

Drought Management in Pennsylvania

Introduction

Like all other states, Pennsylvania is subject to periodic droughts that impact our ability to meet all of our water needs. Droughts can have varying effects, depending upon their timing, severity, duration, and location. Some droughts may have their greatest impact on agriculture, while others may impact water supply or other water use activities such as recreation. Most droughts cause direct impacts to aquatic resources.

Managing the commonwealth's water resources during droughts is the responsibility of the Pennsylvania Emergency Management Agency (PEMA), with direct support from the Department of Environmental Protection (DEP). The Commonwealth Drought Coordinator is assigned by the Secretary of DEP and works closely with the Commonwealth Drought Task Force. The Commonwealth Drought Task Force includes membership from state, federal, and interstate agencies whose operations or programs may be impacted either by droughts directly or by drought management operations. Drought emergencies are managed in conformance with PEMA's drought emergency regulations, found at [4 Pa. Code Chapters 118-120](#).

Drought Monitoring

DEP is responsible for drought monitoring. Many drought management activities are coordinated at the county level, so DEP's monitoring efforts are oriented primarily on a county basis as well. On a routine basis, DEP reviews precipitation, stream flow, groundwater level, soil moisture, and reservoir storage information. Regular attention to these drought "indicators" is designed to provide timely identification of developing drought conditions.

Precipitation Deficits

The earliest indicators of a potential drought are precipitation deficits, because it is precipitation 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 (each county uses a varied number of rain gages to determine the county average). 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 1 lists the drought conditions that are indicated by various precipitation deficit percentages.

Table 1
Precipitation Deficit Drought Indicators

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 behind precipitation in signaling a drought. The U.S. Geological Survey (USGS) maintains a network of stream

gages across the state. DEP currently uses 61 of these gages (58 in Pennsylvania, 2 in Maryland, and 1 in West Virginia), 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.

Both the Commonwealth of Pennsylvania and the USGS use “percentiles” in regard to stream-flow statistics. Every day, USGS stream-gage records are used to compute an average flow of the last 30 days preceding that day (called the “30-day moving average daily flow”), that serves as a stream-flow indicator. The stream-flow indicators are then compared with statistical flow values known as “percentiles” derived from historic stream-gage records. A flow percentile is a value on a scale from 0 to 100 that indicates the percent of the time on that given date throughout the gage period of record that flow has been equal to or below that value.

An average flow over the last 30 days having a percentile range of 10 to 25 is considered as the entry into drought watch; 5 to 10 as entry into drought warning; and 0 to 5 as entry into drought emergency. Suitable stream gages with adequate periods of record do not exist in each of the 67 counties; therefore, surrogate stream-flow gages are used for some counties, as indicated by the triangles on the surface-water and composite drought-monitoring maps. The term “Exceedances” is sometimes used to describe drought statistics and may be considered the complement of percentiles; i.e., a 10 percent exceedance is equivalent to a 90th percentile value, a 75 percent exceedance is equivalent to a 25th percentile value, etc.

Groundwater Levels

Groundwater is usually the third indicator of a developing drought. Groundwater typically lags behind precipitation, largely because of the storage effect. About 80 trillion gallons of groundwater are stored throughout Pennsylvania, enough to cover the entire state with more than eight feet of water, according to DCNR publication ES3, “[The Geology of Pennsylvania’s Groundwater](#).” Therefore, precipitation deficits can accumulate for several months before the resultant lack of groundwater recharge becomes clearly evident in groundwater levels.

As with stream-flow, the term “percentiles” is used in regard to groundwater statistics. Groundwater levels are used to indicate drought status in a manner similar to stream flows. Every day, groundwater levels in USGS observation wells are used to compute an average level of the last 30 days preceding that day (called the “30-day moving average groundwater level”), that serves as a groundwater indicator. The groundwater indicators are then compared with statistical groundwater-level values known as “percentiles” derived from historic observation-well records. A percentile is a value on a scale from 0 to 100 that indicates the percent of the time on that given date throughout the observation well period of record that water levels have been equal to or below that value.

Groundwater percentile ranges of 10 to 25, 5 to 10, and 0 to 5 are used to represent entry into watch, warning and emergency, respectively. Suitable observation wells with adequate periods of record do not exist in each of the 67 counties; therefore, surrogate wells are used for some counties.

Soil Moisture – Palmer Drought Severity Index

Soil moisture information is provided by the National Oceanic and Atmospheric Administration in the form of the “Palmer Drought Severity Index.” The Palmer Index is a computed value, based on a number of meteorological and hydrological factors; it is compiled weekly by the Climate Prediction Center of the National Weather Service. Palmer values of -2.00 to -2.99 indicate a watch status; values of -3.00 to -3.99 indicate warning; and values of -4.00 and less indicate emergency. The Palmer Indices are available for the ten Palmer regions of the state and are updated weekly.

Drought Declarations

DEP and PEMA manage droughts based on a three-stage process. As described in the previous section, the indicators are used to identify, generally on a county basis, the overall water supply conditions. These indicators are used by DEP and PEMA to manage water supply droughts. While some of the indicators could be used as well to help identify meteorological or agricultural or other types of droughts, the primary objective is to identify and manage water supply droughts.

Drought Watch

Generally, when three or more of the indicators are signaling a drought watch condition for a county or group of counties, DEP will notify PEMA of the developing conditions and will ask PEMA to convene a meeting of the Commonwealth Drought Task Force. Based upon recommendations from the Task Force, including direction from the Governor, the Secretary of DEP may issue a drought watch on behalf of the Governor. Press releases are issued to the media and letters are sent to all public water suppliers in the affected area, notifying them of the

need to monitor their own supplies and begin following their drought contingency plans and to update their plans if necessary. Approved drought contingency plans are valid for only three years from the date of approval. Citizens are requested to voluntarily reduce water usage by about five percent. DEP increases its monitoring activities from monthly to weekly and begins to monitor the status of public water suppliers in the affected area. Regular meetings of the Task Force are also scheduled to review developing conditions. The general goal is to reduce water use by 5-10 percent through voluntary water conservation.

Drought Warning

When the indicators signal a warning condition, a similar process is followed, leading to a drought warning announcement, again by the Secretary of DEP on behalf of the Governor. Press releases are issued to the media and letters are again sent to all public water suppliers in the affected area, notifying them of the developing conditions. Citizens are asked to voluntarily reduce water use by 10-15 percent. Frequency of Task Force meetings may be increased as well.

Drought Emergency

When an emergency is indicated, and upon the recommendation of the Task Force, PEMA convenes a meeting of the Emergency Management Council under the chair of the Lt. Governor. Upon consideration of all the information available, including input from the county commissioners and county emergency management staff in the affected counties, the council may recommend that the Governor issue a proclamation of drought emergency. Upon issuance of the emergency proclamation by the Governor, Chapters 118, 119 and 120 of the Emergency Management Regulation become effective.

Again, letters are sent to the public water suppliers. DEP increases its monitoring activities from weekly to daily, and drought reports may be prepared daily and posted on the DEP drought website. PEMA's county drought task forces meet on a regular basis and the Commonwealth Drought Task Force may begin weekly meetings to ensure continued coordination among the agencies.

During an emergency, the Commonwealth Drought Coordinator is responsible for overseeing and coordinating the day-to-day drought management activities of DEP and is also responsible for reviewing and either granting or denying requests for variances from the Chapter 119 nonessential water use restrictions.

Drought Contingency Plans

Chapter 118 requires each public water supplier in a drought emergency area to develop a drought contingency plan, or update an existing one if necessary, and submit it to the Commonwealth Drought Coordinator for review and approval. In extreme droughts, large industrial and commercial water users may also be required to submit drought contingency plans if requested in the Governor's proclamation of emergency or if requested by the Commonwealth Drought Coordinator. Fortunately, Pennsylvania has never experienced a drought so severe as to require industrial and commercial cutbacks.

A public water supply drought contingency plan outlines the public water supplier's sources of water and identifies watch, warning and emergency conditions within the water supply system based on the water levels in those sources. Response actions appropriate to the individual water supply system are identified for each of the drought stages. Based upon the water supplier's individual drought contingency plan, the supplier may request voluntary or mandatory water use restrictions within its own service area in advance of any state announcements or declarations.

Industrial and commercial plans are developed without any specific reference to the user's own supply sources. These plans identify actions the user can take to achieve cutbacks to various percentages of their normal water use, if ordered by the Commonwealth Drought Coordinator. The Commonwealth Drought Coordinator will order such cutbacks only if conditions become so severe that health and safety are threatened.

Nonessential Water Use Restrictions

The drought management activities most visible to the general public during a declared drought emergency are the nonessential water use restrictions required by Chapter 119. These restrictions are designed to achieve a reduction in overall water use of up to 25 percent. The overall objective of all drought management activities is to protect public health, safety and welfare, with health and safety being paramount. To help protect welfare, water use restrictions are limited, at least initially, to nonessential uses. These restrictions apply generally to watering of lawns, gardens and shrubs; washing vehicles and paved surfaces; filling swimming pools; and use of water for ornamental purposes.

Chapter 119.6 states: "If compliance with the prohibition of nonessential use of water would result in extraordinary hardship upon a water user, the water user may apply for an exemption or variance. These requests are reviewed and variances are either granted or denied by the Commonwealth Drought Coordinator."

Water Rationing

In some cases, the Chapter 119 water use restrictions may not be sufficient to protect the supplies of an individual public water supplier. When an individual supplier's sources are so depleted as to threaten health and safety, it may become necessary to ration water within that system in order to protect the sources for these most essential uses. Under the provisions of Chapter 120, a public water supplier or a municipality may request approval to ration water within its service area.

Rationing water is a more severe measure than merely banning nonessential uses of water. Under rationing, each customer on the system is allotted a given amount of water, based on a method of allotment developed by the supplier or municipality. Generally, it will be based on a percentage of previous usage or on a specific daily quantity per household. These restrictions are more likely to have some effect on welfare, because industry and commerce may be cut back as well.

Under Pennsylvania law, only the Governor has authority to ration resources, including water resources. For this reason, approval from the Commonwealth Drought Coordinator, acting as agent for the Emergency Management Council and on behalf of the Governor, is required for a water supplier or municipality to ration water. Requests are reviewed by the Commonwealth Drought Coordinator to ensure that rationing is justified and that appropriate rationing methods will be employed.

River Basin Commission Coordination

Pennsylvania is a member of interstate compact commissions in the Delaware and Susquehanna river basins. These commissions have regulatory authority over the waters in those basins and play a significant role in managing basin waters during droughts. Droughts do not recognize political boundaries and frequently extend beyond Pennsylvania's borders into our neighboring states in those basins. Although these commissions have authority to declare drought emergencies, they both rely upon their respective member states to implement and enforce any actions they may dictate during a drought emergency. DEP coordinates closely with the commissions in all its drought management activities. This helps to ensure that response actions are coordinated to the extent possible across state borders in the watersheds that we share. One of the commissions' primary roles is ensuring effective coordination among the member states.

More Information

For more information on drought management in the commonwealth, contact DEP at 717-772-4048 or visit our website at www.dep.pa.gov/Business/Water/PlanningConservation/Drought/Pages/default.aspx.