City of Canandaigua
Natural Resources Inventory
November 2021

Prepared by GreenHows Consulting & Impact Earth
Prepared for the City of Canandaigua Climate Smart Communities Committee

TABLE OF CONTENTS

SECTION 1: EXECUTIVE SUMMARY

Overview

Climate Smart Communities (CSC) is a New York State program that helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. Benefits include leadership recognition, free technical assistance, and access to grants. The CSC program includes two designations- Registered and Certified. Registered communities have made a commitment to act by passing legislation and formally taking the CSC pledge. Certified (Bronze or Silver, Gold being developed) communities are the foremost leaders in the State; they have gone beyond the CSC pledge by completing and documenting a suite of actions that mitigate and adapt to climate change at the local level.

On April 23, 2019, the City of Canandaigua was designated as a Bronze Certified Climate Smart Community by the New York State Department of Environmental Conservation (NYSDEC), making it only the 23rd municipality in the State to receive certification. Unlike other certified communities, however, the action items that ultimately earned them the recognition were not done as part of the CSC Program. While other communities followed the prescribed path outlined by the CSC program, the City of Canandaigua's certification is the culmination of all the work done by the City over the last decade. One of the explicitly stated goals in their Strategic Plan is Environmental Stewardship, which includes promoting practices that conserve our natural resources, taking a leadership role in the utilization of alternative energy sources, and reducing the City's impact on the environment. However, because the City of Canandaigua has been proactively addressing climate change and taking steps towards creating a more sustainable community for quite some time, they earned the certification without establishing the critical benchmarks other certified municipalities have used to guide future actions. These baselines and inventories must be completed so the City can pursue Silver Certification successfully. Within this project, the City aimed at completing the following action items:

- PE2 Action: Government Operations Greenhouse Gas Inventory - PE2 Action: Community Greenhouse Gas Inventory
- PE6 Action: Natural Resources Inventory
- PE7 Action: Climate Vulnerability Assessment

Following the successful completion of the Greenhouse Gas Inventories, the City has moved on to completing their Natural Resources Inventory.

Welcome to the City of Canandaigua's Natural Resources Inventory Report. This living document serves as a wide-reaching inventory of all the natural resources within the City of Canandaigua, providing the City and it's future with a baseline of information and documentation to best prepare for the City's continued planning and development. Within this document, the team researched and collected as much information as was publicly available at the time to provide a

real-time list, for lack of a better term, of natural resources that hold value for the City, including cultural, environmental, and social resources that exist within the City, and that the team believes could have an impact on future planning and development. The purpose of this NRI is to identify these resources, but then also identify potential risks that should be taken into account as the City continues to grow and develop within their path, and how potential risks from climate change could also impact these resources.

The City of Canandaigua has a history of being a fierce advocate for it's largest natural resource, Canandaigua Lake, and continues down the path of advocacy and sustainable planning when it comes to preserving and conserving it's natural resources and great history. Not covered in this report are the many current projects that the City is undertaking to get ahead of some of the threats within the City, including flood protection, retention ponds, restoration projects, and invasive species prevention/adaptation. While not recorded in this report, it is important to note that these projects are ongoing and that this report exists to provide the City with a baseline of natural resources information to consider for future projects. This report and its findings also are key to the next part of the City's CSC project, the Climate Vulnerability Assessment - which is to be completed before the end of 2021.

Why Inventory Natural Resources?

"Land-use planning is instrumental to balancing future growth and development with the protection of natural resources. Although municipalities frequently need to make decisions affecting these resources, they often don't have adequate data available to inform those decisions. Often they find themselves reacting to proposed development rather than planning for future growth, or making decisions on development projects without considering the larger context. This narrow approach to decision-making loses sight of broader-scale issues and goals, such as climate resilience, walkable communities, connected habitats, or watershed management.

By identifying and describing natural resources at the local scale, a natural resources inventory (NRI) provides communities with a strong foundation for proactive planning and informed decision-making. The process encourages participation in identifying and prioritizing natural resources important to the community, and provides information that will support careful land-use planning and improved resource protection measures. And by incorporating natural resources into every level of decision -making and planning, municipalities can make a meaningful contribution toward preserving the natural heritage of the region, and can ensure that healthy, resilient ecosystems—and the benefits they provide—are available to their communities for future generations."[1]

[1] Haeckel, Ingrid, and Laura Heady. Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed. (Ithaca, NY: Department of Natural Resources, Cornell University, and New York State Department of Environmental Conservation, 2014): https://www.dec.ny.gov/lands/100925.html

What is a Natural Resources Inventory (NRI)?

"A natural resources inventory (NRI) compiles and describes important, naturally occurring resources within a given locality (e.g., municipality, watershed, or region). Cultural resources, such as historic, scenic, and recreational resources, are often included in an NRI, as well. The inventory has two basic purposes: 1) to provide the building blocks for comprehensive land-use and conservation planning, and 2) to allow natural resource information to be included in local planning and zoning. The scope of the NRI is determined by the community. At its simplest, an NRI is the compilation and description of existing natural resources data. At its most complex, it includes detailed analysis of resources or new data collected specifically for the inventory. An NRI is not a static document. As new and revised data become available, the inventory should be updated to insure its completeness and accuracy.

Until an inventory has been conducted, many communities don't have a clear picture of where their natural (and cultural) resources are located, which resources are significant to the community, and why. The compilation of map data tables and descriptions in an NRI contribute to a better understanding and appreciation of the community's natural resources and provide the foundation for a wide range of planning and conservation applications."[2]

How to Use This Inventory

This Natural Resources Inventory should be a valuable reference for City officials, interested community and watershed groups, industry, developers, business owners and residents. The maps in this inventory provide a general representation of the City's natural and cultural resources, the connections between them, and how they relate to patterns of land use and development in the community. They clearly illustrate how nature transcends political and private boundaries. By depicting resources at the townwide scale and beyond, these maps help us understand the larger context of our Town's resources, and can be used to help evaluate the potential impacts of our land-use decisions not only on our own community but also on neighboring municipalities and ecosystems.

According to the NYS DEC's Hudson River Estuary Program, this NRI can be used to:

- "Educate residents and developers about important resources occurring in the City,
- "Understand the resources occurring on or near a property to inform stewardship,
- "Evaluate potential impacts of proposed actions during routine environmental reviews,
- "Update the natural resources section of the City comprehensive plan,
- "Inform municipal open space planning"

[2] Haeckel, Ingrid, and Laura Heady. Creating a Natural Resources Inventory: A Guide for Communities in the Hudson River Estuary Watershed. (Ithaca, NY: Department of Natural Resources, Cornell University, and New York State Department of Environmental Conservation, 2014): https://www.dec.ny.gov/lands/100925.html

- “Review and update existing zoning and subdivision regulations,
- “Designate Critical Environmental Areas, and
- “Inform development of new local policies and environmental review procedures.”

We hope that this document serves as a living resource for the City and all of its future planning, protection, and development.

SECTION 2: INTRODUCTION

Goals

At the heart of the Finger Lakes are the lakes and the watersheds that contribute to them. The City of Canandaigua is on the north shore of one of these beautiful lakes, Canandaigua Lake. It provides the City and surrounding communities with potable water, scenic views, recreational opportunities and is an economic engine by attracting people from all over to visit. Protecting this natural resource has been and will always be a community goal and something the City and its partner communities within its watershed will always have a focus on.

In addition, the City has always strived towards being more environmentally sustainable, not only to better serve our community, but to lead by example by implementing sound innovative projects that work economically and environmentally.

As such, the City is pursuing the development of a natural resources inventory to gain a baseline, continue to learn more and hopefully gain some insights as to what other projects might be worth pursuing.

Data and Methods

This Natural Resources Inventory was mainly compiled by a team of consultants and researchers working with Impact Earth and GreenHows Consulting. This team also worked in collaboration with the City's Climate Smart Communities committee during the development of this inventory report.

Composed of a primary mapping component and accompanied by supporting text, this inventory catalogues a broad variety of existing scientific data. In order to produce a useful document for municipal decision-makers and community residents in a timely and affordable manner, the authors and the City's CSC Committee agreed to restrict data gathering to the geographical boundaries of the City as well as to only record the natural resources listed in the Hudson River Estuary Program's NRI Guidebook, previously referenced above. Because the City had recently completed a Comprehensive Plan, it was decided early on that much of the existing mapping and resources gathered for that plan would provide a sufficient and cost-effective foundation for this NRI, which could be complemented by and lead to future and more-detailed local studies.

The NRI was completed between August 2021 and November 2021.

Most maps were produced or collected from other existing scientific data reports, with the exceptions referenced in the report. Information provided by the maps can be enhanced by local knowledge, and the NRI should be updated at least every 10 years as new data becomes

available. This NRI report incorporates relevant descriptions of resources depicted in each map. This NRI report used other local comparable NYS city/town NRI reports as general guides for map layers, narratives, and report format.

The text of this NRI was largely written by two consultants for the project from GreenHows Consulting and Impact Earth (Cassidy Putney and Abigael Rice) and was edited by the consulting team. A copy of the draft of this report was also provided to the City's CSC Committee and considered edits and feedback from their group as well. Thanks to much guidance from the CSC Committee, the existing Comprehensive Plan and the City's Manager, John Goodwin, this NRI was compiled in a short timeframe to meet the project's timeline goals.

*Current Observed Weather in Canandaigua**
*Prepared for the City of Canandaigua's Climate Vulnerability Assessment Report, 2021

Global and Regional Climate

According to the IPCC report (AR5) completed in 2014[3] and one of their most recent reports completed in 2021[4] confirms that human activity is the leading contribution to the warming global climate, increases in GHG emissions since 1750, changes in precipitation patterns (2021). "It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred "[2]. Also according to the IPCC, the last four decades has become warmer than any decade that preceded it since 1850 and the "likely" total human-caused global surface temperature has risen from 0.8 to 1.3 degree celsius (with a best estimate of 1.07 degree celsius from the periods 1850–1900 to 2010–2019[2].

According to the IPCC[1], climate change impacts are occurring now and additional ones highly likely in the future. In New York State, the average annual temperature has risen 2.4℉ since 1970 and annual precipitation has shifted to fall primarily during the winter rather than summer.[5] The Nature Conservancy in New York estimates that temperatures will increase by an addition 5℉ by the end of the century. As global temperatures rise, and precipitation patterns change, sea levels are predicted to rise one to three feet, putting the major coastal cities in the state at risk. Concurrently, rising temperatures in New York State will increase evaporation rates causing Lake Erie and Ontario to experience a decrease in water level.[6]

In New York, hurricanes have increased in frequency and severity in the area. In 2011, Hurricane Irene caused the destruction of roads and bridges, knocked out power, and forced many to

[3] IPCC report (AR5), 2014
[4] IPCC, *AR6 Climate Change 2021: The Physical Science Basis* https://www.ipcc.ch/report/ar6/wg1/#SPM
[5] https://www.dec.ny.gov/energy/94702.html
[6] https://www.nature.org/media/initiatives/new_york_factsheet_5.pdf

evacuate. While Hurricanes are not an immediate threat to the City of Canandaigua and other communities in the Finger lakes region, the region would be impacted by the associated precipitation and winds. According to the NYS Climaid Report, precipitation is projected to increase steadily across New York: 1-8% by the 2020s, 3-12% by the 2050s, and 4-15% by the 2080[7]. Ice cover on Lake Ontario has decreased below average and remained under 30% coverage since 2006 with the only exception being the 2013-2014 winter.[8]

These changes have caused seasonal changes such as spring starting approximately a week earlier than in the 1950's. Migrating animals are returning to the area earlier in the year, and breeding ranges for animals are shifting northward.[9]

Local Climate

The National Oceanic and Atmospheric Administration (NOAA) weather monitoring station 'Canandaigua 3 S, NY US' was established December 01, 1942. This is the closest weather station and is technically located in the Town of Canandaigua on the east side of Canandaigua Lake (42.84505°, -77.28071°). However, consistent data wasn't produced until the spring of 1944. Using available data from this station's record, Figures 1 through 6 were developed. There was no 'snow' data available for the years 1964-2014 as reported values were either '0' or '-9999' signifying an error and assumed to be zero for the purpose of this report.

For this section, winter is assumed to be October-March and summer April-September.

Winter temperatures

As shown in Figure 1, over the last 80 years, average winter minimum and maximum temperatures have fluctuated as a result of climate change. Most notably is the year-to-year variability in both average highs and average lows. From 1944 to 1988, year-to-year differences in temperature ranged from 2-5 degrees, with few exceptions. Beginning in 1988, however, more drastic year-to-year swings have been observed with 7-9 degree differences.

Also shown in Figure 1, in the early 1980s there's an observable increase in average temperature. Between 1944 and 1983, there are two years in which the average low was nearly 30℉. Between 1983 and 2020, there are eight winters in which the average low was near or greater than 30℉. Similarly, prior to 1983, approximately eleven of the coldest winter days were below -10℉ while there were only three such days between 1983 and 2020 (See Figure 2).

[7] NYS Climaid Report, 2014
[8] NOAA NCEI and NOAA Great Lakes Environmental Research Laboratory.
[9] https://www.dec.ny.gov/energy/94702.html

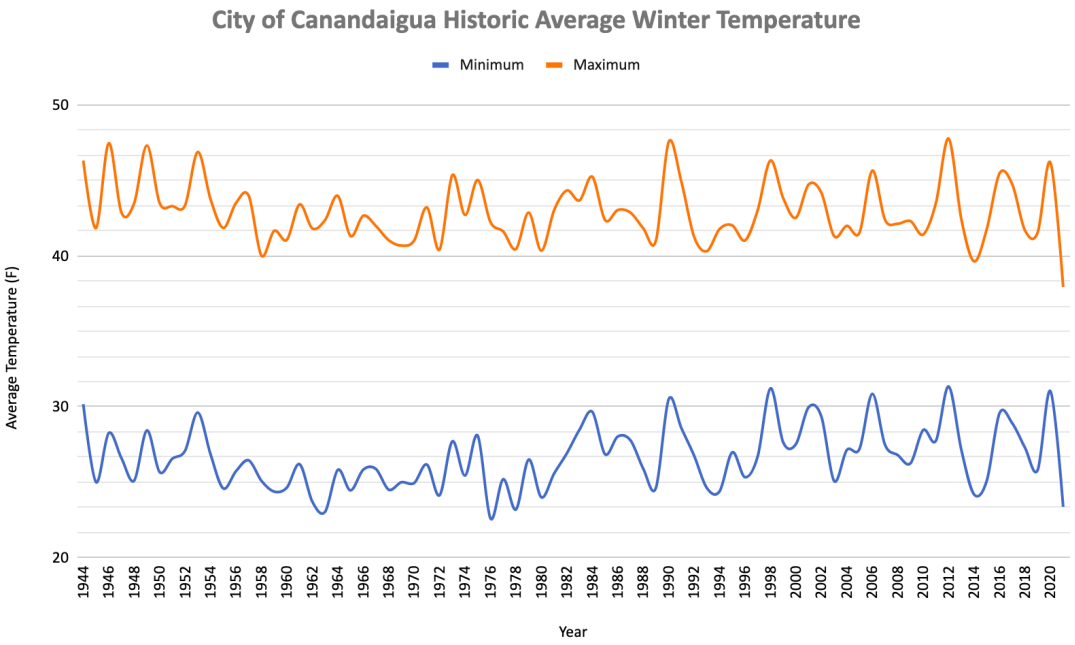


Figure 1: Local Historic Average Winter Temperatures 1944 to 2020

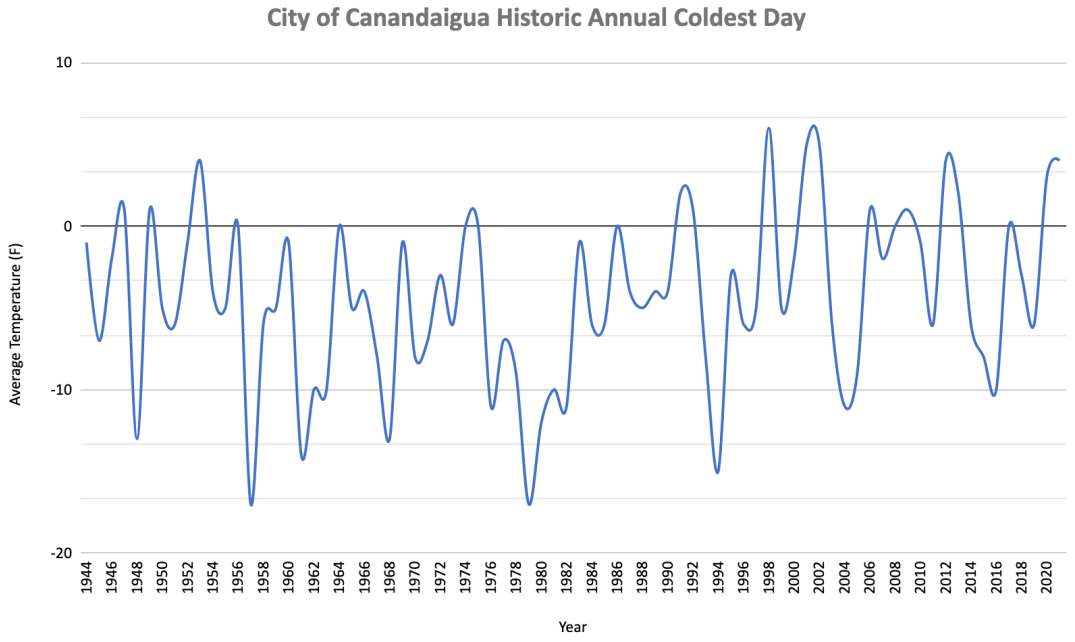


Figure 2: Local Historic Annual Coldest Day Temperature 1944 to 2020

Summer temperatures

As shown in Figure 3, average summer high temperatures have remained consistently between 70℉ and 75℉. However, the average low temperature has steadily increased over the eighty years. In the mid 1900's, summer low temperatures averaged between 48℉ and 56℉. Since 1977, only 1991 saw an average below 50℉, with all other years ranging from 52℉ to 55℉. Since 1999, the coolest averages were 54℉. Based on this data, we see a trend in warming temperatures affecting the City of Canandaigua.

As shown in Figure 4, average summer high temperatures have remained consistent for much of the last eighty years. Before 2000, six summers had an average high temperature at or below 88℉ and only one summer has an average high temperature near 100℉. Since 2000, every summer has been warmer than 88℉ and two warmer than 100℉.

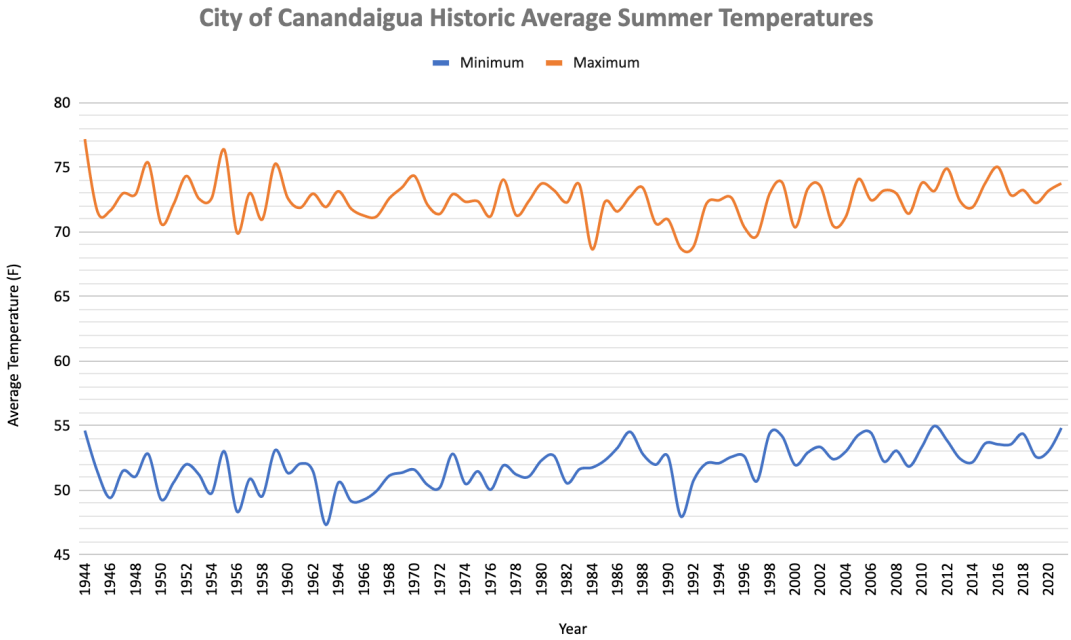


Figure 3: Historic Summer Temperatures 1944 to 2020

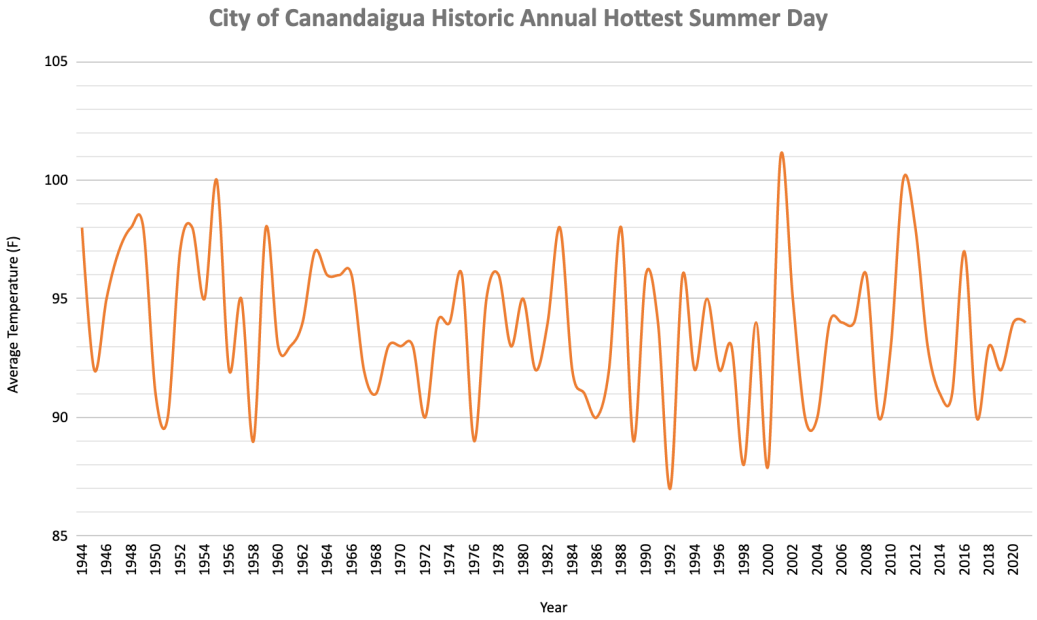


Figure 4: Annual Hottest Summer Day 1944 to 2020

Seasonal precipitation

Climate change has especially affected precipitation in the City of Canandaigua. While data for snowfall between 1963 and 2009 is unavailable, the data from years prior and after shows a clear decrease in snowfall throughout the year and an increase in precipitation, excluding snow, during the summer (See Figure 5). From 1946 to 1963, snowfall ranged from twenty-eighty inches to as much as eighty inches. Most years during this timeframe saw between fifty and sixty inches of snow during the winter. After 2009, snowfall during the winter drastically decreased, with the maximum snowfall in one winter being just thirty-six total inches, with all other years being at or below twenty-four inches.

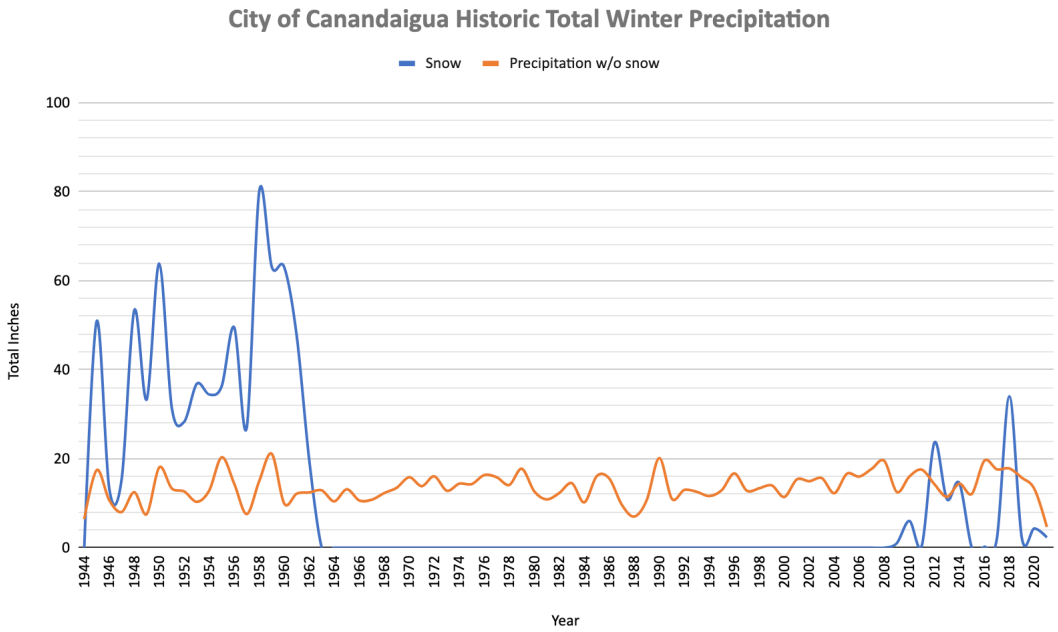


Figure 5: Annual Total Winter Precipitation 1994 to 2020.
Snowfall data is not available from 1963 to 2009.

As shown in Figure 6, late spring and early fall snowfall has also decreased, with regular snowfall accumulating to as much as 5 inches in the 1940's to just two inches in 2016 and 2020. During summer months, annual precipitation excluding snowfall has increased significantly. Before 1984, the average daily precipitation was approximately 0.08 inches with only 7 years receiving more than twenty inches of precipitation and just one year receiving more than twenty-five inches After 1984, this average increased to 0.09 inches with 17 years receiving more than 20 inches and 7 years receiving more than 25 inches.

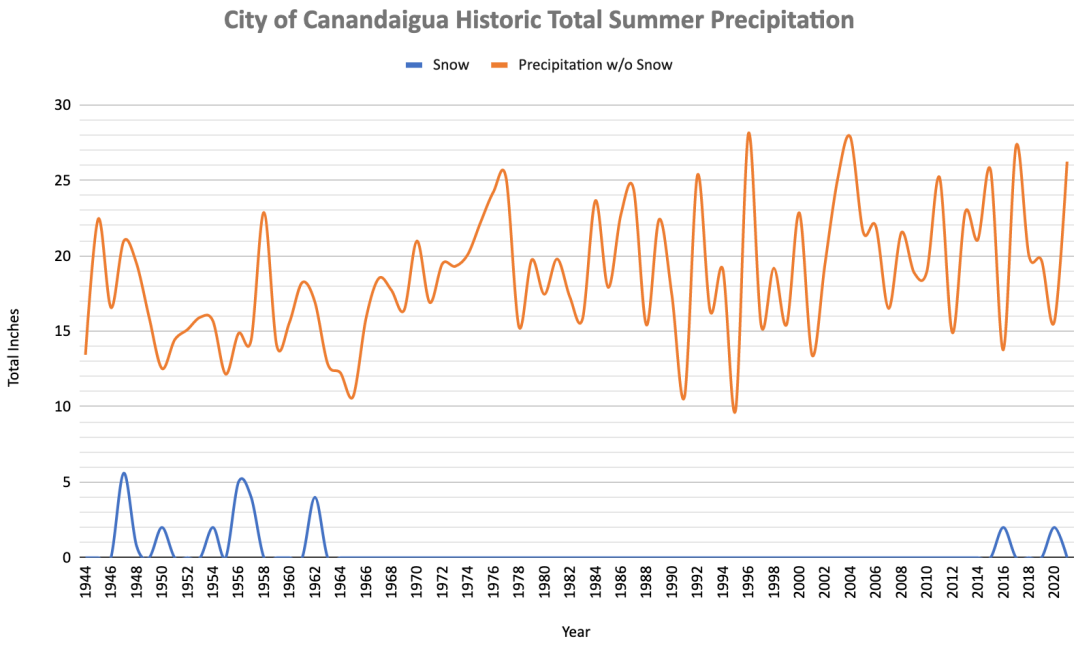
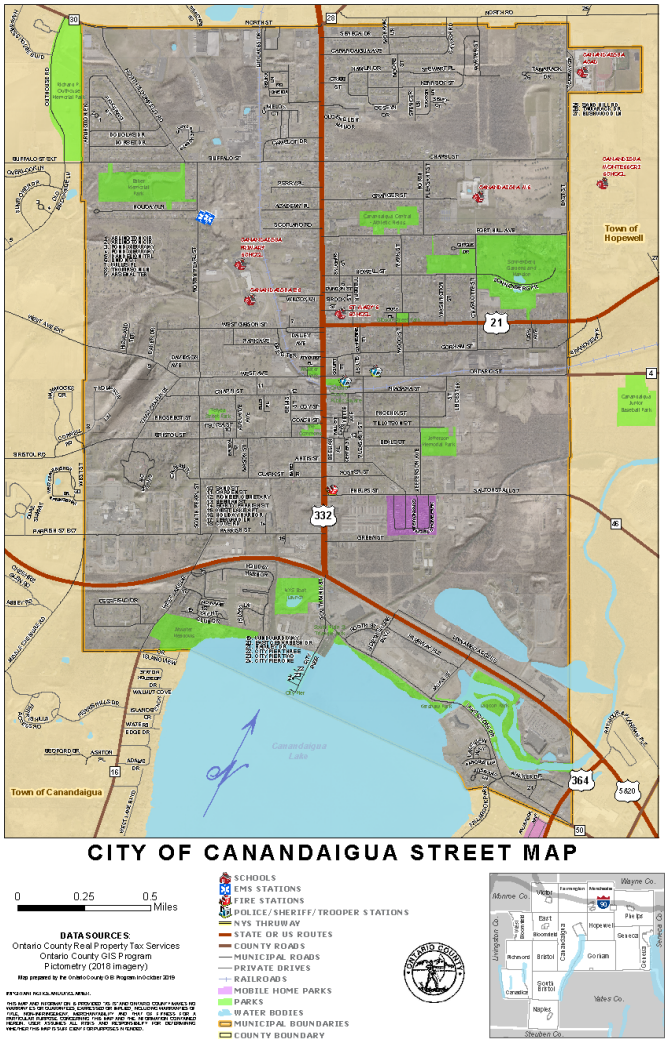


Figure 6: Total Summer Precipitation: 1944 to 2020. Snowfall data is not available from 1963 to 2009.

Summary of Climate Hazards

Based on the data from the weather station over the past 80 years, the City of Canandaigua is experiencing more extreme temperature swings and a trend in warming temperatures. Furthermore, these trends are resulting in less snowfall accumulation throughout the year and increasing amounts of precipitation not related to snowfall. At the state level, concentrations of GHG emissions will continue to contribute to significant increases in the frequency, intensity, and duration of extreme heat events, and overall the region will likely continue to experience frequent Intense precipitation events and less frequent outbreaks of cold air. These climate hazards will pose uncertain challenges to both the City and State level.

BASE MAP



MAP B1: City of Canandaigua Street Map[10]

The City of Canandaigua is located in the Finger Lakes Region of New York State in Ontario County. The City is surrounded by the Town of Canandaigua and the southern end of the city sits on Canandaigua Lake, one of the eleven Finger Lakes. Seen in Table B1, the city's population has decreased by 1% in the past 10 years.

[10] County and Community Maps; community roads map city of canandaigua. *Ontario County New York.* Accessed on September 25, 2021 County-and-Municipal-Maps

	2010 Census	2019 Census	Population Change (%)
City of Canandaigua	10,591	10,576	-1%

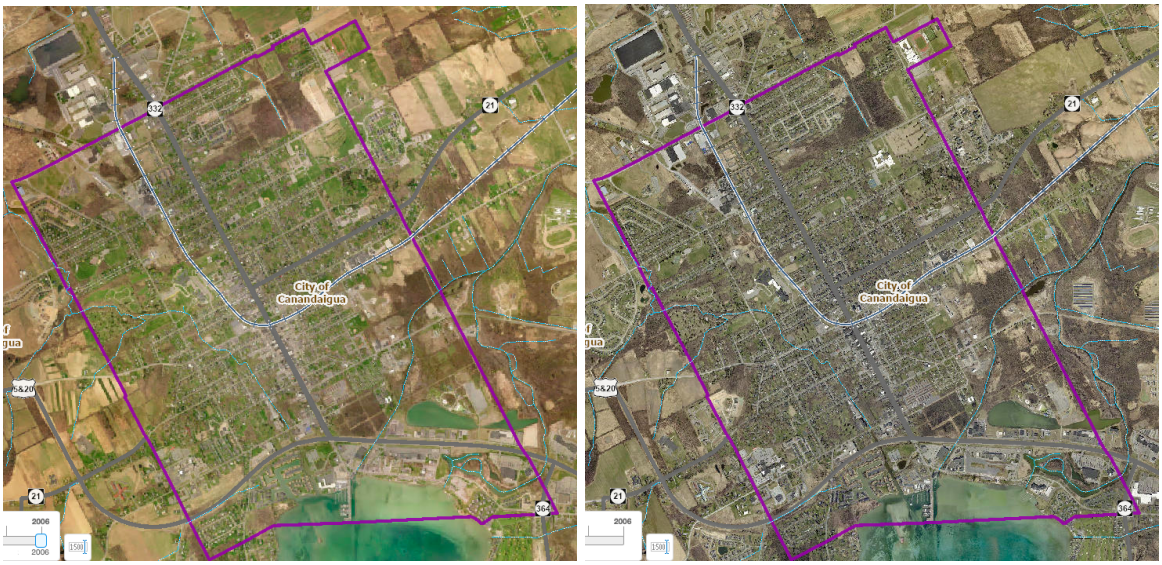
TABLE B1 City of Canandaigua Population Growth from 2010 to 2020, *US Census Bureau*. Accessed on September 25, 2021 INC110219

The City of Canandaigua is at the North end of Canandaigua Lake. There are two watersheds within the city limits, the Canandaigua lake watershed and the Canandaigua Outlet watershed. The Canandaigua Outlet watershed transports water out of the lake into the Erie canal and eventually into the Great Lakes. The city controls two flood channels in the Canandaigua Outlet watershed. The Canandaigua lake watershed transports water into the lake through hundreds of tributaries surrounding the lake. A current emerging threat to the city is flooding near the lake and the flood channels. Flooding puts 20% of the city's properties at risk[11].

MAP B2: Watershed Map, Ontario County GIS, September 25, 2021

[11] Canandaigua, New York. *Flood Factor.* Accessed on September 25, 2021 3612144_fsid

The City has also experienced land use change as population and tourism changes. The following maps show the development growth that the city has been undergoing since 2006. Previous farmland and open grassland, seen in the left hand image, is being developed into mainly residential neighborhoods as seen in the right hand image. A current emerging threat to the city is the loss of biodiversity. Habitat loss is caused by development and invasive species.



MAP B3: Land Use Changes 2006 to 2021 index.html

SECTION 3: GEOLOGY AND SOILS

OVERVIEW

Surficial geology

Surficial geology in the Finger Lakes Region of New York was heavily influenced by glacial activity. Ancient ice carved away at the earth in some locations and deposited materials in others. These "surface deposits in central New York date almost entirely from late Wisconsian time, an expansion of the ice sheet that began some 27,000 years ago and sublimated with maximum extent perhaps 20,000 years ago."[12]

The *Surficial Geologic Map of New York State: Finger Lakes Sheet* shows that the City of Canandaigua has a surface geology consisting primarily of Lacustrine silt and clay. The southwestern boundary of the City lays on a change in surficial geology where till may be found in some areas[13]. This till is classified as calcareous with a calcium carbonate equivalent ranging from 10-30 percent. This till contains free lime at depths of 1 ½ to 2 ½ feet[14].

Lacustrine silt and clay	Generally laminated clay and silt deposited in proglacial lakes, generally calcareous, potential land instability, thickness variable (up to 50 meters)
Till	Variable texture (e.g. clay, silt-clay, boulder clay), usually poorly sorted diamict, deposition beneath glacier ice, generally calcareous in northern part of map, relatively impermeable (loamy matrix), variable clast content - ranging from abundant well-rounded diverse lithologies in valley tills to relatively angular, more limited lithologies in upland tills, potential land instability on steep slopes, thickness variable (1-50 meters)

FIGURE GS1: Surficial Geologies Explanation (Cadwell and others, 1986)

The City of Canandaigua is primarily flat with little to gentle sloping across the region. Steep to extremely steep sloping does occur predominantly around man-made features such as roadways, and in areas of glacial deposition including moraines in the western region of the City.

The Finger Lakes Region is well known for agricultural abundance and soil fertility. The City of Canandaigua is no exception. The Surficial Geologic Map of New York, Map and Chart Series #40 shows the soils in the City of Canandaigua. The predominant soil texture is silt loam with silty clay loam and loam present throughout the City. These textures stem from numerous parent materials, so variety is seen within each of these textures.

---

[12] Cadwell, D.H., and others. "1986 Surficial Geologic Map of New York", *New York State Museum - Geological Survey*, Map and Chart Series #40. Accessed 15 November 2021. http://www.nysm.nysed.gov/common/nysm/files/surf_fingerlakes.jpg

[13] SAME AS 12

[14] Denny, Charles S., and Walter H. Lyford. "Surficial Geology and Soils of the Elmira - Williamsport Region, New York and Pennsylvania" *Geological Survey Professional Paper 379*. 1963. Accessed 15 November 2021. https://pubs.usgs.gov/pp/0379/report.pdf

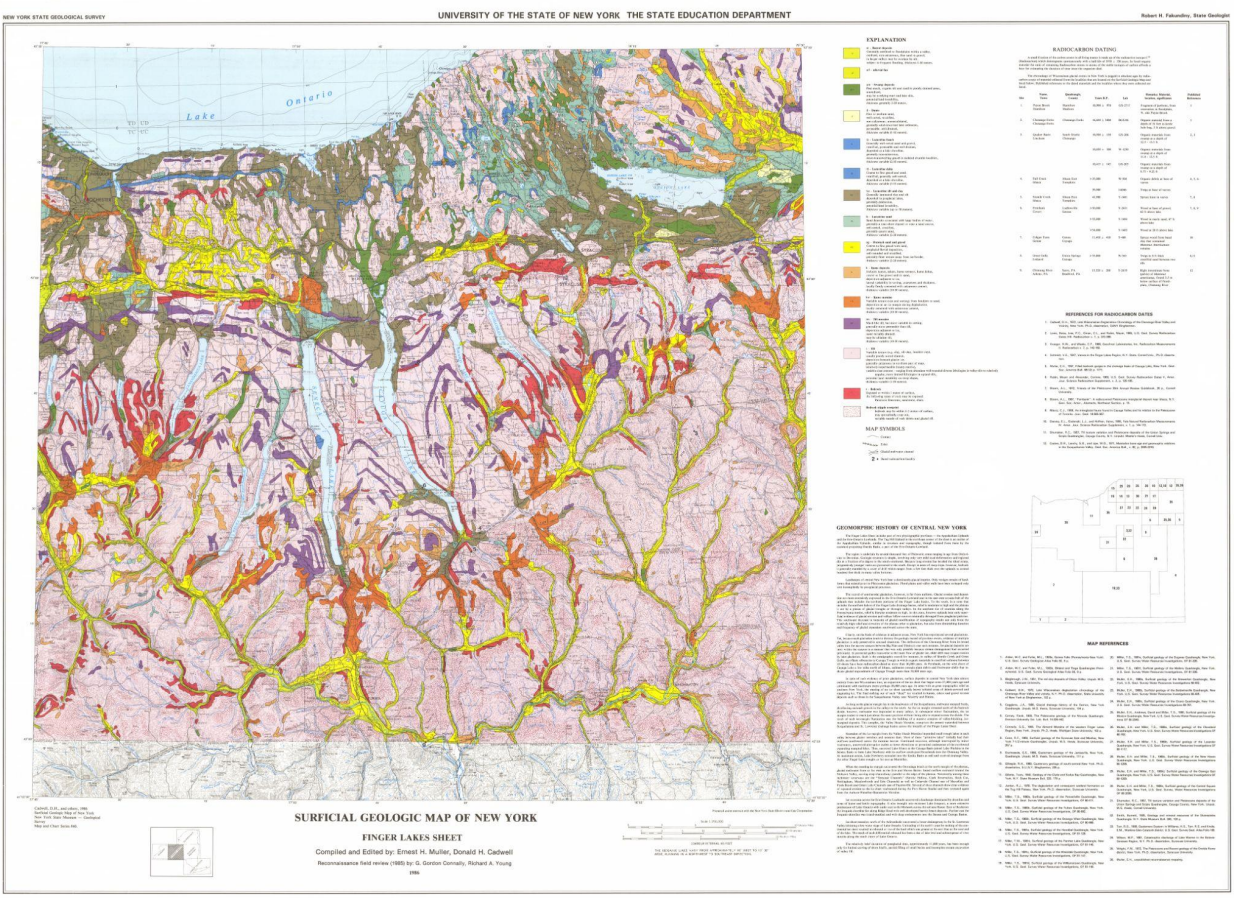


FIGURE GS1: Surficial Geology (Cadwell and others, 1986)

Bedrock geology

The *Geologic Map of New York: Finger Lakes Sheet* details the bedrock formations across the region. The predominant bedrock layer found in Canandaigua was formed in the Paleozoic Era, specifically the Middle Devonian Age. This layer, known as the Hamilton Group includes the Skaneateles Formation, made of Levanna Shale and Stafford Limestone Members. In the most western regions of the City of Canandaigua, bedrock may be the younger Ludlowville Formation, which is described as Deep Run Shale, and Tichenor Limestone, with Wanakah and Ledyard Shale Members, and Centerfield Limestone Members. These shale members lay on the northern extent of the Marcellus Shale Formation.

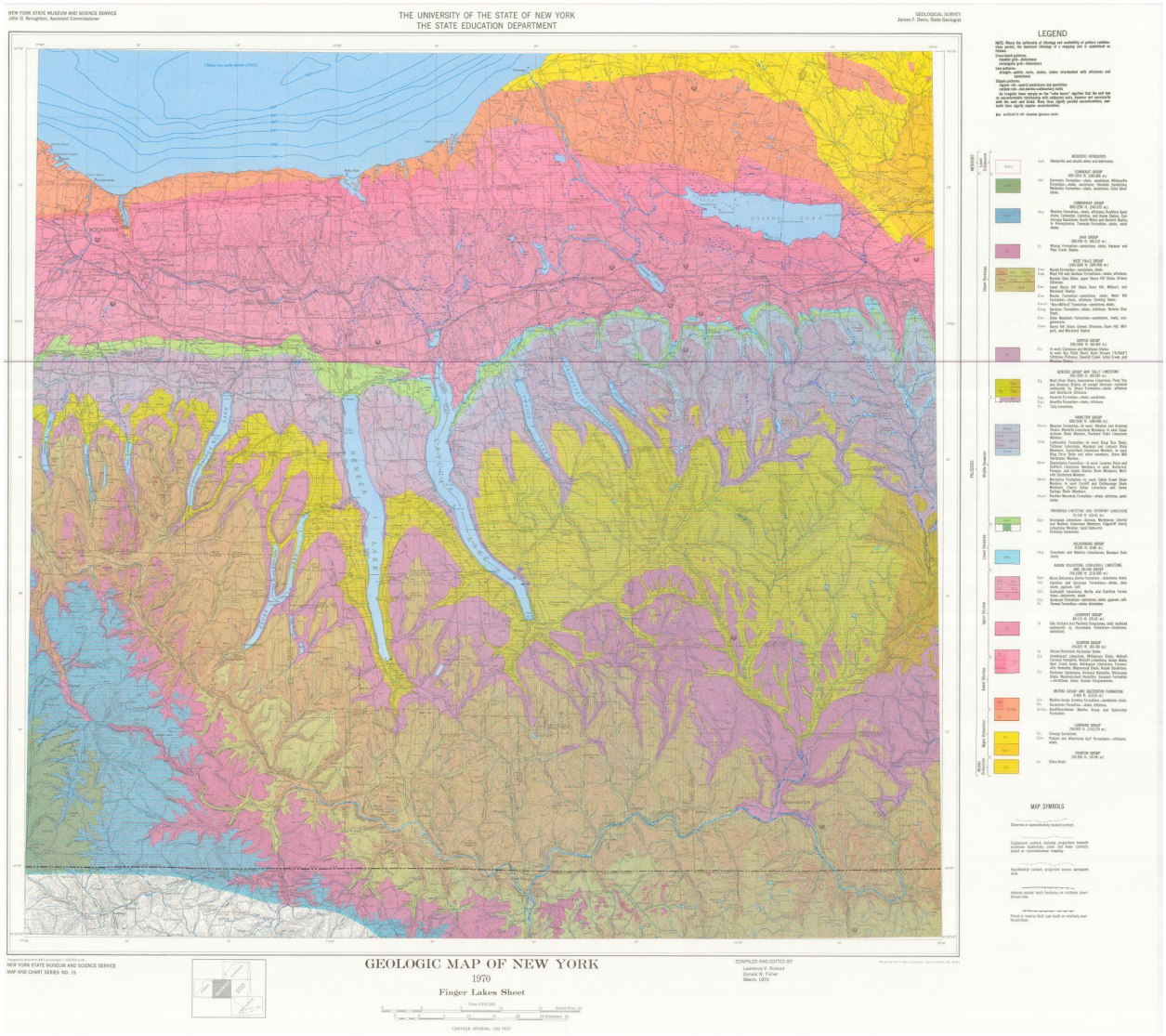
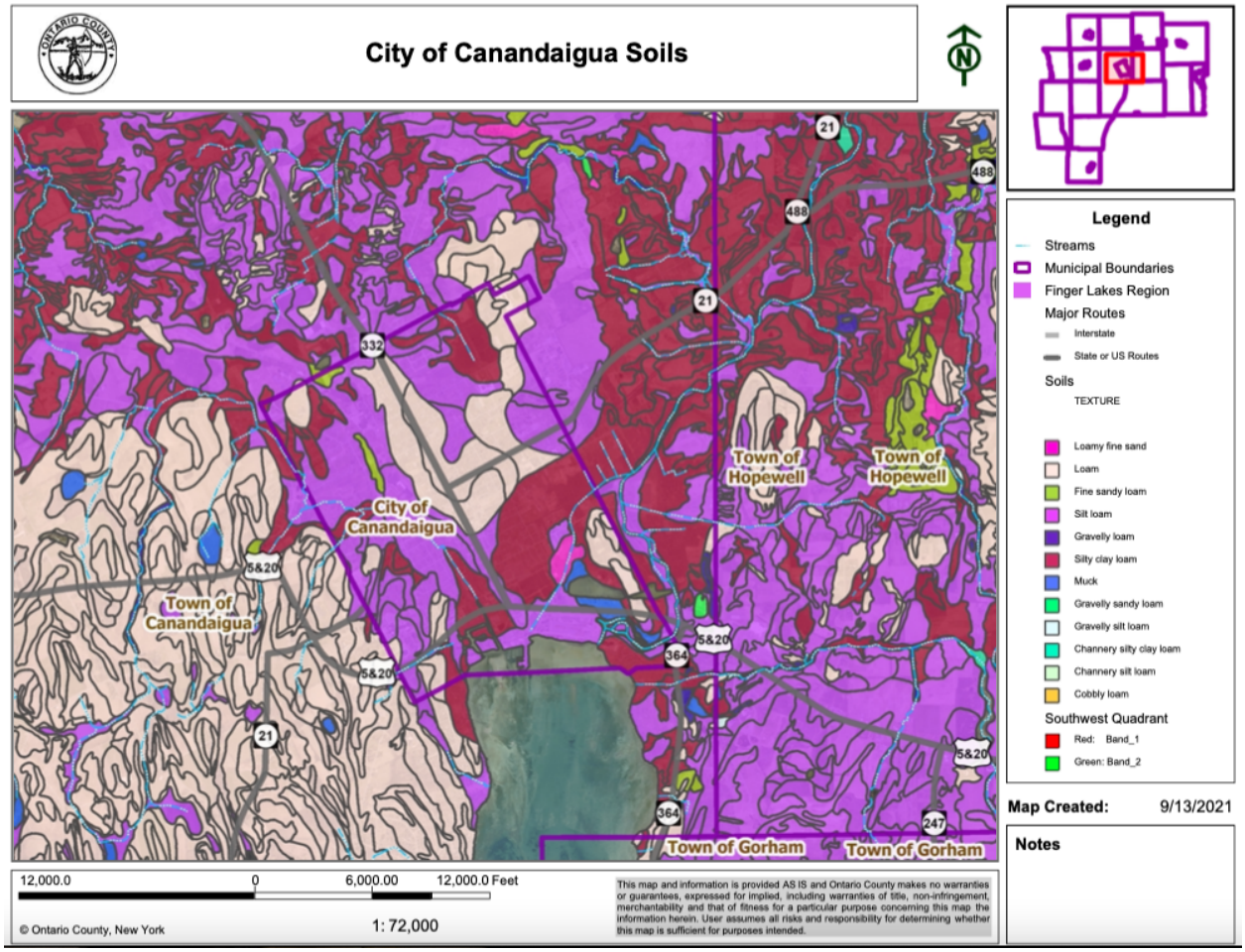


FIGURE GS2: Geologic Survey (Rickard and Fisher 1970)

Soil

Map GS1 shows the soils in the City of Canandaigua. The predominant soil texture is silt loam with silty clay loam and loam present throughout the City. These textures stem from numerous parent materials, so variety is seen within each of these textures.



MAP GS1: Soil, developed with Ontario County GIS on September, 13th, 2021

DEFINITIONS

Surficial Geology - The study of unconsolidated materials sitting above bedrock formed by erosion of the bedrock layer and decomposition of organic matter. Refers to soil horizons E, B, and C.

Bedrock Geology - The study of the solid layer of rock below unconsolidated materials. Refers to soil horizon R, and makes up the outermost layer of Earth's crust.

Soils - organic matter and minerals that support plant growth. Refers to soil horizons O and A.

Glacial activity - Growth and recession of glacial ice resulting in erosion, transportation and deposition of materials.

Soil Texture - Categorization of soil by particle size (diameter): clay (less than 0.002mm), silt (0.002mm - 0.05mm), and sand (0.05 mm to 2.0 mm).

Loam - One of twelve soil texture classes, or combinations of soil textures. Loam is considered an ideal combination of clay, silt, and sand for agriculture.

Hydrofracking - The fracturing of bedrock using high pressure liquid injection resulting in the removal of small pockets of natural gas known as tight gas.

Seismic Design Categories - Rating system of areas based on likelihood of experiencing earthquake shaking of various intensities.

IMPORTANCE

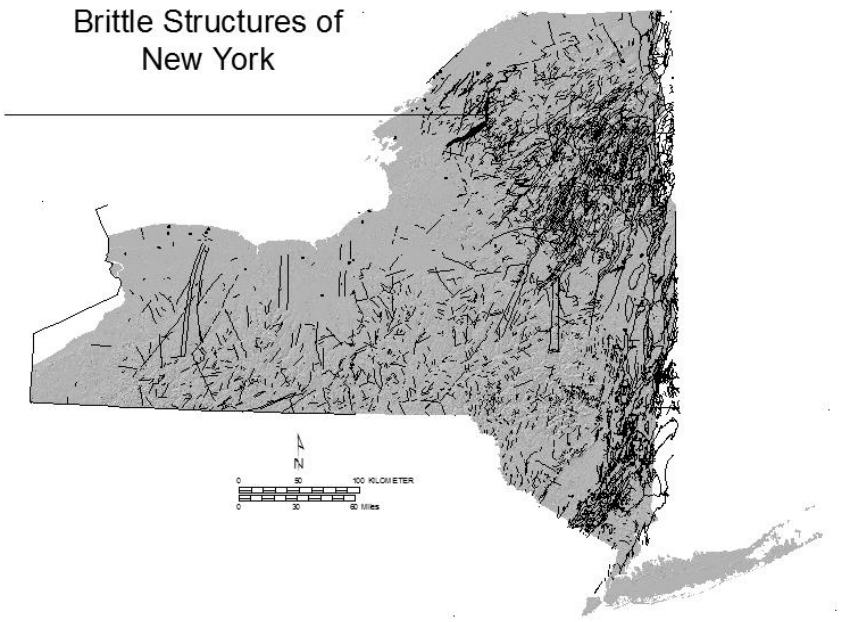
The surficial and bedrock geology within the City of Canandaigua may result in land instability.

The Marcellus Shale formation is commonly used for hydrofracking. Hydrofracking was banned in the City of Canandaigua in 2014. The unanimous vote prohibits "natural gas exploration and the storage, treatment or disposal of drilling wastewater disposal within city limits"[15].

[15] Orr, Steve. "Canandaigua Joins Fracking Ban" *Democrat and Chronicle.* June 6, 2014. Accessed 15 November 2021. https://www.democratandchronicle.com/story/news/2014/06/06/canandaigua-fracking-ban/10079289/

THREATS

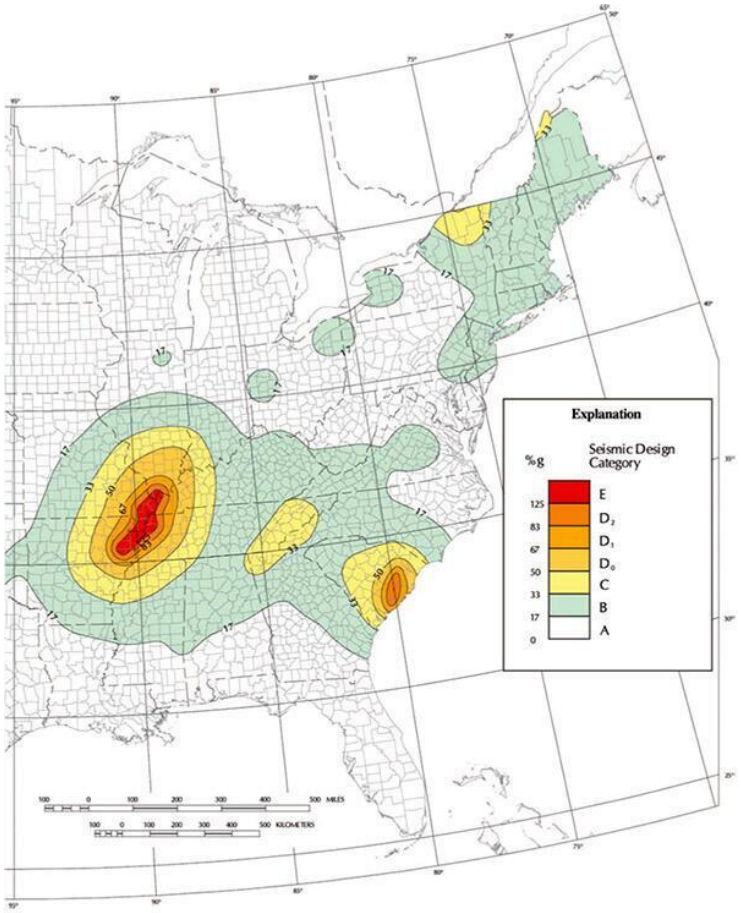
The City of Canandaigua is located within 30 miles of several brittle structures, or fault lines, as seen on Map GS2. FEMA has issued an Earthquake Hazard map designating the City of Canandaigua a Seismic Design Category of A/B, seen on Map GS3. An A/B Zone may experience noticeable shaking, moving furniture, and slight damage[16]. Canandaigua Lake may experience more drastic tides after seismic activity.



MAP GS2: Brittle Structure of New York[17]

[16] FEMA. "Earthquake Hazards". *FEMA Risk Management.* 4 August 2020. Accessed 15 November 2021. https://www.fema.gov/emergency-managers/risk-management/earthquake/hazard-maps

[17] "Brittle Structures of New York". *New York State Museum.* Accessed 15 November 2021. http://search.its.ny.gov/search/nysed.html?q=brittle+structures&site=nysed_museum_collection&client=nysed_museum_frontend&proxystylesheet=nysed_museum_frontend&output=xml_no_dtd&getfields=exclude\



MAP GS3: Earthquake Hazards (FEMA, 2020)

A	Very small probability of experiencing damaging earthquake effects.
B	Could experience shaking of moderate intensity. Moderate shaking—Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage is slight.

TABLE GS2: FEMA Earthquake Hazards Definition (FEMA, 2020)

RECOMMENDATIONS AND BEST PRACTICES

Surifical and bedrock geology, and soil structure should be left undisturbed, whenever possible, by human action. Altering the geology and soils of the area may adversely impact area hydrology, and thus negatively affect Lake Canandaigua.

When building, the potential for unstable foundations and the location of brittle structures should be taken into consideration. While risks are low, some protections may be taken to minimize the chance of infrastructure damage or bodily injury of community members.

SECTION 4: LAND COVER, HABITATS, WILDLIFE

OVERVIEW

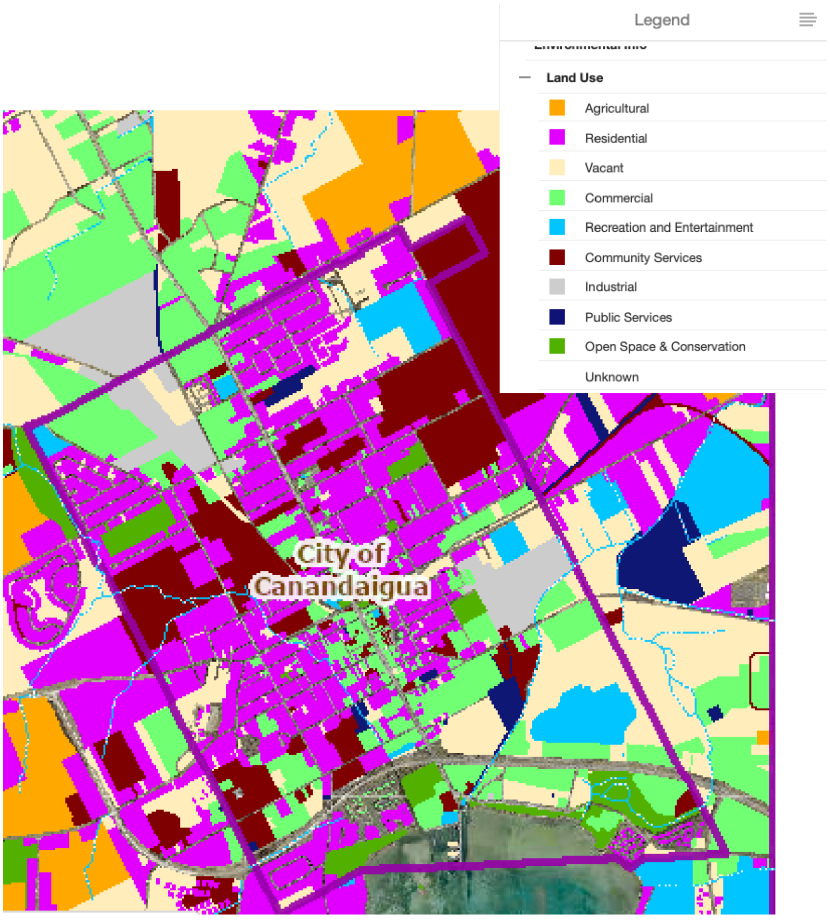
The City of Canandaigua is split between the Canandaigua Lake watershed and the Canandaigua Outlet watershed. The Canandaigua Outlet's mouth begins at Canandaigua Lake and exits 34 miles north into the Erie Canal and Clyde River. The City controls an eastern flood channel that flows through Lagoon Park and the western channel at the Feeder Canal. The Canandaigua Lake watershed is surrounded by 8 main tributaries and hundreds of smaller ones[18]. The watershed map shows the tributaries feeding into Canandaigua Lake.

FIGURE LC1: Canandaigua Lake Watershed Facts

With over 300 miles of tributaries surrounding Canandaigua Lake, and the lake itself being 15.5 miles, the water bodies (open water) are a valuable asset to the surrounding ecosystem and are one of the main natural land cover features in the City of Canandaigua. The other natural land cover features within the city limits include Urban Forests, wetlands, open space, conservation,

[18] 2017, Canandaigua Lake Watershed Council setting

recreation, and community services. The majority of land cover in the city is made up of residential, industrial, and commercial infrastructure.



MAP LC1: Land Cover, developed with Ontario County GIS on September, 14th, 2021

New York state is teeming with animals, plants, fungi, and microorganisms. The City of Canandaigua is not without its own biodiverse ecosystems. Looking at particular wildlife habitats can help identify potential threats to the city's natural resources.

DEFINITIONS

Land Cover - the surface cover on the ground, whether vegetation, urban infrastructure, water, bare soil or other.

Watershed - an area or ridge of land that separates waters flowing to different rivers, basins, or seas.

Disturbance - any relatively discrete event in time that disrupts ecosystem, community, or population structure, and changes resources, substrate availability, or physical environment.

Algal Bloom - a rapid growth of microscopic algae or cyanobacteria in water, often resulting in a colored scum on the surface

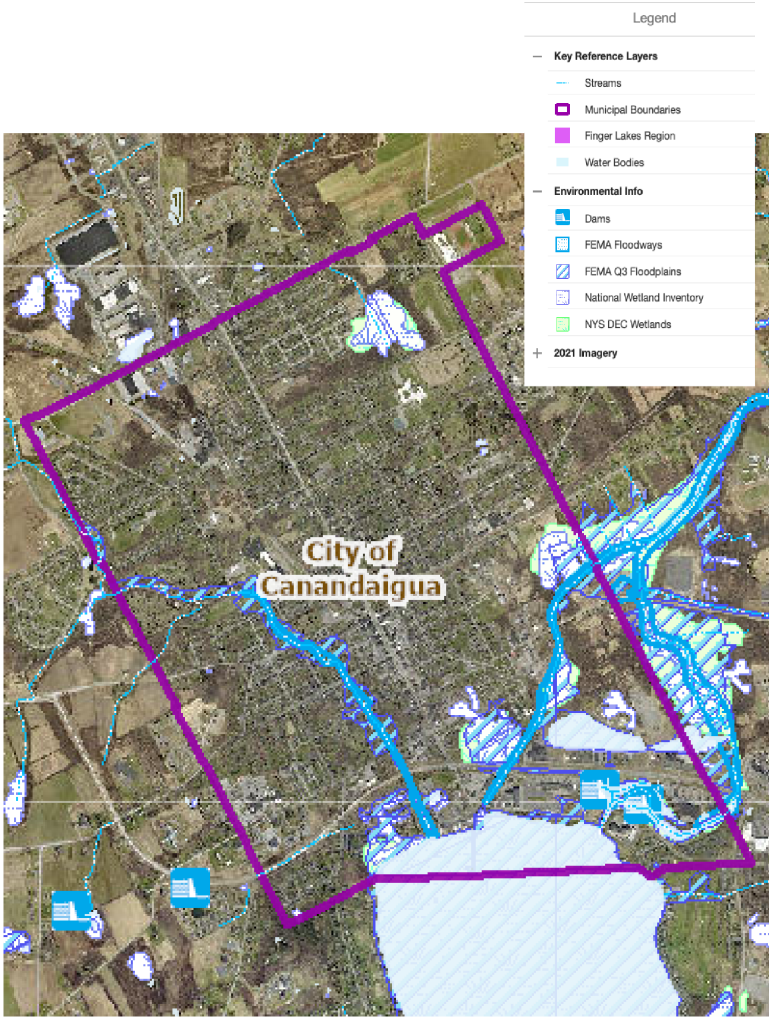
Biodiversity - the variety of life in the world or in a particular habitat or ecosystem

Wetlands - are areas where the ground is saturated with water or covered in standing water for part of the year.

Streetscape - refers to urban roadway design and conditions as they impact street users and nearby residents. Streetscaping recognizes that streets are places where people engage in various activities, including but not limited to motor vehicle travel.

LAND COVER, HABITATS, AND WILDLIFE

Open water includes Canandaigua Lake, floodways, and floodplains. There are two dams in the southeast region of the city that regulate the flow of water from the lake and its tributaries. The FEMA floodplains surround tributaries, Canandaigua Lake, and wetlands.



MAP LC2: Open Water and Wetlands, developed with Ontario County GIS on September, 14th, 2021

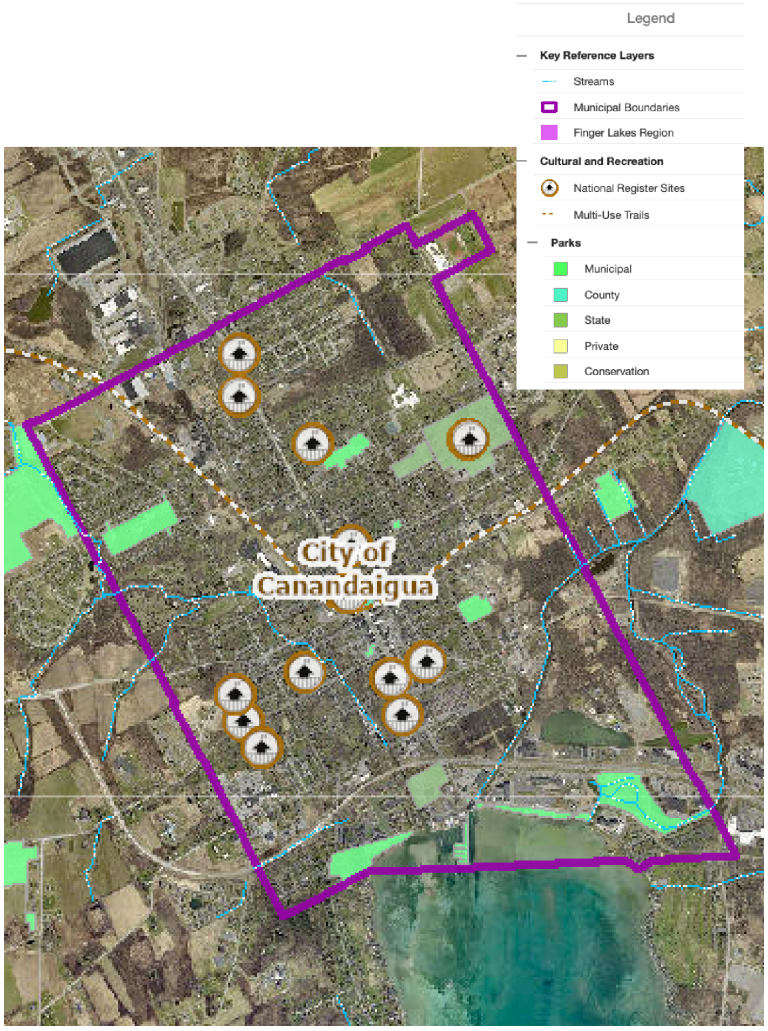
The cold water fish of Canandaigua Lake include lake trout, rainbow trout (introduced from Western US), brown trout, alewife, and rainbow smelt[19]. The warm water fish are smallmouth and largemouth bass, chain pickerel, yellow perch, bluegills, sunfish, rockbass, black crappies, and brown bullheads. Aquatic vegetation is seen mainly in shallow locations and made up of pondweeds, stoneworts, musk grass, and Eurasain milfoil[20].

[19] Fish and Wildlife, 2017 fish-wildlife
[20] Canandaigua Lake, 2021 25578.html

There are two main wetlands in the City of Canandaigua, one in the northeast corner and the other in the southeast corner. Lagoon Park houses the 34 acre nature preserve that protects the southernmost wetland. While there are both freshwater and saltwater wetlands, freshwater wetlands are found throughout New York State. The wetlands are a valuable habitat to waterfowl, mink, muskrats, beaver, and amphibian production[21]. Many birds use wetlands as a nesting site and migratory birds such as the Canadian Goose will stop at wetlands to rest during migration. There is a wide variety of mammals and amphibians that use the habitat as shelter to protect them from prey. Plants that can be found in freshwater wetlands are Cypress and Mangrove trees, as well as species of grasses, wildflowers, and shrubs[22]. These particular plants help retain water which works as a natural prevention to flooding.

Recreation, conservation, Urban Forests, and open spaces are all habitats that local wildlife share. Following the land cover map and the Parks and Recreation map, the City of Canandaigua has a number of sites that protect and shelter wildlife. A variety of wildlife present in such habitats include deer, turkey, goose, squirrel, rabbit, coyote, fox, song birds, falcons, owls, and many more[23].

[21] Fish and Wildlife, 2017 fish-wildlife
[22] Gambrel, E. (2019). Wetland Plants & Wildlife. Sciencing. Wetland-plants-wildlife-8254793.html
[23] SAME AS 21



MAP LC3: Parks and Recreation, developed with Ontario County GIS on September, 14th, 2021

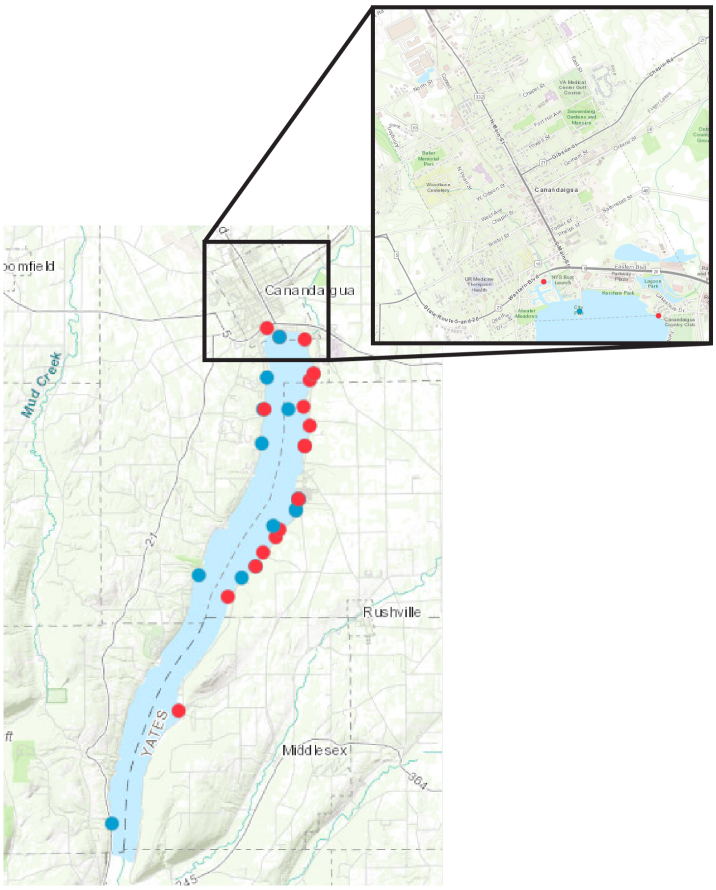
Retention Sites

The City of Canandaigua completed a streetscape project along Main street in 2014 (see Urban and Community Forests section). Infiltration planters were installed to collect rainwater from rain tiles to water the rain gardens[24]. The remaining water (more than 6 inches) is retained using a storm drain. Plants were selected using the following criteria, drought, flood, heat, and salt tolerance, maintenance, and selecting indigenous species. The selection process allows for longer lasting gardens, promotes habitat health, and supports the local wildlife. Plants selected are hydrangeas, prairie dropseed grasses, purple coneflower, rudbeckia, honey locust, hybrid elm accolade, maple, day lily, and more.

[24] August 16, 2014: Streetscape Tour (2014). Canandaigua Botanical Society. Our-next-event.html

Algal Blooms

The Canandaigua Lake Watershed Society trained 70 volunteers to canvas the lake's shoreline and document any algal bloom sightings. The interactive map is updated often, with the last sighting being September 2021[25]. Within the city boundaries there have been three bloom sightings in the past two months. The following map is marked with a dot for each sighting, the red dots are small blooms and the blue are large blooms. All active algal blooms are localized and there are no widespread blooms to date. In the 2021 season, there have been 375 total shoreline survey sightings.



MAP LC4: 2021 Interactive Map, accessed on September 11, 2021

Algal is present when nutrients in the lake are off balance to its natural state. Monitoring the lake's phosphorus and nitrogen levels will help in understanding best practices to manage the influx in algal bloom.

[25] Shoreline Habs Monitoring (2021) Canandaigua Lake Watershed Association shoreline-habs-monitoring

IMPORTANCE

A healthy ecosystem is important for both suburban and urban settings alike. Cities are using 75% of the planet's natural resources[26], meaning that it is more important than ever to maintain and foster a healthy ecosystem. In the City of Canandaigua, Urban Forests, wetlands, parks, and open water are all habitats that local wildlife call home. Having a biodiverse ecosystem will help keep a balanced habitat, and provide stability for wildlife. As well, by protecting and preserving a city's ecosystem, the benefits reach outside of the city boundaries.

THREATS

Identifying threats to the city's natural land cover features is important for the preservation and maintenance of local habitats and wildlife. Today, the most significant threats to New York's biodiversity are habitat destruction and loss, invasive species, pollution, hunting, fishing and illegal collection, and climate change as a whole[27].

Habitat Loss

Habitat loss and destruction occurs when development and other forms of human encroachment affect the landscape. It can also occur from infestations of invasive species and extreme weather change caused by climate change such as flooding, droughts, and more.

Invasive species

It is considered that invasive species are the biggest threat to the biodiversity of New York State. Invasive species contribute to the following[28]:

- Habitat degradation and loss
- The loss of idigenous fish, wildlife and tree species
- The loss of recreational opportunities and income
- Crop damage and diseases in humans and livestock
- Risks to public safety

Currently the City of Canandaigua is facing an infestation of invasive species in Lagoon Park. The wetlands are threatened by habitat loss, indigenous tree and wildlife loss, and loss of recreational opportunities all due to buckthorn alone.

[26] UNEP. Ecosystems and Biodiversity: The Role of Cities. Retrieved from: unhab40.pdf
[27] Biodiversity and Species Conservation 279.html
[28] Nuisance and Invasive Species (2021) department of Environmental Services 265.html

Other invasive plant species include giant hogweed, slender false brome, and wild parsnip. Giant hogweed is part of the carrot family and can grow up to 14 feet in height that is poisonous, causing burns and scarring. The DEC controls the infested locations by either removing the roots or using an herbicide. Slender false broom is a grass that self pollinates, taking over habitats and harming wildlife. It is not found in Ontario currently. Wild parsnip is the most common invasive plant in New York originating in Europe and Asia. Like giant hogweed, it is harmful to humans, also causing burns. The plant has infested so much of the state that there is no action in place to remove it.

Invasive animals in New York are mainly insects that infect a variety of tree species. This list is outlined in detail in the Urban and Community Forests section. The Eurasian boar is the only mammal that is listed on the DEC as an invasive species. Indigenous to Europe and Asia, the boar damages habitats and crops and harms local wildlife. Although the Eurasian boar has been eliminated from New York, it is important to prevent re-entree.

Aquatic invasive plants that are active in Ontario County are starry stonewort and water chestnut. The starry stonewort is invasive algae originating from Eurasia. The plant grows on the lake bed and can get up to 7 feet in height, creating a thick layer. The invasive species is taking over fish shelters and negatively impacting the local competing algae. Removing starry stonewort is being done with herbicide and pulling out the roots, but it is not an effective solution. The water chestnut is in over 40 counties in New York State and is indigenous to Eurasia and Africa. The plant infests freshwater ponds and lakes, overpopulating the water's surface making it hard for recreation, sunlight to reach local plants, and reduces the oxygen levels in the water. The infestation is managed by pulling them out and using herbicides, but catching the infestation early makes it much easier to eliminate.

Hunting, Fishing, and Illegal Collection

Hunting and fishing are done for both sport and necessity or food preference. Catching wildlife is completely safe and beneficial, but overfishing and overhunting can greatly affect the health of an ecosystem. State hunting and fishing regulations help mitigate the pace of species loss, but many indigenous species are being affected by multiple threats not withstansing hunting and fishing. Canandaigua Lake is currently stocked with most fish species listed above (see Land Cover) in order to make up for the fishing occurring. Although there are no endangered fish species recorded in the state, stock fishing is a practice that reintroduces new fish to the ecosystem seasonally, creating an unstable system. Wolf and cougars are the two mammals that are endangered in New York State, making them illegal to hunt.

Climate Change

Climate change can be seen in many facets including extreme weather and an influx in temperature to name a few. The City of Canandaigua is experiencing an increase in flooding.

While prevention has started by building rain retention sites, storm drains, introducing plants that retain more water, and other mitigation efforts, flooding is still a threat to the city's ecosystem. Many local plants and animals are not susceptible to flooding and are thus dying off or being pushed out of their local habitats.

SECTION 5: WATER RESOURCES

OVERVIEW

While briefly discussed in the Land Cover Section, water resources are looked at in more detail in the following section. As noted before, the current natural water resources that are identified in the land cover map (see Land Cover, Habitats, and Wildlife) are water bodies (Canandaigua Lake), watersheds, and wetlands. An overview and description of the natural water resources can be found in the land cover section.

Water distribution in the City of Canandaigua includes water treatment, water quality, and water resource recovery. Water is an extremely valuable resource for both the health of residents and the health of local habitats. Canandaigua Lake is the main water resource used by both, and with many other towns using the lake for drinking water, recreation, and more, the state and local groups alike are monitoring the water quality to ensure that water is safe for use. In this regard, water treatment facilities, water testing and monitoring, and water recovery facilities are important to review in further detail. The City of Canandaigua has a yearly Water Treatment Facility Report and the following section reviews the 2015 and 2020 report to identify any potential changes.

DEFINITIONS

Watershed - an area or ridge of land that separates waters flowing to different rivers, basins, or seas.

Algal Bloom - a rapid growth of microscopic algae or cyanobacteria in water, often resulting in a colored scum on the surface

Wetlands - are areas where the ground is saturated with water or covered in standing water for part of the year.

Natural Capital - the world's stocks of natural asset's which include geology, water, air, soil, and all living things.

WATER RESOURCES

Natural Water Resources

See the Land Cover, Habitats, and Wildlife section for a description of the natural water resources.

Water Quality and Treatment

The city's Water Treatment Facility is located outside of the city limits, on the northwest side of the lake. In 2015, Canandaigua Lake was the sole water source for the water treatment plant[29]. The facility withdrew, treated, and distributed 1.465 billion gallons of water from the lake. The water was distributed to 11,300 residents in the City of Canandaigua, used for the firefighting and hydrants as well as leaks in the City, and lastly sold to the Town of Canandaigua, Hopewell, and Farmington.

REGULATED SUBSTANCES

SUBSTANCE (UNITS)	DATE SAMPLED	MCL	MCLG	AVG AMT.	RANGE (LOW HIGH)	VIOLATION	TYPICAL SOURCE
Barium (ppm)	8/15	2	2	0.022	N/A	No	Discharge of drilling wastes, metal refineries; erosion of natural deposits
Nickel (ppb)	8/15	100	100	0.84	N/A	No	Erosion of natural deposits; discharge from stainless steel factories
Fluoride (ppm)[1]	2015	2.2	N/A	0.79	ND – .98	No	Erosion of natural deposits; water additive; discharge from aluminum and fertilizer factories
Nitrate (ppm)	5/15	10	10	0.23	N/A	No	Runoff from fertilizer use; leaching from septic tanks; erosion of natural deposits
Chromium (ppb)	2015	100	100	<1.0	N/A	No	Erosion of natural deposits; discharge from stainless steel factories
Total Coliform[5]	2015	2 pos. samples	0	1.0	0 – 1.0	No	Naturally present in the environment
Turbidity Combine Filter Effluent (NTU)[2]	2015	TT = 0.3	N/A	1.0 max	0.01 – .25	No	Soil runoff
Turbidity Individual Filter (NTU)	2015	TT = 0.3	N/A	99 % <0.3	0.01 – .50	No	Soil runoff
Alkalinity (ppm)	2015	N/A	N/A	112	109 – 118	No	Naturally present in the environment
Total Organic Carbon (ppm)	2015	N/A	N/A	2.5	1.8 – 2.7	No	Naturally present in the environment, measured at Entry Point
Dissolved Organic Carbon (ppm)	2015	N/A	N/A	2.23	1.9 – 2.6	No	Naturally present in the environment
UV254 (cm^{-1})	2015	N/A	N/A	0.0279	0.0261 – .0305	No	
Specific Ultraviolet Absorbance (L/mg-m)	2015	N/A	2	1.26	0.98 – 1.53	No	
STAGE II							
Total Haloacetic Acids (ppb)	2015	60	N/A	31[3]	18 – 36	No	By products of drinking water chlorination
Total Trihalomethanes (ppb)	2015	80	N/A	60[3]	36 – 92	No	By products of drinking water chlorination
RADIOLOGICAL							
Gross Alpha (pCi/L)	12/13	15	0	ND	N/A	No	Erosion of natural deposits
Radium 226 (pCi/L)	2/13	5	0	ND	N/A	No	Erosion of natural deposits
Radium 228 (pCi/L)	2/13	5	0	0.4	0.4	No	Erosion of natural deposits

LEAD & COPPER

SUBSTANCE (UNITS)	DATE SAMPLED	AL	MCLG	90TH PERCENTILE	RANGE (LOW HIGH)	VIOLATION	TYPICAL SOURCE
Copper (ppm)	6/14	1.3	N/A	0.061[3]	0.0011 – .044	No	Corrosion of household plumbing systems; Erosion of natural deposits; Leaching from wood preservatives
Lead (ppb)	6/14	15	N/A	2.6[3]	<1 – 6.1	0[4] – No	Corrosion of household plumbing systems; Erosion of natural deposits

FIGURE WR1: Water Monitoring for Canandaigua Lake Figure, 2015, 2015WaterReport.pdf

[29] Water Treatment Facility 2015 Quality Report (2015). *The City of Canandaigua.* Retrieved from 2015WaterReport.pdf on October 3, 2021

The City of Canandaigua released the results of their water monitoring in 2015 (Figure WR1). All contaminants are not at harmful levels and potential source of contamination is listed on the far right side. The summarized results of the assessment concluded that[30]:

> "...the total amount of wastewater discharged to surface water in this assessment area is high enough to further raise the potential for contamination (particularly for protozoa). There is also noteworthy contamination susceptibility associated with other discrete contaminant sources, and these facility types include: hazardous waste sites, chemical bulk storage, landfills, mines, RCRA and TRI."

In the 2015 report, residents were asked to limit lawn fertilizer and pesticide use due to runoff that makes its way to the lake. Residents are also encouraged to plant rain gardens, filter stormwater runoff, and use rain barrels.

The 2020 report[31], highlights the improvement to water quality efforts by the Watershed Council since 2015. These projects include a 20 acre water quality basin treating 3000 acres, a 20 acre wetland on FLCC campus that treats 2,000 acres of runoff, getting Berm breaks to utilize 200 acres meadows and wetlands to treat 30,000 acres of drainage, and numerous projects to stabilize roadbanks and streambanks, reducing flooding and improving water quality. Aside from the water treatment improvement that has been done in the past 5 years, algal bloom is an increasing issue that is noted in the report.

In 2020, Canandaigua Lake was the sole water source for the water treatment plant and 25% of the water comes from rainfall directly into the lake, while the other 75% is from the water entering the lake through watersheds[32]. The facility withdrew, treated, and distributed 1.480 billion gallons of water from the lake. The water was distributed to 11,000 residents in the City of Canandaigua, used for the firefighting and hydrants as well as leaks in the city, and lastly sold to the Town of Canandaigua, Hopewell, and Farmington.

[30] Water Treatment Facility 2015 Quality Report (2015). *The City of Canandaigua.* Retrieved from 2015WaterReport.pdf
[31] Water Treatment Facility 2020 Quality Report (2020). *The City of Canandaigua.* Retrieved from Water_Report_2020.pdf
[32] SAME AS 31

REGULATED SUBSTANCES

SUBSTANCE (UNITS)	DATE SAMPLED	MCL	MCLG	AVG AMT.	RANGE (LOW HIGH)	VIOLATION	TYPICAL SOURCE
Barium (ppm)	2/20	2	2	0.024	N/A	No	Discharge of drilling wastes, metal refineries; erosion of natural deposits
Nickel (ppb)	2/20	100	100	1.1	N/A	No	Erosion of natural deposits; discharge from stainless steel factories
Fluoride (ppm)[1]	2020	2.2	N/A	0.78	0.54 – 1.05	No	Erosion of natural deposits; water additive; discharge from aluminum and fertilizer factories
Nitrate (ppm)	2/20	10	10	0.27	N/A	No	Runoff from fertilizer use; leaching from septic tanks; erosion of natural deposits
Chromium (ppb)	2/20	100	100	1.7	N/A	No	Erosion of natural deposits; discharge from stainless steel factories
Total Coliform + E. Coli[2]	2020	>5% positive	0	N/A		No	Naturally present in the environment
Turbidity Combine Filter Effluent (NTU)[2]	2020	TT = 0.3	N/A	0.17 max	0.03 – 0.17	No	Soil runoff
Turbidity Individual Filter (NTU)	2020	TT = 0.3	N/A	99 % ≤ 0.3	N/A	No	Soil runoff
Alkalinity (ppm)	2020	N/A	N/A	106	95 – 118	No	Naturally present in the environment
Total Organic Carbon (ppm)	2020	N/A	N/A	2.13	1.9 – 2.5	No	Naturally present in the environment, measured at Entry Point
Dissolved Organic Carbon (ppm)	2020	N/A	N/A	2.16	1.8 – 2.5	No	Naturally present in the environment, measured at Raw Water Tap
UV254 (cm^{-1})	2020	N/A	N/A	0.0234	0.009 – 0.0304	No	
Specific Ultraviolet Absorbance (L/mg-m)	2020	N/A	2	1.13	0.36 – 1.69	No	
Raw Water Microcystin (ppb)	2020	N/A	N/A	0.4	<0.3-0.81	No	Cyanobacteria
Perfluorooctanesulfonic acid (ng/L)	2020	10	N/A	<1.7	N/A	No	Fire fighting foam, water repellent, industrial processes
Perfluorooctanoic acid (ng/L)	2020	10	N/A	<1.7	N/A	No	Fire fighting foam, water repellent, industrial processes
1,4-Dioxane (ppb)	2020	1	N/A	<0.04	N/A	No	
STAGE II							
Total Haloacetic Acids (ppb)	2020	60	N/A	22[4]	14–31	No	By products of drinking water chlorination
Total Trihalomethanes (ppb)	2020	80	N/A	63[4]	49 – 80	No	By products of drinking water chlorination
RADIOLOGICAL							
Gross Alpha (pCi/L)	12/13	15	0	ND	N/A	No	Erosion of natural deposits
Radium 226 (pCi/L)	2/13	5	0	ND	N/A	No	Erosion of natural deposits
Radium 228 (pCi/L)	2/13	5	0	0.4	0.4	No	Erosion of natural deposits

LEAD & COPPER

SUBSTANCE (UNITS)	DATE SAMPLED	AL	MCLG	90TH PERCENTILE	RANGE (LOW HIGH)	VIOLATION	TYPICAL SOURCE
Copper (ppm)	6/20	1.3	N/A	0.028	0.0027 – 0.030	No	Corrosion of household plumbing systems; Erosion of natural deposits; Leaching from wood preservatives
Lead (ppb)	6/20	15	N/A	1.8[3]	<1 – 10	0[4] – No	Corrosion of household plumbing systems; Erosion of natural deposits

FIGURE WR2: Water Monitoring for Canandaigua Lake Figure, 2020, Water_Report_2020.pdf

The City of Canandaigua released the results of their water monitoring in 2020 (Figure WR2). Similar to the 2015 data, contaminants are not at harmful levels and potential source of contamination is listed on the far right side.

Between 2015 and 2020, the considerable changes to the water quality are minimal. The Watershed Council has put efforts in to stabilize and improve water quality. Algal blooms are more present in the lake which affect the nutrient levels in the water and decrease oxygen.

Wastewater treatment is a vital aspect to restoring water quality, but can use high amounts of energy to maintain. The City of Canandaigua has a Water Recovery Facility located in the city limits. A Water Recovery Facility is more cost effective and is a great way to extract nutrients, energy, and water during the treatment process[33]. The city is installing a disinfection system at the Water Recovery Facility that is to be completed by 2024[34]. The system is meant to treat the water that is entering the Canandaigua Outlet.

[33] Resource Recovery (2020). *Water Environment Federation.* Retrieved from resource-recovery on October 9, 2021.
[34] City of Canandaigua Water Resource Recovery Facility Disinfection (2021). *The City of Canandaigua.* Retrieved from 310374 on October 2, 2021.

IMPORTANCE

As noted in the Watershed Management Plan[35], "(a) Watershed plan makes the protection and restoration of critical areas a major area of focus utilizing a wide array of strategies. Some examples of these critical areas include: wetlands, shorelines, streamside/roadbank buffer areas, floodplains, forested areas and other areas that filter and reduce stormwater runoff." Natural water resources are considered critical areas because they affect the stability of the local wildlife habitats, the natural capital of the region, community health, tourism, food supply, and water quality.

THREATS

The main threat to the City of Canandaigua's water resources is flooding. Urban flooding is generally caused by heavy rainfall[36]. Stormwater drains and stormwater retention sites help minimize flooding, but heavy rain can exceed their retention ability and cause flooding.

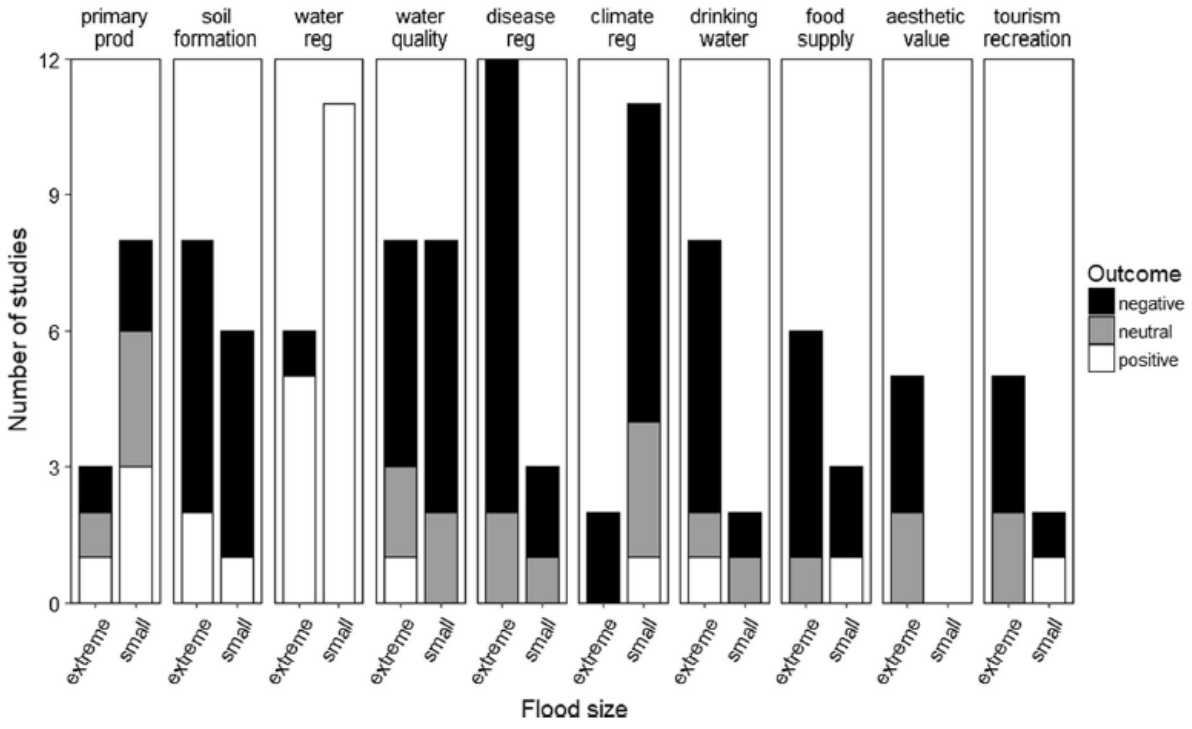


FIGURE WR3: Threats caused by Flooding Figure, 2018, pp 441

[35] Comprehensive Update of the Canandaigua Lake Watershed Management Plan (2014). *Canandaigua Lake Watershed Council.* Retrieved from Watershed-Plan_public_12-20.pdf on October 2, 2021.
[36] Water Quality Risks to Lakes and Rivers (2014). *National Climate Assessment.* Retrieved from water-quality-risks-lakes-and-rivers on October 9, 2021.

Figure WR3 (2018) looks at both extreme and small flooding studies to identify the negative and positive outcomes to each category shown. The top threats (identified as negative outcomes) caused by flooding are climate regulation, water quality, soil formation, drinking water, food supply, and disease regulation. In the 2018 study[37], Talbot et al. describe the results of each threat in further detail:

- "Flooding can disproportionately affect populations that are already at increased risk of disease due to poverty, poor sanitation and housing, and limited access to healthcare systems... Pathogen transmission can occur through ingestion of contaminated drinking water or direct contact with flood waters... Floods can also indirectly impact human health by supporting or spreading breeding grounds and dispersal of pathogen vectors." (pp 449-450)
- "Floods can impact drinking water when contaminants and pathogens are discharged into surface and underground drinking water sources." (pp 452)
- "Floods impact heterotrophic processes tied to the production and consumption of greenhouse gases... In water limited environments where aerobic respiration is often limited by water availability, water additions/small floods generally lead to increased CO2 emissions..." (pp 451)
- "Floods can impact drinking water when contaminants and pathogens are discharged into surface and underground drinking water sources." (pp 452)
- "Small or seasonal flooding also is advantageous for native fish populations relative to invasive fishes occupying the same areas. However, extreme floods can destroy planted crops." (pp 453)
- "Flooding may impact tourism by damaging infras- tructure, reducing safety, damaging sites of interest, and changing tourist perceptions of an area." (pp 454)

RECOMMENDATIONS AND BEST PRACTICES

Restoration is key to mitigating the current climate change and storm water issues. Damage that has been done can be remediated and restored back to health however, it is not the solution to the stormwater issues.

Stabilization projects are recommended to prevent the need for restoration projects to have to occur. Stabilization projects include more wetland creation projects, stormwater retrofits, more rain retention gardens, and other projects that improve the flooding and stormwater issues that will then improve the water quality and water resources.

[37] Talbot. C, et al. (2018). The impact of flooding on aquatic ecosystem services. *Biogeochemistry* (141): 439-461. Retrieved from https://doi.org/10.1007/s10533-018-0449-7 on October 9, 2021.

SECTION 6: URBAN AND COMMUNITY FORESTS

OVERVIEW

The City of Canandaigua is located in the Finger Lakes Region of New York. Surrounded by the Town of Canandaigua, the city boundary is 4.85 sq mi (12.55 km^2). The Southern end of the city touches the northern tip of Canandaigua Lake. The Finger Lakes Region is made up of agricultural land and mixed northern hardwoods. Between 2012 and 2017, New York State had a net forest loss of around 390,000 acres[38]). The loss is due to new agricultural land and development. During the same timeframe, 250,000 acres of land became recovered forestland. Overall, forestland in New York State remained relatively stable.

The City of Canandaigua is a designated Tree City USA and has been for 33 years (2021). In 2011 the city formed a Tree Advisory Board with a mission to enhance and maintain the urban forests of the city and found that the municipal trees are critical to Canandaigua's heritage[39]. The Tree Advisory Board is currently working to limit the reconstruction of streets and sidewalks that damage or remove mature trees. Canandaigua hired a City Arborist to help manage and maintain the mission and goals set out by the Tree Advisory Board. The Board is also working on a replanting plan for Lakefront Park and Lagoon Park.

The City maintains all trees found in parks, urban, and community forests. There are 13 parks in the City of Canandaigua, Atwater Meadows Park, Baker Park, City Pier, Gibson Street Park, Jefferson Park, Kershaw Park, Lakefront Park, Lagoon Park, Swimming Beach, Sonnenberg Park, Telyea Tot Lot, "The Commons", and Triangle Park. Parks such as Atwater Meadows and Lagoon require low maintenance as they are two of the largest Parks in the City and consist of forests and wetlands. As such, invasive species maintenance is the extent of the municipality's maintenance. Other parks with limited trees are more likely to be maintained as weather and other threats may damage isolated trees more easily. Approximately 500 trees within parks and common areas have been inventoried and monitored by the municipality. Another 4,000 trees are inventoried by the City and they are located on City streets.

Urban forests date back to the time of city, town, and village settlements, where most communities chose to plant elms[40]. But, with a lack of diversity, the Dutch Elm disease wiped out most elm trees in a relatively short period of time. The elm trees were replaced by maple and ash trees which have had their fair share of threats such as weather and the Asain longhorn beetle. Both examples show that diversity is key for trees to survive in an Urban Forest setting. Currently,

---

[38] Mehls, B., Ouimette, L., Poteet, D., Rhode, T., & Ticonchunk, B. (2013). Urban Forest Master Plan. Retrieved from: Appendix.A06.Urban_Forest_Master_Plan_Final_Submission_with_Appendices_6-13-13.pdf on September 1st, 2021.

[39] SAME AS 38

[40] Forest Health (2021). *New York State: Department of Environmental Conservation.* Retrieved from: 4969.html on September 6th, 2021.

there are more than 14 species of trees planted throughout the City of Canandaigua with the most common being the Norway Maple.

DEFINITIONS

Community Forest – A wooded property usually owned by a municipality and managed for a variety of purposes, e.g., recreation, fuel wood, lumber, education, water quality, and other municipal and/or resident benefits.

Forest management – The practical application of biological, quantitative, economic, social, and policy principles to the regeneration, utilization, and conservation of forests to meet specified goals and objectives while maintaining the productivity of the forest.

Biodiversity – The variety and variability of all living organisms.

Forestland – Land at least 10 percent stocked by forest trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated.

Forests – An ecosystem characterized by a more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species, composition, structure, age class, and associated processes, and commonly including meadows, streams, fish, and wildlife.

Tree City USA **–** A community that met the four standards established by the Arbor Day Foundation and the National Association of State Foresters, aimed to ensure that every qualifying community would have a viable tree management program and that no community would be excluded because of size.

Urban Forest, Community Forest, Urban and Community Forest – All public and private trees in a town, village, city, or other defined developed area.

Urban Forestry, Community Forestry, Urban and Community Forestry – The management of urban and community forests for their many benefits: air and water quality, energy savings, environmental health, wildlife habitat, human health, and enhancing the quality of life for urban residents.

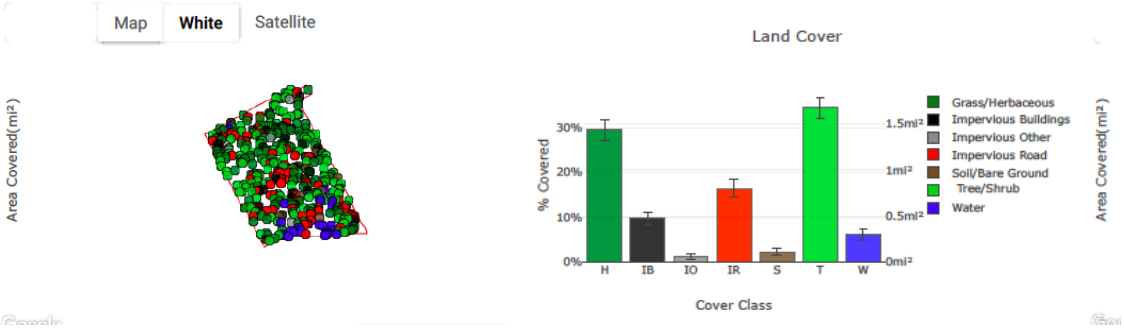
URBAN AND COMMUNITY FORESTS

The topographic map (MAP UCF1) developed through Discover GIS Data NY, shows the City of Canandaigua land cover. The city land cover consists of trees and shrubs, grassland, water, impervious roads, impervious buildings, impervious others, and soil.

MAP UCF1: Developed with: Discover GIS Data NY, September 5th, 2021

Within the city boundary, approximately 35% is covered by trees and shrubs. It is important to note that Atwater Meadows Park is 18 acres of uninterrupted forestland and Lagoon Park is a 34 acre nature preserve of mostly wetlands[41]. In that case, the tree coverage may be increased due to a higher volume of trees in both parks.

[41] Parks Inventory and Master Plan (2016). *City of Canandaigua: the chosen spot.* Retrieved from: Parks_Master_Plan_3.3.2016.pdf on September 1st, 2021.



MAP UCF2: Developed with: I-Tree Canopy, April 21th, 2021

Tree Diversity

There are more than 14 tree species that are planted and maintained by the city. The pie chart (CHART UCF1) shows a list of current (2013) trees planted in the City of Canandaigua. Although there is an attempt to diversify the city's trees, the Norway Maple makes up 25% of the total street trees. As part of the Urban Forest Master Plan developed in 2013, Canandaigua's goal is to "strive for diversity and visual compatibility with other trees and their surroundings"[42]. Their desired goal is to loosely mimic Ithaca, NY's plan which attempts to have no more than 5% of a single tree species planted. Although the City of Canandaigua does not identify a percentage, they intend to diversify the tree species of Canandaigua streets to minimize threats.

[42] Mehls, B., Ouimette, L., Poteet, D., Rhode, T., & Ticonchunk, B. (2013). Urban Forest Master Plan. Retrieved from: Appendix.A06.Urban_Forest_Master_Plan_Final_Submission_with_Appendices_6-13-13.pdf on September 1st, 2021.

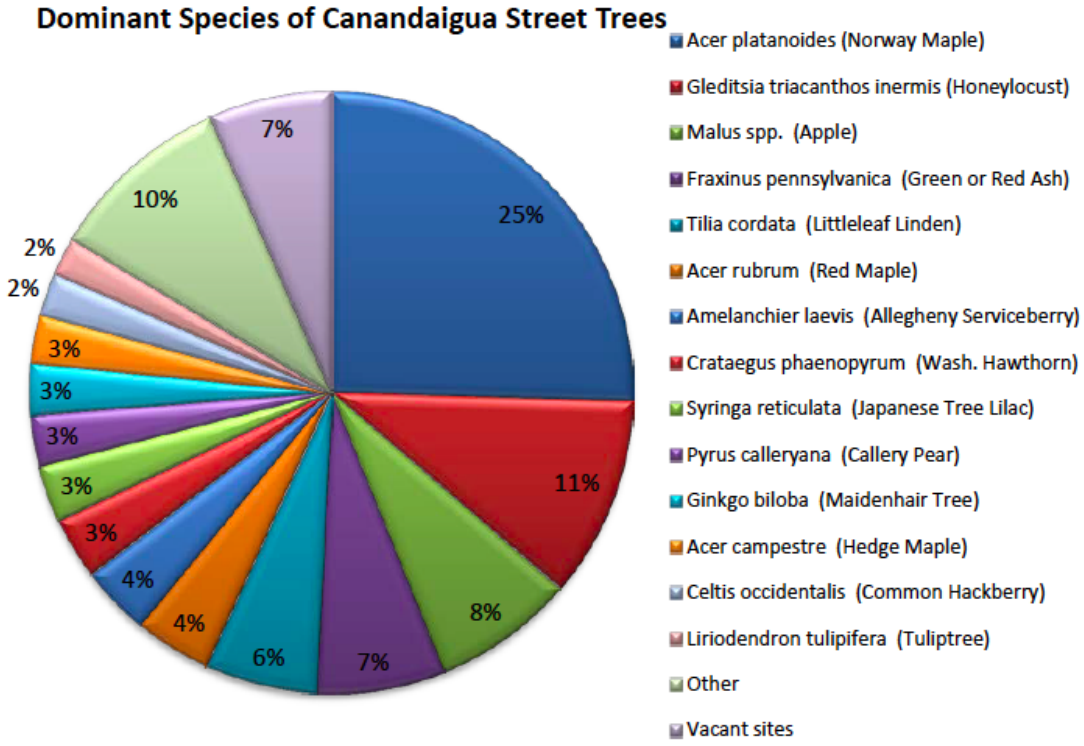


CHART UCF1: Dominant Species of Canandaigua Street Trees

The City of Canandaigua often chooses a 'TREEmendous chosen spot' to highlight street trees. The current location is Charlotte Street. In the 1900's, Mary Clark Thompson, the sister of Charlotte Clark who the street was named after, planted London Plane trees. The tree variety is most likely included in the 'other' of dominant species in the pie chart because out of the 80 trees planted, 67 of the London Plane trees still remain today. It is important to note that the trees are still standing because Charlotte Street is one of a few streets without curbs. The London Plane tree is a cross between an American Sycamore and an Oriental Plane tree. This variety is popular because it can withstand air pollution as well as other urban stresses and when it sheds its bark yearly, it also sheds any contaminants. The new variety of the London Plane tree is no longer being planted because of diseases such as anthracnose.

Lakefront Park Replanting Plan

In the late 90's, the City of Canandaigua inherited the willow trees that were planted at Lakefront Park. Because the willow trees were not maintained properly, limbs were falling, making it both dangerous for the tree and the residents[43]. A restoration plan began in 2015 to remove the willow trees that are no longer salvageable and replace them with a variety of trees to diversify the park.

[43] Lakefront Park (2015). *City of Canandaigua: the chosen spot.* Retrieved from: index.asp on September 4th, 2021.

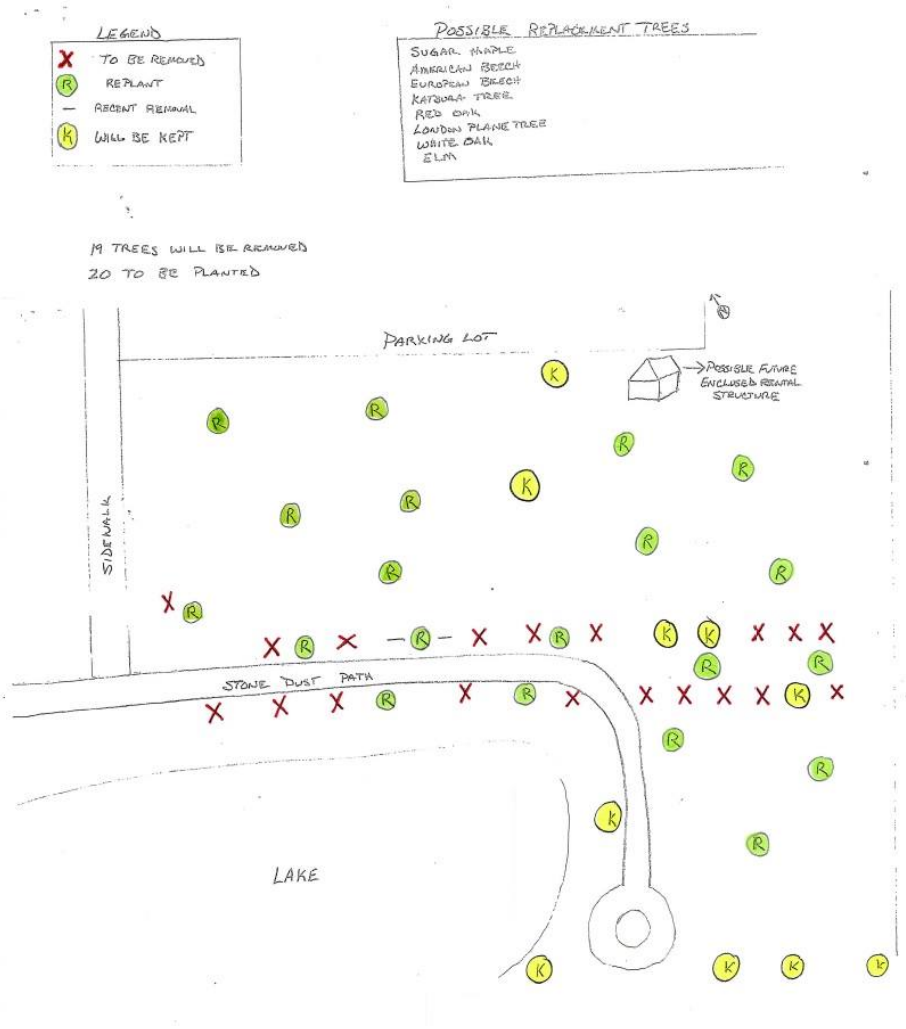


IMAGE UCF1: Lakefront Park Plan, 2015, index.asp

The Tree Advisory Board selected 19 trees that needed to be removed. The hand drawn image of the park (IMAGE UCF1) marks the location of removal with red x's.. There are 10 trees that will remain and 20 new trees will be planted. For the purpose of diversifying, the Board lists 8 possible tree varieties that will replace the willows. They are as follows, Sugar Maple, American Beech, European Beech, Katsura tree, Red Oak, White Oak, London Plane tree, and the elm.

Lagoon Park Restoration Project

The Lagoon Park was previously the site of Roseland Park up until 1985[44]. The vegetation has been left to its natural habitat including the trees. The City removes invasive species in the park so that the natural habitat can thrive. More recently, invasive species have been more aggressive and are hindering the indigenous plants and in turn, decreasing the local insects, birds, and animals that rely on the vegetation of the natural habitat. The goal of the Canandaigua Botanical

[44] Lagoon Park Restoration Project (June, 2013). *Canandaigua Botanical Society.* Retrieved from: lagoon-park-restoration-update.html on September 5th, 2021.

Society and the Tree Advisory Board is to remove any invasive species and exotic plants that grow in Lagoon Park and plant indigenous species in their place.

Invasive species and exotic plants that have been identified by the Canandaigua Botanical Society are buckthorn, crabapple, honeysuckle, multirose, privet, and phragmites. Most maintenance so far has been volunteer labor by City staff, Boys Scouts, and others, but only one third of the park has been restored. The indigenous species that are replanted in Lagoon Park are American elm, American Chokecherry, Arrowwood Viburnum, Bayberry, Black Chokecherry, Bush Honeysuckle, Elderberry, Joe Pye weed, covers root, boneset, Spicebush, and Winterberry.

The Streetscape Project

In 2014, The city completed a $1.6 million project to improve the streets, sidewalks, and green infrastructure along Main Street. The green infrastructure included 9 rain gardens and 8 raised plant beds, planting 40 trees, shrubs, and others[45]. The improvement is used as a storm water and pollutant retention system. The chosen plants and soil filter the storm water to minimize runoff into the lake watershed.

[45] Canandaigua Main Street Streetscape Tour (July, 2014). *Canandaigua Botanical Society.* Retrieved from: our-next-event_19.html on September 6th, 2021.

IMPORTANCE

Americans are moving to Urban communities quicker than estimated, with 81% living in cities today[46]. With the majority of citizens living in cities, the benefits of Urban and Community Forests are becoming increasingly more important to protect, establish and maintain. Currently, 141 million acres of forests are located in both cities and towns combined. The bulk of Urban trees are found in parks, street trees, nature preserves, and more. Identified in the City of Canandaigua's Urban Forest Master Plan (2013), there are 15 main benefits of Urban trees (pp 4):

1. Privacy
2. Screen unsightly areas
3. Protect pedestrians from vehicular traffic
4. Improve air quality
5. Remove particulate matter from the air
6. Remove harmful gases such as carbon dioxide, carbon monoxide, sulfur dioxide and ozone
7. Give off oxygen
8. Roots capture storm-water runoff
9. Leaves attenuate storm-water runoff
10. Provide homes for wildlife
11. Save on fuel and air-conditioning costs
12. Increase property values by 5 to 20%
13. Beautify the city
14. Reduce noise pollution
15. Enhance outdoor urban spaces which, in turn, helps to build stronger communities

[46] Urban Forests (2021). *Forest Service: US Department of Agriculture.* Retrieved from: urban-forests on September 6th, 2021.

THREATS

Urban and Community Forests are threatened by many factors that can be minimized with the work of Tree Advisory Boards, overall municipal support as well as others in the community. In order to identify a list of recommendations to protect, establish, and maintain Urban and Community Forests, all threats must be explained in detail. The current threats to Urban trees are weather, disease, insects, and construction.

Weather

Weather that can threaten Urban trees, especially isolated or exposed street trees, are wind, rain, snow storms, and lightning. Wind storms cause branches to snap and tear. Over time the tree will lose its strength to protect itself from disease and insects. Snow storms and ice storms add an unbearable amount of weight to the tree that many snap and break. While some trees can withstand the damage, others will be killed during an ice storm. Lighting is similar in that it can snap and tear branches, but it can also shed the tree of its bark. A healthy bark is a tree's main defense from disease and insect, thus a damaged trunk exposes a tree to further affliction.

Urban forests can be threatened by fires as well. Wildlifes are more likely to occur in heavily populated and developed areas such as cities. The City of Canandaigua is in a Non Fire District, meaning that wildfires are not managed by New York State[47]. The majority of wildfire occurrences in New York are caused by humans (95%), debris burning (33%), incendiary fires (16%), and campfires (16%). Building fires also pose a threat to street trees if they are in close enough proximity to the burning.

Disease and Insects

The current diseases and insects that are affecting New York State trees include, emerald ash borer, gypsy moth, hemlock woolly adelgid, beech leaf disease, and oak wilt disease[48]. Sirex woodwasp, southern pine beetle, spotted lanternfly, and tent caterpillars are other invasive insects that are threatening New York trees, but they are not currently found in Western New York.

Invasive insects continue to be one of the greatest threats to New York forests. The emerald ash borer is an invasive beetle from Asia that kills North American Ash species. The insect flies short distances, meaning it travels long distances through ash firewood and nursery stock. They burrow through the trunk and eat away at the tree's interior trunk growth, killing it from the inside. The only way to remove emerald ash borer from an infested tree is to use pesticide or remove the tree entirely.

---

[47] Wildfires (2021). *New York State: Department of Environmental Conservation.* Retrieved from: 4975.html on September 6th, 2021.
[48] Forest Health (2021). *New York State: Department of Environmental Conservation.* Retrieved from: 4969.html on September 6th, 2021.

Gypsy moths are another common invasive insect of New York that originated in France. In the summer of 2021, there was a caterpillar outbreak, with increasing damage to deciduous leaves. While oak is the gypsy moth's preferred species, they will infest many other deciduous varieties such as maples, willow, birch, apple, and many more. When a tree loses its leaves too early for consecutive years, it opens the tree up to receive other diseases and insects. Due to their current infestation, gypsy moths cannot be neutralized in large forested areas.

The hemlock woolly adelgid is a small insect from Asia that infests eastern hemlocks. The insect feeds off of the trees nutrients, and within 4 to 10 years the tree is killed. Other hemlocks are also vulnerable to infestation but not commonly killed. Hemlocks are vital to New York States ecological health because their canopy protects many indigenous wildlife living in New York. Hemlock aslo minimize erosion and their shade, when found near water, provide temperature control to fish. Infested trees can be treated with insecticide or be removed. New York State is releasing specific silverflies and beetles that eat the hemlock woolly adelgid and are finding it successful in the Catskills and Finger Lakes Region.

There are only two diseases threatening New York trees currently, the beech leaf disease and oak wilt disease. The beech disease has not been seen in Ontario county yet, but in 2021 was found in Livingston and Cayuga counties. The disease can kill a mature beech tree within 6-10 years and a youth in as little as a year. Infested trees have wilting and yellow leaves that drop early and in some cases, branches do not bud. Beech trees are indigenous to New York and vital to the ecosystem. They provide nuts and a nesting site for local wildlife. At this time there is no way to treat and control the beech leaf disease.

The oak wilt disease is threatening red and white oaks that are indigenous to New York. The disease is a fungus that blocks the nutrients and water from reaching the crown of the tree. Without the proper nutrients to survive, the red oaks will die within weeks to months and spread to other trees, and white oaks can die within a few years, but will not spread to other trees. A tree that is infested will have wilted and brown leaves and branches start to die back and drop their leaves. Canandaigua is one of the few locations that oak wilt disease has been found in New York. New York is managing the threat by removing diseased trees and creating oak-free zones, as well as using root disruption to separate root systems to limit the spread.

Construction/Development

The Tree Advisory Board identified that reconstruction of streets and sidewalks are a great threat to Urban trees in the City of Canandaigua. As noted in the Canandaigua Street Reconstruction: preserving our heritage trees (2012), streets that have already been reconstructed have lost all of their mature street trees. New trees are less likely to thrive in their new conditions because the roots have limited room to expand with 3 feet deep sidewalks[49]. While it is a threat to Urban trees, reconstruction is still necessary for cities to grow and expand.

[49] Merhls, B., Ouimette, L., Poteet, D., & Rhode, T. (2012) Canandaigua Street Reconstruction: preserving our heritage trees. Retrieved from: Canandaigua_Street_Reconstruction_Final_Feb_15_2012.pdf on September 1st, 2021.

RECOMMENDATIONS AND BEST PRACTICES

The City of Canandaigua can include Urban Forestry mitigation and adaptation strategies to the City's climate action plan. Healthy Urban Forests help manage climate threats and are resilient to climate change impacts. By increasing the number of dense wood urban trees within City limits, GHG emissions are reduced because these trees store high amounts of carbon. Other ways to mitigate climate change with Urban trees is to increase the number of trees used for stormwater management and selectively planting trees in street improvement projects.

Tree Selection is vital to maintaining healthy Urban and Community Forests. Limiting the number of single species that are planted will create a diverse and healthy ecosystem. The City of Canandaigua is improving the diversity of Urban trees, but should consider the number of maples that are planted. Planting diverse trees that are pest resistant, indigenous to the region, and drought tolerant will promote a healthy Urban Forest. As well, consider the appropriate trees planted to withstand and retain stormwater in areas that require water retention.

Consistent tree pruning and trimming is important for keeping trees resistant to weather, disease, and insect infestation. Maintenance of Urban trees is no small task, and while the City is required to do this work, as seen in the Lagoon Park Restoration Project, managing these trees and their invasive counterparts can be overwhelming. The City may consider partnerships with local owners, groups, and nonprofits who have a vested interest in protecting Urban and Community Forests. The Tree Advisory Board is one avenue that the City can use to find other local partnerships willing to participate. The Tree Advisory Board and the City of Canandaigua should also consider utilizing or establishing a volunteer-based Urban Forest working group. Such a group can help collect data, promote awareness to Urban and Community forests, increase the number of individuals willing to help in restoration projects, and create social ties.

SECTION 7: CULTURAL AND SCENIC RESOURCES

OVERVIEW

Historic Resources

French missionaries settled in the Ontario County region, including the Canandaigua area, as early as the 1660's. The land was later purchased from the native communities by Oliver Phelps and Nathaniel Gorham of Massachusetts. The Village of Canandaigua, which precedes the City of Canandaigua, was devastated in 1779 by General John Sullivan, under George Washington's orders, in retaliation for raids staged in the area by Seneca warriors and Loyalists. Sullivan's troops later returned to settle in the area.

"Canandaigua became the frontier capital of western New York after a surveyor's error placed Geneva east of the Massachusetts Pre-Emption Line. Canandaigua's position of prominence made it an exciting place. In 1794 the United States government concluded one of its first treaties with the Indians there. The "Pickering Treaty" is still in force and is marked by observances each November 11. Politicians like Gideon Granger and John C. Spencer rose to national prominence. John Swift, Peter B. Porter, and Claudius Victor Boughton became regional heroes in the War of 1812 which raged close by.

Before the Civil War, Ontario County was a hotbed for the social and political reforms of the day....Several stations on the Underground Railroad were established in the county after 1850. The Court House was the scene of several hotly contested trials held under the Fugitive Slave Law. In 1872 a federal court, sitting in Canandaigua, found Susan B. Anthony guilty of violating a federal statute when she voted in Rochester. One of the first true mental hospitals in the state was set up in Canandaigua at Brigham Hall; cited now on the National Register of Historic Places."[50]

The City of Canandaigua is home to numerous historic locations recognized on the National and/or State Historic Site Listings. These locations include:

- Adelaide Avenue School (106-116 Adelaide Avenue)
- Benham House (#280-282 South Main Street)
- Brigham Hall Complex (229 Bristol Street)
- Bemis Street (#123, 125, 106, 126-132, 134
- Bristol Street (#9-81, 38-80)
- Center Street (#198, 200-256, 258 1/2, 201, 203-257)
- Coy Street (#9-13, 15, 24-26)
- Dailey Avenue (#15, 17-21, 23)

[50] https://ontariocountyny.gov/137/County-History

- Fort Hill Avenue (#40)
- Gibson Street (#29-185, 16-232)
- Gorham Street (#6-116, 25-115, 117)
- Howell Street (#15-185, 187, 16, 18-152)
- Niagara Street (#13, 15-19)
- North Main Street (#2-336, 27-335)Park Place (#99, 100-136)
- Phoenix Street (#9-11, 17, 4, 6-20)
- Sly Street (#19, 21-23)
- South Main Street (#29, 33-245, 28, 44-230, 236)
- Cobblestone Manor (#495 North Main Street)
- Granger Cottage (#60 Granger Street)
- Granger Homestead [Francis Granger house](#426 North Main Street)
- Marshall House (#274 Bristol Street)
- Saltonstall Street School (47 Saltonstall Street)
- Sonnenberg Gardens (#151 Charlotte Street)
- Thaddeus Chapin House (#128 Thad Chapin Street)
- U.S. Post Office [YMCA] (#28 N. Main St.) - Listed separately by National Register November 17, 1988
- #426 South Main Street

Ontario County Courthouse

“The Ontario County Courthouse is home to the judicial branch of Ontario County and is rich in local history. The Greek Revival-styled building built in 1858 is an important landmark and distinct part of women's history. On June 17, 1873, suffragette Susan B. Anthony was on trial here for "illegal voting" in a federal election. The trial opened to a packed courtroom and Anthony pleaded innocent to the charges. The presiding judge would not allow Anthony to testify and in fact instructed the all male jury to find her guilty. She was found guilty the next day and fined $100. Anthony's supporters paid the fine, and although Anthony's trial made an important statement, it was still another 48 years before women were able to vote legally in a federal election.”[51]

IMAGE CR1: https://ww2.nycourts.gov/courts/7jd/ontario/index.shtml

[51] https://www.visitfingerlakes.com/listing/ontario-county-courthouse/304/

Granger Homestead and Carriage Barn

The family home of Gideon Granger was built by the former Postmaster General in the early 1800's. Used by multiple generations, the house was eventually sold and renovated to become the Granger Place School for Girls. Today, the home and associated buildings are maintained as a museum and event space used frequently by locals and visitors.[52]

IMAGE CR2[53]

[52] https://www.visitfingerlakes.com/listing/granger-homestead-and-carriage-museum/4911/

[53] *https://www.google.com/url?sa=i&url=https%3A%2F%2Fgrangerhomestead.org%2Fvisit%2F&psig=AOvVaw1oHZrZxH7JFZz67Br36KJs&ust=1633027453885000&source=images&cd=vfe&ved=0CAsQjRxqFwoTCJibrb7rpPMCFQAAAAAdAAAAABAD*

The Canandaigua Lady

“A replica paddleboat from the 1800's, continues the tradition of the steam and paddleboat passenger service that flourished in the 19th century.
Scenic Resources”[54]

IMAGE CR3[55]

[54] *https://www.visitfingerlakes.com/plan-your-trip/finger-lakes-facts/canandaigua-lake/*
[55]https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.visitfingerlakes.com%2Flistings%2Fcanandaigua-lady%2F590%2F&psig=AOvVaw2F_wuPtQMCc5lxgKGyY6jf&ust=1633027491764000&source=images&cd=vfe&ved=0CAsQjRxqFwoTCPCrnM_rpPMCFQAAAAAdAAAAABAD

Scenic Resources

The Finger Lakes region is known for its beautiful scenery. The City of Canandaigua is approximately 4.8 square miles located on the northern shore of Canandaigua Lake. Canandaigua Lake is sixteen miles long and one mile wide with an average depth of 127 ft. Water recreational activities, hiking, and biking are common activities in the City of Canandaigua and Canandaigua Lake. Local highlights include Squaw Island and the City Pier.

IMAGE CR4[56]

[56] https://www.visitfingerlakes.com/plan-your-trip/finger-lakes-facts/canandaigua-lake/

Squaw Island

“Squaw Island is one of two islands located in the Finger Lakes. It is the smallest Fish and Wildlife Management Area in New York State, and is one of the few places in the world where limestone oncolites form. Oncolites, often called "water biscuits," are light, feathery rocks that crack when dried out. The island used to be two square acres but has been drastically shrinking due to weather and erosion. During the Sullivan Campaign in 1779, Squaw Island was used as a place of refuge for Native American Women and children. Today, you can rent kayaks, canoes, and water bikes to paddle out to the island.”[57]

IMAGE CR5[58]

[57] https://www.visitfingerlakes.com/plan-your-trip/finger-lakes-facts/canandaigua-lake/

[58]https://www.google.com/imgres?imgurl=https%3A%2F%2Fhomeinthefingerlakes.com%2Fwp-content%2Fuploads%2F2017%2F07%2FSquaw-Island-1008.jpg&imgrefurl=https%3A%2F%2Fhomeinthefingerlakes.com%2Fsquaw-island-canandaigua-lake%2F&tbnid=y1i6acY8wox0gM&vet=12ahUKEwixjKPp66TzAhUng3IEHfSzBr4QMygBegUIARDNAQ..i&docid=vmz4reU2VP72CM&w=700&h=464&q=squaw%20island&ved=2ahUKEwixjKPp66TzAhUng3IEHfSzBr4QMygBegUIARDNAQ

City Pier

Historic boathouses, built in the mid-1900s to store boats and farm products in transit from Canandaigua Lake steamboats, line the pier and draw artists and photographers.[59]

IMAGES CR6, CR7[60]

[59] https://www.visitfingerlakes.com/plan-your-trip/ontario-county-ny/canandaigua/

[60] *https://www.visitfingerlakes.com/listing/canandaigua-city-pier/566/*

Recreational Resources

The City of Canandaigua is home to thirteen public parks. These parks are described in the March 2016 *Parks Inventory and Master Plan*. The parks' amenities are described below in FIGURE CR1.

City of Canandaigua the Chosen Spot		Atwater Meadows Park	City Pier	Frank Baker Park	Gibson Street Park	Jefferson Memorial Park	Kershaw Park	Lagoon Park	Lakefront Park	Northeast Park	Somenberg Park	Telyea Street Tot Lot	The Commons	Triangle Park
Park Amenities														
Access	Parking		X	X		X	X		X	X	X		X	
	Bus Stop					X								
	Connected to Sidewalks		X	X	X	X	X	X	X		X	X	X	X
	Bike Rack		X	X		X	X[2]		X		X		X	
Utilities & Services	Public Restroom		X	X		X[1]	X			X	X[1]			
	Drinking Fountain(s)		X	X		X	X		X	X	X	X	X	
	Lights		X	X		X	X				X		X	
	Dog Waste Bag Dispenser		X	X		X	X		X	X	X			
	Concession						X							
Picnic & Event Areas	Tables		X	X		X	X		X		X	X	X	
	Grills			X		X	X		X		X			
	Building/Inside Area			X[1]		X[1]					X[1]			
	Pavilion			X			X							
	Gazebo						X							
Sports	Vollyball Court					X					X			
	Basketball Court(s)			X		X					X	X		
	Baseball/Softball Field(s)					X					X			
	Football, Soccer, Lacrosse, Rugby Field(s)			X						X				
	Tennis/Pickelball Court(s)			X							X			
Exercise & Play	Playground			X		X	X				X	X		
	Swing Set			X		X					X	X		
	Swimming Area						X							
	Skate Park					X								
Liesure Activities	Fishing Pier/Outlook(s)						X	X	X					
	Small Craft Boat Launch						X		X					
	Boat Dock(s)								X					
	Benches		X	X	X	X	X		X		X	X		
	Walking Trail(s) OR Walkways	X		X			X	X	X		X			
	Public Art Space (Stage)												X	
MISC	Momument					X	X							X
	Statue						X				X			

FIGURE CR1: City of Canandaigua Park Amenities

"The City of Canandaigua Park's Bureau manages 140 acres of grass turf and several acres of landscaped areas for multiple uses. The types of uses range from grassed areas in front of public buildings that receive little direct use to sports fields that receive intensive use.

"Management of turf and landscaped areas occasionally requires the use of fertilizers to maintain a healthy dense turf along with the use of pesticides to control pests that adversely affect or destroy these areas or, in some cases, negatively impact the park user's enjoyment of these resources. Pesticides may also be used to remove invasive species that have a substantial negative impact on habitat or in some cases are harmful to humans (e.g., Giant Hogweed). On average, the City has applied pesticides to its turf areas every 5 years with a range of 3-8 years

based on the park. According to Cornell Turf Management Researchers this is a very low application frequency"[61]

Despite the opinion of Cornell Turf Management Researches, City of Canandaigua placed a five year moratorium on pesticide application, as set forth in the Turf and Landscape Management, effective June 2, 2016. The City Council finds that a moratorium of five (5) years duration, during which the City Council will study the impacts and controls of pesticide use, "coupled with a mechanism for an 'emergency application' procedure, will achieve an appropriate balancing of interests between the public need to safeguard the resources of the City of Canandaigua and the health, safety, and general welfare of its residents."[62]

DEFINITIONS

Flood - Overflow of the inland resulting in accumulation of water over normally dry land usually caused by heavy rains or levee breaches.

Invasive Species - Non-native species introduced to an area where it becomes established and negatively impacts native flora and fauna.

Cyanobacteria - photosynthetic prokaryotes, one of the oldest known organisms on Earth

IMPORTANCE

"As the western gateway to the Finger Lakes the City of Canandaigua provides an ideal home base for an exciting tourism experience. Indeed, tourism and agriculture rank as the highest income producers in the area.

The City offers outstanding hotel and bed and breakfast accommodations, and world class eateries abound. Within the city limits our historical landmarks lead a growing heritage tourism base.

Speaking of agriculture, Canandaigua is in the center of Finger Lakes wine country. Touring the various wine trails draws thousands each year

[61]https://www.canandaiguanewyork.gov/vertical/sites/%7BA388F052-E1B1-4CA4-8527-A8BB46320BB9%7D/uploads/2016-037A_FINAL__Pesticide_Moratorium.pdf
[62]https://www.canandaiguanewyork.gov/vertical/sites/%7BA388F052-E1B1-4CA4-8527-A8BB46320BB9%7D/uploads/2016-037A_FINAL__Pesticide_Moratorium.pdf

The City of Canandaigua, with pristine Canandaigua Lake at its southern boundary, beckons visitors from throughout the world."[63]

The historical, scenic, and recreational resources located within the City of Canandaigua support the tourism industry, which many local businesses and residents depend on.

THREATS

Invasive species

Many of the scenic resources in the City of Canandaigua rely on the health of Canandaigua Lake. The Canandaigua Lake Association states that fourteen aquatic invasive species have entered Lake Canandaigua. The most recognized being invasive mussels which "displace native species, attach to and cover many surfaces, have sharp shells, and are a nuisance to humans. Although they have some predators, they breed faster than they can be consumed. As filter feeders, they remove particles from the water, affecting the clarity, content, and ultimately the food chain of aquatic ecosystems." The introduction and establishment of zebra mussels to Canandaigua Lake saw a clarification of the lake waters. While beneficial for swimming, this clarification has many ecological impacts including a decrease in nutrients and represents the decline of native species.[64]

IMAGE CR7[65]

[63]https://www.canandaiguanewyork.gov/index.asp?Type=B_LOC&SEC=%7B95930CFF-8241-4B14-900D-9E2D0A616C11%7D
[64] http://fingerlakesinvasives.org/invasive_species/zebra-mussel/
[65]https://www.google.com/url?sa=i&url=http%3A%2F%2Ffingerlakesinvasives.org%2Finvasive_species%2Fzebra-mussel%2F&psig=AOvVaw3hvZfI0oPXw8FQUnnQ-3Fh&ust=1633028048113000&source=images&cd=vfe&ved=0CAsQjRxqFwoTCNCEvNvtpPMCFQAAAAAdAAAAABAD

Algae Blooms

Cyanobacteria, commonly referred to as blue green algae or harmful algae blooms (HABs), occur throughout the region. This bacteria can be “harmful to human and animal health and degrade...water quality”. HABs are instigated and worsened by:

- Phosphorus and nitrogen inputs in stormwater runoff
- Calm, sunny weather conditions
- Invasive species altering ecosystems, namely invasive mussels which don’t filter cyanobacteria out of the water.[66]

Flooding

Floods are the most common (and among the most deadly) natural disasters in the United States...As global warming continues to exacerbate...extreme weather, our nation’s floodplains are expected to grow by approximately 45 percent by century’s end.[67] The Canandaigua Lake Watershed has recently experienced such flooding resulting in damage to roads, private property, and public spaces.[68]

“Flooding also brings contamination and disease. Floodwaters can carry raw sewage, leaked toxic chemicals, and runoff from hazardous waste sites and factory farms. They can pollute drinking water supplies and cause eye, ear, skin, and gastrointestinal infections. When floodwaters recede, bacteria and mold may remain, increasing rates of respiratory illnesses, such as asthma. Flooding can also contribute to mental health problems, lead to economic loss (as in the form of lost business or wages), and uproot whole communities.”[69]

[66] https://www.canandaigualakeassoc.org/water-quality/harmful-algal-blooms/
[67] https://www.nrdc.org/stories/flooding-and-climate-change-everything-you-need-know
[68] https://www.canandaigualake.org/copy-of-setting
[69] https://www.nrdc.org/stories/flooding-and-climate-change-everything-you-need-know

RECOMMENDATIONS AND BEST PRACTICES

There is little to be done to reverse the establishment of invasive species. Oftentimes, as in the case of invasive mussels, manual removal is the most effective retroactive action. Alternatively, a proactive approach to prevent the establishment of an invasive species is best. It is a best practice to encourage and communicate requirements to clean boats, fishing gear, and other materials which has made contact with the water. This is especially true for materials used in other bodies of freshwater prior to being used at Canandaigua Lake.[70]

Nutrients which feed HABs originate in the watershed before accumulating in the lake. Sources may include the abundant farmland in the area and run-off from residential lawns treated with pesticides and/or fertilizers. Reducing nutrients entering the watershed is the only approach to minimize algae blooms. Programs discouraging or banning the use of chemical fertilizers in some or all applications is best practice. Alternatively, reducing stormwater runoff through a municipal stormwater treatment facility could be considered. A lower cost and more immediate approach would be to incentivise rain gardens, planting native species in green spaces, and reducing non-permeable surfaces. These systems reduce the volume of stormwater runoff, and therefore nutrients, entering Canandaigua Lake.[71]

“The Canandaigua Lake Watershed Council is working with local municipal agencies to build more flood resiliency in our infrastructure by replacing culverts and stabilizing road banks. The Council is also implementing projects throughout the watershed to help prevent future flooding, such as building rain gardens, restoring wetlands, and protecting open space.”[72]

[70] http://fingerlakesinvasives.org/invasive_species/zebra-mussel/
[71] https://www.canandaigualakeassoc.org/water-quality/harmful-algal-blooms/
[72] https://www.canandaigualake.org/copy-of-setting

SECTION 8: LAND USE

OVERVIEW

Zoning and tax parcel maps are used to identify areas within the given boundary that are protected or otherwise preoccupied. A zoning map is a reference to the land use of the City of Canandaigua and tax parcel maps help in the development of protection and mitigation plans.

In 2018, the City of Canandaigua developed architectural standards that consider design, orientation, adjacency to water, materials used, lighting and more. The standards protect the heritage of the city as well as[73]:

- Stabilize and improve properties and values.
- Foster civic pride.
- Strengthen the local economy.
- Promote the use of historic districts, buildings and structures for the education, pleasure and welfare of the citizens of the City.

Code 850-10 for the City of Canandaigua states that natural resources shall be protected and no person should remove natural features or topsoil unless for construction. As well, natural gas extraction shall not be permitted unless approved. Other ordinances that the city established include historic preservation and boathouse regulations. Projects that have been approved by the zoning board are the lakeshore development, Cottages at Canandaigua, Inn on the lake, and Legion Heights.

The existing regulations and standards set in place by the city are described here in more detail to best assess the current use of the land. Once land use is established, best practices are developed to improve future land use. This will ensure that best practices are in place to benefit the community and the environment.

[73] City of Canandaigua Architectural Standards (2018). *Chapter 850 Zoning*. Retrieved from CA2661-850c Architectural Standards.pdf on October 23, 2021.

DEFINITIONS

Adverse Impact- A negative consequence for the physical, social, or economic environment resulting from an action or project.

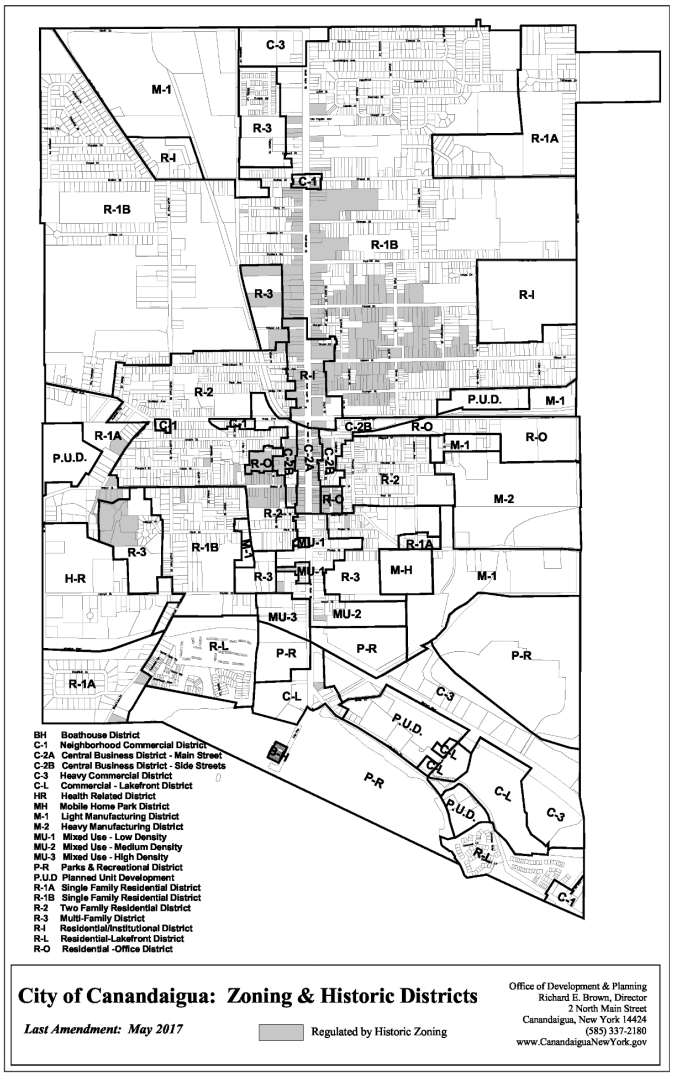
Built Environment- Buildings, roads, parks, and all other improvements constructed by people that form the physical character of a community.

Carrying Capacity- (1) The level of land use, human activity, or development for a specific area that can be accommodated permanently without an irreversible change in the quality of air, water, land, or plant and animal habitats. (2) The upper limits of development beyond which the quality of human life, health, welfare, safety, or community character within an area will be impaired. (3) The maximum level of development allowable under current zoning.

NWI- National Wetlands Inventory

LAND USE

The City of Canandaigua last updated their zoning map in May 2017 (see Map LU1). The map is parceled out by district and density zones. The main categories are parks and recreation, residential, commercial, manufacturing, and mixed-use. Most districts in the city are residential, particularly in the north end. The south end of the city is made up of commercial and business districts, parks and recreation, and a few residential.

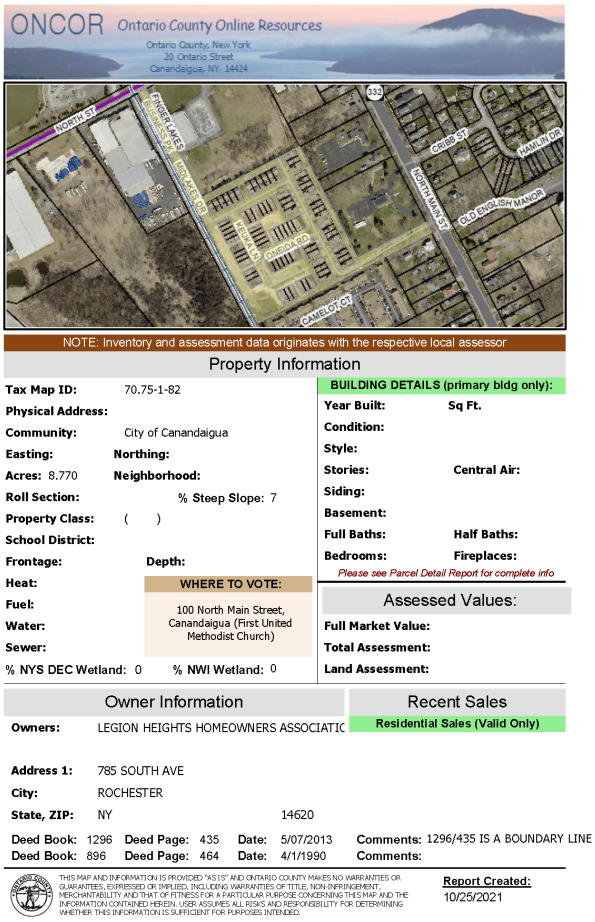


MAP LU1: 2017, Zoning Map[74]

[74] index.asp

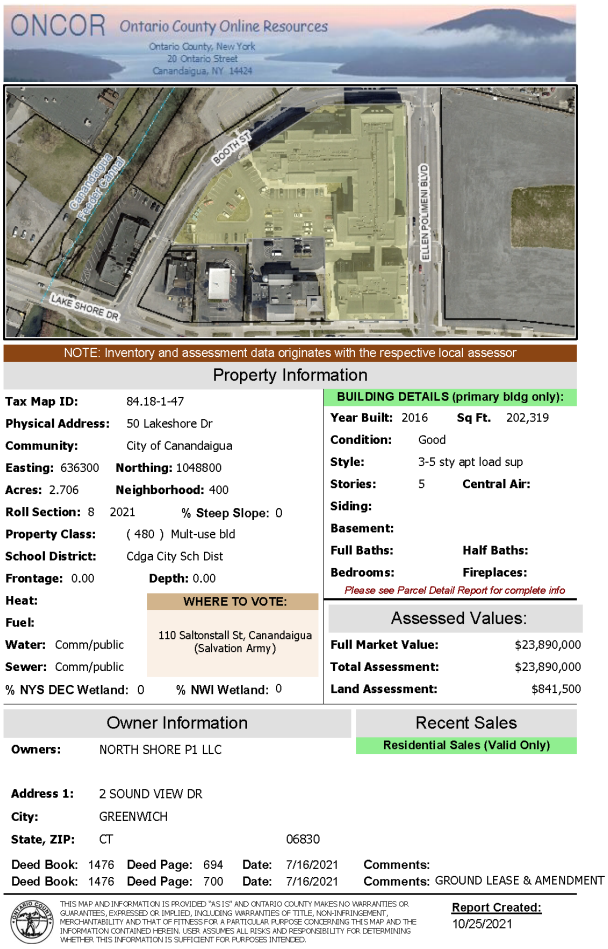
Approved Project Development

The legion heights development project was approved in 1988 for 81 townhomes. In 2020, the planning commission approved 2 more townhomes to the original design. The Map LU2 shows that there is no known wetland on the property and there is a slight slope. The amendment to the original plan is not significant enough to pose a threat to the capacity of the given land.



MAP LU2: 2021, developed using Geocortex Viewer

The planned unit development project that is now known as the lakeshore development, was approved in 2013. The project adds 450 residential units as well as thousands of square feet for commercial use. The project changes the once vacant land, into a tourist and residential upgrade to the lakefront location. A portion of the project is complete and phase 2 is currently being implemented. There are 6 more phases to the project after phase 2 is completed. The LU map 3 is only a fraction of the 34 acre lakeshore development plan.

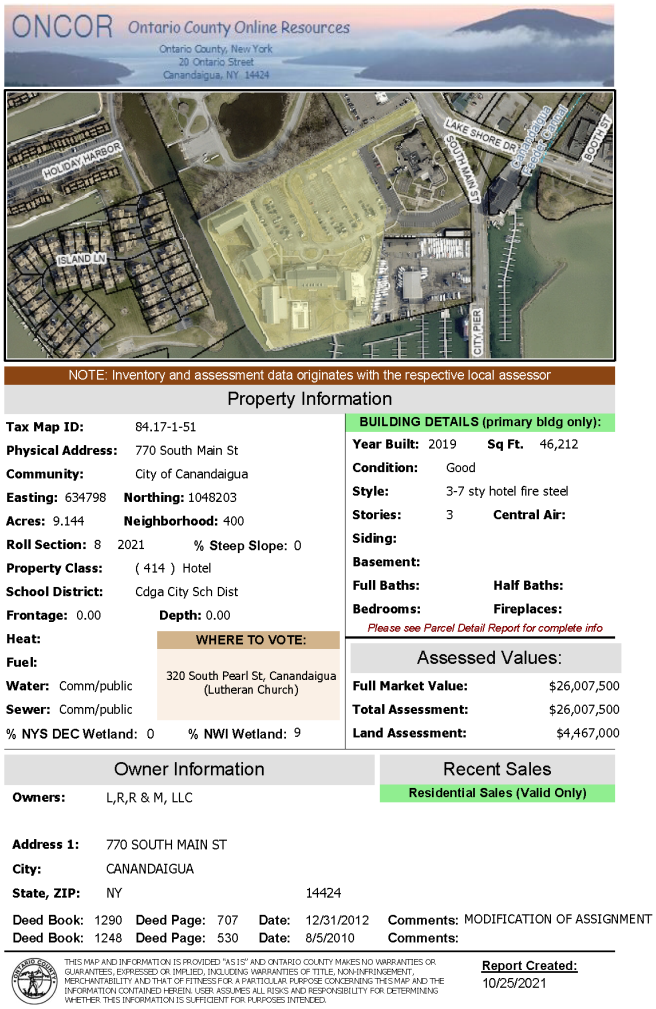


MAP LU3: 2021, developed using Geocortex Viewer

There were many revisions done to the plan before its approval in 2013. Examples of the revisions include more green and open spaces, saving existing trees, planting wetland friendly vegetation, stormwater retention, and 1.6 acres of added parks and recreation[75]. Wetland vegetation is of concern due to the proximity of the wetland reserve and the importance of maintaining the existing ecosystem. Also, creating green spaces are recommended so as to not rely heavily on Kershaw Park which is directly south of the lakeshore development. The environmental revisions to the lakeshore development plan are examples of recommendations and best practices that should be used in all planning and zoning applications.

The Inn on the Lake is another example of a recently approved development project that encourages tourism. In 2018, the plan was approved to demolish the old hotel and rebuild an Inn, restaurant, bar, and event space. The site is on a small percentage of NWI wetlands (Map LU4) and sits directly off of the lake and western flood channel. No resources were found on the site plans revisions.

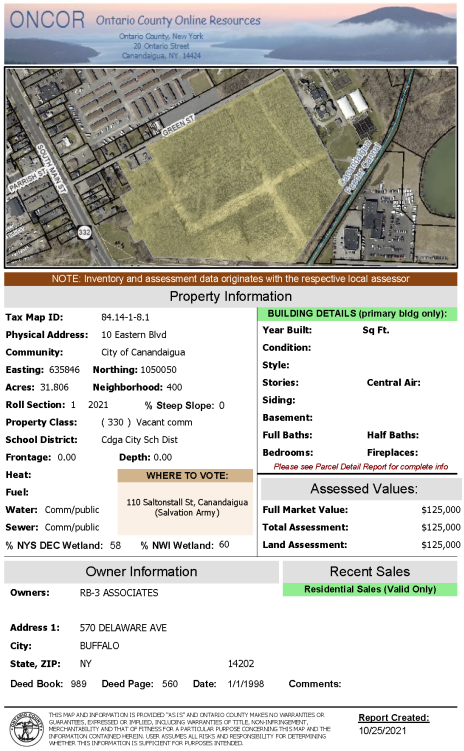
[75] Canandaigua City Council (2010). *City of Canandaigua.* Final Environmental Impact Statement for the Canandaigua Lakefront Planned Unit Development. Retrieved from FEIS.05-13.2010.pdf on October 25, 2020.



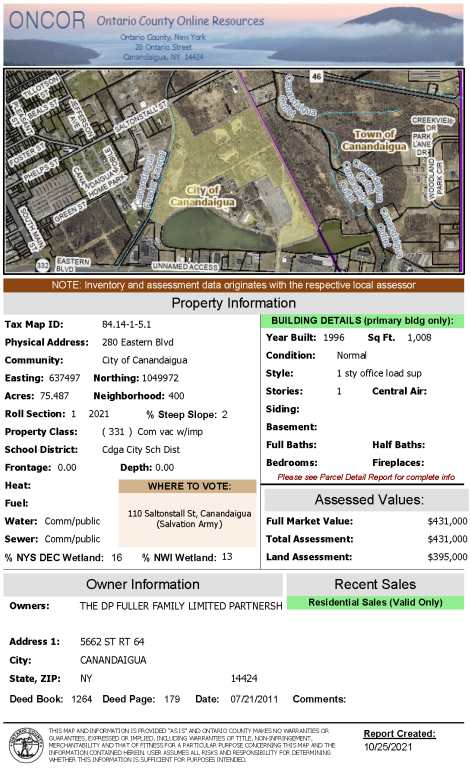
MAP LU4: 2021, developed using Geocortex Viewer

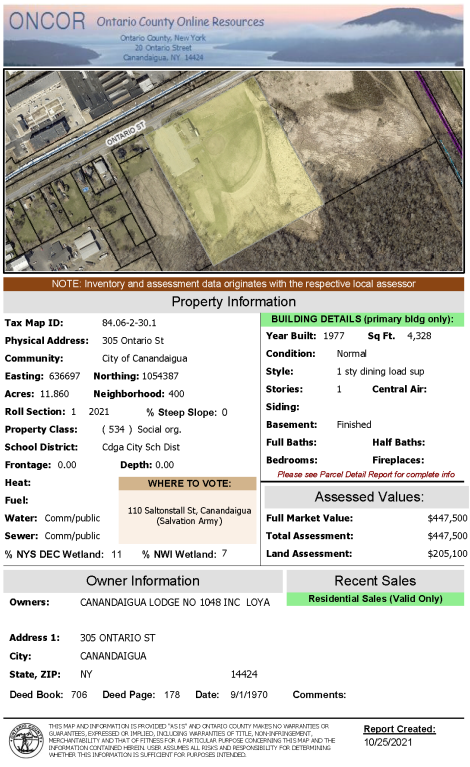
<u>Underdeveloped Land</u>

LU maps 5-7 are examples of large areas of almost vacant land that are privately owned. These parcels of land either are partial wetlands, are forested, or are bare. Identifying similar areas and marking them for land protection sites may be important to consider. The increase of development projects to promote population increase and tourism should be offset with land protection and rehabilitation projects so as to not create threats to the community and environment.



MAP LU5: 2021, developed using Geocortex Viewer





MAP LU6 (left) and **MAP LU7** (right), 2021, developed using Geocortex Viewer

IMPORTANCE

The carrying capacity considers the limits to a given area that will overwhelm the environment. Limits may include development, population size, resource extraction, farming, and tourism to name a few. When any of these categories are over produced, the environment becomes vulnerable to threats. When a community considers the carrying capacity of the given area, land protection and preservation programs and other best practices can be implemented. Zoning and land use planning is a way to regulate the carrying capacity so as to minimize the risk of creating an unstable environment.

The importance to land use planning include[76]:

- Provides a beneficial framework for the development of a project before development officially begins
- Helps to anticipate the future of a particular area, which allows developers to implement an infrastructure that acts as risk mitigation
- Effective land-use planning positively impacts the urban economy
- Can assist in putting measures in place to combat climate change
- Promotes better use and conservation of natural resources, along with protecting the environment
- Prevents development in areas that have a high risk of natural hazards
- Protects lands from negative impacts of transportation while reducing exposure to pollution and costs
- Minimizes the public health and safety risks for the local community
- Prevents land use conflicts

[76] Pickett, Ray, and Silver (2021). *Why Land Use PLanning is Critical for Development*. Retrieved from why-land-use-planning-is-critical-for-development on October 25, 2021.

THREATS

Tourism

Tourism is an increasing threat to land use in the City of Canandaigua. While tourism is necessary for the overall improvement and well-being of the city, it is important to balance the growth of commercial tourism with recreational tourism that does not hinder the local environment. Two of the three most recent zoning approval projects in the city were approved with the means of increasing tourism. Keeping this in mind, land use planning recommendations should fine tune tourist focused projects before approval.

Development

With The growth of tourism and the residential population comes development projects. Similar to tourism, development is vital for the improvement and wellbeing of the city and its residents. This does not mean that development should be valued about environmental and community wellbeing. As such, it is important to handle under developed land properly and consider the threats that over development can have on the environment which includes climate change, invasive species, flooding, and others mentioned in the land cover, habitats, and wildlife section and the urban and community forests section.

RECOMMENDATIONS AND BEST PRACTICES

In order to minimize threats on the carrying capacity of the City of Canandaigua that include tourism and development, recommendations fall mainly to the city and boards set in place to review development applications. Before zoning and planning applications are approved they should be filtered and revised through not only a planning commission but also conservation, preservation, historic, and tree committees and boards. Not only does this method go through multiple revision phases, it also is seen by more individuals of the community before it is finalized and being built.

The city should consider protecting more green and open spaces that are currently vacant. Both vegetative and rehabilitation spaces are valuable spaces to revitalize to balance the development being done in the south end of the city. There are limited parks and protected areas in the north end of the city currently.

Lastly, the city can place a limit on new development projects within the city boundary. This does not include refurbishing spaces and improving historic buildings. Limiting the number of new development projects will help stabilize the carrying capacity of the city.

SECTION 9: DARK SKIES

OVERVIEW

Light pollution is the only pollution that can be eliminated almost simultaneously when lights are regulated. The City of Canandaigua is gradually improving their venues and attractions as described in the Land Use section. With such infrastructure comes more night lighting. Dark sky is the natural light that is emulated by the stars and moon. The natural habitat is accustomed to dark skies and when light pollution occurs, the local wildlife are affected as well as community members. The Dark Skies Image is an example of the effect that one safety light has on the surrounding environment.

IMAGE DS1: Dark Skies Image, International Dark-Sky Association, 2021

The three main types of light pollution are glare, skyglow, and light trespass. Glare is uncomfortable and can be unsafe for pedestrians. Light trespass is when unwanted light enters one's home, and skyglow is the accumulation of light glowing in high populated areas[77]. Types of Pollution Figure shows the way in which a street light can emit all three types of light pollution.

[77] What is Light Pollution? (2021) *Globe at Night.* Retrieved from light-pollution.php on October 9, 2021.

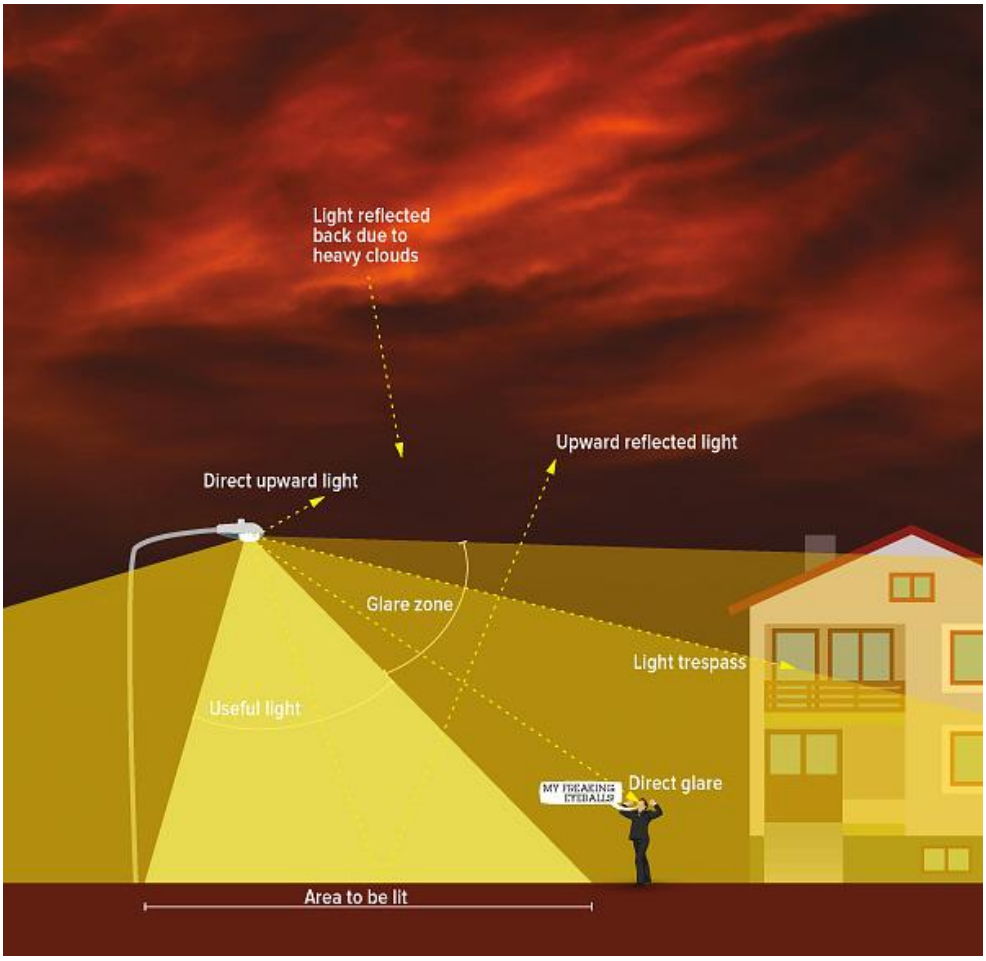


FIGURE DS1: Types of Light Pollution Image, International Dark-Sky Association, 2021

DEFINITIONS

Light Pollution- the inappropriate or excessive use of artificial light

Glare- excessive brightness that causes visual discomfort

Skyglow- brightening of the night sky over inhabited areas

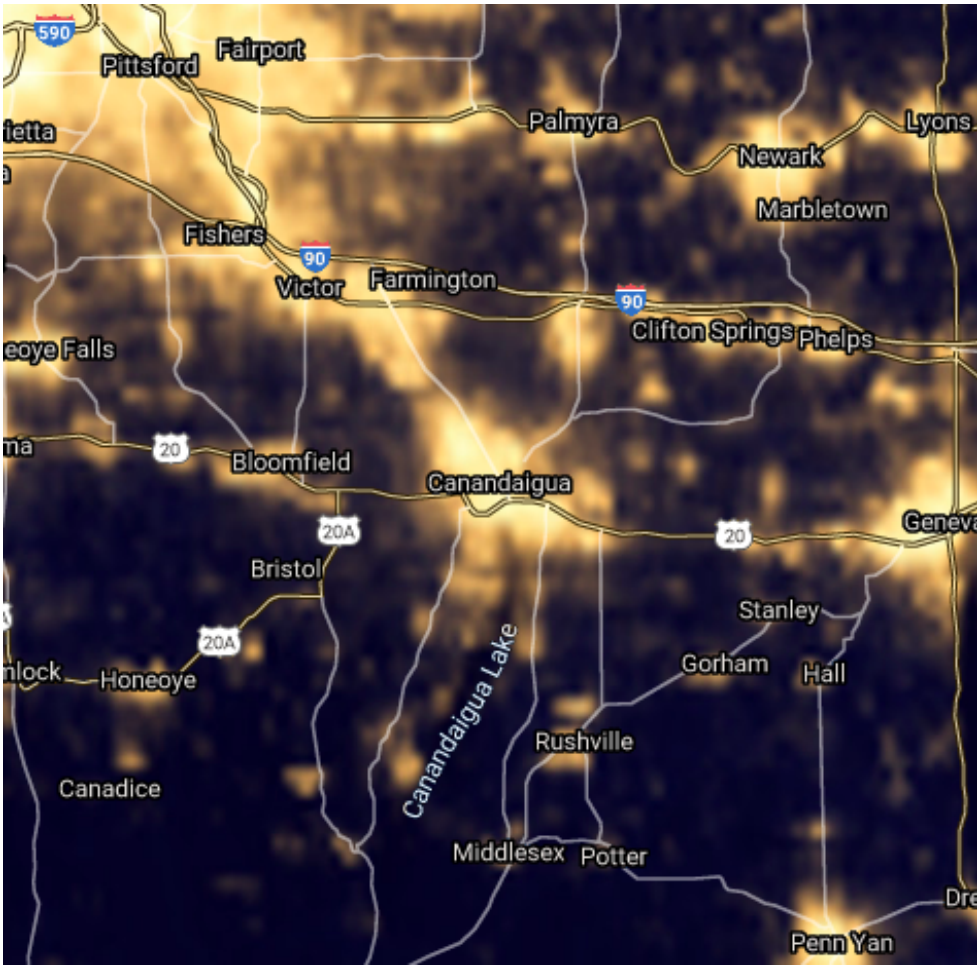
Light Trespass- light falling where is not intended or needed

Clutter- bright, confusing, and excessive groupings of light sources

Circadian Rhythm- is a natural, internal process that regulates the sleep–wake cycle and repeats roughly every 24 hours.

DARK SKIES

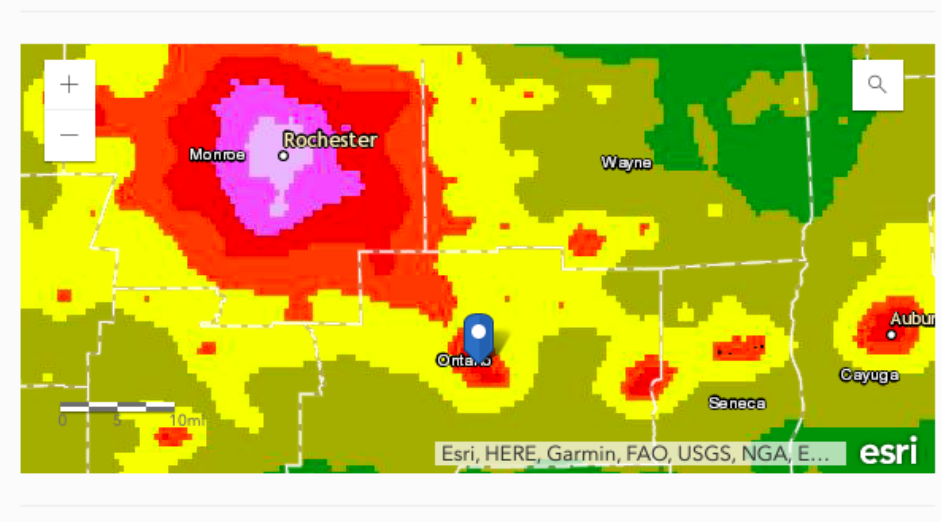
The Interactive map from NASA uses google to display a top view of the earth's night sky. The map includes city and town lights visible at night. Although the image is not clear in resolution, it is clear to see that the City of Canandaigua has plenty of light pollution, similar to Geneva and Pittsford's light pollution.



MAP DS1: NASA Blue Marble Navigator, 2012

The artificial lights map is developed by research completed in June of 2021[78]. The brighter the light, the less you will be able to see the night sky. The brightest light is white meaning it has the greatest amount of light pollution. A lack of artificial light is purple to black which is mainly seen in the National Parks. As seen in the artificial light map (MAP DS2), Rochester, at its brightest, is pink, and the City of Canandaigua is red. Using the legend, red is the fourth brightest artificial light on the spectrum.

[78] Artificial Lights Map (2021) The New World Atlas of Artificial Sky Brightness. *Cires.* Retrieved from artificial-sky on October 9, 2021.



MAP DS2: Artificial Lights Map, 2021

Ratio to natural brightness	Artificial brightness (μcd/m²)	Approximate total brightness (mcd/m²)	Color	
<0.01	<1.74	<0.176	Black	
0.01–0.02	1.74–3.48	0.176–0.177	Dark gray	
>0.02–0.04	>3.48–6.96	>0.177–0.181	Gray	
>0.04–0.08	>6.96–13.9	>0.181–0.188	Dark blue	
>0.08–0.16	>13.9–27.8	>0.188–0.202	Blue	
>0.16–0.32	>27.8–55.7	>0.202–0.230	Light blue	
>0.32–0.64	>55.7–111	>0.230–0.285	Dark green	
>0.64–1.28	>111–223	>0.285–0.397	Green	
>1.28–2.56	>223–445	>0.397–0.619	Yellow	
>2.56–5.12	>445–890	>0.619–1.065	Orange	
>5.12–10.2	>890–1780	1.07–1.96	Red	
>10.2–20.5	>1780–3560	>1.96–3.74	Magenta	
>20.5–41	>3560–7130	>3.74–7.30	Pink	
>41	>7130	>7.30	White	

MAP DS3: Artificial Lights Map Legend, 2021

IMPORTANCE

As stated in Globe at Night, what is light pollution (2021), “Too much light pollution has consequences: it washes out starlight in the night sky, interferes with astronomical research, disrupts ecosystems, has adverse health effects and wastes energy.” With these consequences in mind, the threats identified to dark skies are habitat disruption, human health risk, and energy usage.

THREATS

Habitat Disruption

The natural world functions with both light and dark; both day and night. The cyclical ecosystem requires that animals get proper sleep and plants are given a break from light. Light pollution is a direct threat to the health of the entire natural system. Nocturnal animals especially are affected by the disruption in dark skies. Night time is their time to hunt, but artificial light confuses their sleeping schedule. As well, migratory birds are not accustomed to the change and thus their migration pattern is affected. Lastly, while predators use the daytime to hunt, the nighttime is for prey to get relief from the predator.

Human Health Risk

Human health is also at risk due to light pollution. Both the circadian rhythm and melatonin production require day and night to function properly. When humans attempt to sleep and light trespass enters the room, the natural 24 hour cycle of wake to sleep is altered. When both the rhythm and melatonin are off balance, humans can have side effects that include sleep disorders, headaches, fatigue, stress, and anxiety[79]. It has also been found that blue light is more harmful to humans than other artificial lights[80]. LED lights emit blue light and are found in technological devices as well as outdoor lighting.

Energy Usage

Lighting is one-fourth of the world's energy usage[81] which includes outdoor lighting and around 30% of outdoor light in the United States is wasted[82]. We typically think of turning off lights in our home when the space is not being used. That method should also be considered for outdoor lighting to save on energy usage.

[79] What is Light Pollution? (2021) *Globe at Night.* Retrieved from light-pollution.php on October 9, 2021.
[80] Human Health (2021) *International Dark-Sky Association.* Retrieved from human-health on October 10 2021.
[81] SAME AS 79
[82] Light Pollution Wastes Energy and Money (2021) *International Dark-Sky Association.* Retrieved from energy-waste on October 10, 2021.

RECOMMENDATIONS AND BEST PRACTICES

Similar to the Town of Canandaigua, the City of Canandaigua should consider implementing a light pollution law. The law can manage business lights, recreational facilities lights, shielding lights that are required to stay on, light pole maximum length, maximum light trespass limits, and the use of white lights. With light laws set in place threats to the natural habitat, human health, and energy cost are all minimized.

Community organizations and public announcements can promote residential light management as well. As seen in the dark skies image (2021), residents can mitigate light pollution by turning off or putting their garage lights and any other outdoor lights on a timer. Individuals have the ability to improve light pollution on a small scale which makes a large scale difference.

ALL ADDITIONAL REFERENCES CITED

(2021) County and Community Maps; community roads map city of canandaigua. *Ontario County New York.* Accessed on September 25, 2021 County-and-Municipal-Maps

(2021) Canandaigua, New York. *Flood Factor.* Accessed on September 25, 2021 3612144_fsid

"Brittle Structures of New York". *New York State Museum.* Accessed 15 November 2021. http://search.its.ny.gov/search/nysed.html?q=brittle+structures&site=nysed_museum_collection&client=nysed_museum_frontend&proxystylesheet=nysed_museum_frontend&output=xml_no_dtd&getfields=exclude\

Cadwell, D.H., and others. "1986 Surficial Geologic Map of New York", *New York State Museum - Geological Survey*, Map and Chart Series #40. Accessed 15 November 2021. http://www.nysm.nysed.gov/common/nysm/files/surf_fingerlakes.jpg

Denny, Charles S., and Walter H. Lyford. "Surficial Geology and Soils of the Elmira - Williamsport Region, New York and Pennsylvania" *Geological Survey Professional Paper 379*. 1963. Accessed 15 November 2021. https://pubs.usgs.gov/pp/0379/report.pdf

FEMA. "Earthquake Hazards". *FEMA Risk Management.* 4 August 2020. Accessed 15 November 2021. https://www.fema.gov/emergency-managers/risk-management/earthquake/hazard-maps

Orr, Steve. "Canandaigua Joins Fracking Ban" *Democrat and Chronicle.* June 6, 2014. Accessed 15 November 2021. https://www.democratandchronicle.com/story/news/2014/06/06/canandaigua-fracking-ban/10079289/

Rickard, Lawrence V., and Donald W. Fisher. "The Geologic Map of New York: Finger Lakes Sheet" *Geologic Survey, 1970.* Accessed 15 November 2021. http://www.nysm.nysed.gov/common/nysm/files/finger_lakes_bedrock_sheet.jpg

Checklist of Amphibians... vertchklst0410.pdf

Wildlife Management Unit Boundary Map wmutownmap09.pdf

Biodiversity and Species Conservation 279.html

Nuisance and Invasive Species (2021) department of Environmental Services 265.html
Fish and Wildlife, 2017 fish-wildlife

Canandaigua Lake, 2021 25578.html

2017, Canandaigua Lake Watershed Council setting

Gambrel, E. (2019). Wetland Plants & Wildlife. Sciencing. Wetland-plants-wildlife-8254793.html

Ontario County GIS Mapping index.html

New York Nature Explorer (2021) Department of Environmental Services town

2021 Interactive Bloom Map (2021) Canandaigua Lake Watershed Association shoreline-habs-monitoring

Shoreline Habs Monitoring (2021) Canandaigua Lake Watershed Association shoreline-habs-monitoring

August 16, 2014: Streetscape Tour (2014). Canandaigua Botanical Society. Our-next-event.html

UNEP. Ecosystems and Biodiversity: The Role of Cities. Retrieved from: unhab40.pdf

Water Treatment Facility 2015 Quality Report (2015). *The City of Canandaigua.* Retrieved from 2015WaterReport.pdf on October 3, 2021

Water Treatment Facility 2020 Quality Report (2020). *The City of Canandaigua.* Retrieved from Water_Report_2020.pdf on October 3, 2021

Comprehensive Update of the Canandaigua Lake Watershed Management Plan (2014). *Canandaigua Lake Watershed Council.* Retrieved from Watershed-Plan_public_12-20.pdf on October 2, 2021.

City of Canandaigua Water Resource Recovery Facility Disinfection (2021). *The City of Canandaigua.* Retrieved from 310374 on October 2, 2021.

Resource Recovery (2020). *Water Environment Federation.* Retrieved from resource-recovery on October 9, 2021.

Water Quality Risks to Lakes and Rivers (2014). *National Climate Assessment.* Retrieved from water-quality-risks-lakes-and-rivers on October 9, 2021.

Talbot. C, et al. (2018). The impact of flooding on aquatic ecosystem services. *Biogeochemistry* (141): 439-461. Retrieved from https://doi.org/10.1007/s10533-018-0449-7 on October 9, 2021.

Water Monitoring for Canandaigua Lake Figure, 2020, Water_Report_2020.pdf

Water Monitoring for Canandaigua Lake Figure, 2015, 2015WaterReport.pdf

Threats caused by Flooding Figure, 2018, pp 441 https://doi.org/10.1007/s10533-018-0449-7

Canandaigua Main Street Streetscape Tour (July, 2014). *Canandaigua Botanical Society.* Retrieved from: our-next-event_19.html on September 6th, 2021.

Lagoon Park Restoration Project (June, 2013). *Canandaigua Botanical Society.* Retrieved from: lagoon-park-restoration-update.html on September 5th, 2021.

Lakefront Park (2015). *City of Canandaigua: the chosen spot.* Retrieved from: index.asp on September 4th, 2021.

Mehls, B., Ouimette, L., Poteet, D., Rhode, T., & Ticonchunk, B. (2013). Urban Forest Master Plan. Retrieved from: Appendix.A06.Urban_Forest_Master_Plan_Final_Submission_with_Appendices_6-13-13.pdf on September 1st, 2021.

Parks Inventory and Master Plan (2016). *City of Canandaigua: the chosen spot.* Retrieved from: Parks_Master_Plan_3.3.2016.pdf on September 1st, 2021.

Merhls, B., Ouimette, L., Poteet, D., & Rhode, T. (2012) Canandaigua Street Reconstruction: preserving our heritage trees. Retrieved from: Canandaigua_Street_Reconstruction_Final_Feb_15_2012.pdf on September 1st, 2021.

Urban Forests (2021). *Forest Service: US Department of Agriculture.* Retrieved from: urban-forests on September 6th, 2021.

Wildfires (2021). *New York State: Department of Environmental Conservation.* Retrieved from: 4975.html on September 6th, 2021.

Forest Health (2021). *New York State: Department of Environmental Conservation.* Retrieved from: 4969.html on September 6th, 2021.

City of Canandaigua Architectural Standards (2018). *Chapter 850 Zoning*. Retrieved from CA2661-850c Architectural Standards.pdf on October 23, 2021.

Pickett, Ray, and Silver (2021). *Why Land Use PLanning is Critical for Development*. Retrieved from why-land-use-planning-is-critical-for-development on October 25, 2021.

Canandaigua City Council (2010). *City of Canandaigua.* Final Environmental Impact Statement for the Canandaigua Lakefront Planned Unit Development. Retrieved from FEIS.05-13.2010.pdf on October 25, 2020.

LU Map 1 (2017). *Zoning Map*. City of Canandaigua. Retrieved from index.asp on October 3, 2021.

LU Map 2-7 (2021). *Geocortex Viewer*. Ontario County Online Resources. Created with index.html on October 25, 2021.

Dark Skies Image (2021) Light Pollution. *International Dark-Sky Association.* Retrieved from light-pollution on October 9, 2021.

Types of Light Pollution Image (2021) Light Pollution. *International Dark-Sky Association*. Retrieved from light-pollution on October 9, 2021.

NASA Blue Marble Navigator (2012) *Blue Marble.* Retrieved from 2012 on October 9, 2021.

Light Pollution (2021). *International Dark-Sky Association.* Retrieved from light-pollution on October 9, 2021.

Artificial Lights Map (2021) The New World Atlas of Artificial Sky Brightness. *Cires.* Retrieved from artificial-sky on October 9, 2021.

What is Light Pollution? (2021) *Globe at Night.* Retrieved from light-pollution.php on October 9, 2021.

Human Health (2021) *International Dark-Sky Association.* Retrieved from human-health on October 10 2021.

Light Pollution Wastes Energy and Money (2021) *International Dark-Sky Association.* Retrieved from energy-waste on October 10, 2021.