5.4.2 Drought

This section provides a profile and vulnerability assessment for the drought hazard.

Hazard Profile

This section provides profile information including: description, location and extent, previous occurrences and losses, and the probability of future occurrences.

Description

The Climate Prediction Center (CPC) of the National Weather Service (NWS) defines drought as a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area (CPC, 2004). According to the New York State Hazard Mitigation Plan (NYS HMP), drought is a normal, recurrent feature of climate. Although its features vary from region to region, this hazard occurs almost everywhere. Defining drought is therefore difficult; it depends on differences of regions, water supply needs, and disciplinary perspectives. In general, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector (NYS DHSES, 2011). Other climatic factors, such as high temperatures, prolonged high winds and low relative humidity, can aggravate the severity of a drought. These conditions are caused by anomalous weather patterns when shifts in the jet stream block storm systems from reaching an area. As a result, large high-pressure cells may dominate a region for a prolonged period, thus reducing precipitation.

According to the Federal Emergency Management Agency (FEMA) and the NWS, there are four different ways that drought can be defined or grouped:

- *Meteorological/Climatological Drought* is defined in terms of the departure from a normal precipitation pattern and the duration of the drought hazard and has a slow-onset that usually takes at least three months to develop and may last for several seasons or years.
- *Hydrological Drought* is associated with the effects of substandard periods of precipitation, including snowfall, shortfalls on surface or subsurface water supply (for example, stream flow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought originate with a deficiency of precipitation; hydrologists are more concerned with how this deficiency plays out through the hydrologic system.
- *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, etc. 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.
- *Socioeconomic Drought* occurs when physical water shortage begins to affect the population, individually and collectively. Most socioeconomic definitions of drought associate it with supply, demand, and economic good (NYS DHSES, 2013).

Drought can produce a range of impacts that span many sectors of an economy and can reach beyond an area experiencing physical drought. This exists because water is integral to our ability to produce goods and provide services. Direct impacts of drought include reduced crop yield, increased fire hazard, reduced water levels, and damage to wildlife and fish habitat. The consequences of these impacts illustrate indirect impacts that include: reduction in crop, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment,

reduced tax revenues due to reduced expenditures, increased crime, foreclosures, migration, and disaster relief programs. The many impacts of drought can be listed as economic, environmental, or social (NYS DHSES, 2011).

Economic impacts occur in agriculture and related sectors because of the reliance of these sectors on surface and subsurface water supplies. Environmental impacts are the result of damage to plant and animal species, wildlife habitat, and air and water quality, forest and grass fires, degradation of landscape quality, loss of biodiversity and soil erosion. Social impacts involve public safety, health, conflicts between water users, reduced quality of life and inequities in the distribution of impacts and disaster relief (NYS DHSES, 2011). A summary of potential impacts associated with drought are identified in Table 5.4.2-1. This table includes only some of the potential impacts of drought.

Table 5.4.2-1. Economical, Environmental and Social Impacts of Drought

Economical	Environmental	Social
• Loss of national economic growth, slowing down of economic development • Damage to crop quality, less food production • Increase in food prices • Increased importation of food (higher costs) • Insect infestation • Plant disease • Loss from dairy and livestock production • Unavailability of water and feed for livestock which leads to high livestock mortality rates • Disruption of reproduction cycles (breeding delays or unfilled pregnancies) • Increased predation • Increased fire hazard - Range fires and Wildland fires • Damage to fish habitat, loss from fishery production • Income loss for farmers and others affected • Unemployment from production declines • Loss to recreational and tourism industry • Loss of hydroelectric power • Loss of navigability of rivers and canals	• Increased desertification - Damage to animal species • Reduction and degradation of fish and wildlife habitat • Lack of feed and drinking water • Disease • Increased vulnerability to predation. • Loss of wildlife in some areas and too many in others • Increased stress to endangered species • Damage to plant species, loss of biodiversity • Increased number and severity of fires • Wind and water erosion of soils • Loss of wetlands • Increased groundwater depletion • Water quality effects • Increased number and severity of fires • Air quality effects	• Food shortages • Loss of human life from food shortages, heat, suicides, violence • Mental and physical stress • Water user conflicts • Political conflicts • Social unrest • Public dissatisfaction with government regarding drought response • Inequity in the distribution of drought relief • Loss of cultural sites • Reduced quality of life which leads to changes in lifestyle • Increased poverty • Population migrations

Source: NYS DHSES, 2011

Extent

The extent (e.g., magnitude or severity) of drought can depend on the duration, intensity, geographic extent, and the regional water supply demands made by human activities and vegetation. The intensity of the impact from drought could be minor to total damage in a localized area or regional damage affecting human health and the economy. Generally, impacts of drought evolve gradually and regions of maximum intensity change with time. The severity of a drought is determined by areal extent as well as intensity and duration. The frequency of a drought is determined by analyzing the intensity for a given duration,

which allows determination of the probability or percent chance of a more severe event occurring in a given mean return period.

In New York State, the Department of Environmental Conservation (NYSDEC) and the New York State Drought Management Task Force, have identified four stages of droughts. The stages are as follows:

- *Normal* is considered the standard moisture soil levels found throughout the State
- *Drought Watch* is the first stage. This stage is declared by the NYSDEC and is intended to give advanced notice of a developing drought. At this stage, the general 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. This stage also is 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. This stage is declared by the New York State Disaster Preparedness Commission (NYSDPC), based on recommendation of the 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 New York State's 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 are likely unable to response adequately (NYS DHSES, 2013).

New York State uses two methodologies to determine the different drought stages. The most commonly used indicator is the Palmer Drought Severity Index (PDSI), which is primarily based on soil conditions. These are typically the first indicators that a moisture deficit is present. The second used in New York State was created by the NYSDEC and is known as the State Drought Index (SDI).

According to the National Integrated Drought Information System (NIDIS), the Palmer Drought Severity Index (PDSI) was developed in 1965, and indicates the prolonged and abnormal moisture deficiency or excess. It uses temperature and precipitation data to calculate water supply and demand, incorporates soil moisture, and is considered most effective for unirrigated cropland. The PDSI primarily reflects long-term drought and has been used extensively to initiate drought relief (NIDIS, 2013).

Table 5.4.2-2 lists the Palmer Classifications. Zero is used as normal and drought is shown in terms of negative numbers. For example, -2 is moderate drought, -3 is severe drought and -4 is extreme drought. The PDSI also reflects excess precipitation using positive numbers. For example, 2 is moderate rainfall (National Drought Mitigation Center [NDMC] 2013).

Table 5.4.2-2. PDSI Classifications

Palmer Classifications	
4.0 or more	extremely wet
3.0 to 3.99	very wet
2.0 to 2.99	moderately wet
1.0 to 1.99	slightly wet
0.5 to 0.99	incipient wet spell

Palmer Classifications	
0.49 to -0.49	near normal
-0.5 to -0.99	incipient dry spell
-1.0 to -1.99	mild drought
-2.0 to -2.99	moderate drought
-3.0 to -3.99	severe drought
-4.0 or less	extreme drought

Source: NDMC 2013

The SDI evaluates drought conditions on a more comprehensive basis by measuring whether numerous indicators reach dire thresholds. It compares four parameters to historic or "normal" values to evaluate drought conditions: stream flows, precipitation, lake and reservoir storage levels, and groundwater levels. The State's Drought Management Task Force uses those factors as well as water use, duration of the dry period, and season to assess drought in different areas of the State. 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 different circumstances of each drought management region (NYS DHSES 2013; NYSDEC 2013a). Table 5.4.2-3 shows the SDI range values for drought by the four drought stages.

Table 5.4.2-3. State Drought Index Range of Values

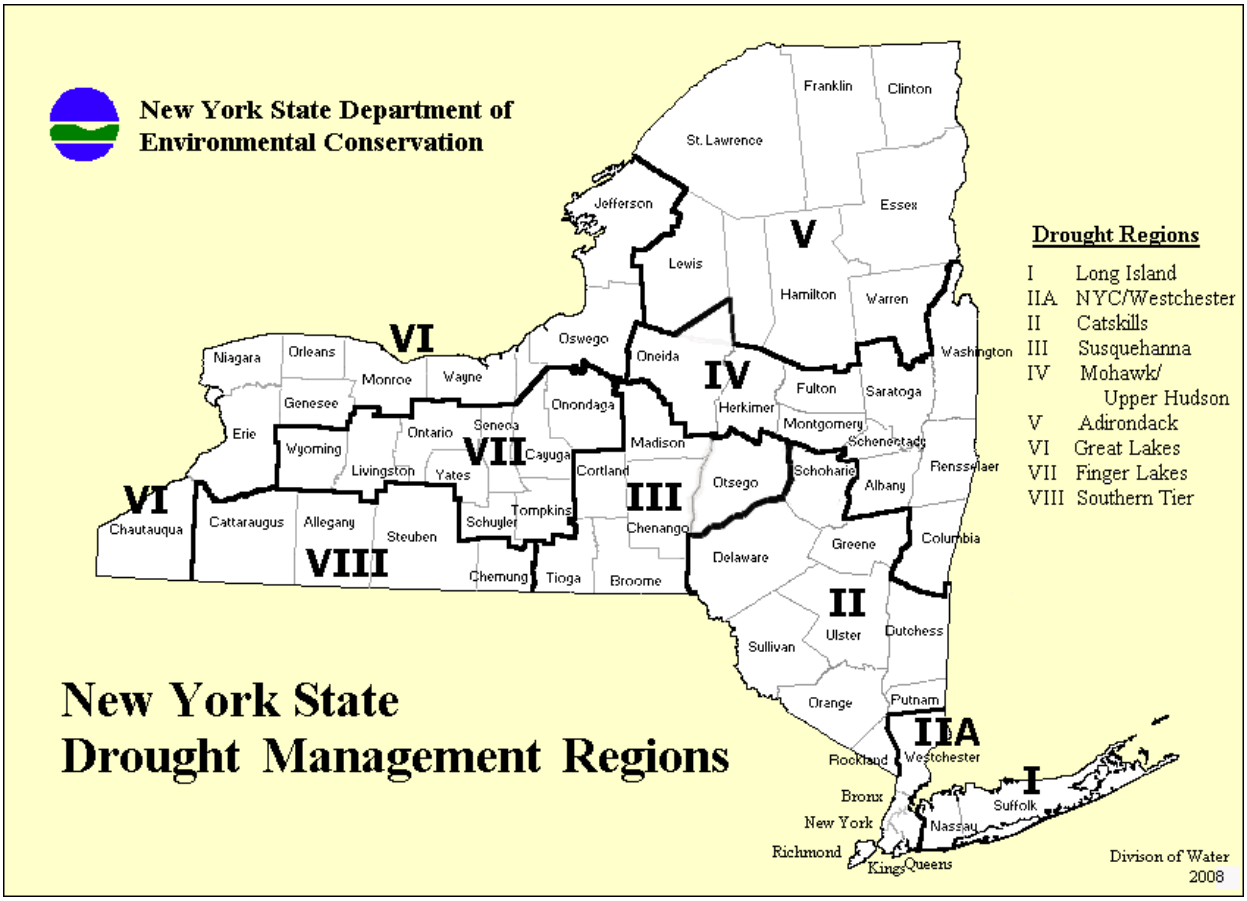
Drought Stage	Drought Index Range
Normal	100 to 150
Watch	75 to 100
Warning	50 to 70
Emergency	0 to 50

Source: NYS DHSES, 2013

Location

New York State is divided into nine drought management regions based roughly on drainage basin and county lines. The NYSDEC monitors precipitation, lake and reservoir levels, stream flow, and groundwater level on a monthly basis in each region and more frequently during periods of drought. The NYSDEC uses this data to assess the condition of each region, which can range from "normal" to "drought disaster" (NYSDEC 2013a). Suffolk County is identified as NYSDEC Drought Management Region 1, the Long Island Drought Region (Figure 5.4.2-1).

Figure 5.4.2-1. NYSDEC Drought Management Regions of New York State



Source: NYSDEC 2013b

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with drought events throughout New York State and Suffolk County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

Between 1954 and 2013, FEMA declared that New York State experienced one drought-related disaster (DR) or emergency (EM) classified as one or a combination of the following disaster types: water shortage. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declaration. Suffolk County was declared as a disaster area for this drought-related event (FEMA, 2013).

The 2007 Plan discussed drought events that occurred in Suffolk County from 1910 to 2007. For this 2014 plan update, drought events that occurred in Suffolk County between January 1, 2008 and present will be included. Based on all sources researched, known drought events, between 2008 and 2013, that have affected Suffolk County and its municipalities are identified in Table 5.4.2-4. Not all sources have been identified or researched; therefore, Table 5.4.2-4 may not include all events that have occurred throughout the County and region. Events included in the 2007 Plan are provided in Appendix H.

Table 5.4.2-4. Drought Events Between 2008 and 2013.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
August – September 2010	Drought	N/A	N/A	Lowest PDSI of -3.13	NRCC
April 2012	Drought	N/A	N/A	The NWS stated that parts of southern Connecticut and southeastern New York State were experiencing severe drought conditions. New York City, the lower Hudson River Valley and northeastern New Jersey were suffering from moderate drought. New York City's water supply reservoirs were reported to be 6% below normal levels. This was the first drought on Long Island in 13 years. Numerous brush fires occurred in Suffolk County and were linked to this drought event. The long-duration deficit of rainfall, lack of snow and dry and windy days all contributed to Long Island's susceptibility to brush fires.	Tuitt, 2012; Simmins, 2012

Sources: NRCC, 2013; NOAA-NCDC, 2013; SHELDUS, 2012; NDMC, 2012; USDA, 2013
FEMA Federal Emergency Management Agency
N/A Not Applicable
NRCC Northeast Regional Climate Center

Probability of Future Events

It is estimated that Suffolk County will continue to experience direct and indirect impacts of drought and its impacts on occasion, with the secondary effects causing potential disruption or damage to agricultural activities and creating shortages in water supply within communities.

In Section 5.3, the identified hazards of concern for Suffolk County were ranked. 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 Committee, the probability of occurrence for drought in Suffolk County is considered 'frequent' (hazard event that occurs more frequently than once in 10 years) in Table 5.3-3).

Climate Change Impacts

According to the 2014 New York State HMP update, rising summer temperatures, along with little change in summer rainfall, are projected to increase the frequency of short-term droughts. This scenario will lead to impacts on the natural and managed ecosystems across New York State. Water management and hydrology are also affected (NYS DHSES 2013).

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Suffolk County is part of Region 4, New York City and Long Island. Some of the issues in this region, affected by climate change, include: the area contains the highest population density in the State; sea level rise and storm surge increase coastal flooding, erosion, and wetland loss; challenges for water supply and wastewater treatment; increase in heat-related deaths; illnesses related to air quality increase; and higher summer energy demand stresses the energy system (NYSERDA, 2011).

Temperatures and precipitation amounts are expected to increase throughout the State, as well as in Region 4. It is anticipated that by the 2020s, the State's temperature will rise between 1.5 and 3ºF; 3 to 5.5ºF by the 2050s; and 4 to 9ºF by the 2080s. The lower ends of these ranges are for lower greenhouse gas emissions scenarios and the higher ends for higher emission scenarios (NYSERDA, 2011).

In Region 4, it is estimated that temperatures will increase by 3ºF to 5ºF by the 2050s and 4ºF to 7.5ºF by the 2080s (baseline of 53ºF). Precipitation totals will increase between 0 and 10% by the 2050s and 5 to 10% by the 2080s (baseline of 43 inches). Table 5.4.2-5 displays the projected seasonal precipitation change for the New York City and Long Island ClimAID Region (NYSERDA, 2011).

Table 5.4.2-5. Projected Seasonal Precipitation Change in Region 4, 2050s (% change)

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

Source: NYSERDA, 2011

Annual temperatures in New York State have been rising throughout the State since the start of the 20th century. State-average temperatures have increased by approximately 0.6°F since 1970, with winter warming exceeding 1.1°F per decade. Extreme heat events are likely to increase throughout New York State and short-duration warm season droughts will become more common.

With the increase in temperatures, heat waves will become more frequent and intense, increasing heat-related illness and death and posing new challenges to the energy system, air quality and agriculture. Summer droughts are projected to increase, affecting water supply, agriculture, ecosystems, and energy projects (NYSERDA, 2011).

By the end of the 21st century, the number of droughts is likely to increase, as the effect of higher temperatures on evaporation is likely to outweigh the increase in precipitation. Droughts in the northeast U.S. have been associated with local and remote modes of multi-year ocean-atmosphere variability that are unpredictable and may change with climate change. Changes in the distribution of precipitation throughout the year and the timing of snowmelt could potentially impact the frequency of droughts (occurring more frequently) (NYSERDA, 2011).

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the drought hazard, all of Suffolk County has been identified as the hazard area. Therefore, all assets in the County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable to a drought. The following text evaluates and estimates the potential impact of the drought hazard on the County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Change of vulnerability as compared to that presented in the 2008 Suffolk County Hazard Mitigation Plan
- Further data collections that will assist understanding this hazard over time

Overview of Vulnerability

The entire County is vulnerable to drought. Assets at particular risk would include areas used for agricultural purposes (farms and cropland), any open land or structures located along the wildland/urban interface (WUI) that could become vulnerable to the wildfire hazard due to extended periods of low rain and high heat, usually associated with a drought. In addition, water supply resources could be impacted by extended periods of low rain. Finally, vulnerable populations could be particularly susceptible to the drought hazard and cascading impacts due to age, health conditions, and limited ability to mobilize to shelter, cooling and medical resources.

Potential drought impacts are agricultural, hydrologic and socioeconomic. The sequence of these impacts further emphasizes their differences. When a drought begins, the agricultural sector is typically the first to be affected due to its heavy dependence on store soil water. During dry periods, soil water can be quickly depleted. In precipitation deficiencies continue, then people who depend on other sources of water will begin to feel the impacts of the shortage. Those who rely on surface water (for example, reservoirs and lakes) and subsurface water (for example, groundwater) are usually the last to be affected. A short-term drought that persists for three to six months may have little impact on these sectors, depending on the characteristics of the hydrologic system and the intensity of water use (NYS HMP 2014).

Numerous economic impacts occur in agriculture and related sectors, including forestry, fisheries, and water activities, because of the reliance of these sectors on surface and subsurface water supplies. Droughts are often associated with losses in crop yields and livestock production, increase issues with insect infestations, increase in forest diseases, and reduce growth. Forest and grass fire occurrences also increase substantially during extended drought periods, which in turn place human and wildlife populations, as well as property, at higher levels of risk (NYS HMP 2014).

Loss of income is another factor used when assessing the impacts of drought. Examples of income loss include a reduced income for farmers, along with retailers and others who provide goods and services to farmers. The recreation and tourism industries may also experience a loss of income due to the increase of food, energy and other products prices as supplies are reduced. In some cases, local shortages of certain goods result in the need to import goods from outside the affected region. Reduced water supply

impacts the use of rivers and other waterbodies. Hydropower production may also be impacted by drought effects as well (NYS HMP 2014).

Environmental losses from drought include damages to plant and animal species, wildfire habitat, and air and water quality; forest and grass fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some impacts may be short-term and others may linger for longer periods of time. If changes in climate intensify, environmental impacts and losses may become more intensified. Wildfire habitat may be degraded through the loss of wetlands, lakes, and vegetation. Increased soil erosion can lead to a more permanent loss of biological productivity of landscapes. However, quantifying environmental losses is difficult (NYS HMP 2014).

Social impacts primarily involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts related to economic and environmental have social impacts as well (NYS HMP 2014).

Data and Methodology

Data was collected from HAZUS-MH, USDA, NOAA-NCDC, Suffolk County, and the Planning Committee sources. Insufficient data was available to model the long-term potential impacts of a drought on the County. Over time, additional data will be collected to allow better analysis for this hazard. Available information and a preliminary assessment are provided below.

Impact on Life, Health and Safety

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 have the potential to lead to loss of human life (NDMC 2014) (http://drought.unl.edu/DroughtforKids/HowDoesDroughtAffectOurLives/TypesofDroughtImpacts.aspx). Other possible impacts to health due to 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) (http://www.cdc.gov/nceh/drought/).

As previously stated, drought conditions can cause shortages in water for human consumption. Droughts can also lead to reduced local firefighting capabilities. The drought hazard is a concern for Suffolk County because both public and private water supply sources exist in the County and are from local groundwater resources. Long Island's groundwater system is a federally-designated "sole source" aquifer. Additionally, the area is also identified as a Primary Water Supply Aquifer by New York State Department of Health (1981) and NYSDEC (1987) (USEPA, 2007). The total capacity of the aquifers underlying Suffolk County is about 70 trillion gallons. Precipitation is the sole source of all naturally occurring fresh groundwater on Long Island. Seasonal- or long-term fluctuations in precipitation volume and, thus, in recharge, are reflected by the water levels in all aquifers.

There are more than 1,100 active public water supply wells in Suffolk County that serve more than 90% of the County's population. Water is withdrawn from three major aquifers found beneath the County (Lloyd, Magothy, and Upper Glacial). In addition, individual on-site private wells provide water to approximately 50,000 year-round and seasonal homes in the County (Suffolk County Office of Water Resources 2014).

The 2014 New York HMP states that between 2010 and 2012, Suffolk County had 50% or more land area experiencing drought for a total of 40 weeks during that time period. The New York State HMP also indicated that Suffolk County had an unknown amount of average annual drought losses (NYS HMP 2014).

Impact on General Building Stock

No structures are anticipated to be directly affected by a drought event. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. The Central Pine Barrens is located within three of the County's jurisdictions (Towns of Brookhaven, Riverhead, and Southampton). The Pine Barrens is a large forested are of approximately 102,500 acres and has an extensive history and ongoing risk of frequent wildfires (Central Pine Barrens Joint Planning & Policy Commission 2013) (http://pb.state.ny.us/).

Risk to life and property is greatest in those areas where forested areas adjoin urbanized areas (high density residential, commercial and industrial) or WUI. Therefore, all assets in and adjacent to, the WUI zone around the Central Pine Barrens, including population, structures, critical facilities, lifelines, and businesses are considered vulnerable to wildfire.

Impact on Critical Facilities

Water supply facilities may be affected by short supplies of water. As mentioned, drought events generally do not impact buildings; however, droughts have the potential to impact agriculture-related facilities and critical facilities that are associated with potable water supplies. Also, those critical facilities in and adjacent to the WUI zone around the Central Pine Barrens are considered vulnerable to wildfire.

Impact on the Economy

When a drought occurs, the agricultural industry is most at risk in terms of economic impact and damage. During droughts, crops do not mature leading to a lessened crop yield, wildlife and livestock are undernourished, land values decrease, and ultimately there is financial loss to the farmer (FEMA, 1997).

A prolonged drought can have serious direct and indirect economic impacts on a community. As noted in the NYS HMP, it is difficult to estimate financial damages as a result of a drought because 'the more removed the impact from the cause, the more complex the link to the cause' (NYS HMP, 2011).

General economic effects from a drought include the following:

- Decreased land prices
- Loss to industries directly dependent on agricultural production (e.g., machinery and
- Fertilizer manufacturers, food processors, dairies, etc.)
- Unemployment from drought-related declines in production
- Strain on financial institutions (foreclosures, more credit risk, capital shortfalls)
- Revenue losses to Federal, State, and Local governments (from reduced tax base)
- Reduction of economic development
- Fewer agricultural producers (due to bankruptcies, new occupations)
- Rural population loss (NYS HMP, 2011).

A summary of the direct and indirect losses to agricultural producers, livestock producers, timber production, fishery production, and tourism is presented in Table 5.4.2-6 (NYS HMP, 2011).

Table 5.4.2-6. Impacts on the Economy

Losses to Agricultural Producers	Losses to Livestock Producers	Loss from Timber Production
Annual and perennial crop losses	Reduced productivity of rangeland	Wildland fires
Damage to crop quality	Reduced milk production	Tree disease
Income loss for farmers due to reduced crop yields	Forced reduction of foundation stock	Insect infestation
Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.)	High cost/unavailability of water for livestock	Impaired productivity of forest land
Insect infestation	Cost of new or supplemental water resource development (wells, dams, pipelines)	Direct loss of trees, especially young ones
Plant disease	High cost/unavailability of feed for livestock	
Wildlife damage to crops	Increased feed transportation costs	Loss from impaired navigability of streams, rivers, and canals
Increased irrigation costs	High livestock mortality rates	
Cost of new or supplemental water resource development (wells, dams, pipelines)	Disruption of reproduction cycles (delayed breeding, more miscarriages)	Increase in food prices
	Decreased stock weights	Increased importation of food (higher costs)
Damage to fish habitat	Increased predation	**Water Suppliers**
Loss of fish and other aquatic organisms due to decreased flows	Grass fires	Revenue shortfalls and/or windfall profits
Loss to Recreation and Tourism Industry	**Energy-related Effects**	Cost of water transport or transfer
Loss to manufacturers and sellers of recreational equipment	Increased energy demand and reduced supply because of drought-related power curtailments	Cost of new or supplemental water resource development
Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc.	Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power	

Source: NYSDPC, 2011

Based on the 2007 Census of Agriculture, there were 585 farms in Suffolk County, with 34,404 acres of total land in farms. The average farm size was 59 acres. Suffolk County farms had a total market value of products sold of $242.9 million ($224.7 million in crops including nursery and greenhouse; and $18.2 million in livestock, poultry and their products), averaging $415,270 per farm. The Census indicated that 377 of farm operators reported farming as their primary occupation (USDA 2007). Table 5.4.2-7 shows the acreage of agricultural land exposed to the drought hazard.

Table 5.4.2-7. Agricultural Land in Suffolk County in 2007

Number of Farms	Land in Farms (acres)	Total Cropland (acres)	Harvested Cropland (acres)	Total Cropland Used Only For Pasture/Grazing (acres)
585	34,404	26,342	21,054	2,798

Source: USDA 2007

In 2007, the top three agricultural products sold in Suffolk County were: nursery, greenhouse, floriculture, and sod at $182.9 million; vegetables, melons, potatoes, and sweet potatoes at $26.7 million; and fruits,

tree nuts and berries at $13.8 million. Suffolk County was the highest rank in the State for its sales of nursery, greenhouse, floriculture, and sod (USDA 2007).

Suffolk County wineries contribute to local tourism in the County, attracting approximately 1.3 million visitors annually (Long Island Wine Council 2014) (http://www.liwines.com/wp-content/themes/twentyten/statistics.php). According to 2008 statistics, New York State is the third largest wine growing region in the U.S., with Long Island considered as the premier region in the State for the production of vinifera wines. Over 3,000 acres were planted in 2004 (Long Island Wine Council 2014).

If the average production (dollar value) per crop type could be identified on a per acre basis, loss estimates could be developed based on assumed percent damage that could result from a drought. If a drought impacted 40-percent of the agricultural products sold from Suffolk County farms, based on 2002 market values, this would be a loss of $80.48 million. This figure does not include how the tourism industry and local jobs are impacted.

A prolonged drought can have a serious economic impact on a community. Increased demand for water and electricity may result in shortages and a higher cost for these resources (FEMA, 2005; New York State, 2004). Industries that rely on water for business may be impacted the hardest (e.g., landscaping businesses). Even though most businesses will still be operational, they may be impacted aesthetically. These aesthetic impacts are most significant to the recreation and tourism industry. In addition, droughts in another area could impact the food supply/price of food for residents in the County.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across Suffolk County. Future growth could impact the amount of potable water available due to a drain on the available water resources. Other areas that could be impacted include agriculture and recreational facilities such as golf courses, farms, and nurseries. Areas targeted for potential future growth and development in the next five (5) years have been identified across the County at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP.

Effect of Climate Change on Vulnerability

According to the 2014 New York State HMP update, rising summer temperatures, along with little change in summer rainfall, are projected to increase the frequency of short-term droughts. This scenario will lead to impacts on the natural and managed ecosystems across New York State. Water management and hydrology are also affected (NYS DHSES 2013).

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Suffolk County is part of Region 4, New York City and Long Island. Some of the issues in this region, affected by climate change, include: the area contains the highest population density in the State; sea level rise and storm surge increase coastal flooding, erosion, and wetland loss; challenges for water

supply and wastewater treatment; increase in heat-related deaths; illnesses related to air quality increase; and higher summer energy demand stresses the energy system (NYSERDA, 2011).

Temperatures and precipitation amounts are expected to increase throughout the State, as well as in Region 4. It is anticipated that by the 2020s, the State's temperature will rise between 1.5 and 3ºF; 3 to 5.5ºF by the 2050s; and 4 to 9ºF by the 2080s. The lower ends of these ranges are for lower greenhouse gas emissions scenarios and the higher ends for higher emission scenarios (NYSERDA, 2011).

In Region 4, it is estimated that temperatures will increase by 3ºF to 5ºF by the 2050s and 4ºF to 7.5ºF by the 2080s (baseline of 53ºF). Precipitation totals will increase between 0 and 10% by the 2050s and 5 to 10% by the 2080s (baseline of 43 inches). Table 5.4.2-8 displays the projected seasonal precipitation change for the New York City and Long Island ClimAID Region (NYSERDA, 2011).

Table 5.4.2-8. Projected Seasonal Precipitation Change in Region 4, 2050s (% change)

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

Source: NYSERDA, 2011

Even though an increase in annual precipitation is projected, other climate change factors, such as an extended growing season, higher temperatures, and the possibility of more intense, less frequent summer rainfall, may lead to additional droughts and increased short-term drought periods (Cornell University, Date Unknown).

Droughts can cause deficits in surface and groundwater used for drinking water. The New York State Water Resources Institute at Cornell University conducted a vulnerability assessment of drinking water supplies and climate change. To assess water supplies in New York State, it was assumed that long-term average supply will remain the same but the duration and/or frequency of dry periods may increase. Both types of water supplies, surface water and groundwater, were divided into three categories: sensitive to short droughts (two to three months), sensitive to moderate and longer droughts (greater than six months), and relatively sensitive to any droughts. Major reservoir systems are presumed to have moderate sensitivity to drought because there is a likelihood of decreases in summer and fall water availability (Cornell University, Date Unknown). The greatest likelihood of future water shortages is likely to occur on small water systems (Cornell University, Date Unknown).

Change of Vulnerability

When examining the change in the County's vulnerability to drought events from the 2008 original HMP to this update, it is important to look at each entity that is exposed and vulnerable. The total population across the County has minimally changed as shown by the 2000 to 2010 U.S. Census.

In terms of the agricultural industry for Suffolk County, from 2002 to 2007, there was a 10% decrease in number of farms (651 farms to 585 farms, respectively); however, the County had a one-percent increase in land in farms (34,127 acres to 34,404 acres) and a 13% increase in average size of farms (52 acres to 59 acres). Also, the County experienced a 21% increase in market value of products sold, from over $201 million in 2002 to over $242 million in 2007. Therefore, due to the increase in farm size and market value of products sold, the County's potential crop loss due to drought may increase overall.

Additional Data and Next Steps

For the Plan Update, any additional information regarding localized concerns and past impacts will be collected and analyzed. This data will be developed to support future revisions to the plan. Mitigation efforts could include building on existing New York State, Suffolk County, and local efforts. The lead State Agency for drought preparedness is the NYSDEC.