



## 5.4.2 Drought

This section provides profile information including description, location, extent, previous occurrences and losses, probability of future occurrences, and climate change impacts, as well as the vulnerability assessment for the drought hazard in Genesee County.

### 5.4.2.1 Hazard Profile

#### Description

Drought is a period characterized by long durations of below-normal precipitation. Drought is a temporary irregularity and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought conditions occur in virtually all climatic zones, yet its characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

There are four different ways that drought can be defined or grouped:

- **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 types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods depends on weather (for example, water, forage, food grains, fish, and hydroelectric power). Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply (National Drought Mitigation Center 2014).

#### 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. In New York State (NYS), there is an abundant supply of water found throughout the State with streams, lakes, and coastal areas that have an average precipitation ranging from 60 inches in the Catskills to 28 inches in the Lake Champlain Valley. Variations in the normal amounts can lead to periods of dry weather and periods of drought (NYS Division of Homeland Security and Emergency Services [DHSES] 2014).

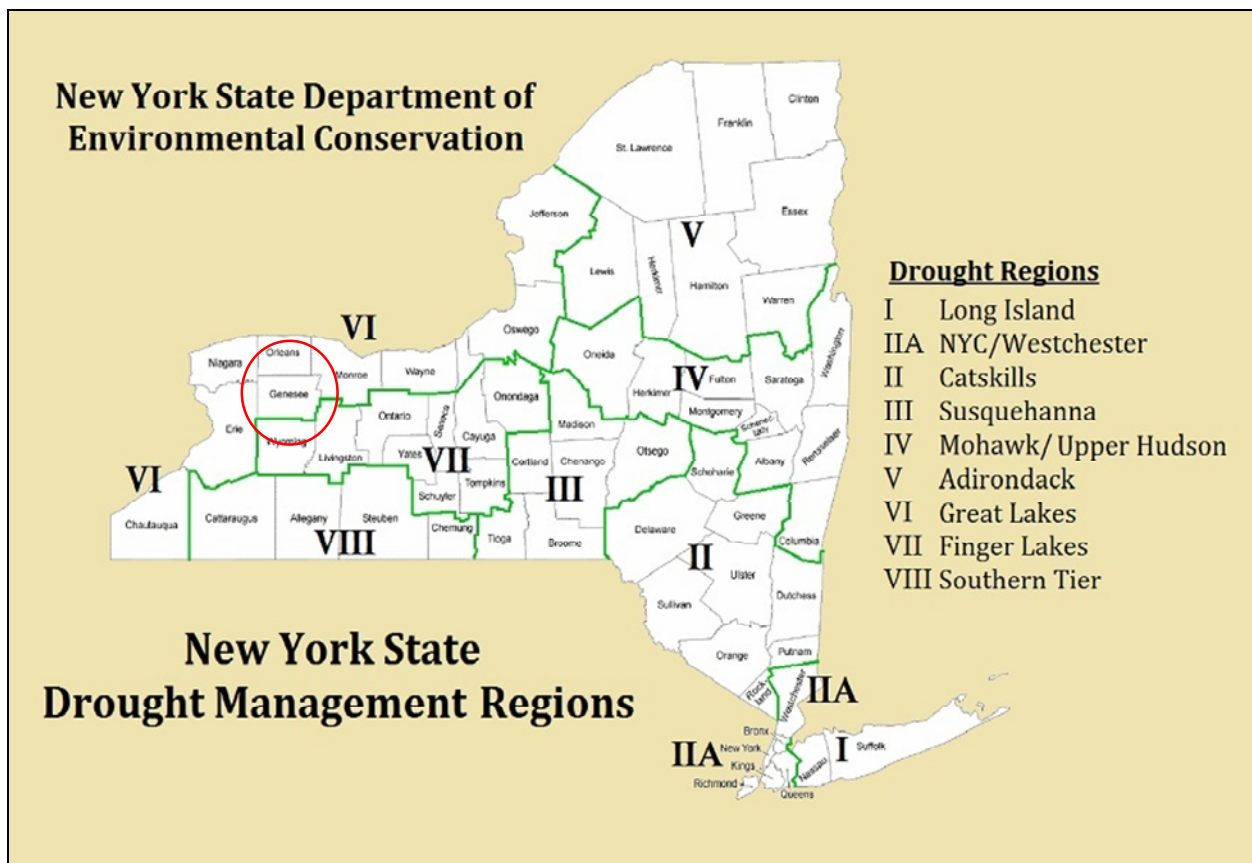
The National Oceanic and Atmospheric Administration (NOAA) has divided the United States into 344 climate divisions. According to NOAA, New York State is made up of 10 climate divisions: Western Plateau, Eastern



Plateau, Northern Plateau, Coastal, Hudson Valley, Mohawk Valley, Champlain Valley, St. Lawrence Valley, Great Lakes, and Central Lakes (NOAA 2016). Genesee County is located in the Great Lakes Climate Division.

The New York State Department of Environmental Conservation (NYS DEC) has divided New York State into nine drought management regions based roughly on drainage basins and county lines. NYS DEC monitors precipitation, lake and reservoir levels, stream flow, and groundwater level at least monthly in each region and more frequently during periods of drought. NYS DEC uses this data to assess the condition of each region, which can range from "normal" to "drought disaster" (NYS DEC 2016). Figure 5.4.2-1 shows the drought regions of New York State with Genesee County circled. Genesee County is located within the Great Lakes drought region (Region VI).

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



Source: NYS DEC 2016

Note: The red circle indicates the location of Genesee County.

**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 (NOAA 2000). The NYS DEC and the New York State Drought Management Task Force identifies droughts in the following four stages:

- **Normal** is considered the standard moisture soil level found throughout New York State
- **Drought Watch** is the first stage of drought. This stage is declared by the NYS DEC and is intended to give advance notice of a developing drought. As 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 of drought. This stage is also declared by the NYS DEC 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 NYS DHSES, based upon 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 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 likely are unable to respond adequately (NYS DHSES 2014).

New York State uses two methodologies to determine the various drought stages. The Palmer Drought Index (PDI) 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 -5 to +5 with positive values indicating wetter conditions and negative values representing drier conditions (NYS DHSES 2014).

The second methodology used by New York State was developed by the NYS DEC 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 are 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 (NYS DHSES 2014).

In Genesee County, the greatest agricultural impact of drought would be insufficient water for consumption by and cooling of farm animals. Table 5.4.2-1 shows the typical water consumption for a number of animals common to Genesee County farms.

**Table 5.4.2-1. Typical Water Consumption of Animals**

Animal	Water Consumption, Typical	
	(gallons per day)	(liter per day)
Chickens/100	6	23
Cow, Dry	15	57
Milking Cows	35	130
Dairy Calves (1 - 4 months)	2.4	9
Dairy Heifers (5 - 24 months)	6.6	25
Dry Cows	9.3	41
Hog	4	15
Horse, Steer	12	45
Pig, feeder	1.1 - 2	9-May
Sheep	2	7.5
Turkeys/100	20	75

Source: King 2015



Previous Occurrences and Losses

Many sources provide historical information regarding previous occurrences and losses associated with drought events throughout New York State and Genesee County. Information about loss and impact resulting from each of many events can vary depending on the source. Notably, monetary amounts cited in this section on drought derive solely from information obtained during research for this Hazard Mitigation Plan (HMP) update.

Between 1954 and 2017, New York State experienced one Federal Emergency Management Agency (FEMA)-declared drought-related major declaration (DR) classified as a water shortage. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Genesee County was not included in this declaration (FEMA 2017).

In addition to FEMA and State disaster declarations, Genesee County has been included in agriculture-related drought disasters. According to the U.S. Department of Agriculture (USDA), these types of disasters are quite common; between one-half and two-thirds of the counties in the United States have been designated as disaster areas in each of the past several years. The USDA Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans (EM) to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM eligibility, other emergency assistance programs, such as Farm Service Agency (FSA) disaster assistance programs, have historically used disaster designations as an eligibility requirement trigger. Table 5.4.2-2 provide the USDA Secretarial disaster declarations from January 1, 2012 through December 31, 2017. During this time, Genesee County was included in four drought-related USDA declarations.

Table 5.4.2-2. Drought-Related USDA Declarations in Genesee County, 2012 to 2017

Table with 4 columns: Year, Approval Date, Designation Number, and Description of Disaster. Rows include data for 2012, 2016, and 2017.

Source: USDA 2018

Crop losses can have a significant impact on the economy by reducing produce sales and purchases. Such impacts may have long-term consequences, particularly if crop yields are low the years following a drought as well. The USDA Risk Management Agency (RMA)-insured crop losses through Genesee County because of drought conditions are shown in Table 5.4.2-3. Table 5.4.2-3 shows the highest year of crop losses as over \$4.5 million in the 17-year period. Please note that these data only apply to insured crops.

Table 5.4.2-3. USDA Crop Losses from Drought in Genesee County, 2000-2017

Table with 3 columns: Year, Crop Type, and Losses. Rows show data from 2010 to 2017, including crop types like corn, green peas, and wheat, and loss amounts such as \$2,500,677 in 2016.



Year	Crop Type	Losses
2009	Not applicable – no losses associated with drought events	N/A
2008	Soybeans	\$524
2007	Corn, dry beans, green peas, onions, potatoes, processing beans, soybeans, wheat	\$560,722.44
2006	Processing beans, green peas, sweet corn	\$209,760.64
2005	Corn, dry beans, onions, processing beans, sweet corn	\$149,465.08
2004	Not applicable – no losses associated with drought events	N/A
2003	Not applicable – no losses associated with drought events	N/A
2002	Corn, dry beans, green peas, onions, processing beans, soybeans, sweet corn	\$234,765.85
2001	Corn, dry beans, green peas, soybeans	\$34,952
2000	Not applicable – no losses associated with drought events	N/A

Source: USDA 2017

For this 2019 HMP Update, known drought events (including FEMA and USDA disasters) that have impacted Genesee County between 2000 and 2017 are identified in Table 5.4.2-4. Please note that not all events that have occurred in the County are included due to the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information 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 Update.



Table 5.4.2-4. Drought Events in Genesee County between 2000 and 2017

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts*
October 2017	Drought	N/A	N/A	Up to 19 percent of the County experienced abnormally dry conditions.
April 2016 - March 2017	Drought	N/A	N/A	The County experienced a period of sustained drought. At its worst (August-September 2016), 95 percent of the County was in an extreme drought, with the remaining 5 percent in a severe drought.
December 2015 - February 2016	Drought	N/A	N/A	The County experienced a period of sustained drought. 94 percent of the County was in abnormally dry conditions, with the remaining 6 percent in a moderate drought.
December 2014 - July 2015	Drought	N/A	N/A	The County experienced a period of sustained drought. At its peak (May-June 2015), the entire County was in abnormally dry conditions.
October 2013	Drought	N/A	N/A	17 percent of the County experienced abnormally dry conditions.
May - October 2012	Drought	N/A	N/A	The County experienced a period of sustained drought. At its worst (July-September 2012), the entire County was in a moderate drought.
July - October 2011	Drought	N/A	N/A	The County experienced a period of sustained drought. At its worst (August), the entire County was in a moderate drought. Between June and July, the County had over \$215,000 in crop losses.
June 2010	Drought	N/A	N/A	The entire County experienced a period of abnormally dry conditions.
April - May 2010	Drought	N/A	N/A	The entire County experienced a period of abnormally dry conditions.
May - June 2009	Drought	N/A	N/A	The entire County experienced a period of abnormally dry conditions.
June 2008	Drought	N/A	N/A	The entire County experienced a period of abnormally dry conditions.
June - November 2007	Drought	N/A	N/A	The County experienced a period of sustained drought. At its worst (September) the entire County was in a severe drought.
May - September 2006	Drought	N/A	N/A	The entire County experienced a period of abnormally dry conditions. Overall, the County had over \$209,000 in crop losses associated with this event.
July - September 2005	Drought	N/A	N/A	The County experienced a period of sustained drought. At its peak (August), 13 percent of the County was in a moderate drought, and the rest of the County experienced abnormally dry conditions. This event led to over \$149,000 in crop losses.
May - June 2005	Drought	N/A	N/A	The entire County experienced a period of abnormally dry conditions. This event led to over \$118,000 in crop losses.





Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts*
April - June 2003	Drought	N/A	N/A	The County experienced a period of sustained drought. At its peak (May), 98 percent of the County experienced abnormally dry conditions.
September 2002	Drought	N/A	N/A	The County experienced a period of sustained drought. At its peak, 30 percent of the County was in a moderate drought, and the rest of the County experienced abnormally dry conditions. Approximately \$1,830 in crop losses are associated with this event.
June-August 2002	Drought	N/A	N/A	The entire County experienced a period of abnormally dry conditions. During this time, the County experienced over \$195,000 in crop losses associated with this event.
January - February 2002	Drought	N/A	N/A	The entire County experienced a period of abnormally dry conditions.
July - December 2001	Drought	N/A	N/A	The County experienced a period of sustained drought. At its peak (August-September), the entire County experienced a severe drought. Between July and August, the County experienced over \$12,000 in crop losses associated with the drought conditions.
May - June 2001	Drought	N/A	N/A	The County experienced a moderate drought. In June, the County experienced over \$22,000 in crop losses associated with the drought conditions.
January 2001	Drought	N/A	N/A	20 percent of the County experienced abnormally dry conditions.

Sources: U.S. Drought Monitor 2017; USDA 2018  
 \* Losses reported only applies to insured crops.  
 N/A Not applicable  
 USDA U.S. Department of Agriculture  
 RMA Risk Management Agency



Probability of Future Events

Sporadic occurrences of drought are common within the United States. Streams, lakes, and coastal regions in the State of New York are supplied by an annual average precipitation ranging from 28 to 60 inches per year. Although the State manages mild moist climates, typical variations in weather patterns can lead to dry periods. Overall, based on historical occurrences, New York State’s overall annual future probability for drought is 3 percent (NYS DHSES 2014). However, as the climate changes and temperatures rise, the probability of future droughts will likely increase. Therefore, it is likely that droughts will occur in the State and County of varied severity in the future.

For the 2019 HMP update, the most up-to-date data were collected to calculate the probability of future occurrence of drought events (of all magnitudes) for Genesee County. Information from NOAA National Centers for Environmental Information (NCEI) storm events database, the Northeast Regional Climate Center (NRCC) drought periods, and the Drought Impact Reporter were used to identify the number of drought events that occurred between 1950 and 2017. Using these sources ensures the most accurate probability estimates possible. Table 5.4.2-5 below show these statistics, as well as the annual average number of events and the estimated percent chance of an incident occurring in any given year.

Table 5.4.2-5. Probability of Future Occurrences of Drought Events

Hazard Type	Number of Occurrences Between 1950 and 2017	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in Any Given Year	Percent Chance of Occurrence in Any Given Year
Drought	21	0.31	3.24	0.31	30.9%

Source: NOAA-NCEI 2018; NRCC 2018; DIR 2018

Genesee County is estimated to continue to experience direct and indirect impacts of drought 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 Genesee 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 the County is considered “frequent” (likely to occur within 25 years, as presented in Table 5.3-1).

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 expected to be affected (NYS DHSES 2014).

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 evident within the State. Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation (ClimAID) was undertaken to provide decision-makers with information on the State’s vulnerability to climate change, and to facilitate 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. Genesee County is part of geographical Region 1, Western New York and the Great Lakes Plain. Some of the issues in this region, affected by climate change, include relatively low rainfall and increased summer drought risk, the need for irrigation for high-value crops, and improved conditions for grapes (NYSERDA 2014).

Temperatures and precipitation amounts are expected to increase throughout the State, as well as within Region 1. The State’s temperature is expected to rise between 2.0 and 3.4 degrees Fahrenheit (°F) by the 2020s, between 4.1 and 6.8 °F by the 2050s, and between 5.3 and 10.1 °F by the 2080s. The lower ends of these ranges assume lower greenhouse gas emissions scenarios, and the higher ends of these ranges assume higher greenhouse gas emission scenarios. By the end of the century, the greatest warming is projected to be in the northern parts of the State. (NYSERDA 2014).

Within Region 1, temperatures are anticipated to increase between 3.7 and 7.3 °F by the 2050s, and between 4.2 and 12.0 °F by the 2080s (baseline of 47.7°F). Precipitation totals will increase between 0 and 10 percent by the 2050s, and between 0 and 15 percent by the 2080s (baseline of 37 inches). Table 5.4.2-6 lists projected seasonal precipitation changes within the Western New York and Great Lakes Plain ClimAID Region (NYSERDA 2014).

**Table 5.4.2-6. Projected Seasonal Precipitation Change in Region 1, 2050s (% change)**

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

Source: *NYSERDA 2011*

Annual temperatures have been rising throughout New York State since the start of the 20<sup>th</sup> 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 as shown in Table 5.4.2-7 below. Heat waves are defined as 3 or more consecutive days with maximum temperatures at or above 90 °F. Summer droughts are projected to increase under these conditions, affecting water supply, agriculture, ecosystems, and energy projects (NYSERDA 2014).

**Table 5.4.2-7. Extreme Event Projections for Region 1 – Western New York and the Great Lakes Plain**

Middle Range (25th to 75th Percentile)	2020s	2050s	2080s
Days over 90 °F (8 days)	14 to 17	22 to 34	27 to 57
# of Heat Waves (0.7 heat waves)	2 to 2	3 to 4	3 to 8
Duration of Heat Waves (4 days)	4 to 4	4 to 5	5 to 6
Days below 32 °F (133 days)	103 to 111	84 to 96	68 to 88
Days over 1” Rainfall (5 days)	5 to 5	5 to 5	5 to 6
Days over 2” Rainfall (0.6 days)	0.6 to 0.7	0.6 to 0.8	0.6 to 0.9

Source: *NYSERDA 2014*

By the end of the 21<sup>st</sup> 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 United States 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 distribution of precipitation throughout the year and in timing of snowmelt could increase frequency of droughts (NYSERDA 2011).

### 5.4.2.2 Vulnerability Assessment

To understand risk, a community must evaluate exposed and vulnerable assets within the identified hazard area. Regarding the drought hazard, all of Genesee County has been identified as exposed to the hazard. Therefore, all assets within the County (population, structures, critical facilities, and lifelines), as described in the County Profile (Section 4), are potentially vulnerable to drought. This section evaluates and estimates potential impacts 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 in vulnerability from that presented in the 2008 Genesee County HMP
- Further data acquisitions that will improve understanding of this hazard over time

#### Overview of Vulnerability

Drought is a concern to Genesee County, mainly due to its impact on public health, natural resources, and agriculture. Assets at particular risk would include any open land or structures located along the wildland/urban interface (WUI) that could become vulnerable to the wildfire hazard due to the 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. Many residents are served by private wells, which can be significantly affected by periods of diminished groundwater resources. Lastly, 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. Overall, Genesee County’s vulnerability has not changed since the 2008 HMP and the entire County continues to be exposed and vulnerable to the drought hazard.

#### Data and Methodology

Data were acquired from the following sources: HAZUS-MH, USDA, NOAA-NCEI, Genesee County, and the Planning Committee. Not enough data were available to model the long-term potential impacts of a drought on the County. Over time, additional data will be obtained to allow better analysis of this hazard. Available information and a preliminary assessment are included below.

#### Impacts on Life, Health, and Safety

The entire population of Genesee County is vulnerable to drought events. According to the 2010 U.S. Census, the County had a population of 744,344. Drought conditions can affect people’s health and safety, including health problems related to low water flows, poor water quality, and dust. Droughts also can lead to loss of human life (National Drought Mitigation Center [NDMC] 2014). 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 (Center for Disease Control and Prevention [CDC] 2012).



As previously stated, drought conditions can cause shortages of water for human consumption. Droughts can also lead to reduced local firefighting capabilities. The drought hazard is a concern for Genesee County because rural populations within the County rely on private water supply from local groundwater resources.

According to the 2014 New York State HMP, between 2010 and 2011, Genesee County had 50 percent or more land area undergoing drought for 30 weeks during an abnormally dry period, and for 17 weeks during a drought-moderate period (NYS DHSES 2014).

### **Impact on General Building Stock**

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No structures are anticipated to be directly affected by a drought event. However, droughts contribute to conditions conducive to wildfires and droughts reduce fire-fighting capabilities. Risk to life and property is greatest in those areas where forested areas adjoin urbanized areas (high-density residential, commercial, and industrial) also known as the wildland urban interface (WUI). Therefore, all assets in and adjacent to the WUI zone—including population, structures, critical facilities, lifelines, and businesses—are considered vulnerable to wildfire. Section 5.4.13 of this HMP presents the wildfire risk assessment.

### **Impact on Critical Facilities**

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

### **Impact on the Economy**

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Drought causes many economic impacts on agriculture and related sectors (forestry, fisheries, and waterborne activities). In addition to losses in yields for crop and livestock production, drought is associated with increased insect infestations, plant diseases, and wind erosion. Drought can lead to other losses because so many sectors are affected, such as losses associated with reduced income for farmers, and reduced business for retailers and others who provide goods and services to farmers. These business losses lead to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue. Prices for food, energy, and other products may also increase as supplies decrease (NYS DHSES 2014).

When a drought occurs, the agricultural industry is most at risk for economic impact and damage. During droughts, crops do not mature, which results in smaller crop yields, undernourishment of wildlife and livestock, decreases in land values, and ultimately financial loss to the farmer (FEMA 1997). The agricultural sector in New York State encompasses more than 34,000 farms that occupy approximately one-quarter of the State's land area and contribute \$4.5 billion annually to the State's economy. A large majority of the State's agriculture is rain-fed without irrigation. However, summer precipitation is currently not sufficient to fully meet crop water needs during most years (NYSERDA 2011).

Table 5.4.2-8 summarizes direct and indirect losses to agricultural producers, livestock producers, timber producers, fishery producers, and tourism (NYS DHSES 2011).



**Table 5.4.2-8. Impacts on the Economy**

Losses to Agricultural Producers	Losses to Livestock Producers	Losses to Timber Producers
Annual and perennial crop losses	Reduced productivity of rangeland	Losses from wildland fires
Damage to crop quality	Reduced milk production	Losses from tree disease
Income loss for farmers due to reduced crop yields	Forced reduction of foundation stock	Losses from 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 saplings
Plant disease	High cost/unavailability of feed for livestock	Transportation Industry
Wildlife damage to crops	Increased feed transportation costs	Loss from impaired navigability of streams, rivers, and canals
Increased irrigation costs	High livestock mortality rates	Decline in food production/disrupted food supply
Cost of new or supplemental water resource development (wells, dams, pipelines)	Disruption of reproduction cycles (delayed breeding, more miscarriages)	Increase in food prices
Loss from Fishery Production	Decreased stock weights	Increased importation of food (higher costs)
Damage to fish habitat	Increased predation	
Loss of fish and other aquatic organisms due to decreased flows	Increased risk of grass fires	
Loss to Recreation and Tourism Industry	Energy-related Effects	Water Suppliers
Loss to manufacturers and sellers of recreational equipment	Increased energy demand and reduced supply because of drought-related power curtailments	Revenue shortfalls and/or windfall profits
Losses related to curtailed activities (such as hunting and fishing, bird watching, boating, etc.)	Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power	

Source: New York State Disaster Preparedness Commission (NYSDFPC) 2011

Loss estimation stems from lost agricultural revenues statewide. Table 5.4.2-9 below enumerates Genesee County’s farmland acreage exposure to the drought hazard as well as the annual market value of all agricultural products sold, as documented in the 2012 USDA Census of Agriculture (the most current census data available). If a drought were to eliminate the entire Genesee County agricultural yield, total losses may exceed \$236,952,000, which would be devastating to the local economy (USDA 2012).

**Table 5.4.2-9. Estimated County Losses Relating to Agricultural Production**

Number of Farms	Land in Farms (acre)	Market Value of Products Sold (\$)	Average Per Farm (\$)
549	187,317	\$236,952,000	\$431,606

Source: USDA 2012

As stated earlier, crop losses can have a significant impact on the economy by reducing produce sales and purchases. Such impacts may have long-term consequences, particularly if crop yields are low in the years following a drought as well. USDA RMA-insured crop losses through Genesee County as a result of drought conditions are shown in Table 5.4.2-3. Table 5.4.2-3 shows the highest year of crop losses as over \$9.1 million in the 17-year period. Please note that these data only apply to insured crops.





A prolonged drought can have a serious economic impact on a community. Increased demand for water and electricity may result in shortages and higher costs for these resources (FEMA 2005; New York State 2004). Industries that rely on water for business may 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 or price of food for residents within the County.

### **Future Growth and Development**

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As discussed in Section 4, areas targeted for future growth and development have been identified across Genesee County. Future growth could affect the amount of potable water available due to a drain on 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 within the next 5 years have been identified across the County at the municipal level. The jurisdictional annexes in Volume II of this HMP include municipal-specific information.

### **Effects of Climate Change on Vulnerability**

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Nearly every region in the country is facing some increased risk of seasonal drought. Climate change can significantly affect the sustainability of water supplies in the future. As parts of the United States get drier, the amount and quality of water available will likely decrease, impacting people’s health and food supplies. With climate change, the entire country will likely face some level of drought. A report by the Natural Resources Defense Council (NRDC) found that 1,100 counties (one-third of all counties in the contiguous 48 states) face higher risks of water shortages by mid-century as a result of climate change. More than 400 of these counties will face extremely high risks of water shortages (NRDC 2015).

### **Change of Vulnerability**

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An examination of change in the County’s vulnerability to drought events from the 2008 HMP to this update must scrutinize each exposed and vulnerable entity. Total population across the County has changed, as indicated by a comparison of the 2000 U.S. Census with the 2010 U.S. Census.

Regarding the agricultural industry within Genesee County, from 2007 to 2012, Genesee County was less than 1 percent change in the number of farms (551 farms to 549 farms), and land in farms increased by 2 percent (183,539 acres to 187,317 acres). The County also saw an increase in the size of farms – from 333 acres to 341 acres. Additionally, Genesee County experienced a 33-percent growth in the market value of products sold, from \$177,810,000 in 2007 to \$236,952,000 in 2012. Therefore, due to this increase in market values of products sold, the County’s potential crop loss due to drought may increase overall (USDA Census of Agriculture 2012).

### **Additional Data and Next Steps**

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For the HMP Update, any additional information regarding localized concerns and past impacts will be acquired and analyzed. These data will be developed to support future revisions to the plan. Mitigation efforts could include building on current New York State, Genesee County, and local efforts. The lead state agency for drought preparedness is the NYS DEC.