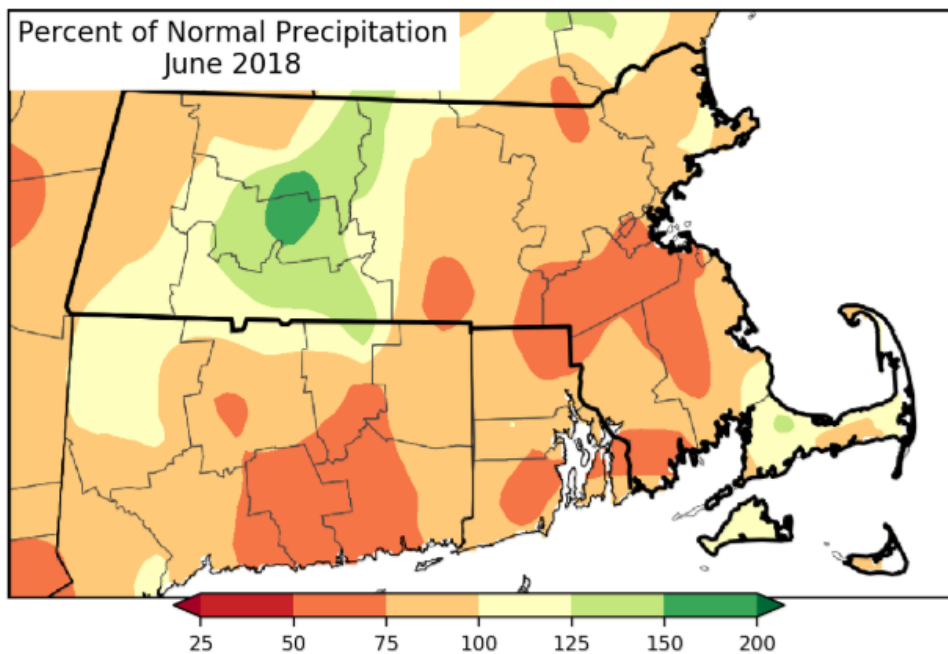


June 2018 Hydrologic Conditions in Massachusetts

SUMMARY OF CONDITIONS

- Although Precipitation, Streamflow, Groundwater and Crop Moisture Indices are Normal for all regions, dry conditions persist throughout the State except the Cape and Islands.
- The Reservoir Index for the Central and Southeast regions is at Watch and Advisory level, respectively. Other regions remain Normal.
- The Fire Index is elevated ranging from Advisory to Watch in all regions. However, the Chief Fire Warden reports no fire issues.
- NOAA’s forecast for July projects above normal temperatures and slightly below normal precipitation. Drought development is likely for all of Massachusetts except the Southeast and Cape and Islands regions.
- Appendix I provides values of indices not presented in the main report. Appendix II provides a description of the indices from the Drought Management Plan.

PRECIPITATION



June precipitation was near average across all regions except for the Connecticut River Valley which received 1.7 inches above normal. With last month’s deficit, the two-month precipitation is below average but thresholds are not triggered. The Indices remain Normal for all Regions.

Map from the Northeast Regional Climate Center’s Monthly Maps.

<http://www.nrcc.cornell.edu/regional/monthly/monthly.html>

Region	Estimated Rainfall (inches)	Departure from Average June (inches)	MA Drought Plan Levels	
			Standardized Precipitation Index (SPI)	Percent of Normal Index
Western	3.71	-0.43	Normal	Normal
CT River Valley	5.65	1.71	Normal	Normal
Central	4.02	0.26	Normal	Normal
Northeast	3.46	0.03	Normal	Normal
Southeast	2.92	-0.45	Normal	Normal
Cape Cod & Islands	3.37	0.01	Normal	Normal

Key to Drought Levels
Normal
Advisory
Watch
Warning
Emergency

STREAMFLOW

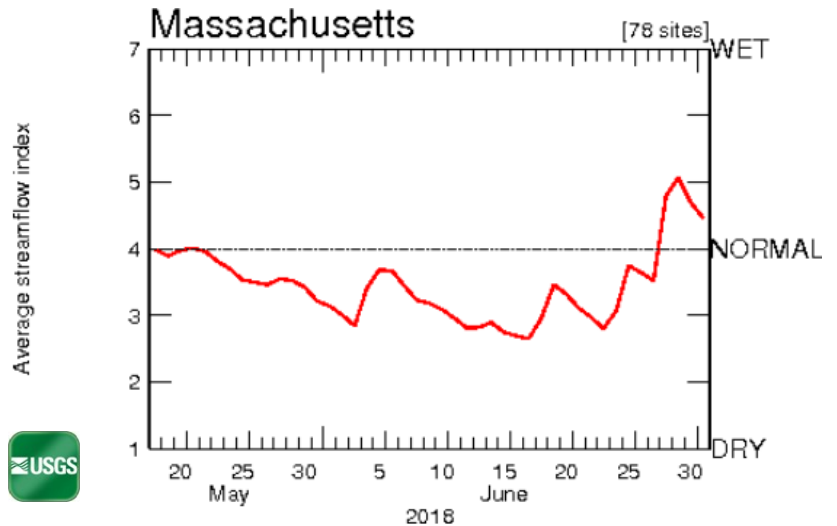
In general, flows have been below normal since mid-May. The last few days of June experienced multiple rain events, bolstering streamflow before declining again. Below normal to less than 10th percentile flows are scattered across the State but the Index remains Normal for all Regions until two consecutive months are below normal.

Average Daily Streamflow Compared to Historical for the Day of the Year

This plot depicts data for the 45-day period ending at the beginning of July.

KEY:

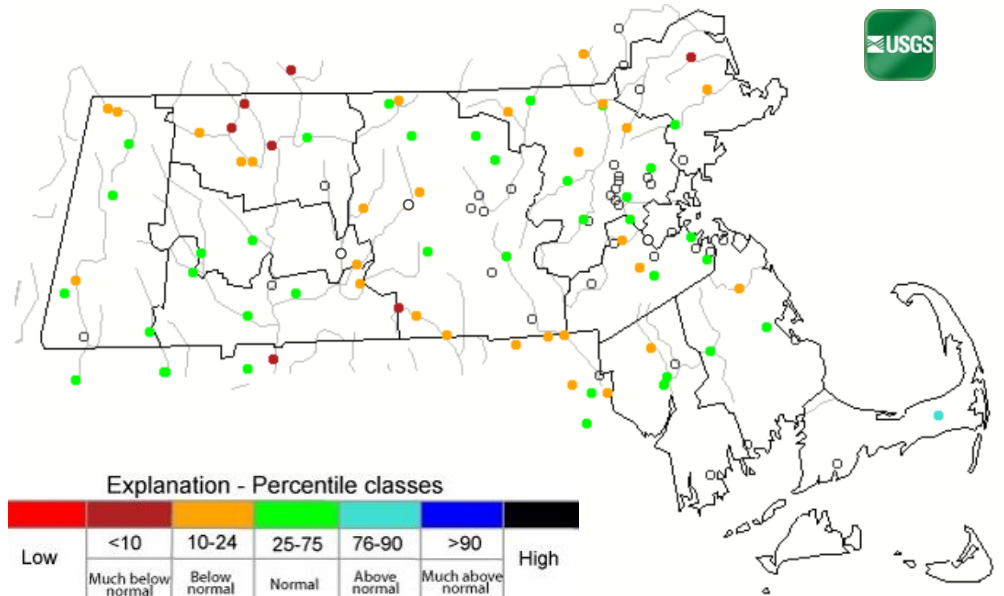
- 1 = New record low for day
- 2 = < 10th percentile
- 3 = 10th – 24th percentile
- 4 = 25th – 74th percentile
- 5 = 75th – 89th percentile
- 6 = > 90th percentile
- 7 = New record high for day



Average June Streamflow Compared to Historical for the Month of the Year

Streamflow is monitored by the Commonwealth of Massachusetts and United States Geological Survey (USGS) cooperative stream gaging program.

<http://waterwatch.usgs.gov/index.php?r=ma&id=mv01d>



Region	Number of Gages					MA Drought Plan Index/# of consecutive months majority below 25th percentile
	Total Reporting for June	<25th to 10th percentile	<10th percentile to above record low	Record low	>90th percentile flow	
Western	7	3	0	0	0	Normal/0
CT River Valley	14	5	3	0	0	Normal/1
Central	11	4	1	0	0	Normal/0
Northeast	19	7	1	0	0	Normal/0
Southeast	6	2	0	0	0	Normal/0

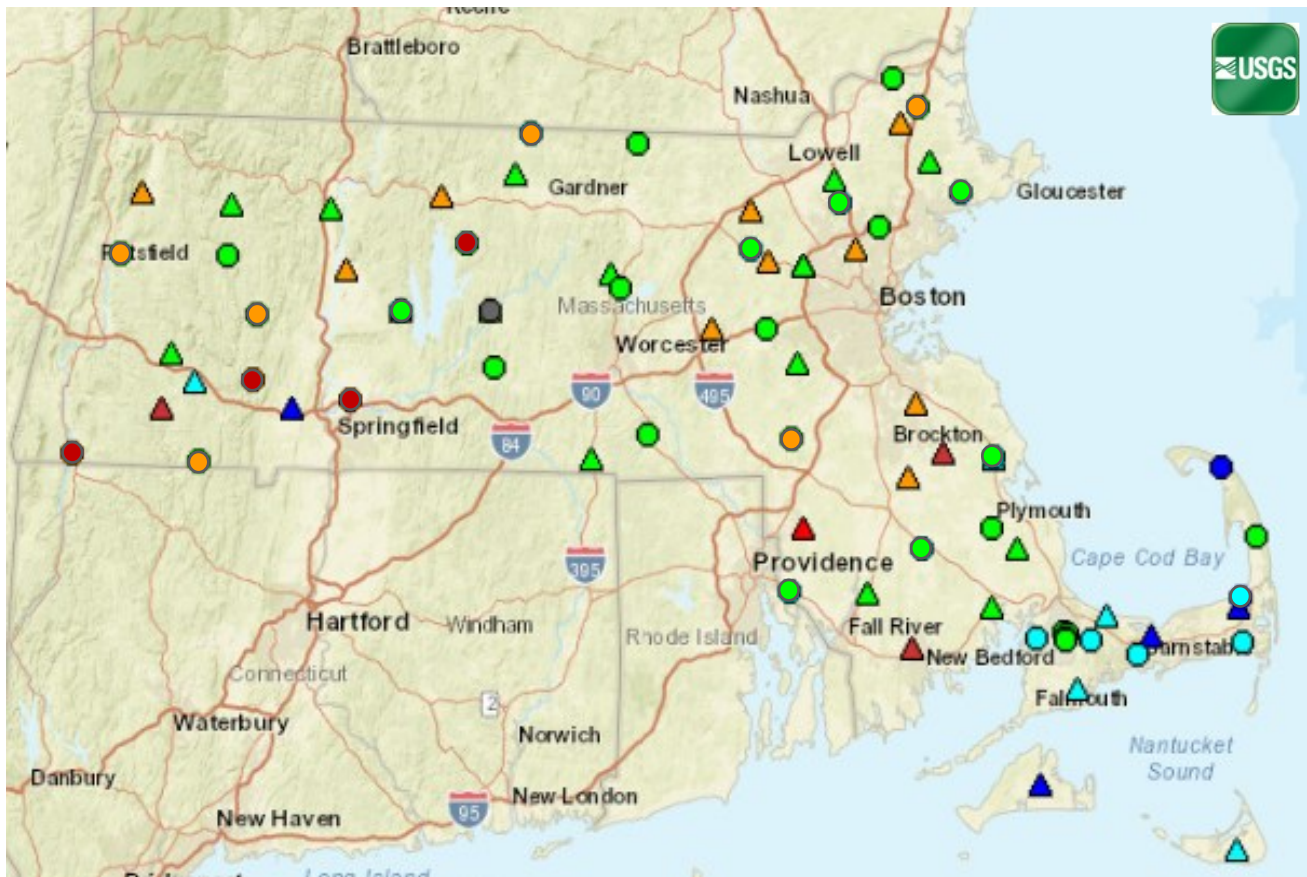
Notes: Gage counts are non-cumulative except for "total reporting". Not all gages report in all months due to ice, beaver dams or other conditions. Streamflow index is not applicable to Cape Cod and the Islands.

GROUNDWATER

Groundwater levels have also been low since May. However, relative to this time of year, the Cape and Islands remain above normal. All other regions have a scattered mix of groundwater levels from normal to less than the 10th percentile of normal and one record low in the Southeast. The Western and Connecticut River Valley regions have the majority of wells below normal but the Groundwater Index remains normal until three consecutive months are below normal. Therefore, the index for all regions remains Normal.

Groundwater Conditions in the Climate Response Network at the End of June

<https://groundwaterwatch.usgs.gov/NetMapT1L2.asp?ncd=crn&sc=25>



Region	Number of wells					MA Drought Plan Index /# consecutive months majority below 25 th percentile
	Total Reporting for June	<25th to 10th percentile	<10th percentile to above record low	Record low	> 90th percentile	
Western	5	2	2	0	0	Normal/2
CT River Valley	11	3	3	0	1	Normal/1
Central	10	1	2	0	0	Normal/0
Northeast	16	6	0	0	0	Normal/0
Southeast	12	2	2	1	0	Normal/0
Cape and Islands	11	0	0	0	3	Normal/0

Notes: Well counts are non-cumulative except for “total reporting”. Not all data are available in time for reporting.

RESERVOIRS

At the end of June, three reservoirs were one standard deviation or more below average June conditions. The Index is elevated for the Central and Southeast regions.

Region	Total Reporting for June	Reservoir Levels	MA Drought Management Plan Reservoir Index
Western	1	Normal	Normal
CT River Valley	2	Normal	Normal
Central	4	Southbridge & A-1: 1 SD Below	Watch
Northeast	8	Normal	Normal
Southeast	3	Cohasset: 2 SD Below	Advisory
Cape Cod & Islands	1	Normal	Normal

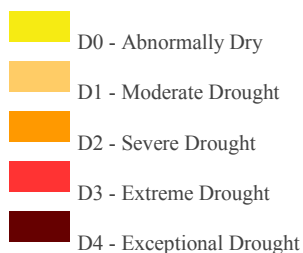
SD = standard deviations

DROUGHT CONDITIONS AND FORECASTS BY NOAA AND PARTNERS

U.S. Drought Monitor: Drought Conditions as of July 10, 2018

Summary: The USDM map shows Abnormally Dry conditions in the State except in the southern half of Southeast and the Cape and Islands regions.

USDM maps are produced by the National Drought Mitigation Center (NDMC). For methods and weekly updates see: <http://droughtmonitor.unl.edu>



NOAA Climate Prediction Center (CPC): Temperature and Precipitation Outlook

July: The outlook projects a 70 percent probability of above normal temperatures and 40-50 percent probability chance for below normal precipitation in Massachusetts.

July through September: The outlook projects 50-60 percent probability of above normal temperatures and equal chances for below normal, normal and above normal precipitation in Massachusetts.

<http://www.cpc.ncep.noaa.gov/products/predictions>

DROUGHT CONDITIONS AND FORECASTS BY NOAA AND PARTNERS, cont.

NOAA CPC: Monthly and Seasonal Drought Outlook

Both the short and long term outlooks project the development of drought conditions.

<http://www.cpc.ncep.noaa.gov/products/Drought/>

- Drought persists
- Drought remains but improves
- Drought removal likely
- Drought development likely

Valid for July 2018



Valid June 21 through September 30, 2018



Key Links: Massachusetts Drought Management: <http://www.mass.gov/eea/agencies/dcr/water-res-protection/water-data-tracking/drought-status.html>

DCR Precipitation Monitoring Composite Reports and SPI

<https://www.mass.gov/service-details/precipitation-composite-estimates-1>

<https://www.mass.gov/service-details/standardized-precipitation-index-spi-0>

This report was prepared by the Massachusetts Department of Conservation and Recreation. Data may be preliminary in nature. Additional information, previous hydrological conditions reports, and drought management information can be found on our web site:

<https://www.mass.gov/water-data-tracking>

Appendix I: Additional Information

Keetch-Byram Drought Index

DCR data as of July 10, 2018 showed all regions but the Cape and Islands with slightly elevated fire danger. All regions but the Cape and Islands are at an Advisory level for this index.

<u>Region</u>	<u>KBDI</u>	<u>Fire Index Level</u>
West	407	Watch
CT River Valley	202, 177	Advisory
Central	340, 315	Advisory
Northeast	343, 351, 351	Advisory
Southeast	276, 200	Advisory
Cape and Islands	260	Advisory

Crop Moisture Index for the Week Ending June 30, 2018

At the end of June, the index is Normal for all regions. The Crop Moisture Index shows the short-term need versus available water in a shallow soil profile. This index responds quickly to changing conditions and is subject to frequent change. The drought level for this indicator is determined based on the repeated or extended occurrence at a given level. This indicator is most relevant during growing season.

http://www.cpc.noaa.gov/products/analysis_monitoring/regional_monitoring/cmi.gif

Appendix I: Additional Information, continued

Percent of Average Historical Precipitation for June 2018

June-18	Normal	Actual	Percent Normal	Excess/ Deficit	-----Excess or Deficit Since Last-----								
					10/1/2017	2 Months	% Norm	3 Months	% Norm	6 Months	% Norm	12 Months	% Norm
State	3.65	3.92	107	0.27	3.37	-1.30	82	0.04	100	3.37	115	1.85	104
Western	4.14	3.71	90	-0.43	3.85	-1.70	79	-1.13	90	3.64	117	2.18	105
Connecticut River	3.94	5.65	143	1.71	2.24	-0.39	95	0.81	107	2.05	109	-0.60	99
Central	3.76	4.02	107	0.26	3.23	-1.45	80	-0.15	99	1.16	105	1.59	103
Northeast	3.43	3.46	101	0.03	1.84	-1.46	79	0.50	105	2.63	112	-0.28	99
Southeast	3.37	2.92	87	-0.45	3.34	-1.71	75	-0.03	100	5.09	123	0.83	102
Cape Cod and Islands	3.36	3.37	100	0.01	8.40	-1.46	79	-0.92	92	8.14	136	13.09	129

Note: Precipitation values are total rainfall and melted snow in inches.
Values are estimated pending receipt of additional data and final calculations.

Standardized Precipitation Index for June 2018

<u>REGION</u>	3-Month SPI	6-Month SPI	12-Month SPI
Western Region	-0.29	0.93	0.37
Connecticut River Region	0.29	0.47	-0.08
Central Region	0.03	0.33	0.27
Northeast Region	0.25	0.65	0.01
Southeast Region	0.09	1.10	0.16
Cape & Islands	-0.21	1.80	1.87

Appendix II: Description of Drought Indices

(from Table 3 of Massachusetts Drought Management Plan).

Drought Level	Standardized Precipitation Index	Crop Moisture Index*	Keetch-Byram Drought Index*	Precipitation	Groundwater	Streamflow	Reservoir***
Normal	3-month > -1.5 <u>or</u> 6-month > -1.0 <u>or</u> 12-month > -1.0	0.0 to -1.0 slightly dry	< 200	1 month below normal	2 consecutive months below normal**	1 month below normal**	Reservoir levels at or near normal for the time of year
Advisory	3-month = -1.5 to -2.0 <u>or</u> 6-month = -1.0 to -1.5 <u>or</u> 12-month = -1.0 to -1.5	-1.0 to -1.9 abnormally dry	200-400	2 month cumulative below 65% of normal	3 consecutive months below normal**	At least 2 out of 3 consecutive months below normal**	Small index Reservoirs below normal
Watch	3-month < -2.0 <u>or</u> 6-month = -1.5 to -3.0 <u>or</u> 12-month = -1.5 to -2.0	-2.0 to -2.9 excessively dry	400-600	1 of the following criteria met: 3 month cum. < 65% <u>or</u> 6 month cum. < 70% <u>or</u> 12 month cum. < 70%	4-5 consecutive months below normal**	At least 4 out of 5 consecutive months below normal**	Medium index Reservoirs below normal
Warning	6-month < -3.0 <u>or</u> 12-month = -2.0 to -2.5	< -2.9 severely dry	600-800	1 of the following criteria met: 3 month cum. < 65% and 6 month cum. < 65%, <u>or</u> 6 month cum. < 65% and 12 month cum. < 65%, <u>or</u> 3 month cum. < 65% and 12 month cum. < 65%	6-7 consecutive months below normal**	At least 6 out of 7 consecutive months below normal**	Large index reservoirs below normal
Emergency	12-month < -2.5	< -2.9 severely dry	600-800	Same criteria as Warning and previous month was Warning or Emergency	>8 months below normal**	>7 months below normal**	Continuation of previous month's conditions

* The Crop Moisture Index is subject to frequent change. The drought level for this indicator is determined based on the repeated or extended occurrence at a given level.

** Below normal for groundwater and streamflow are defined as being within the lowest 25th percentile of the period of record.

*** Water suppliers should be consulted to determine if below normal reservoir conditions are due to operational issues.

Source: Massachusetts Drought Management Plan, May 2013 (<http://www.mass.gov/eea/docs/eea/wrc/droughtplan.pdf>).