4.3.3 Drought

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the drought hazard in Rockland County.

Hazard Description

A drought is a period of unusually constant dry weather that persists long enough to cause deficiencies in water supply (surface or underground) that can last a short period or for many years. Droughts are slow-onset hazards, but, over time, they can severely affect crops, municipal water supplies, recreational resources, and wildlife. If drought conditions extend over several years, the direct and indirect economic impacts can be significant. High temperatures, high winds, and low humidity can worsen drought conditions and make areas more susceptible to wildfire. In addition, human actions and demands for water resources can accelerate drought-related impacts (MitigateNY 2018).

Droughts can be categorized as one or more of the following four types (National Drought Mitigation Center 2023):

- ***Meteorological*** drought is a measure of departure of precipitation from normal. It is defined solely on the relative degree of dryness. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.
- ***Agricultural*** drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, and other parameters. It occurs when there is not enough water available for a particular crop to grow at a particular time. Agricultural drought is defined in terms of soil moisture deficiencies relative to water demands of plant life, primarily crops.
- ***Hydrological*** drought is associated with the effects of periods of precipitation shortfalls (including snowfall) on surface or subsurface water supply. It occurs when these water supplies are below normal. It is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- ***Socioeconomic*** drought is associated with the supply and demand of an economic good with elements of meteorological, hydrological, and agricultural drought. This differs from the aforementioned because its occurrence depends on current economic trends of supply and demand to identify or classify droughts. Socioeconomic drought occurs when the demand for an economic good exceeds supply because of a weather-related shortfall in water supply.

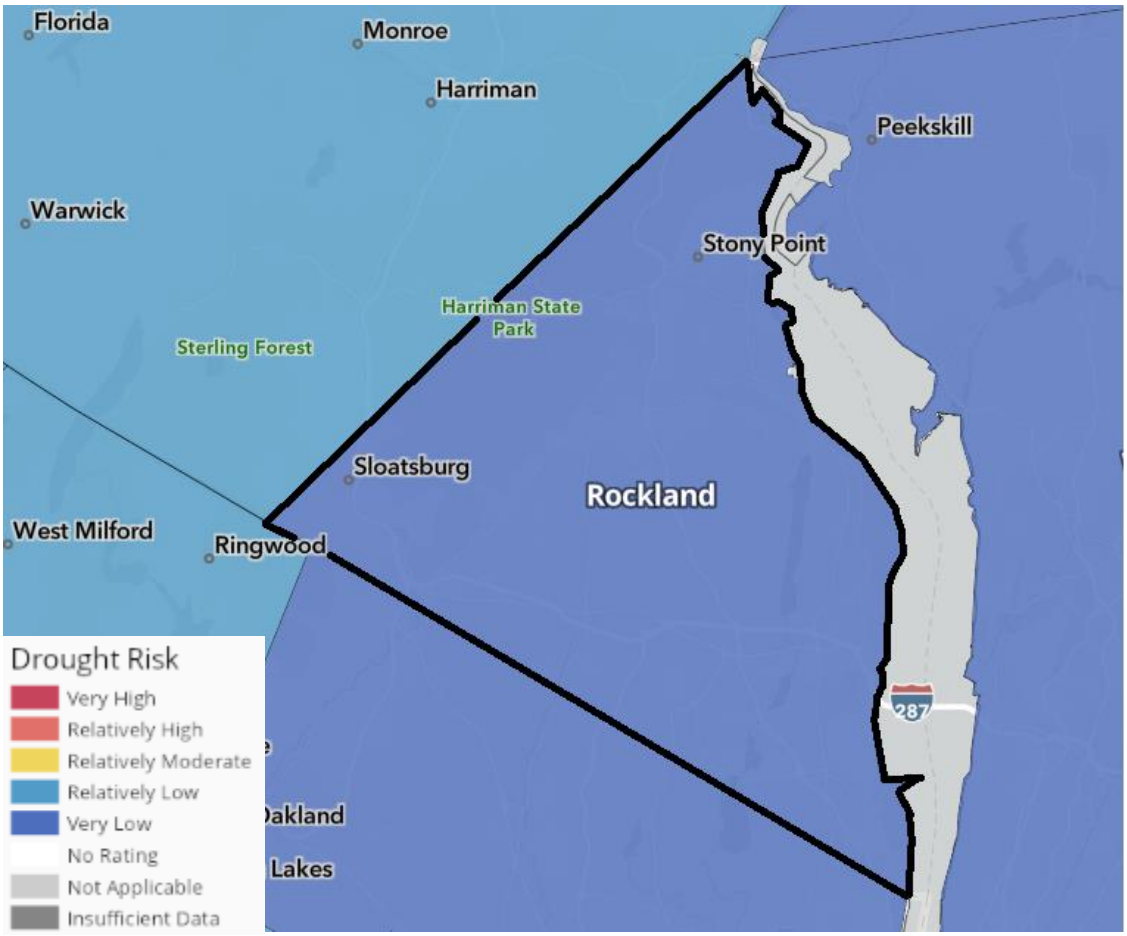
Location

Droughts can occur in all parts of the United States and any time of the year. Drier regions are more susceptible to long-term or extreme drought conditions, while other areas tend to be more susceptible to short-term, less severe droughts. Variations in the precipitation amounts can lead to periods of dry weather and drought. In the

State of New York, average precipitation amounts range from 60 inches in the Catskills to 28 inches in the Lake Champlain Valley (NYSDEC 2023).

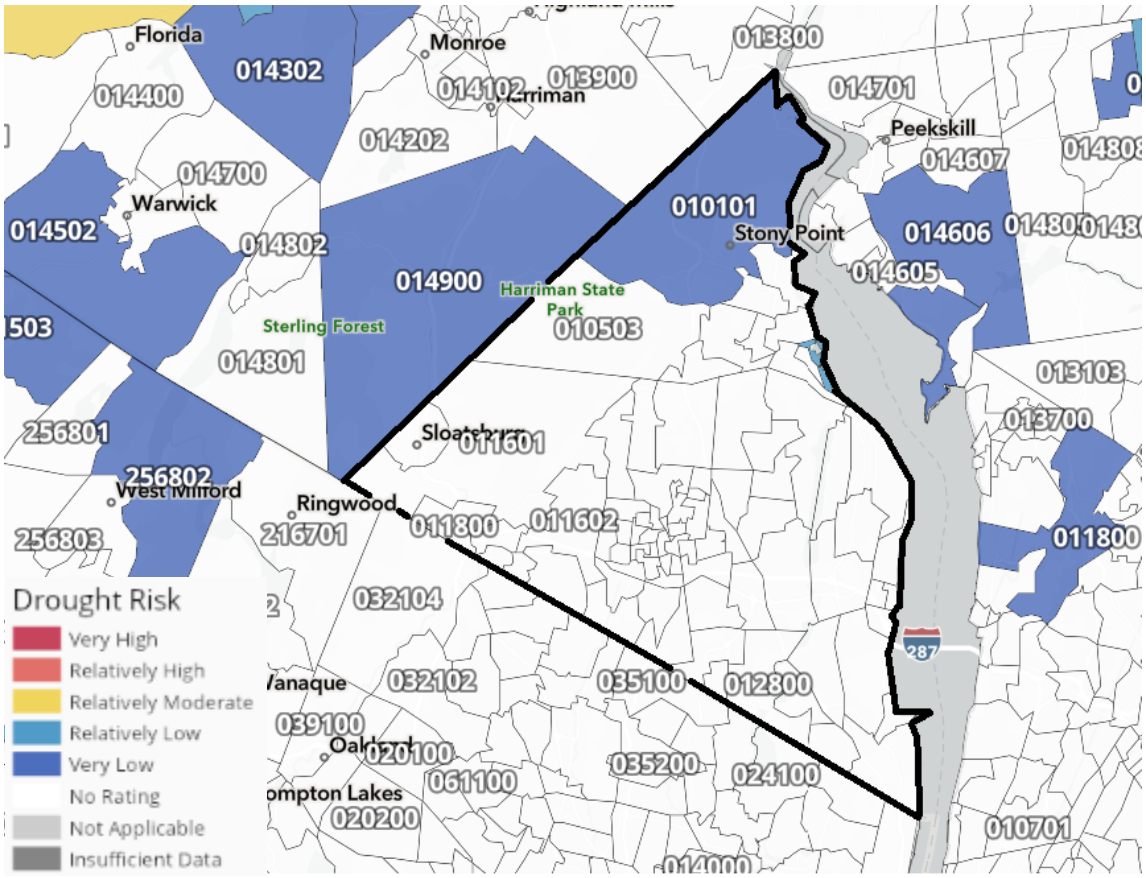
Figure 4.3.3-1 and Figure 4.3.3-2 show the Drought Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to drought. According to the National Risk Index, on the county scale, the County has a very low risk to drought; on the census tract scale, much of the County has no rating, however, some census tracks range from a very low risk to a relatively low risk (FEMA 2019).

Figure 4.3.3-1. National Risk Index, Drought Risk Index Score Using the County Scale



Source: *FEMA 2019*
Note: *Rockland is outlined in a boldened black border.*

Figure 4.3.3-2. National Risk Index, Drought Index Score Using the Census Tract Scale



Source: *FEMA 2019*
Note: *Rockland is outlined in a boldened black border.*

Extent

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts (USDA 2023).

The New York State Department of Environmental Conservation (NYSDEC) has divided the State into nine drought management regions based on drainage basins and county lines. NYSDEC monitors precipitation, lake and reservoir levels, stream flow, and groundwater level at least monthly in each region and more frequently during periods of drought. NYSDEC and the New York State Drought Management Task Force use this data to assign each region one of the following four drought stages (NYSDEC 2023):

- ***Normal*** is considered the standard moisture soil levels found throughout the State.
- ***Drought Watch*** is the first stage of drought. This stage is declared by the NYSDEC and is intended to give advance notice of a developing drought. As this stage, the public is urged to conserve water. Public water purveyors and industries are urged to update and begin to implement individual drought contingency plans.
- ***Drought Warning*** is the second stage of drought. This stage is also declared by the NYSDEC and is a notice of impending and imminent severe drought conditions. A warning declaration includes stepping up public

awareness and increasing voluntary conservation. Public water supply purveyors and industries are urged to continue to implement local drought contingency plans. Federal, state, and local water resources agencies are notified to prepare for emergency response measures.

- ***Drought Emergency*** is the third stage of drought. This stage is declared by the NYSDHSES, based upon recommendation of the New York State Drought Management Task Force. It is a notice of existing severe and persistent drought conditions. An emergency declaration is a notice for local water resources agencies to mandate conservation and implement other emergency response measures. A continuing and worsening drought emergency may result in the the State governor declaring a drought disaster. It is a notice of the most severe and persistent drought conditions. At this stage, a significant proportion of communities in the impacted area may lack the capabilities to respond to a drought of this scale.

The State of New York uses two primary methodologies to determine the various drought stages. The Palmer Drought Severity Index (PDSI) is a commonly used drought indicator and is primarily based on soil conditions. These are typically the first indicators that a moisture deficit is present. These values range from negative five to positive five, where positive values indicate wetter conditions and negative values represent drier conditions (NYSDEC 2023).

The second methodology used by the State was developed by the NYSDEC and is referred to as the State Drought Index (SDI). The SDI evaluates drought conditions on a more comprehensive basis by measuring whether numerous indicators reach dire thresholds. The data collected is compared against critical threshold values to show a normal or changeable drought condition. The indicators are weighted on a regional basis to reflect the unique circumstances of each drought management region (NYSDEC 2023). It is through this SDI that New York State determines if various regions are experiencing the various levels of drought conditions detailed above.

The State of New York also tracks the Standardized Precipitation Evapotranspiration Index (SPEI) as an additional drought measurement tool. The SPEI, along with the PDSI, can be used to evaluate the levels of soil moisture and forecast potential impacts to agriculture within the State (NYSDEC 2023).

The PDSI and SPEI are monitored to help the State understand potential impacts of drought on agricultural conditions (NYSDEC 2023). For more information on the potential agricultural and environmental impacts of drought on Rockland County, refer to the Vulnerability Assessment later in this section.

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was included in one major disaster (DR) or emergency (EM) declaration for drought-related events (FEMA 2023). There were no declarations that occurred between 2017 and 2023 for drought-related events. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2017 and 2023, Rockland County was included in one drought-related agricultural disaster declarations. For declarations that occurred between 2017 and 2023, refer to Table 4.3.3-1.

Table 4.3.3-1. USDA Declarations for Drought Events in Rockland County (2017 to 2023)

Event Date	Event Type	USDA Declaration Number	Description
August 9, 2022	Drought	USDA S5306	Serious, widespread drought conditions affected the entire tri-state area, leading to mandatory water restrictions. Rockland County declared a Stage II Water Emergency due to drought. This event was caused by unprecedented flow levels in the Ramapo River that limited the use of a nearby reservoir, which is a significant source of water for Rockland County.

Sources: USDA 2023; NBC 2022

Previous Events

For this 2024 HMP update, known hazard events that impacted Rockland County between January 2017 and December 2023 are discussed in Table 4.3.3-2. For events prior to 2017, refer to the 2018 Rockland County HMP.

Table 4.3.3-2. Hazard Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
August 9, 2022	Drought	USDA S5306	Yes	Countywide	Serious, widespread drought conditions affected the entire tri-state area, leading to mandatory water restrictions. Rockland County declared a Stage II Water Emergency due to drought. This event was caused by unprecedented flow levels in the Ramapo River that limited the use of a nearby reservoir, which is a significant source of water for Rockland County.

Sources: USDA 2023; NBC 2022

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from the Drought Impact Reporter, the 2019 State of New York HMP, the 2018 Rockland County HMP, and FEMA were used to identify the number of events that occurred between 2010 and 2023. Table 4.3.3-3 provides the calculated probability of future drought events in Rockland County.

Table 4.3.3-3. Probability of Future Drought Events in Rockland County

Hazard Type	Number of Occurrences Between 2010 and 2023	Percent Chance of Occurring in Any Given Year
Drought	15	100 percent

Sources: Drought Impact Reporter 2023

Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected drought events since 1968. Due to limitations in data, not all drought events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

In Section 4.4, the identified hazards of concern for Rockland County were ranted. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for drought in the County is considered 'occasional'.

Climate Change Projections

In New York, there is an expectation that droughts – specifically seasonal summer ones – could become more common because of climate change. By the end of the century, late-summer short-duration droughts may increase in the New York metropolitan region. It is less clear what impacts climate change will have on longer term "multi-year" droughts in the New York region, but climate change is likely to make at least some droughts more common. Climate change increases the potential for drought events, can make drought conditions more severe and lengthier, and accelerates the water cycle leading to secondary impacts such as drier soils, melting of polar ice, and increases occurrence of extreme weather events (World Economic Forum 2022). Since 1970, average annual temperatures in the State have increased by 0.6°F per decade (NYSERDA 2014).

The West Hudson River Valley, encompassing Rockland County, is expected to experience average temperatures increases 3.1°F to 6.9°F by the 2050s and 4.0°F to 10.7°F by the 2080s (baseline of 50.0°F). Precipitation totals will increase between 1 percent and 14 percent by the 2050s and 2 percent to 18 percent by the 2080s (baseline of 46.0 inches). Table 4.3.3-4 displays the projected seasonal precipitation change for the Catskill Mountains and West Hudson River Valley ClimAID Region (NYSERDA 2014).

Table 4.3.3-4. Projected Seasonal Precipitation Percent Change in Region 2 from Present to 2050s

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA 2014

In the West Hudson River Valley region, the number of days per year with maximum temperatures over 90 to 95° Fahrenheit and the total number of heat waves per year are expected to increase into the 2080s (NYSERDA 2014). These increases in temperature have the potential to worsen drought conditions, elevating the risk for adverse impacts for the County.

Table 4.3.3-5. Changes in Extreme Events in Region 2 – Heat Waves and Drought Conditions

Event Type	# Days Per Year	Baseline	2020s	2050s	2080s
Heat Waves	**Number of Days per year with maximum temperature exceeding: minimum, (central range), and maximum**				
	90°F	12 days	13 (14 to 24) 34	16 (22 to 40) 53	21 (28 to 65) 75
	Number of heat waves per year	2 events	2 (2 to 3) 5	2 (3 to 5) 7	3 (4 to 9) 10
	Average duration	4 days	4 (4 to 5) 5	5 (5 to 5) 6	5 (5 to 6) 8

Source: NYSERDA 2014

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following discusses Rockland County's vulnerability, in a qualitative nature, to the drought hazard.

Impact on Life, Health, and Safety

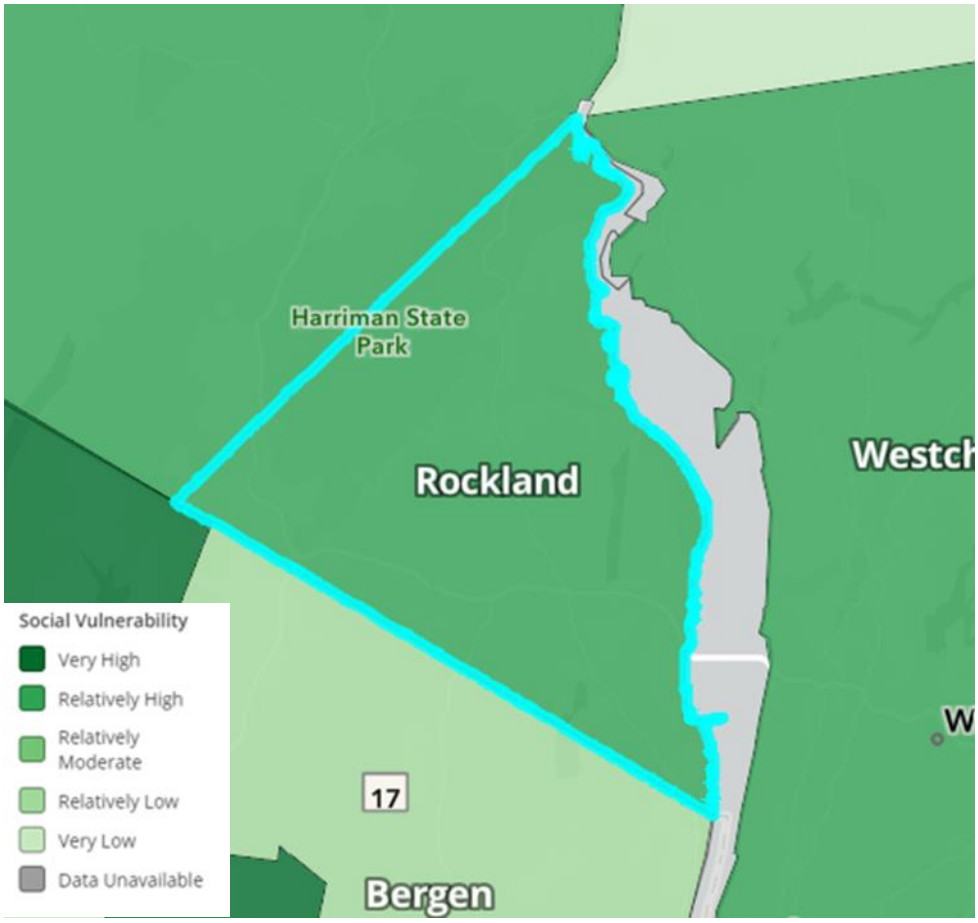
The entire population of Rockland County (461,860) is exposed to this hazard. Drought conditions can affect people's health and safety, including health problems related to low water flows and poor water quality, and health problems related to dust. Droughts also can lead to loss of human life (NDMC 2013). Other possible impacts

on health from drought include increased recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and sanitation and hygiene; compromised food and nutrition; and increased incidence of illness and disease. Health implications of drought are numerous. Some drought-related health effects are short-term while others can be long-term (CDC 2012).

Socially Vulnerable Population

Socially vulnerable populations are most susceptible to drought events based on several factors, including their physical and financial ability to react or respond during a drought. Vulnerable populations include homeless persons, elderly (over 65 years old), low income or linguistically isolated populations, people with life-threatening illnesses, and residents that may have limited access to water as is. The population over the age of 65 is also more vulnerable. They may require extra water supplies or need assistance to obtain water and are more likely to seek or need medical attention. According to the 2021 ACS, there are 49,451 total persons living below the poverty level, 52,060 persons over the age of 65 years, 27,605 persons under the age of five years, 26,990 non-English speakers, 29,008 persons with a disability, 49,451 living in poverty, and 109,704 living below ALICE in Rockland County. Figure 4.3.3-3 displays the FEMA National Risk Inventory's Social Vulnerability Index for Rockland County, which is identified as 'relatively high'.

Figure 4.3.3-3. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA n.d.

Impact on General Building Stock

A drought event is not expected to directly affect any structures. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. Risk to life and property is greatest within those areas where forested areas adjoin urbanized areas (high-density residential, commercial, and industrial) or wildland urban interface (WUI).

Impact on Critical Facilities and Community Lifelines

Drought events generally do not impact buildings; however, droughts have the potential to impact agriculture-related facilities and critical facilities that are associated with water supplies such as potable water used with fire-fighting services.

Drought affects groundwater sources, but generally not as quickly as surface water supplies. Groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams also. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

Impact on the Economy

Drought can produce a range of impacts that span many economic sectors and can reach beyond an area experiencing physical drought. As previously discussed, water withdrawals are not only used for potable water but for use in the commercial/industrial/mining sectors and power generation.

One impact of drought is its impact on water supply. When drought conditions persist with little to no relief, water restrictions may be put into place by local or state governments. These restrictions may include placing limitations on when or how frequent lawns can be watered, car washing services, or any other recreational/commercial outdoor use of water supplies. In exceptional drought conditions, watering of lawns may not be an option (NC State University 2013).

Increased demand for water and electricity can also result in shortages and higher costs for these resources. Industries that rely on water for business could be impacted the most (e.g., landscaping businesses). Although most businesses will still be operational, they may be impacted aesthetically. These aesthetic impacts are most significant within the recreation and tourism industry. Moreover, droughts within another area could impact the food supply and price of food for residents within the county.

Impact on the Environment

Drought can impact the environment because it can trigger wildfires, increase insect infestations, and exacerbate the spread of disease (NOAA 2000). Droughts will also impact water resources that are relied upon by aquatic and terrestrial species. Ecologically sensitive areas, such as wetlands, can be particularly vulnerable to drought periods because they are dependent on steady water levels and soil moisture availability to sustain growth. As a result, these types of habitats can be negatively impacted after long periods of dryness.

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. The County considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected Development

Section 3 identifies areas targeted for future growth and development across the County. Any areas of growth located in the County could be susceptible to drought. Specific areas of recent and new development are indicated in tabular form and/or on the hazard maps included in Volume II, Section 9 (Annexes) of this plan.

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics projects Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018). Changes in the density of the population can impact the number of persons exposed to drought and the draw upon water resources.

Other Identified Conditions

As mentioned previously, studies indicate that the State of New York is expected to observe a rise in average annual temperatures. Furthermore, there is a projected increase in the occurrence of droughts, which could impact the availability of water supplies and place added strain on the population and their access to clean drinking water. A decrease in water supply, or an increase in demand for water, may heighten the County's susceptibility to structural fires and wildfires. Consequently, it may be necessary for critical water-related service sectors to modify their management strategies and proactively allocate resources to adapt to forthcoming shifts.

Change of Vulnerability Since 2018 HMP

The total population across the County has increased since the last plan. This increase can place a greater stress on the water supply during a drought event.