



## 5.4.2 Drought

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 Morris County.

### 2015 Plan Update Changes

- The hazard profile has been significantly enhanced to include a detailed hazard description, location, extent, previous occurrences, probability of future occurrence, and potential change in climate and its impacts on the drought hazard is discussed. The drought hazard is now located in Section 5 of the plan update.
- New and updated figures from federal and state agencies are incorporated.
- Previous occurrences were updated with events that occurred between 2010 and 2014.
- A vulnerability assessment was conducted for the drought hazard and it now directly follows the hazard profile.

#### 5.4.2.1 Profile

##### Hazard Description

As defined by the National Weather Service (NWS), drought is a deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, and/or people. It is a normal, recurrent feature of climate that occurs in virtually all climate zones, from very wet to very dry. Drought is a temporary aberration from normal climatic conditions and can vary significantly from one region to another. Human factors, such as water demand and water management, can exacerbate the impact that a drought has on a region. 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 2012).

Scientists at this time do not know how to predict drought more than one month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation



and temperature may last from several months to several decades. How long they last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale (NDMC Date Unknown).

### **Location**

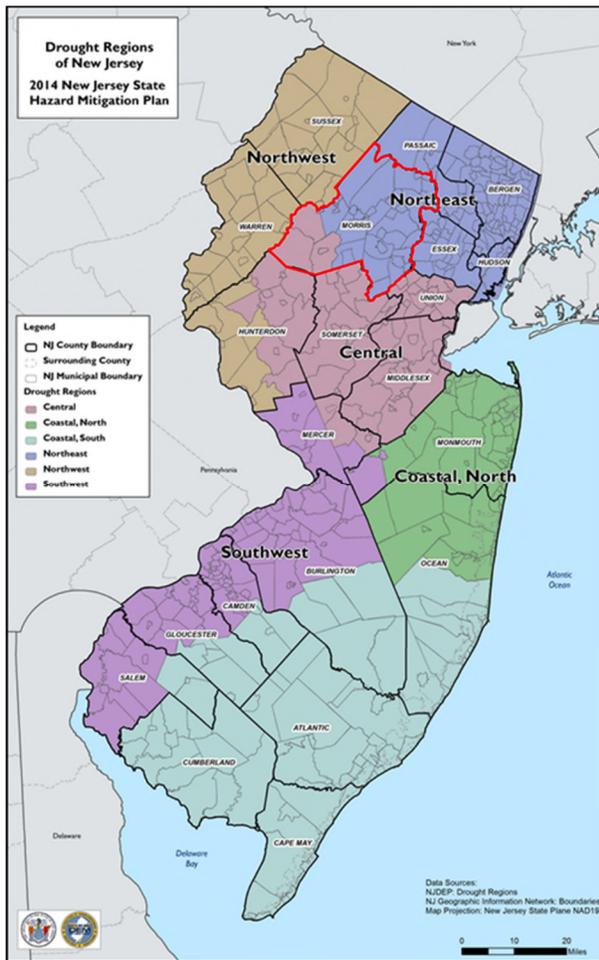
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Climate divisions are regions within a state that are climatically homogenous. The National Oceanic and Atmospheric Administration (NOAA) has divided the U.S. into 359 climate divisions. The boundaries of these divisions typically coincide with the county boundaries, except in the western U.S., where they are based largely on drainage basins (U.S. Energy Information Administration, Date Unknown). According to NOAA, New Jersey is made up of three climate divisions: Northern, Southern, and Coastal; Morris County is located in the Northern Climate Division (NOAA, 2012).

Drought regions allow New Jersey to respond to changing conditions without imposing restrictions on areas not experiencing water supply shortages. New Jersey is divided into six drought regions that are based on regional similarities in water supply sources and rainfall patterns. Morris County is located in two drought regions: 1) the Northeast Drought Region and 2) Central Drought Region (Hoffman and Domber, 2003) (see Figure 5.4.2-1). These regions were developed based upon hydro-geologic conditions, watershed boundaries, municipal boundaries, and water supply characteristics. Drought region boundaries are contiguous with municipal boundaries because during a water emergency, the primary enforcement mechanism for restrictions is municipal police forces.



Figure 5.4.2-1. Drought Regions of New Jersey



Source: NJHMP 2014

Note: The red outline indicates the location of Morris County. The County is located within the Northeast and Central Drought Regions of New Jersey.

### 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 Date Unknown). Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people indirectly. When measuring the severity of droughts, analysts typically look at economic impacts on a planning area.

### Drought Indices

A number of drought indices are available from U.S. Geological Survey (USGS) and the New Jersey Department of Environmental Protection (NJDEP) to assess the various impacts of dry conditions. However, the USGS indicators are not used by NJDEP to a significant extent. The State uses a multi-index system that takes advantage of some of these indices to determine the severity of a drought or extended period of dry conditions.

The following text provides information regarding the drought indices used by NJDEP to determine drought conditions throughout the State. These indices were designed for the particular characteristics and needs of New Jersey.



- The **Groundwater Level Index** is based on the number of consecutive months that groundwater levels are below normal (lowest 25% of period of record for the respective months). The U.S. Geological Survey (USGS) monitors groundwater levels in a network of monitoring wells throughout New Jersey. Groundwater condition maps showing areas of above normal, normal, and below normal (monthly conditions compared to monthly normals) are provided by the USGS on a monthly basis.
- The **Stream Flow Index** is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record for the respective months). The USGS monitors stream flow in a network of 111 gages throughout New Jersey. Stream flow conditions maps showing areas of above normal, normal and below normal (monthly conditions compared to monthly normals) are provided by the USGS on a monthly basis. In addition, USGS provides a table that describes the cumulative monthly stream flow condition as normal, above normal, or below normal (USGS 2013).
- New Jersey maintains a real-time groundwater level monitoring system consisting of seven observation wells throughout the state. The network, a cooperative between the USGS and NJDEP, uses satellite telemetry to provide observations in four-hour increments. Observations are available on the USGS website at <http://water.usgs.gov/nj/nwis/current/?type=gw>. The primary purpose of the network is to provide information regarding the status of wells throughout the state and to anticipate potential shortages (NJDEP 2002).
- The **Reservoir Index** is based on the water levels of small, medium, and large index reservoirs across the state. The reservoir level relative to normal conditions will be considered. The NJDEP maintains a listing of current reservoir levels across the State and the Northeast. The current reservoir levels are available at <http://www.njdrought.org/reservoir.html>.
- New Jersey also maintains a real time **Regional Drought Indicator Status**, showing the level of 90-day precipitation, 90-day stream flow, reservoir levels, the Delaware River Basin Commission reservoir levels, and the unconfined groundwater levels in terms of dryness indices. These indicators determine the Declared Drought Status for each drought region. The observations and status are available at <http://www.njdrought.org/status.html>.

### Watches, Warnings and Emergencies

During periods of drought, the NJDEP may issue drought watches, drought warnings, or a water emergency. A drought watch is an administrative designation made by the NJDEP when drought or other factors begin to adversely affect water supply conditions. A watch indicates that conditions are dry but not significantly. During a drought watch, the NJDEP closely monitors drought indicators and consults with affected water suppliers. The watch designation is used to alert the public about deteriorating conditions, while reminding water supply professionals to keep watch on conditions and update contingency plans (NJDEP 2011).

A drought warning represents a non-emergency phase of managing available water supplies during the developing stages of drought and falls between the watch and emergency levels of drought response. Under a drought warning, the NJDEP commissioner may order water purveyors to develop alternative sources of water or transfer water between areas of the State with relatively more water to those with less (NJDEP 2011).

A water emergency (or drought emergency) can only be declared by the governor. During a water emergency, a phased approach to restricting water consumption is typically initiated. Phase I water use restrictions typically target non-essential, outdoor water use (NJDEP 2011).

### Previous Occurrences and Losses

Between 1954 and 2014, the State of New Jersey experienced two FEMA declared drought-related major disasters (DR) or emergencies (EM) classified as a water shortage. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Of those two declarations, Morris County has been included in both declarations (FEMA 2014).



Agriculture-related drought disasters are quite common. One-half to two-thirds of the counties in the U.S. 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 to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2012 and 2014, New Jersey has been included in seven USDA declarations. Of those seven declarations, Morris County has been included in one as a result of drought conditions (S3487 in 2012).

For this 2014 Plan Update, known drought events that have impacted Morris County between 2008 and 2014 are identified in Appendix G. For events that occurred prior to 2008, see the 2010 Morris County HMP. Please note that not all events that have occurred in Morris 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.

### **Probability of Future Occurrences**

Based upon risk factors for and past occurrences, it is likely that droughts will occur across New Jersey and Morris County in the future. In addition, as temperatures increase (see climate change impacts), the probability for future droughts will likely increase as well. Therefore, it is likely that droughts will occur in New Jersey of varied severity in the future.

It is estimated that Morris 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 Morris 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 5.3-3).

### **Climate Change Impacts**

Water resources are important to both society and ecosystems. Humans depend on reliable, clean supply of drinking water to sustain their health. Water is also needed for agriculture, energy production, navigation, recreation, and manufacturing. These water uses put pressure on water resources and are most likely to be worsened by climate change in the future.

The climate of New Jersey is already changing and will continue to change over the course of this century. Since 1900, temperatures in the northeastern U.S. have increased an average of 1.5 degrees Fahrenheit (°F). The majority of this warming has occurred since 1970. From 1970 to 2010, average temperatures in New Jersey have increased 1.2°F (Office of the New Jersey State Climatologist [ONJSC] 2013). In terms of winter temperatures, the northeast region has seen an increase in the average temperature of 4°F since 1970 (Northeast Climate Impacts Assessment [NECIA] 2007). By the 2020s, the average annual temperature in New Jersey is projected to increase by 1.5°F to 3°F above the statewide baseline (1971 to 2000), which was 52.7°F. By 2050, the temperature is projected to increase 3°F to 5°F, and by 2080 projections show an increase of 4°F to 7.5°F (Sustainable Jersey Climate Change Adaptation Task Force 2013). However, both northern and southern New Jersey have become wetter over the past century. Northern New Jersey’s 1971-2000 precipitation average was over five inches (12%) greater than the average from 1895-1970. Southern New Jersey became 2” (5%) wetter late in the 20th century (Office of New Jersey State Climatologist). Average annual precipitation is projected to increase in the region by 5% by the 2020s and up to 10% by the 2050s. Most of the additional precipitation is expected to come during the winter months (New York City Panel on Climate Change [NPCC] 2009).



As temperatures rise, people and animals will need more water to maintain their health and to thrive. Many economic activities, such as hydropower, raising livestock, and growing foods, will also require water. The amount of water available for these activities may be reduced as temperatures rise and if competition for water resources increases. As shown in the paragraph above, these trends will certainly affect the probability and frequency of dryer conditions that could lead to drought events in Morris County.



### 5.4.2.2 Vulnerability Assessment

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To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the drought hazard, all of Morris County has been identified as exposed. Therefore, all assets in the County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are exposed and potentially 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 2010 Morris County Hazard Mitigation Plan
- Further data collections that will assist understanding this hazard over time

#### Overview of Vulnerability

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The entire County is vulnerable to drought. However, areas at particular risk are areas used for agricultural purposes (farms and cropland), open/forested land vulnerable to the wildfire hazard, densely-populated areas where communities rely on surface water supplies (above ground reservoirs) for industrial, commercial, and domestic purposes, and certain areas where elderly, impoverished or otherwise vulnerable populations are located. 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.

Droughts conditions can cause a shortage of water for human consumption and reduce local fire-fighting capabilities. According to the New Jersey HMP, counties most often affected by a drought are densely populated areas that rely on above-ground reservoirs for their water supply; this includes Morris County. Areas more resistant to drought conditions are less densely populated and rely on groundwater or surface water sources (NJ HMP, 2011). Morris County is located within the Northeast Drought Region of New Jersey. According to the NJDEP, water supply sources available to this region include rivers and New Jersey reservoirs, both major supply sources, and unconfined groundwater (minor supply source).

#### Data and Methodology

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Data was collected from HAZUS-MH, USDA, NOAA-NCDC, Morris County, and the Planning Committee. 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

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Droughts may have devastating effects on communities and the surrounding environment. The amount of devastation depends on the strength and duration of a drought event. 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 can include watering of lawns, washing cars, etc. In exceptional drought conditions, watering of lawns and crops may not be an option. If crops are not able to receive water, farmland will dry out and crops will die. This can lead to crop shortages, which, in turn, increases the price of food (North Carolina State University 2013).



Droughts also have the potential to lead to water pollution due to the lack of rain water to dilute any chemicals in water sources. Contaminated water supplies may be harmful to plants and animals. If water is not getting into the soils, the ground will dry up and become unstable. Unstable soils increase the risk of erosion and loss of top soil (North Carolina State University 2013).

The impacts on public health from drought can be severe which includes increase in heat-related illnesses, waterborne illnesses, recreational risks, limited food availability, and reduced living conditions. Those individuals who rely on water, such as farmers, may experience financial-related stress. Decreased amounts and quality of water during drought events have the potential to reduce the availability of electricity (hydropower, coal-burning and nuclear) (North Carolina State University 2013).

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). 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).

In 2009, 103 million gallons per day (MGD) were withdrawn from Morris County's surface and groundwater resources. Of this amount, only 47 MGD were used in Morris County and 56 MGD were exported from the County eastward to support major urban areas, including Jersey City (Hudson County) and Newark (Essex County) (Morris County Planning Board 2013). 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 stream flows are lowest. The following table provides the drinking water suppliers for Morris County.

**Table 5.4.2-1. Drinking Water Suppliers in Morris County**

Name	Population Served	Source Type
Abernaki Trail Homeowners Association	70	Groundwater
AWM Country Oaks	475	Groundwater
AWM Four Seasons at Chester	280	Groundwater
Boonton Twp Water Dept.	305	Surface Water
Boonton Water Dept.	9,532	Surface Water
Butler Water Dept.	7,630	Surface Water
Chatham Water Dept.	8,460	Groundwater
Dover Water Commission	27,806	Groundwater
East Hanover Twp. Water Dept.	11,393	Groundwater
Fayson Lakes Water Company Inc.	3,010	Groundwater
Florham Park Water Dept.	8,846	Groundwater
Green Briar Res. Health	43	Groundwater
Hoffman Homes	120	Groundwater
Jefferson Twp. W U Lk Hop	8,500	Groundwater
Jefferson Twp. U Milton Sys	4,500	Groundwater



Table 5.4.2-1. Drinking Water Suppliers in Morris County

Name	Population Served	Source Type
Jefferson Twp. W Vassar Road	90	Groundwater
Kinnelon Water Dept.	1,001	Surface Water
Lakeshore Company	300	Groundwater
Lincoln Park Jacksonville System	800	Groundwater
Lincoln Park Water Dept.	11,000	Surface Water
Loziers Trailer Park	57	Groundwater
Madison Water Dept.	15,820	Groundwater
Merry Heart of Boonton Twp	140	Groundwater
Mine Hill Twp Water Dept	3,679	Groundwater
Montville Twp. MUA	21,000	Surface Water
Morris County MUA	32,980	Groundwater
Mount Arlington Boro DPW Main	1,650	Purchased Groundwater
Mount Arlington DPW Kadel Sys.	869	Groundwater
Mount Olive Twp W D Main	6,800	Groundwater
Mount Olive Twp W D Sand	500	Groundwater
Mount Olive W.D. Goldmine Sys.	210	Groundwater
Mount Olive Water Dept. L	76	Groundwater
Mountain Lakes Water Dept	4,000	Groundwater
Mountain Shore Water Sup	90	Groundwater
Mount Olive Twp Tinc Farm	500	Groundwater
Mount Olive Twp W D Carlton	120	Groundwater
Mount Olive Twp W D Village	2,800	Groundwater
Mount Olive Twp WD Pinecrest	600	Groundwater
Mount Olive Villages Water	5,000	Groundwater
Netcong Water Dept.	3,342	Groundwater
NJ American W Co West Jersey	744	Groundwater
NJ American Water Company	217,230	Surface Water
NJ American Water ITC System	6,000	Groundwater
NJ VASA Home Water Sys.	120	Groundwater
Oak Ridge Mobile Home Park	100	Groundwater
Parsippany-Troy Hills Water Dept.	50,036	Groundwater
Pequannock Twp Water Dept.	14,002	Groundwater
Pequannock Twp WD-Cedar Crest	1,463	Surface Water
Plausha Park Water Co.	200	Groundwater
Randolph Twp Public Works Dept.	18,000	Purchased Groundwater
Riverdale Boro Water Dept.	2,850	Surface Water
Rockaway Boro Water Dept.	7,066	Groundwater
Rockaway Twp Water Dept.	15,000	Groundwater
Roxbury Twp W Dept. – Evergreen	100	Groundwater
Roxbury Twp W Dept. – Shore	6,809	Groundwater
Roxbury Twp W Dept. – Sky V	1,500	Groundwater



Table 5.4.2-1. Drinking Water Suppliers in Morris County

Name	Population Served	Source Type
Roxbury Twp WD Lookout	100	Groundwater
Roxbury Water Co.	11,230	Groundwater
Sandy Point Mobile Home	75	Groundwater
Sheerwood Village	95	Groundwater
Sisters of Charity of SE	1,100	Groundwater
Sisters of Christian Charity	70	Groundwater
Southeast Morris County MUA	67,657	Surface Water
Sun Valley Park	42	Groundwater
United Water Arlington Hills	2,000	Groundwater
Washington Twp MUA-Hager	3,202	Groundwater
Washington Twp MUA-School	4,675	Groundwater
Wharton Water Dept.	7,500	Groundwater
Windy Acres Mobile Home	100	Groundwater
YB Properties LLC	44	Groundwater

Source: U.S. EPA 2015

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 Morris County because the County’s water is supplied by both surface water and groundwater. Surface water supplies are affected more quickly during droughts than groundwater sources.

**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. 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 wildfire 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. Refer Section 5.4.9 for the Wildfire risk assessment.

**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 are considered vulnerable to wildfire.

**Impact on the Economy**

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 that 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.

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. A summary of potential impacts associated with drought are identified in Table 5.4.2-2. This table includes only some of the potential impacts of drought.

**Table 5.4.2-2. Economic, Environmental, and Social Impacts of Drought**

Economic	Environmental	Social
<ul style="list-style-type: none"> <li>Loss of national economic growth, slowing down of economic development</li> </ul>	<ul style="list-style-type: none"> <li>Increased desertification - damage to animal species</li> </ul>	<ul style="list-style-type: none"> <li>Food shortages</li> </ul>
<ul style="list-style-type: none"> <li>Loss of national economic growth, slowing down of economic development</li> </ul>	<ul style="list-style-type: none"> <li>Reduction and degradation of fish and wildlife habitat</li> </ul>	<ul style="list-style-type: none"> <li>Loss of human life from food shortages, heat, suicides, violence</li> </ul>
<ul style="list-style-type: none"> <li>Damage to crop quality, less food production</li> </ul>	<ul style="list-style-type: none"> <li>Lack of feed and drinking water</li> </ul>	<ul style="list-style-type: none"> <li>Mental and physical stress</li> </ul>
<ul style="list-style-type: none"> <li>Increase in food prices</li> </ul>	<ul style="list-style-type: none"> <li>Disease</li> </ul>	<ul style="list-style-type: none"> <li>Water user conflicts</li> </ul>
<ul style="list-style-type: none"> <li>Increased importation of food (higher costs)</li> </ul>	<ul style="list-style-type: none"> <li>Increased vulnerability to predation</li> </ul>	<ul style="list-style-type: none"> <li>Political conflicts</li> </ul>
<ul style="list-style-type: none"> <li>Insect infestation</li> </ul>	<ul style="list-style-type: none"> <li>Loss of wildlife in some areas and too many in others</li> </ul>	<ul style="list-style-type: none"> <li>Social unrest</li> </ul>
<ul style="list-style-type: none"> <li>Plant disease</li> </ul>	<ul style="list-style-type: none"> <li>Increased stress to endangered species</li> </ul>	<ul style="list-style-type: none"> <li>Public dissatisfaction with government regarding drought response</li> </ul>
<ul style="list-style-type: none"> <li>Loss from dairy and livestock production</li> </ul>	<ul style="list-style-type: none"> <li>Damage to plant species, loss of biodiversity</li> </ul>	
<ul style="list-style-type: none"> <li>Unavailability of water and feed for livestock which leads to high livestock mortality rates</li> </ul>	<ul style="list-style-type: none"> <li>Increased number and severity of fires</li> </ul>	<ul style="list-style-type: none"> <li>Inequity in the distribution of drought relief</li> </ul>
<ul style="list-style-type: none"> <li>Disruption of reproduction cycles (breeding delays or unfilled pregnancies)</li> </ul>	<ul style="list-style-type: none"> <li>Wind and water erosion of soils</li> </ul>	<ul style="list-style-type: none"> <li>Loss of cultural sites</li> </ul>
<ul style="list-style-type: none"> <li>Increased predation</li> </ul>	<ul style="list-style-type: none"> <li>Loss of wetlands</li> </ul>	<ul style="list-style-type: none"> <li>Reduced quality of life which leads to changes in lifestyle</li> </ul>
<ul style="list-style-type: none"> <li>Increased fire hazard - range fires and wildland fires</li> </ul>	<ul style="list-style-type: none"> <li>Increased groundwater depletion</li> </ul>	<ul style="list-style-type: none"> <li>Increased poverty</li> </ul>
<ul style="list-style-type: none"> <li>Damage to fish habitat, loss from fishery production</li> </ul>	<ul style="list-style-type: none"> <li>Water quality effects</li> </ul>	<ul style="list-style-type: none"> <li>Population migrations</li> </ul>
<ul style="list-style-type: none"> <li>Income loss for farmers and others affected</li> </ul>	<ul style="list-style-type: none"> <li>Increased number and severity of fires</li> </ul>	
<ul style="list-style-type: none"> <li>Unemployment from production declines</li> </ul>	<ul style="list-style-type: none"> <li>Air quality effects</li> </ul>	
<ul style="list-style-type: none"> <li>Loss to recreational and tourism industry</li> </ul>		
<ul style="list-style-type: none"> <li>Loss of hydroelectric power</li> </ul>		
<ul style="list-style-type: none"> <li>Loss of navigability of rivers and canals</li> </ul>		

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). 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.

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 drought directly or indirectly impacts all people in affected areas. A drought can result in farmers not being able to plant crops or the failure of already planted crops. This results in loss of work for farm workers and those in related food processing jobs. Based on the 2012 Census of Agriculture, there were 366 farms in Morris County, with 14,458 acres of total land in farms. The average farm size was 40 acres. Morris County farms had a total market value of products sold of \$27.2 million in crop sales and \$1.2 million in livestock sales), averaging \$77,560 per farm. The Census indicated that 159 of farm operators reported farming as their primary occupation (USDA 2012). Table 5.4.2-3 shows the acreage of agricultural land exposed to the drought hazard.

**Table 5.4.2-3. Agricultural Land in Morris County in 2012**

Number of Farms	Land in Farms (acres)	Total Cropland (acres)	Harvested Cropland (acres)	Irrigated Land (acres)
366	14,458	7,215	6,077	726

Source: USDA 2012

The 2012 Census of Agriculture for Morris County indicated that the top crop items, by acres, in the County are nursery, greenhouse, floriculture and sod (21,436 acres), vegetables, melons, potatoes, and sweet potatoes (3,146 acres), and fruits, tree nuts and berries crops (1,458 acres) (USDA 2012).

### Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across Morris 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 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

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. Western United States have already been experiencing water shortages due to severe dry-spells. With climate change, the entire country will likely face some level of drought. A report by the National 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.

### Change of Vulnerability

When examining the change in the County’s vulnerability to drought events from the 2010 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 continued to increase over the past few years, which will place a greater stress on the water supply



during a drought event. In terms of the agricultural industry for Morris County, there has been a 13% decrease in the total number of farms and a 15% decrease in total farmland area (USDA 2012).

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

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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 Jersey, Morris County, and local efforts.