| | **Overall SVI Ranking** | **0.74** |
| Household Composition & Disability | Aged 65 or more | 12.7% |
| | Aged 17 or less | 19.1% |
| | Older than 5 with Disability | 15.1% |
| | Single-Parent Households | 9.5% |
| | **Overall SVI Ranking** | **0.45** |
| Minority Status & Language | Minority | 48.1% |
| | Speaks English “less than well” | 1.9% |
| | **Overall SVI Ranking** | **0.58** |
| Housing Type & Transportation | Multi-Unit Structures | 14.2% |
| | Mobile Homes | 0.06% |
| | Crowding | 1.6% |
| | No Vehicle | 22.3% |
| | Group Quarters | 8.3% |
| | **Overall SVI Ranking** | **0.5** |

Considering New York State as a whole, Schenectady County's SVI ranking (0.39) is more moderate than in other areas in the state, such as Sullivan County (0.79) and Montgomery County (0.83). That said, taken down to the census tract level, the City of Schenectady houses several communities with SVI rankings over 0.5. In fact, all neighborhoods in the city, with the exception of Union Street and the Stockade have areas where the SVI is greater than 0.5 (Figure 12). Overall percentile rankings are greater than 0.9 in the Hamilton Hill/Vale neighborhood.

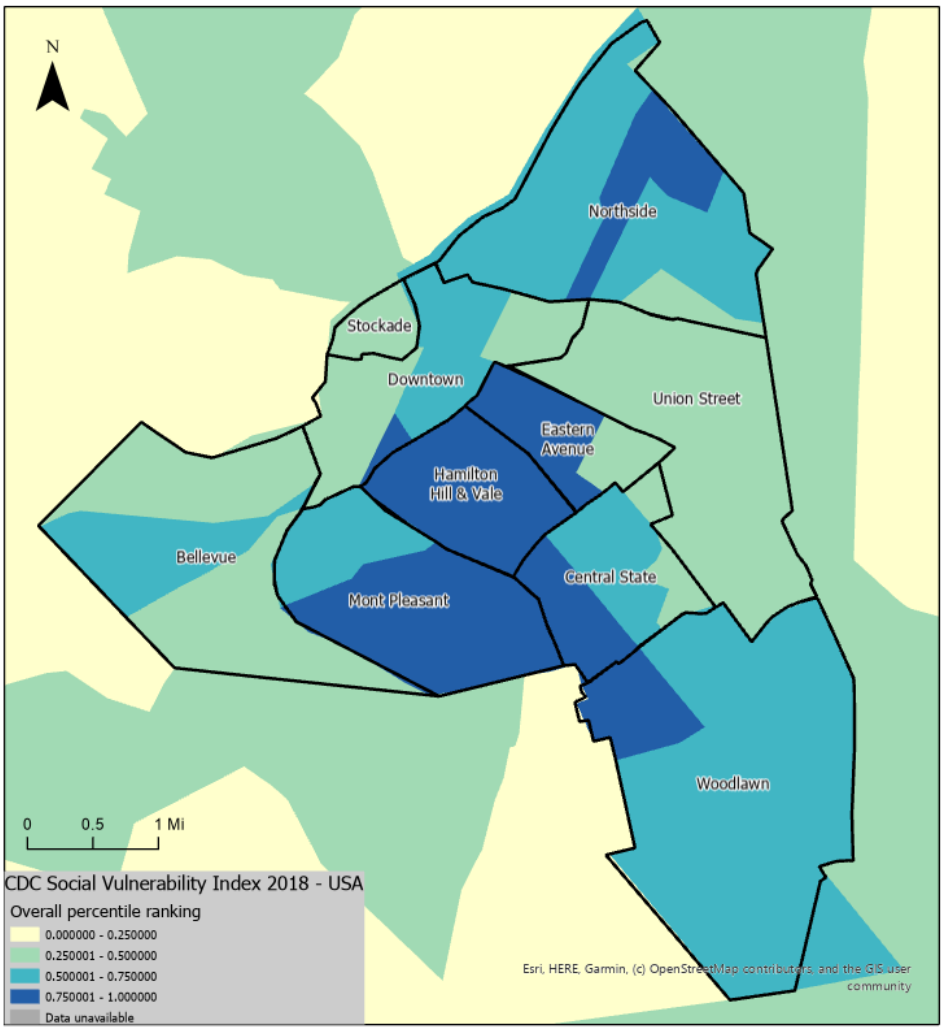



*Figure 12. CDC social vulnerability index (SVI) in the City of Schenectady. Darker blue areas represent those with higher social vulnerability.*

The CDC also created a "flag" system to highlight areas that have any of the 15 variables in the 90th percentile. The City has 17 flags in the housing/transportation category (primarily Downtown and in the Stockade), 11 in the socioeconomic category (primarily in Northside), 7 in the household composition category (primarily Hamilton Hill/Vale), and none in the minority status/language category, for a total of 35 flags. The Hamilton Hill/Vale neighborhood is the only neighborhood with flags in three of four categories. These high rankings and numerous flags indicate that a large proportion of

the city's population is particularly vulnerable, especially as climate change continues to increase the frequency and intensity of natural disasters.

Climate Change Education

A vulnerability that is less often explored with regards to climate change is education. As a recent article published in *Science* noted, "general empowerment of populations through universal primary and secondary education is not only essential to poverty alleviation, but also to reducing vulnerability to natural disasters" (Lutz et al., 2014).

There is a common misconception that the choice is to either improve the economy *or* the environment, rather than to improve the economy *and* the environment simultaneously (Hoffman et al., 1999; Hugo, 2008). Overcoming this misconception will be key to getting support for "green" initiatives from residents and local officials alike.

When citizens are educated about climate change and its widespread impacts, it reduces their vulnerability because it empowers them to take action. However, public opinion of and willingness to support climate change mitigation and adaptation initiatives often depends on how directly the impacts of climate change are felt by a given community. Numerous studies suggest that those who have personally seen and experienced its negative impacts are more likely to back environmental initiatives (e.g. Brody et al., 2008; Zahran et al., 2008). As new policies and investments around environmental initiatives arise, it is critical for the city to engage with its residents and businesses to ensure that climate related vulnerabilities are lessened equitably. Through education, local officials will be communicating more with the public on climate change related projects. This presents an opportunity for local decision makers to be educated as well, as they gain an understanding of the vulnerabilities and benefits sought by communities which can often be overlooked.

## Environmental Justice

As the previous sections have highlighted, climate change poses a disproportionately high threat to communities of lower socioeconomic status. NYSERDA's 2014 ClimAID report provides two primary drivers of this inequality:

- Lower-income populations and communities of color are more often concentrated in areas that expose them to climate-related health threats
- Those of lower socioeconomic status often have pre-existing vulnerabilities that may be exacerbated by the changing climate (e.g., underlying health conditions, inferior public infrastructure, limited access to healthcare, etc.)

For example, low-income populations and communities of color are disproportionately located in inner-city urban areas. Those neighborhoods tend to contain surfaces that trap heat (i.e., the urban “heat island” effect, Bornstein, 1968). As a result, lower-income populations and communities of color will likely be exposed to more heat-related stresses as higher temperatures cause longer and more intense heat waves. Furthermore, medical conditions that make people more vulnerable to changes in climate, such as cardiovascular issues and asthma, are often more prevalent in low-income and racial minority communities. These communities may also live in areas where there are higher numbers of heat-trapping buildings without air conditioning, and/or where there is a higher prevalence of mold growth and other allergens. In short, there are numerous compounding factors that make certain already disadvantaged populations especially vulnerable to climate change.

Particular vulnerabilities related to environmental justice also include access to healthy foods, safe water, parks and green space, exposure to toxins such as lead and poor air quality. An estimated 22.9% of low-income residents are faced with limited access to healthy foods within the city, according to a health equity study conducted by the Healthy Capital District Initiative. (HCDI, 2018) Climate change poses a greater risk to areas with high food-insecurity as access becomes more difficult and the cost of healthy foods significantly surpasses easily accessible foods with little to no nutritional value. Additionally, a 2019 Community Health Needs Assessment conducted by Schenectady County and Ellis Medicine demonstrate the increased prevalence of health related issues in areas that have poor access to healthy and affordable foods (SCPH, 2019).

These patterns, where the burdens of climate-related health problems are disproportionately borne by low-income populations and communities of color, violate principles of environmental justice. The inequities must be addressed through targeted policies and actions. At the state level, The New York Climate Leadership and Community Protection Act (CLCPA), which was passed in 2019, takes an important step in the right direction by creating a Climate Justice Working Group and setting a target for disadvantaged communities to receive 40% (and no less than 35%) of the benefits from all New York State climate programs. However, as the following section will address, there are many more actions that can be taken on the local scale to combat climate-related inequalities.

Although the City of Schenectady has several grassroots organizations that address issues of environmental justice and education (e.g., Roots and Wisdom), there is still plenty of room for growth. The current vulnerabilities relating to environmental justice are symptoms of largely unjust land use and economic practices that concentrate pollution and other environmental harms largely in low-income communities and communities of color. Identifying such vulnerabilities and the remedies needed, requires working directly with these communities to establish the strategies necessary to bring about environmental justice while protecting against the impending impacts of climate change.

# Recommendations & Adaptation Strategies

Identifying vulnerabilities in the City of Schenectady is only the first step of responding to climate change in this community. The next step is to decide what concrete actions can be taken, and by whom, in order to adapt to and mitigate the effects of local climate change. The effects of climate change are evidently widespread and ongoing and will therefore require continual assessment and interventions. To build climate resilience in the City, the entire community must be involved in creating a plan of action, which should include both grassroots efforts and top-down initiatives set forth by local officials and public health agencies. The table below organizes a series of potential actions by asset category and priority. Ideally, a plan will be developed by local officials and community members to begin working on high priority actions as soon as possible. Priorities and specific task are subject to change based on new information and available funding for implementation.

| Asset Category | Vulnerabilities | Proposed Adaptation/Mitigation Strategy | Responsible Entity | Priority |
|---|---|---|---|---|
| Energy Sources & Infrastructure | Energy price fluctuations | Community Choice Aggregation | City Council | Medium |
| Energy Sources & Infrastructure | Higher temps will impact demand for energy | Invest in cooling strategies/infrastructure (e.g., green roofs, tree planting, green spaces, etc.) Incentivize energy-efficient and energy-conserving building technology | Parks Dept., Utilities & Facilities | Medium |
| Energy Sources & Infrastructure | Increase in extreme weather events will increase likelihood of transformer failure and widespread outages | Micro-grid incentives and solar development to offset load. Tree trimming near power lines, transformers, and utility poles to lessen impacts from storms. | Parks Dept., Utilities | Low |
| Energy Sources & Infrastructure | Availability of renewables | REC purchasing, Solar development projects | Finance Dept. (with help of CSC Group) | Low |
| Transportation | Lack of infrastructure to support and promote non-motorized movement throughout the city. | Increase pedestrian and multi-modal transportation-oriented design. Adopt a complete streets policy | Engineering, DOT, CDTC, CDTA | High |
| Transportation | Bus stop locations in poor condition. Shelter from weather events is critical | Work with local community organizations to obtain funding to improve bus stop shelters | CDTC, CDTA, CDRPC | High |

| Asset Category | Vulnerabilities | Proposed Adaptation/Mitigation Strategy | Responsible Entity | Priority |
|---|---|---|---|---|
| Transportation | Number of railway and vehicular bridges could be at risk from flooding or erosion based on their locations | Develop alternative transportation plans for flooding events; invest in green transportation infrastructure in these areas in particular | Engineering, DOT | High |
| Transportation | Public transportation located within 100-year floodplain (26 bus routes) | Create a plan for rerouting buses as needed, in conjunction with new road plans as they are made. | CDTA, OGS, Development | Medium |
| Transportation | Heavy rainfall could increase number of landslides that are located close to busy streets and highways | Create more green spaces and buffer zones near particularly vulnerable areas | Development | Medium |
| Wastewater/Storm-water Infrastructure | High energy use, water quality impairment and water usage | Evaluate and update existing infrastructure and facilities (energy efficiency and flood-proofing); drought water restrictions | Water Dept. | High |
| Wastewater/Storm-water Infrastructure | Lack of green infrastructure | Implement a green purchasing policy - upgrade facilities with greener technology as they age/break | OGS (Water Dept.) | Medium |
| Wastewater/Stormwater Infrastructure | Increased demand for water supply | Enhanced monitoring of groundwater levels. Implement water conservation strategies. | Water Dept. | Low |
| Wastewater/Storm-water Infrastructure | WWTP is in an area that has frequent flooding events | Implement stormwater management plans. Invest in flood-proof technology for the plant; continual monitoring of water levels near the plant; research potential relocation of plant (long-term goal) | OGS (Water Dept.) | Low |
| Wastewater/Storm-water Infrastructure | Flooding by WWTP could impact water quality | Increase water quality testing after flooding events; create a plan for warning residents and providing an emergency supply of clean water | Water Dept., Fire Department, DEC | Low |
| Critical Facilities | Identify vulnerable facilities throughout City | Pinpoint facilities most at risk and rank them by importance and level of risk. Then develop a plan to improve and monitor facility infrastructure and/or relocate the facility | Office of General Services, Development Dept., Facilities and Utilities Dept. | High |

| Asset Category | Vulnerabilities | Proposed Adaptation/Mitigation Strategy | Responsible Entity | Priority |
|---|---|---|---|---|
| Critical Facilities | Comprehensive plan to address facilities potentially at risk | See above | "" | High |
| Ecological | Ice jams & flooding along the Mohawk River | Implement Adaptive Preservation plan in the historic Stockade District as outlined in the 2019 FEMA Stockade Resilience Study. Invest in live monitoring along the Mohawk River. | Development, Engineering, Mayor's Office, DHSES/FEMA | High |
| Ecological | Significant flooding | Restore wetland areas, restrict development adjacent to flood prone areas, increase permeable surface requirements and preserve natural ecosystems. | Development, Engineering | Medium |
| Ecological | Low diversity and fair to poor health conditions. Limited tree canopies in LMI neighborhoods | Conduct a full assessment of trees in the city; create a comprehensive Tree Maintenance Plan to maintain existing trees and plant new, more resilient, and non-invasive ones | Development Dept., DEC | Medium |
| Ecological | Certain plants and animal species may be at risk with rising temperatures | Inventory vulnerable species of plants and animals in the city; create a plan to study and protect the habitat of these species | Local community/grassroots organizations in partnership with City | Medium |
| Ecological | Invasive species will become more prevalent with rising winter temperatures and cause more destruction to existing species | Develop and implement invasive species management plan | Parks Dept. SCEAC | Low |
| Public Health | High heat days and heat related death or illness | Increase number of cooling centers and making sure they are in every neighborhood | Fire Dept. | High |
| Public Health | Poor air quality - disproportionately impacting LMI neighborhoods | Monitor air quality and make public data to inform people | Mayor's Office | High |
| Public Health | Vector Born Disease | Develop policy to handle possible increases in disease and/or infection | Mayor, Emergency Response Team | Medium |

| Asset Category | Vulnerabilities | Proposed Adaptation/Mitigation Strategy | Responsible Entity | Priority |
|---|---|---|---|---|
| Public Health | Limited healthy and local food choices available | Build grocery stores in LMI areas. Promote local small-scale urban agriculture and CSAs/Farmer's Markets | Development, Golub Corp., SICM, Electric City Food Coop, City Mission | Medium |
| Public Health | Potential risk to water supply | Drought restrictions on water use; provide educational resources to public on water conservation | Water Dept., Fire Dept., DEC | Low |
| Socioeconomic | Social vulnerability (CDC) | Prioritize climate mitigation and adaptation efforts in areas that are most socially vulnerable | All Departments | High |
| Socioeconomic | Economic vulnerability | Increase access to jobs training focused on green building | Affirmative Action, Development | Low |
| Environmental Justice | Brownfield remediation | Create map and inventory of local sites; form economic partnerships with community groups to fund brownfield redevelopment | Development, Metroplex, DEC | High |
| Environmental Justice | Proximity to commercial and industrial sites | Zoning reforms including increase in the number of multi-family homes allowed in the city | Development Dept. | High |
| Environmental Justice | Inefficient residential building energy systems | Provide energy education workshops. Share available resources for energy retrofits and weatherization programs offered by third parties | Buildings Dept., Development | High |
| Environmental Justice | Limited access to green spaces | Increase funding toward gardens and parks in LMI (socially and economically disadvantaged) neighborhoods; repurpose vacant lots | Development Dept., DEC | Low |

# Appendix

## References

Albany Pinebush Preserve Commission. “Complete 2017 Management Update for the Albany Pinebush Preserve.” Technical Report, 2017.

Bornstein, R.D. “Observations of the Urban Heat Island Effect in New York City.” *Journal of Applied Meteorology* 7 (1968): 575–582.

Brody, S.D., et al. “Examining the Relationship Between Physical Vulnerability and Public Perceptions of Global Climate Change in the United States.” *Environment and Behavior* 40.1 (2008): 72-95.

Brooks, N. “Vulnerability, risk and adaptation: A conceptual framework.” Tyndall Centre Working Paper 38, September 2003.

Buell, Bill. “Streams of Subconsciousness.” *Schenectady Gazette*. August 19, 2003.

Capital District Regional Planning Commission (CDRPC), Capital Region Chamber, The Community Foundation for the Greater Capital Region, Capital District Transportation Committee (CDTC). Capital Region Community Indicators - Schenectady. 2018. https://www.capitalregionindicators.org/profile/3665508.

Centers for Disease Control (CDC). CDC Social Vulnerability Index. September 15, 2020. https://www.atsdr.cdc.gov/placeandhealth/svi/index.html.

City of Schenectady. Stockade Comprehensive Mitigation Analysis & Technical Feasibility Assessment and Engineering Design. December 31, 2019.

Davey Resource Group. “Tree Master Plan for the City of Schenectady.” Technical Report, 2003.

Department of Environmental Conservation (DEC). Nuisance & Invasive Species. n.d. https://www.dec.ny.gov/animals/265.html.

Schenectady County Heat-Health Profile Report. Developed by New York State Department of Health, Center for Environmental Health. 2019. https://www.health.ny.gov/environmental/weather/profiles/docs/schenectady.pdf

DiNapoli, T. P. “The Prevalence and Cost of Asthma in New York State.” Technical Report, 2014. https://www.osc.state.ny.us/files/reports/special-topics/pdf/health-asthma-2014.pdf

Federal Emergency Management Agency (FEMA). OpenFEMA. 2020. https://www.fema.gov/about/reports-and-data/openfema.

Lutz, W., Muttarak, R., and Striessnig, E. “Universal education is key to enhanced climate adaptation.” *Science Magazine* 346, 6213 (2014): 1061-1062.

Haluza-DeLay, R. “Educating for Environmental Justice.” *International Handbook on Environmental Education Research*, edited by M. Brody, J. Dillon, R. Stevenson, A. Wals, London: Rutledge, 2013, pp. 394-402.

HCDINY (Healthy Capital District Initiative New York). Schenectady County Data Resources. 2019. http://www.hcdiny.org/tiles/index/display?alias=Schenectady

HCDINY (Healthy Capital District Initiative New York). Health Equity Report. February, 2018. Health equity report.

Hoffman, A. et al.“A Mixed-Motive Perspective on the Economics Versus Environment Debate.” Institute for Policy Research at Northwestern University, IPR working papers (1999): 1255-1276.

Hugo, G. “Migration, Development, the Environment.” Draft paper for Research Workshop on Migration and the Environment: Developing a Global Research Agenda, Munich, Germany, April 2018.

IPCC. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* edited by Core Writing Team, R.K. Pachauri and L.A. Meyer. IPCC, Geneva, Switzerland, 2014. 151 pp.

NOAA. National Weather Service Forecast Office - Schenectady. 2020. https://www.weather.gov/.

NYSERDA. “Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State.” Technical Report, 2011.

NYSERDA. “Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State.” Technical Report, 2014.

Rosenzweig, C. and Soleck, W. “Introduction to Climate Change Adaptation in New York City: Building a Risk Management Response.” *Annals of the New York Academy of Sciences* 1196 (2010): 13-17.

Schenectady County. “Schenectady County Multi- Jurisdictional Hazard Mitigation Plan Update.” Technical Report, 2016.

Schenectady County Department of Public Works. Schenectady County Phase II Stormwater Management Program. n.d. https://www.schenectadycounty.com/node/226.

Schenectady County Department of Economic Development and Planning. Great Flats Aquifer. n.d. https://www.schenectadycounty.com/node/224

SCPH (Schenectady County Public Health Services). 2019-2021 collaborative Community Health Needs Assessment (CHNA), Implementation Strategy (IS), Community Health Improvement Plan (CHIP), and Community Service Plan (CSP) for Schenectady County and its Hospitals. October 1, 2019. http://ellismedicine.org/pdf/2019SchenectadyCHNAISCHIPCSPincludingHCDICHNA.pdf

Semenza, J.C. et al. “Public Perception of Climate Change.” American Journal of Preventive Medicine 35.5 (2008): 479-487.

U.S. Energy Information Administration (EIA). Electric Power Annual. October 21, 2020. https://www.eia.gov/electricity/annual/.

U.S. Energy Information Administration (EIA). TOTAL ENERGY. 2020. https://www.eia.gov/totalenergy/data/browser/index.php?tbl=T01.10#/?f=A

U.S. Environmental Protection Agency (EPA). Power Profiler. 2020. https://www.epa.gov/egrid/power-profiler#/NYUP.

Water Environment Research Foundation (WERF). “Implications of Climate Change for Adaptation by Wastewater and Stormwater Agencies.” Technical Report, 2009.

Zahran, S. et al. "Social vulnerability and the natural and built environment: a model of flood casualties in Texas." *Disasters* 32.4 (2008): 537-560.