- Dewatering**:** intercepts groundwater before it reaches the bluff face. Wells and groundwater trenches collect groundwater and re-channel it through pipes over the bluff face to the base of the bluff.
- Vegetation: naturally and inexpensively protects the bluffs. Root systems absorb groundwater and hold the soil together. Leaves intercept the impact of raindrops and transfer water absorbed by the root systems into the atmosphere through evapo-transpiration.

The PADEP Coastal Zone Management Program provides funding as well as technical assistance for projects located within the 76.6 miles of coastline and landward to the Lake Erie watershed boundary. Grant funds can be used for many types of projects including education, construction, research, planning, acquisition, and design. The program's main goal is to balance coastal land use with conservation and protection of water-related resources.

4.3.1.9. State Facility Loss Estimation

No state facilities fall within 500 feet of the Lake Erie shoreline, so potential loss estimates are low. However, degradation of Presque Isle State Park due to coastal erosion could lead to losses related to tourism dollars and incalculable damage to the unique natural environment there.

4.3.2. Drought

4.3.2.1. Location and Extent

The current climate in Pennsylvania, when compared to many other states across the U.S., is generally water-rich. However, like all other states, Pennsylvania is subject to periodic droughts that impact the Commonwealth's ability to meet its water needs. Droughts are regional climatic events which can impact large areas ranging from several counties in Pennsylvania to the entire mid-Atlantic region. While large geographic areas can be impacted by a given drought, areas with extensive agricultural land use can experience particularly significant impacts.

4.3.2.2. Range of Magnitude

Droughts can have varying effects, depending upon what month they occur, severity, duration and location. Some droughts may have their greatest impact on agriculture and even short term droughts, when coupled with extreme temperatures can be devastating. Others may impact water supply or other water use activities such as recreation. Most droughts cause direct impacts to aquatic resources. Drought events are defined by rainfall amounts, vegetation conditions, soil-moisture conditions, water levels in reservoirs, stream flow, agricultural productivity, or economic impacts.

Hydrologic drought events result in a reduction of stream flows, reduction of lake/reservoir storage, and reduced groundwater levels. These events have a significant adverse impact on public water supplies for human consumption, rural water supplies for livestock consumption and agricultural operations, water quality, natural soil water or irrigation water for agriculture, soil moisture, conditions conducive to wildfire events and water for navigation and recreation. PEMA has primary responsibility for managing droughts with direct support from PADEP. According to *Drought Management in Pennsylvania* (2102), PEMA and PADEP use the following three stages to describe and manage droughts. They are listed in order of increasing severity:

- **Drought Watch:** A period to alert government agencies, public water suppliers, water users and the public regarding the potential for future drought-related problems, Drought Watches are invoked when three or more drought indicators are present for a county or group of counties. The focus is on increased monitoring, awareness and preparation for response if conditions worsen. A request for voluntary water conservation is made. The objective of voluntary water conservation measures during a drought watch is to reduce water uses by 5 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions.

- **Drought Warning:** This phase involves a coordinated response to imminent drought conditions and potential water supply shortages through concerted voluntary conservation measures to avoid or reduce shortages, relieve stressed sources, develop new sources, and if possible, forestall the need to impose mandatory water use restrictions. The objective of voluntary water conservation measures during a drought warning is to reduce overall water uses by 10-15 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions. At

- **Drought Emergency:** This stage is a phase of concerted management operations to marshal all available resources to respond to actual emergency conditions, to avoid depletion of water sources, to assure at least minimum water supplies to protect public health and safety, to support essential and high priority water uses and to avoid unnecessary economic dislocations. It is possible during this phase to impose mandatory restrictions on non-essential water uses that are provided in the Pennsylvania Code (Chapter 119), if deemed necessary and if ordered by the Governor of Pennsylvania. The objective of water use restrictions (mandatory or voluntary) and other conservation measures during this phase is to reduce consumptive water use in the affected area by fifteen percent, and to reduce total use to the extent necessary to preserve public water system supplies, to avoid or mitigate local or area shortages and to assure equitable sharing of limited supplies.

- **Local Water Rationing:** Although not a drought phase, local municipalities may, with the approval of the PA Emergency Management Council, implement local water rationing to share a rapidly dwindling or severely depleted water supply in designated water supply service areas. These individual water rationing plans, authorized through provisions of the Pennsylvania Code (Chapter 120), will require specific limits on individual water consumption to achieve significant reductions in use. Under both mandatory restrictions imposed by the Commonwealth and local water rationing, procedures are provided for granting of variances to consider individual hardships and economic dislocations.

The Commonwealth uses five indicators to assess drought conditions: 1) Precipitation Deficits, 2) Stream Flows, 3) Groundwater Levels, 4) Soil Moisture, and 5) Reservoir Storage.

Precipitation Deficits

The earliest indicators of a potential drought are precipitation deficits (measured as the departure from normal, 30 year average precipitation), because it is rainfall that provides the basis for both our ground and surface water resources. The National Weather Service has long-term monthly averages of precipitation for each county. These averages are updated at the end of each decade, based upon the most recent 30 years, and are considered "normal" monthly precipitation. Each month, the total cumulative precipitation values in each county, for periods ranging from three to 12 months, are compared against the normal values for the same periods. Totals that are less than the normal values represent deficits, which are then converted to percentages of the normal values. Table 4.3.2-1 lists the drought conditions that are indicated by various precipitation deficit percentages.

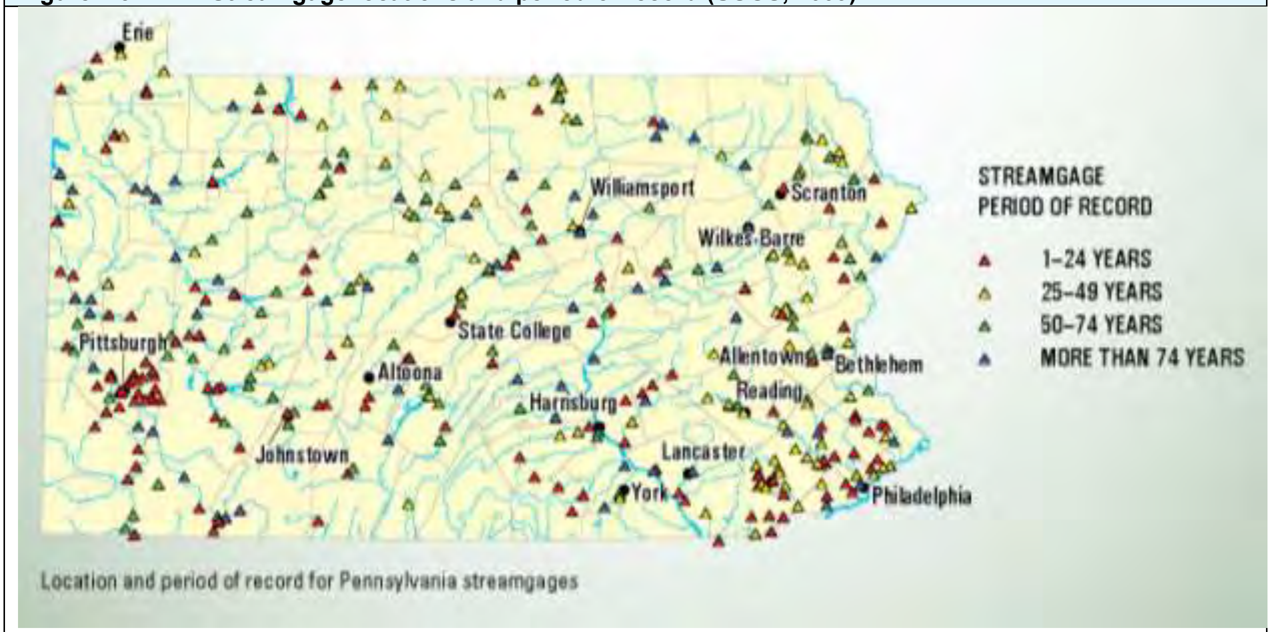
Table 4.3.2-1 Precipitation deficit drought indicators for Pennsylvania (PADEP, 2012)

DURATION OF DEFICIT ACCUMULATION (months)	**DROUGHT WATCH** (deficit as percent of normal precipitation)	**DROUGHT WARNING** (deficit as percent of normal precipitation)	**DROUGHT EMERGENCY** (deficit as percent of normal precipitation)
3	25	35	45
4	20	30	40
5	20	30	40
6	20	30	40
7	18.5	28.5	38.5
8	17.5	27.5	37.5
9	16.5	26.5	36.5
10	15	25	35
11	15	25	35
12	15	25	35

Stream Flows

After precipitation, stream flows provide the next earliest indication of a developing drought. Stream flows typically lag one to two months behind precipitation in signaling a drought. The U.S. Geological Survey maintains a network of stream gages across the state, shown in Figure 4.3.2-1. The DEP currently uses 73 of these gages, equipped with satellite communication transmitters, as its drought monitoring network. Similar to precipitation, long-term 30-day average stream flow values have been computed for each of the stream gages, but rather than using only the past 30 years, the entire period of record for each gage is used. For example, the Susquehanna River gage at Harrisburg has more than 110 years of record from which the long-term 30-day average, or normal, flows are now determined.

Figure 4.3.2-1 Streamgage locations and period of record (USGS, 2009).



Drought status is determined from stream flows based on *exceedances*, rather than percentages, as are used for precipitation. Exceedances are similar to percentiles; a 75-percent exceedance flow value means that the current 30-day average flow is exceeded in the stream 75-percent of the time; in other words, the 30-day average flow in the stream is less than that value only 25-percent of the time. Similarly, with a 90-percent exceedance flow value, the 30-day average flows in the stream would be less than that value only 10-percent of the time, and only 5-percent of the time for a 95-percent exceedance. For stream flows, the 75-, 90-, and 95-percent exceedance 30-day average flows are used as indicators for drought watch, warning and emergency.

Groundwater Levels

Groundwater is usually the third indicator of a developing drought. Groundwater typically lags two to three months behind precipitation, largely because of the storage effect. According to the PADEP Water Management about 80 trillion gallons of groundwater is stored throughout Pennsylvania enough to cover the entire state with more than eight feet of water. Therefore, precipitation deficits can accumulate for several months before the resultant lack of groundwater recharge becomes clearly evident in groundwater levels.

The USGS also maintains a network of groundwater monitoring wells, just recently upgraded to at least one well in each county. Groundwater is used to indicate drought status in a manner similar to stream flows. Groundwater level exceedances of 75, 90 and 95 percent are used to indicate watch, warning and emergency status. In this case, it is the 30-day average depth to groundwater that is measured and monitored, again in relation to long-term 30-day averages based on the period of record for each county well. An example of the monitoring performed by other agencies and utilized by the Commonwealth is shown for Bucks County at: http://waterdata.usgs.gov/pa/nwis/uv/?site_no=402643075150501&PARAmeter_cd=72019.

Soil Moisture

Soil moisture information is provided by the National Oceanic and Atmospheric Administration in the form of the *Palmer Drought Severity Index* (PDSI). The PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions which measures dryness based on recent precipitation and temperature (see Table 4.3.2-2). Based on a number of meteorological and hydrological factors, it is compiled weekly by the Climate Prediction Center of the National Weather Service.

Table 4.3.2-2 Palmer Drought Severity Index (PSDI) classifications (NDMC, 2009).

SEVERITY CATEGORY	PSDI VALUE	DROUGHT STATUS
Extremely wet	4.0 or more	*none*
Very wet	3.0 to 3.99	*none*
Moderately wet	2.0 to 2.99	*none*
Slightly wet	1.0 to 1.99	*none*
Incipient wet spell	0.5 to 0.99	*none*
Near normal	0.49 to -0.49	*none*
Incipient dry spell	-0.5 to -0.99	*none*
Mild drought	-1.0 to -1.99	*none*
Moderate drought	-2.0 to -2.99	Watch
Severe drought	-3.0 to -3.99	Warning
Extreme drought	-4.0 or less	Emergency

Reservoir storage levels

Water level storage in several large public water supply reservoirs (especially three New York City reservoirs in the Upper Delaware River Basin) is the fifth indicator that the PADEP uses for drought monitoring. Depending on the total quantity of storage and the length of the refill period for the various reservoirs, PADEP uses varying percentages of storage draw down to indicate the three drought stages for each of the reservoirs.

The worst drought event on record occurred in 1963, when precipitation statewide averaged below normal for ten of twelve months. Drought emergency status led to widespread water use restrictions, and reservoirs dipped to record low levels. Corn, hay, and other agricultural products shriveled in parched field, causing economic losses. Governor William Scranton sought drought aid for Pennsylvania in the face of mounting agricultural losses, and the event became a presidentially declared disaster in September 1963.

4.3.2.3. Past Occurrence

A summary of declared drought status for each county in Pennsylvania between November, 1980 and February, 2008 is provided in Table 4.3.2-3. Figure 4.3.2-2 shows the number of drought *emergency* declarations for each county in Pennsylvania from 1980 to 2013. Using the information provided in Section 4.2.1, two Presidential and seven Gubernatorial Declarations were issued as a result of drought events.

Table 4.3.2-3 Summary of declared drought status from 1980 to 2013 by county (PADEP, 2013).

COUNTY	TOTAL DROUGHT WATCHES	TOTAL DROUGHT WARNINGS	TOTAL DROUGHT EMERGENCIES
Adams	23	14	12
Allegheny	20	13	1
Armstrong	22	11	4
Beaver	25	11	1
Bedford	22	13	14
Berks	19	20	12
Blair	27	10	9
Bradford	28	10	8
Bucks	15	22	10
Butler	24	10	5
Cambria	25	12	9
Cameron	25	13	10
Carbon	17	16	16
Centre	24	14	10
Chester	18	18	14
Clarion	20	12	6
Clearfield	22	13	10
Clinton	24	14	9
Columbia	23	15	6
Crawford	26	8	6
Cumberland	24	14	11
Dauphin	27	12	9
Delaware	16	19	12
Elk	30	8	7
Erie	27	9	6
Fayette	20	9	5
Forest	27	8	4
Franklin	24	13	10
Fulton	26	11	12
Greene	26	9	5
Huntingdon	23	14	8
Indiana	25	11	6
Jefferson	19	11	6
Juniata	26	15	7
Lackawanna	16	15	12
Lancaster	23	16	10

Table 4.3.2-3 Summary of declared drought status from 1980 to 2013 by county (PADEP, 2013).

COUNTY	TOTAL DROUGHT WATCHES	TOTAL DROUGHT WARNINGS	TOTAL DROUGHT EMERGENCIES
Lawrence	23	10	5
Lebanon	19	19	14
Lehigh	15	20	12
Luzerne	19	16	15
Lycoming	28	10	10
McKean	28	9	4
Mercer	27	10	4
Mifflin	25	13	7
Monroe	18	15	14
Montgomery	13	23	10
Montour	24	16	6
Northampton	15	20	14
Northumberland	22	17	6
Perry	25	15	9
Philadelphia	13	23	10
Pike	17	16	13
Potter	26	13	9
Schuylkill	18	17	20
Snyder	22	14	10
Somerset	21	9	9
Sullivan	27	11	6
Susquehanna	23	10	8
Tioga	26	10	8
Union	25	14	8
Venango	27	7	4
Warren	24	9	4
Washington	26	10	3
Wayne	17	14	14
Westmoreland	20	10	1
Wyoming	25	11	6
York	25	14	10

Figure 4.3.2-2 Number of emergency drought declarations in Pennsylvania by County between 1980 and 2013 (PADEP, 2013).

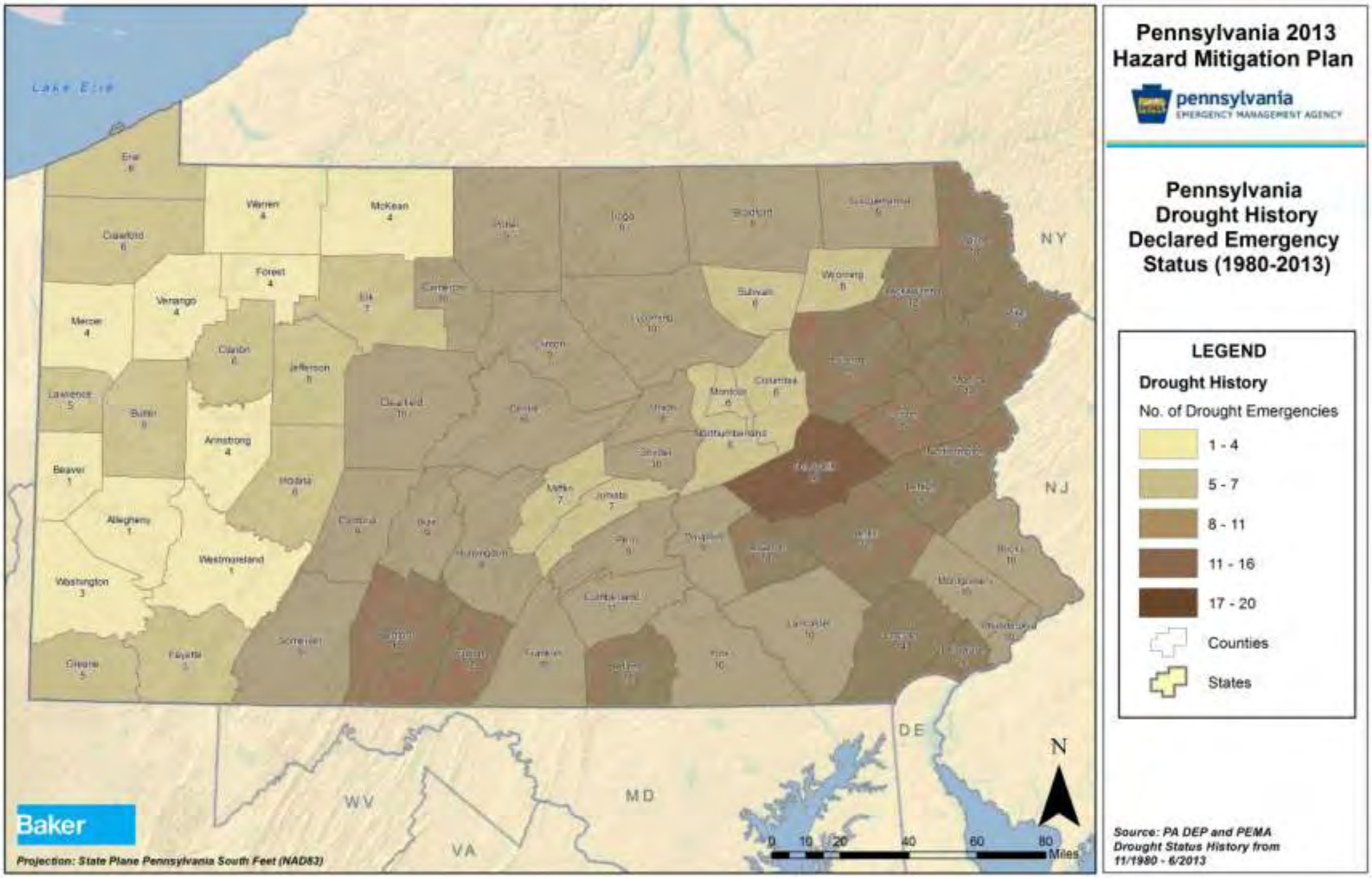


Figure 4.3.2-3 provides a summary of PDSI values for eight climate divisions throughout Pennsylvania for severe or extreme drought events experienced between January 1895 and May 2013. It is clear that periods of dry soil moisture conditions vary by region; however, several widespread (i.e. low PDSI values for multiple climate divisions) events have occurred. For example, between 1930 and 1932, most divisions reported extremely low PDSI values. This includes the South Central Climate Division which reported a PDSI value of -8.13 in January 1931.

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

POCONO MOUNTAINS CLIMATE DIVISION			EAST CENTRAL MOUNTAINS CLIMATE DIVISION		
DROUGHT PERIODS	DURATION	LOWEST PDSI	DROUGHT PERIODS	DURATION	LOWEST PDSI
9/1895 - 1/1896	5 months	-4.02 in 1/1896	11/1895 - 1/1896	3 months	-4.01 in 1/1896
12/1896 - 4/1897	5 months	-3.45 in 3/1897	11/1900 - 2/1901	4 months	-4.11 in 2/1901
11/1900 - 2/1901	4 months	-3.78 in 2/1901	8/1909 - 1/1910	6 months	-4.48 in 11/1909
8/1909 - 1/1910	6 months	-4.69 in 12/1909	7/1910 - 8/1910	2 months	-3.33 in 8/1910
7/1910 - 8/1910	2 months	-3.39 in 8/1910	10/1910 - 7/1911	10 months	-4.18 in 12/1910
10/1910 - 7/1911	10 months	-3.98 in 12/1910	10/1914 - 12/1914	3 months	-3.83 in 11/1914
10/1914 - 12/1914	3 months	-3.96 in 11/1914	11/1922 - 12/1922	2 months	-3.91 in 12/1922
10/1922 - 1/1924	16 months	-4.86 in 12/1922	5/1923 - 12/1923	8 months	-4.35 in 8/1923
8/1930 - 6/1931	11 months	-5.49 in 1/1931	8/1930 - 6/1931	11 months	-5.01 in 1/1931
10/1931 - 2/1932	5 months	-4.69 in 12/1931	9/1931 - 9/1932	13 months	-4.41 in 12/1931
11/1939 - 1/1940	3 months	-3.69 in 1/1940	11/1939 - 1/1940	3 months	-3.96 in 1/1940
10/1963 - 12/1963	3 months	-4.04 in 10/1963	9/1941 - 2/1942	6 months	-4.20 in 11/1941
7/1964 - 4/1966	22 months	-5.63 in 11/1964	9/1957 - 11/1957	3 months	-3.09 in 10/1957
6/1966 - 11/1966	6 months	-4.13 in 8/1966	8/1964 - 1/1966	18 months	-4.99 in 7/1965
1/1967 - 2/1967	2 months	-3.50 in 2/1967	6/1966 - 11/1966	6 months	-4.27 in 8/1966
12/1980 - 1/1981	2 months	-3.72 in 1/1981	1/1967 - 2/1967	2 months	-3.44 in 2/1967
8/1991 - 9/1991	2 months	-3.17 in 8/1991	8/1980 - 1/1981	6 months	-5.10 in 1/1981
8/1995 - 9/1995	2 months	-3.31 in 8/1995	3/1985 - 4/1985	2 months	-4.32 in 4/1985

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

			8/1991 - 4/1992	9 months	-3.58 in 2/1992
			7/1999 - 8/1999	2 months	-3.60 in 8/1999
SOUTHEASTERN PIEDMONT CLIMATE DIVISION			**UPPER SUSQUEHANNA CLIMATE DIVISION**		
DROUGHT PERIODS	**DURATION**	**LOWEST PDSI**	**DROUGHT PERIODS**	**DURATION**	**LOWEST PDSI**
11/1895 - 1/1896	3 months	-3.71 in 1/1896	9/1895 - 1/1896	5 months	-4.84 in 1/1896
12/1900 - 2/1901	3 months	-4.09 in 2/1901	4/1896 - 4/1897	13 months	-4.17 in 8/1896
11/1909 - 1/1910	3 months	-3.89 in 12/1909	6/1900 - 2/1901	9 months	-5.03 in 2/1901
10/1910 - 3/1911	6 months	-3.73 in 12/1910	10/1908 - 3/1909	6 months	-5.19 in 12/1908
8/1923 - 12/1923	5 months	-3.61 in 8/1923	5/1909 - 9/1911	29 months	-7.25 in 12/1909
8/1930 - 6/1931	11 months	-5.22 in 1/1931	8/1913 - 9/1913	2 months	-3.17 in 9/1913
11/1941 - 1/1942	3 months	-3.18 in 11/1941	10/1914 - 1/1915	4 months	-4.91 in 11/1914
11/1949 - 1/1950	3 months	-3.56 in 1/1950	3/1915 - 7/1915	5 months	-3.81 in 4/1915
8/1957 - 11/1957	4 months	-3.85 in 11/1957	11/1916 - 5/1917	7 months	-3.72 in 4/1917
6/1963 - 8/1963	3 months	-3.53 in 8/1963	4/1921 - 2/1922	11 months	-3.99 in 10/1921
8/1964 - 2/1965	7 months	-4.13 in 11/1964	4/1922 - 5/1922	2 months	-3.60 in 5/1922
4/1965 - 3/1966	12 months	-4.56 in 12/1965	9/1922 - 3/1924	19 months	-5.65 in 12/1922
6/1966 - 8/1966	3 months	-4.76 in 8/1966	8/1929 - 9/1929	2 months	-3.44 in 8/1929
4/1969 - 5/1969	2 months	-3.25 in 5/1969	7/1930 - 4/1932	22 months	-7.35 in 2/1931
7/1999 - 8/1999	2 months	-3.47 in 7/1999	8/1932 - 9/1932	2 months	-4.00 in 9/1932
11/2001 - 5/2002	7 months	-4.73 in 2/2002	6/1955 - 7/1955	2 months	-3.88 in 7/1955
7/2002 - 9/2002	3 months	-4.00 in 8/2002	7/1962 - 8/1962	2 months	-3.09 in 8/1962
			10/1963 - 12/1963	3 months	-3.83 in 10/1963
			9/1964 - 9/1965	13 months	-5.64 in 12/1964
			7/1966 - 2/1967	8 months	-4.17 in 8/1966

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

			10/1988 - 4/1989	7 months	-4.06 in 1/1989
			6/1991 - 2/1992	9 months	-4.37 in 11/1991
LOWER SUSQUEHANNA CLIMATE DIVISION			**MIDDLE SUSQUEHANNA CLIMATE DIVISION**		
DROUGHT PERIODS	**DURATION**	**LOWEST PDSI**	**DROUGHT PERIODS**	**DURATION**	**LOWEST PDSI**
11/1895 - 2/1896	4 months	-4.70 in 1/1896	9/1895 - 2/1896	6 months	-5.43 in 1/1896
4/1896 - 1/1897	10 months	-4.20 in 8/1896	4/1896 - 6/1897	15 months	-5.01 in 8/1896
10/1900 - 2/1901	5 months	-4.87 in 2/1901	10/1897 - 11/1897	2 months	-3.49 in 10/1897
12/1908 - 1/1909	2 months	-3.58 in 1/1909	5/1900 - 4/1901	12 months	-5.91 in 2/1901
8/1909 - 5/1910	10 months	-4.55 in 12/1909	6/1901 - 7/1901	2 months	-3.72 in 7/1901
10/1910 - 7/1911	10 months	-4.44 in 7/1911	11/1908 - 3/1909	5 months	-4.84 in 1/1909
10/1914 - 12/1914	3 months	-3.90 in 11/1914	5/1909 - 7/1911	27 months	-6.53 in 12/1909
10/1922 - 12/1923	15 months	-4.35 in 12/1922	9/1914 - 1/1915	5 months	-4.83 in 11/1914
6/1925 - 9/1925	4 months	-4.02 in 9/1925	4/1915 - 7/1915	4 months	-3.51 in 5/1915
5/1926 - 7/1926	3 months	-3.45 in 7/1926	11/1916 - 7/1917	9 months	-4.09 in 5/1917
7/1930 - 4/1932	22 months	-6.73 in 1/1931	11/1918 - 4/1919	6 months	-3.53 in 4/1919
8/1932 - 9/1932	2 months	-3.47 in 9/1932	10/1920 - 1/1921	4 months	-3.21 in 11/1920
10/1941 - 2/1942	5 months	-3.62 in 11/1941	3/1921 - 4/1924	38 months	-6.72 in 12/1922
11/1964 - 1/1965	3 months	-3.30 in 12/1964	3/1925 - 1/1926	11 months	-4.48 in 9/1925
6/1965 - 9/1965	4 months	-3.79 in 7/1965	3/1926 - 9/1926	7 months	-4.63 in 7/1926
11/1965 - 1/1966	3 months	-4.07 in 12/1965	12/1928 - 3/1929	4 months	-3.88 in 3/1929
5/1966 - 8/1966	4 months	-5.70 in 8/1966	7/1929 - 10/1929	4 months	-4.23 in 8/1929
7/1991 - 2/1992	8 months	-3.66 in 7/1991	12/1929 - 9/1932	34 months	-7.58 in 1/1931
7/1999 - 8/1999	2 months	-3.56 in 7/1999	7/1934 - 8/1934	2 months	-3.35 in 8/1934
11/2001 - 8/2002	10 months	-5.62 in 2/2002	11/1939 - 1/1940	3 months	-4.19 in 1/1940

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

			10/1941 - 11/1941	2 months	-3.08 in 11/1941
			11/1953 - 1/1954	3 months	-3.18 in 1/1954
			10/1964 - 2/1965	5 months	-3.88 in 11/1964
			5/1965 - 9/1965	5 months	-4.48 in 7/1965
			7/1966 - 8/1966	2 months	-3.95 in 8/1966
			12/1980 - 1/1981	2 months	-4.03 in 1/1981
			7/1991 - 2/1992	8 months	-3.91 in 11/1991
			8/1995 - 9/1995	2 months	-3.61 in 9/1995
CENTRAL MOUNTAINS CLIMATE DIVISION			**SOUTH CENTRAL MOUNTAINS CLIMATE DIVISION**		
DROUGHT PERIODS	**DURATION**	**LOWEST PDSI**	**DROUGHT PERIODS**	**DURATION**	**LOWEST PDSI**
8/1895 - 10/1896	15 months	-5.57 in 1/1896	9/1895 - 8/1896	12 months	-5.68 in 1/1896
12/1896 - 4/1897	5 months	-3.53 in 1/1897	10/1897 - 11/1897	2 months	-3.61 in 10/1897
10/1897 - 11/1897	2 months	-3.57 in 10/1897	5/1900 - 7/1901	15 months	-5.92 in 2/1901
11/1899 - 1/1900	3 months	-3.12 in 11/1899	10/1901 - 11/1901	2 months	-3.92 in 11/1901
5/1900 - 1/1902	21 months	-6.12 in 12/1900	11/1904 - 2/1905	4 months	-3.62 in 12/1904
5/1905 - 7/1905	3 months	-3.09 in 5/1905	4/1905 - 6/1905	3 months	-3.07 in 5/1905
10/1908 - 3/1909	6 months	-5.70 in 12/1908	11/1908 - 3/1909	5 months	-4.69 in 12/1908
5/1909 - 7/1911	27 months	-6.45 in 12/1909	8/1909 - 7/1911	24 months	-5.41 in 12/1909
9/1914 - 1/1915	5 months	-4.82 in 11/1914	9/1914 - 12/1914	4 months	-4.50 in 11/1914
3/1915 - 6/1915	4 months	-4.10 in 4/1915	4/1915 - 5/1915	2 months	-3.38 in 4/1915
4/1917 - 5/1917	2 months	-3.11 in 5/1917	3/1921 - 10/1921	8 months	-3.86 in 7/1921
4/1921 - 2/1922	11 months	-4.39 in 7/1921	6/1922 - 11/1923	18 months	-6.19 in 12/1922
5/1922 - 11/1923	19 months	-6.71 in 12/1922	4/1925 - 9/1925	6 months	-4.41 in 9/1925

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).					
8/1925 - 9/1925	2 months	-3.84 in 9/1925	5/1926 - 7/1926	3 months	-3.83 in 7/1926
4/1926 - 7/1926	4 months	-4.04 in 7/1926	7/1930 - 8/1931	14 months	-8.17 in 1/1931
7/1930 - 6/1931	12 months	-7.60 in 12/1930	10/1931 - 2/1932	5 months	-3.92 in 11/1931
11/1931 - 12/1931	2 months	-3.75 in 11/1931	8/1932 - 9/1932	2 months	-3.83 in 9/1932
8/1939 - 9/1939	2 months	-3.60 in 8/1939	11/1953 - 2/1954	4 months	-4.41 in 2/1954
11/1939 - 2/1940	4 months	-3.96 in 1/1940	8/1963 - 12/1963	5 months	-4.61 in 10/1963
11/1949 - 12/1949	2 months	-3.32 in 11/1949	11/1964 - 12/1964	2 months	-3.43 in 12/1964
6/1963 - 8/1963	3 months	-3.11 in 8/1963	6/1965 - 1/1966	8 months	-4.85 in 12/1965
10/1963 - 12/1963	3 months	-3.82 in 10/1963	6/1966 - 2/1967	9 months	-4.87 in 1/1967
10/1964 - 2/1965	5 months	-4.64 in 12/1964	5/1969 - 6/1969	2 months	-3.29 in 5/1969
6/1965 - 9/1965	4 months	-3.66 in 7/1965	7/1991 - 6/1992	12 months	-4.70 in 11/1991
7/1966 - 8/1966	2 months	-3.73 in 8/1966	12/1998 - 2/1999	3 months	-4.22 in 12/1998
7/1991 - 6/1992	12 months	-4.50 in 12/1991	7/1999 - 8/1999	2 months	-3.69 in 7/1999
8/1995 - 9/1995	2 months	-3.85 in 9/1995	10/2001 - 4/2002	7 months	-5.31 in 2/2002
11/1998 - 12/1998	2 months	-4.34 in 12/1998	7/2002 - 8/2002	2 months	-3.53 in 8/2002
6/1999 - 1/2000	8 months	-4.31 in 8/1999			
7/2001 - 8/2001	2 months	-3.45 in 8/2001			
SOUTHWEST PLATEAU CLIMATE DIVISION			**NORTHWEST PLATEAU CLIMATE DIVISION**		
DROUGHT PERIODS	**DURATION**	**LOWEST PDSI**	**DROUGHT PERIODS**	**DURATION**	**LOWEST PDSI**
7/1895 - 8/1896	14 months	-5.36 in 1/1896	6/1895 - 2/1896	9 months	-5.20 in 11/1895
10/1897 - 11/1897	2 months	-3.65 in 10/1897	4/1896 - 6/1896	3 months	-4.24 in 5/1896
11/1899 - 1/1900	3 months	-3.06 in 1/1900	8/1899 - 2/1900	7 months	-4.29 in 11/1899
4/1900 - 5/1901	14 months	-5.25 in 2/1901	4/1900 - 6/1902	27 months	-5.14 in 12/1900
10/1901 - 1/1902	4 months	-4.19 in 11/1901	10/1908 - 3/1909	6 months	-5.59 in 12/1908

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

11/1904 - 7/1905	9 months	-3.89 in 12/1904	8/1909 - 1/1910	6 months	-4.34 in 12/1909
10/1908 - 3/1909	6 months	-5.32 in 12/1908	3/1910 - 12/1910	10 months	-4.22 in 8/1910
9/1909 - 12/1909	4 months	-4.15 in 12/1909	5/1911 - 7/1911	3 months	-4.12 in 7/1911
3/1910 - 12/1910	10 months	-4.20 in 8/1910	11/1914 - 12/1914	2 months	-3.70 in 11/1914
2/1911 - 3/1911	2 months	-3.20 in 3/1911	6/1921 - 10/1921	5 months	-3.71 in 7/1921
5/1911 - 7/1911	3 months	-4.29 in 7/1911	9/1922 - 12/1923	16 months	-4.81 in 12/1922
4/1915 - 5/1915	2 months	-3.37 in 4/1915	8/1930 - 2/1933	31 months	-7.07 in 2/1931
8/1922 - 11/1923	16 months	-5.53 in 12/1922	7/1933 - 6/1935	24 months	-6.60 in 7/1934
8/1925 - 9/1925	2 months	-3.89 in 9/1925	9/1936 - 11/1936	3 months	-3.44 in 9/1936
7/1930 - 12/1931	18 months	-7.38 in 1/1931	4/1941 - 6/1941	3 months	-3.64 in 5/1941
5/1932 - 2/1933	10 months	-4.43 in 9/1932	11/1953 - 2/1954	4 months	-4.07 in 12/1953
5/1934 - 7/1934	3 months	-4.01 in 7/1934	12/1960 - 1/1961	2 months	-3.85 in 1/1961
11/1939 - 1/1940	3 months	-4.00 in 1/1940	10/1963 - 2/1964	5 months	-3.90 in 10/1963
10/1953 - 7/1954	10 months	-5.18 in 12/1953	7/1991 - 3/1992	9 months	-4.81 in 11/1991
9/1963 - 2/1964	6 months	-4.23 in 12/1963	5/1992 - 6/1992	2 months	-3.67 in 6/1992
7/1965 - 9/1965	3 months	-3.68 in 8/1965			
7/1966 - 2/1967	8 months	-3.72 in 1/1967			
10/1968 - 11/1968	2 months	-3.08 in 10/1968			
8/1991 - 2/1992	7 months	-4.19 in 10/1991			
5/1992 - 6/1992	2 months	-3.54 in 6/1992			

Instrumental records of drought for the United States extend back approximately 100 years. These records capture the major 20th century droughts, but are too short to assess the reoccurrence of major droughts such as those of the 1930s and 1950s. As droughts continue to have increasingly costly and devastating impacts on our society, economy and environment, it is becoming even more important to put the severe droughts of the 20th-century into a long-term perspective. This perspective can be gained through the use of paleoclimatic records of drought.

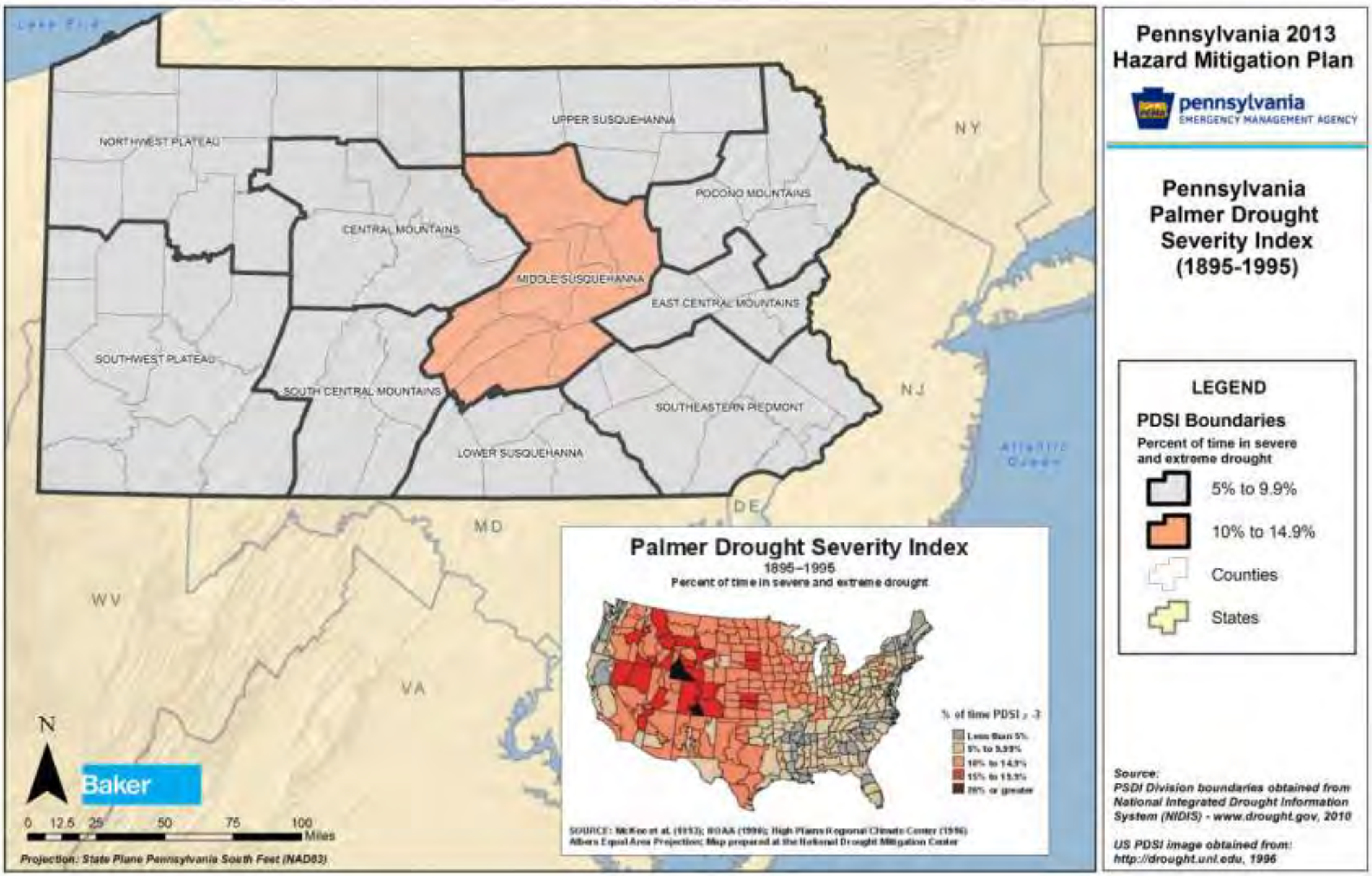
Data from a variety of paleoclimate sources document drought conditions across North America over the last 10,000 years. These records, with decade to century resolution, document extended periods of extremely dry conditions in different regions of North America. This paleoclimatic record of past droughts is considered by scientists as a better guide than what is provided by the instrumental record alone of what we should expect in terms of the magnitude and duration of future droughts. For example, paleoclimatic data suggest that droughts as severe at the 1950s drought have occurred in central North America several times a century over the past 300-400 years, and thus we should expect (and plan for) similar droughts in the future. The paleoclimatic record also indicates that droughts of a much greater duration than any in 20th century have occurred in parts of North American as recently as 500 years ago. These data indicate that we should be aware of the possibility of such droughts occurring in the future as well. The occurrence of such sustained drought conditions today would be a natural disaster of a magnitude unprecedented in the 20th century. Although severe droughts have occurred in the 20th century, a more long-term look at past droughts, when climate conditions appear to have been similar to today, indicates that 20th century droughts do not represent the possible range of drought variability.

4.3.2.4. Future Occurrence

It is difficult to forecast the severity and frequency of future drought events in Pennsylvania. However, two important studies were performed which provide suggest probability of future occurrence. A study by Sheffield and Wood (2007) shows that there has been relatively little change in PDSI values over the 50-year period ending in 2004. This research is interpreted to indicate that soil moisture and drought conditions can be relatively equivalent to the average PDSI values experienced over the period 1954 to 2004. In addition, based on data from 1895 to 1995, Pennsylvania can be divided into ten PDSI areas (see Figure 4.3.2-3). Each of these areas have been assigned a percent of time PDSI values are less than or equal to three – a value equivalent to a drought warning or drought emergency in Pennsylvania. Historically, nine of ten areas in the Commonwealth are under a drought warning or emergency 5-10% of the time while one area in central Pennsylvania is under a drought warning or emergency 10-15% of the time. Note that these conclusions are based on past occurrences over a relatively short record period which may not represent adequate statistical sampling.

Please note, the data in Figure 4.3.2-3 shows the percent of time sections of Pennsylvania were in severe and extreme drought over a 100 year period, while the data in Figure 4.3.2-2 shows the total number of drought emergencies by county for a 29 year period. The data was collected by different agencies using different periods of time and units of measurement. Combined this analysis suggests the Eastern portion of the Commonwealth has a higher risk for drought than the Western portion. Since the data is based on different sources and methodologies, it should be considered as providing complementary information about drought risk in Pennsylvania. Overall, though, with most of the Commonwealth being in severe or extreme drought less than 15% of the time, the probability of future droughts is considered *possible.*

Figure 4.3.2-3 Percent of time areas of the United States have PSDI values <= -3 (NDMC, 2009).



Uncertainty regarding the future occurrence of droughts exists due to the potential impacts of climate change. A number of climate model simulations for doubled carbon dioxide concentrations suggest an increased frequency of drought in mid-continent regions (e.g. Gregory et al., 1997) whereas other model simulations and recent decadal trends in the instrumental record suggest wetter conditions, at least in the short term, due to an intensification of the hydrologic cycle associated with warmer sea surface temperatures. Improved estimates of future drought events requires improvements in climate modeling and increased understanding of the processes underlying drought behavior exhibited in both the instrumental and the paleoclimate records.

4.3.2.5. Environmental Impacts

According to the National Drought Mitigation Center at the University of Nebraska-Lincoln (2013), environmental impacts of drought include:

- Damage to animal species in the form of reduced water and feed availability, degradation of fish and wildlife habitat, migration and concentration issues (too many or too few animals in a given area), stress to endangered species, and loss of biodiversity
- Lower water levels in reservoirs, lakes, and ponds
- Reduced stream flow
- Loss of wetlands
- Increased groundwater depletion, land subsidence, and reduced groundwater recharge
- Water quality impacts like salinity, water temperature increases, pH changes, dissolved oxygen, or turbidity
- Loss of biodiversity
- Loss of trees
- Increased number and severity of fires
- Reduced soil quality and erosion issues
- Increased dust or pollutants.

4.3.2.6. Jurisdictional Vulnerability Assessment

As a hazard, droughts primarily impact water supply and agricultural land. Areas of the Commonwealth that reply on private wells are more impacted by water supply reductions than areas of the Commonwealth on public water supply; frequently, these areas reliant on groundwater wells are more rural in nature. Table 4.3.5-5 shows the number of groundwater wells per county in Pennsylvania as reported to the Pennsylvania Groundwater Information System (2013). PaGWIS relies on voluntary submissions of well record data by well drillers; as a result, it is the best available data but is not completely comprehensive.

Table 4.3.2-5 Domestic water wells by county (PADEP, 2013).

COUNTY	TOTAL DOMESTIC WATER WELLS	COUNTY	TOTAL DOMESTIC WATER WELLS
Adams	12,204	Lackawanna	12,532
Allegheny	1,816	Lancaster	81,317
Armstrong	2,082	Lawrence	16,223
Beaver	14,598	Lebanon	20,034
Bedford	15,361	Lehigh	18,833
Berks	28,264	Luzerne	4,764
Blair	3,493	Lycoming	21,686
Bradford	8,273	McKean	2,283
Bucks	30,128	Mercer	8,478
Butler	18,229	Mifflin	7,441
Cambria	3,270	Monroe	44,742
Cameron	1,929	Montgomery	19,939
Carbon	23,180	Montour	3,166
Centre	12,807	Northampton	23,052
Chester	58,493	Northumberland	7,754
Clarion	1,673	Perry	16,341
Clearfield	8,197	Philadelphia	219
Clinton	7,739	Pike	8,831
Columbia	5,407	Potter	13,370
Crawford	7,766	Schuylkill	9,709
Cumberland	22,028	Snyder	7,787
Dauphin	2,433	Somerset	14,896
Delaware	2,654	Sullivan	1,005
Elk	21,294	Susquehanna	11,039
Erie	847	Tioga	19,269
Fayette	1,366	Union	5,047
Forest	30,187	Venango	2,906
Franklin	8,887	Warren	2,805
Fulton	14,682	Washington	5,835
Greene	7,707	Wayne	4,515
Huntingdon	3,588	Westmoreland	5,247
Indiana	6,523	Wyoming	3,917
Jefferson	7,401	York	36,814
Juniata	28,264	Unknown	20,289
GRAND TOTAL – REPORTED DOMESTIC WATER WELLS			***876,591***

Everyone is impacted by the effects of water supply reductions, but jurisdictions with large amounts of farmland and high agricultural yields are more likely to be affected by drought hazards. According to the 2007 US Department of Agriculture Agricultural Census, in Pennsylvania, the top ten jurisdictions for agricultural production are as follows:

1. Lancaster County (18.5% of state total sales)
2. Chester County (9.5% of state total sales)
3. Berks County (6.3% of state total sales)
4. Franklin County (5.2% of state total sales)
5. Lebanon County (4.4% of state total sales)
6. Adams County (3.7% of state total sales)
7. York County (3.7% of state total sales)
8. Cumberland County (2.3% of state total sales)
9. Schuylkill (2.1% of state total sales)
10. Bradford County (2.1% of state total sales)

Beyond these agricultural counties, Table 4.3.2-6 lists which counties did and did not profile drought hazards, along with any ranking provided. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 40 counties which currently have calculated risk factor values for drought, the average value is 2.3; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for Drought is 2, while the Pennsylvania THIRA scored drought as a 7 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.2-6 Counties profiling drought hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.4
Allegheny	X		Medium	2.2
Armstrong	X		Not Ranked	No RF
Beaver	X		Medium	2.2
Bedford	X		Medium	2.2
Berks	X		Not Ranked	No RF
Blair		X		

Table 4.3.2-6 Counties profiling drought hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Bradford	X		Not Ranked	No RF
Bucks	X		Medium	2.1
Butler	X		Medium	2.2
Cambria	X		Medium	2.2
Cameron	X		Low	1.9
Carbon	X		Medium	2.2
Centre	X		High	2.5
Chester	X		Not Ranked	No RF
Clarion	X		Not Ranked	No RF
Clearfield	X		Low	1.8
Clinton	X		Medium	2.0
Columbia	X		Medium	2.2
Crawford	X		Medium	2.1
Cumberland	X		High	2.6
Dauphin	X		Not Ranked	No RF
Delaware	X		Medium	2.2
Elk	X		Medium	2.0
Erie	X		Medium	2.0
Fayette	X		Medium	2.0
Forest	X		Not Ranked	No RF
Franklin	X		Not Ranked	No RF
Fulton		X		
Greene	X		Medium	2.2
Huntingdon	X		Not Ranked	No RF
Indiana	X		Medium	2.3
Jefferson	X		Medium	2.4
Juniata	X		High	2.5
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Medium	2.2
Lawrence	X		Medium	2.2
Lebanon*	X		Not Ranked	8.0
Lehigh	X		Medium	2.2
Luzerne	X		Not Ranked	No RF

Table 4.3.2-6 Counties profiling drought hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Lycoming	X		High	2.8
McKean	X		Medium	2.2
Mercer	X		Medium	2.2
Mifflin	X		Not Ranked	No RF
Monroe	X		Medium	2.2
Montgomery	X		High	2.5
Montour*	X		Not Ranked	8.8
Northampton	X		Medium	2.2
Northumberland	X		High	2.5
Perry*	X		Not Ranked	15
Philadelphia**	X		Low	C
Pike	X		High	2.5
Potter	X		Not Ranked	No RF
Schuylkill	X		Not Ranked	No RF
Snyder	X		Medium	2.2
Somerset		X	Not Ranked	No RF
Sullivan	X		Not Ranked	No RF
Susquehanna	X		Medium	2.2
Tioga	X		Medium	2.2
Union	X		Not Ranked	No RF
Venango	X		Medium	2.2
Warren	X		Medium	2.2
Washington	X		Not Ranked	No RF
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		Medium	2.2

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As indicated in Section 4.3.2.2, precipitation is a leading indicator of drought. Table 4.3.2-7 lists the average annual precipitation (in inches) per county for over a 30 year period according to the DEP. The Commonwealth recognizes that the period of record of for this data is nearly twenty years old; therefore, precipitation normals shown Table 4.3.2-8 may not fully represent current climate conditions. Nonetheless, this is the best available data source for comprehensive precipitation normals on a county by county basis. The top five counties experiencing the lowest accumulation of precipitation are Tioga, Bradford, Beaver, Huntingdon, and Allegheny Counties.

Table 4.3.2-7 Annual precipitation normals by county for the period 1961 to 1990 (PADEP, 2010b).

COUNTY	PRECIPITATION DEPTH (inches)	COUNTY	PRECIPITATION DEPTH (inches)	COUNTY	PRECIPITATION DEPTH (inches)
Adams	41.4	Elk	43.3	Montgomery	44.2
Allegheny	37.8	Erie	43.5	Montour	40.5
Armstrong	41.7	Fayette	42.5	Northampton	44
Beaver	36.9	Forest	43.3	Northumberland	40.9
Bedford	38	Franklin	40.9	Perry	39.8
Berks	45.9	Fulton	38.2	Philadelphia	44.1
Blair	39.2	Greene	39	Pike	42.6
Bradford	34.7	Huntingdon	37.5	Potter	40.2
Bucks	44.5	Indiana	45.5	Schuylkill	46
Butler	39.9	Jefferson	44	Snyder	41.9
Cambria	44.3	Juniata	39.8	Somerset	41.8
Cameron	42.8	Lackawanna	41.6	Sullivan	37.9
Carbon	46.3	Lancaster	40.9	Susquehanna	40.3
Centre	39.4	Lawrence	38.4	Tioga	34.5
Chester	44.2	Lebanon	42.5	Union	41.7
Clarion	44.1	Lehigh	45.2	Venango	43.1
Clearfield	41.2	Luzerne	41.3	Warren	44.3
Clinton	39.9	Lycoming	38.5	Washington	38.8
Columbia	41.1	McKean	43.9	Wayne	42.8
Crawford	43.3	Mercer	41.2	Westmoreland	42.3
Cumberland	39.1	Mifflin	39	Wyoming	37.9
Dauphin	40.8	Monroe	47.3	York	39.5
Delaware	43.9				

Normal precipitation estimates for the period 1971-2000 are available for National Weather Service offices and principal climatological stations through the NOAA publication, *Climatography of the U.S. No. 81*. In addition, precipitation normals for select cities throughout the Commonwealth for the period 1971-2000 are available (Table 4.3.2-9). Of the eight cities listed, Pittsburgh and Avoca, PA typically experience the lowest levels of precipitation annually.

Table 4.3.2-8 Monthly and annual precipitation normals from 1971 to 2000 for select cities in Pennsylvania (NOAA, 2009)

CITY	PRECIPITATION DEPTH (inches)												
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
Allentown, PA	3.50	2.75	3.56	3.49	4.47	3.99	4.27	4.35	4.37	3.33	3.70	3.39	45.17
Erie, PA	2.53	2.28	3.13	3.38	3.34	4.28	3.28	4.21	4.73	3.92	3.96	3.73	42.77
Harrisburg, PA	3.18	2.88	3.58	3.31	4.60	3.99	3.21	3.24	3.65	3.06	3.53	3.22	41.45
Middletown-Harrisburg International Airport	3.18	2.88	3.58	3.31	4.60	3.99	3.21	3.24	3.65	3.06	3.53	3.22	41.45
Philadelphia, PA	3.52	2.74	3.81	3.49	3.88	3.29	4.39	3.82	3.88	2.75	3.16	3.31	42.05
Pittsburgh, PA	2.70	2.37	3.17	3.01	3.80	4.12	3.96	3.38	3.21	2.25	3.02	2.86	37.85
Avoca, PA	2.46	2.08	2.69	3.28	3.69	3.97	3.74	3.10	3.86	3.02	3.12	2.55	37.56
Williamsport, PA	2.85	2.61	3.21	3.49	3.79	4.45	4.08	3.38	3.98	3.19	3.62	2.94	41.59

4.3.2.7. State Facility Vulnerability Assessment

Drought does not pose a direct threat to state critical facility buildings – it affects land and water supply. However, the Commonwealth identifies 106 food and agriculture-related critical facilities, including seed producers, dairies, and other food producers; it can be expected that droughts will have either a direct effect on critical facilities in this category by hindering production or an indirect effect by increasing the cost of food production inputs. Additionally, the Commonwealth owns bird and fish hatcheries that may be disproportionately impacted by a drought. A drought may also impact the 37 water-related critical facilities. Table 4.3.2-9 identifies where the 106 agricultural facilities are located throughout the state. Lancaster County has the most facilities with 18, followed by Dauphin County with 12 facilities.

Table 4.3.2-9 Number of State Critical Facilities per county that their primary sector is Agriculture.			
COUNTY	**NUMBER OF AGRICULTURE CRITICAL FACILITIES**	**COUNTY**	**NUMBER OF AGRICULTURE CRITICAL FACILITIES**
Adams	5	Lancaster	18
Allegheny	4	Lebanon	3
Berks	8	Lehigh	1
Blair	2	Luzerne	1
Bradford	1	Lycoming	2
Bucks	1	Mercer	1
Cambria	1	Mifflin	1
Chester	3	Montgomery	3
Clearfield	1	Northampton	2
Columbia	2	Northumberland	5
Cumberland	4	Philadelphia	4
Dauphin	12	Schuylkill	4
Delaware	1	Snyder	2
Erie	3	Somerset	1
Fayette	1	Susquehanna	1
Franklin	1	Washington	1
Juniata	1	Westmoreland	1
Lackawanna	1	York	3

4.3.2.8. Jurisdictional Loss Estimation

Jurisdictional loss estimation stems from lost agricultural revenues statewide. Since droughts are large-scale, regional events that are likely to impact an entire county at a time, all agricultural yields in each county are potentially threatened by drought hazards. Table 4.3.2-10 enumerates each county's acreage of land contained in farms as well as the annual market value of all agricultural products sold, from 2007. As stated in Section 4.3.2.6., Lancaster, Chester, Berks, Franklin, Lebanon, Adams, York, Cumberland, Schuylkill, and Bradford counties are the counties most threatened by drought since they have the highest agricultural production; if a drought were to eliminate these counties' agricultural yield, total losses could top $3.3 billion. High farmland acreage generally indicates a larger market value in agricultural products sold.

Table 4.3.2-10 Estimated jurisdictional losses relating to agricultural production (USDA, Census of Agriculture, 2007).		
COUNTY	**TOTAL ACRES OF LAND IN FARMS**	**MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)**
Adams	174,595	$216,994,000
Allegheny	38,023	$9,514,000
Armstrong	122,275	$51,976,000
Beaver	67,075	$15,187,000

Table 4.3.2-10 Estimated jurisdictional losses relating to agricultural production (USDA, Census of Agriculture, 2007).

COUNTY	TOTAL ACRES OF LAND IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Bedford	210,990	$90,858,000
Berks	222,119	$367,840,000
Blair	87,434	$85,199,000
Bradford	266,635	$121,311,000
Bucks	75,883	$70,573,000
Butler	129,850	$38,664,000
Cambria	87,924	$23,168,000
Cameron	5,092	$828,000
Carbon	20,035	$8,944,000
Centre	148,464	$69,661,000
Chester	166,891	$553,290,000
Clarion	132,140	$21,958,000
Clearfield	62,721	$11,102,000
Clinton	56,626	$43,661,000
Columbia	122,621	$45,874,000
Crawford	232,093	$101,036,000
Cumberland	157,388	$132,803,000
Dauphin	89,533	$82,887,000
Delaware	4,361	$9,455,000
Elk	33,258	$3,717,000
Erie	173,125	$71,284,000
Fayette	140,688	$25,974,000
Forest	10,728	$3,106,000
Franklin	242,634	$304,450,000
Fulton	103,516	$38,038,000
Greene	150,203	$9,316,000
Huntingdon	148,289	$62,320,000
Indiana	187,711	$76,428,000
Jefferson	87,043	$25,317,000
Juniata	97,681	$91,658,000
Lackawanna	39,756	$16,216,000
Lancaster	425,336	$1,072,151,000
Lawrence	92,391	$35,639,000
Lebanon	113,486	$257,097,000
Lehigh	84,643	$72,059,000
Luzerne	66,577	$18,151,000
Lycoming	160,456	$53,381,000
McKean	41,466	$5,185,000

Table 4.3.2-10 Estimated jurisdictional losses relating to agricultural production (USDA, Census of Agriculture, 2007).

COUNTY	TOTAL ACRES OF LAND IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Mercer	171,860	$60,655,000
Mifflin	94,133	$86,818,000
Monroe	29,165	$7,819,000
Montgomery	41,908	$30,028,000
Montour	50,252	$36,193,000
Northampton	68,252	$31,762,000
Northumberland	147,660	$110,978,000
Perry	144,375	$105,052,000
Philadelphia	262	$487,000
Pike	27,569	$2,524,000
Potter	88,457	$31,377,000
Schuylkill	118,501	$124,752,000
Snyder	100,179	$109,041,000
Somerset	206,651	$83,152,000
Sullivan	27,821	$7,240,000
Susquehanna	158,218	$49,287,000
Tioga	184,108	$53,828,000
Union	63,795	$90,497,000
Venango	64,796	$11,796,000
Warren	99,582	$18,603,000
Washington	211,053	$28,649,000
Wayne	92,939	$29,428,000
Westmoreland	167,489	$58,437,000
Wyoming	77,957	$13,496,000
York	292,507	$212,634,000
TOTAL	***7,809,244***	***$5,808,803,000***

4.3.2.9. State Facility Loss Estimation

The vulnerable state critical facilities identified in Section 4.3.2.7 are agriculture-related facilities, all but three of which are privately held entities for which replacement values are unavailable. The three publicly held agriculture facilities are offices and laboratory space of the Department of Agriculture which are unlikely to face the direct impacts on drought seen by agricultural producers. While not critical, the state also owns a number of bird and fish hatcheries that may experience reduced yields in times of drought.