

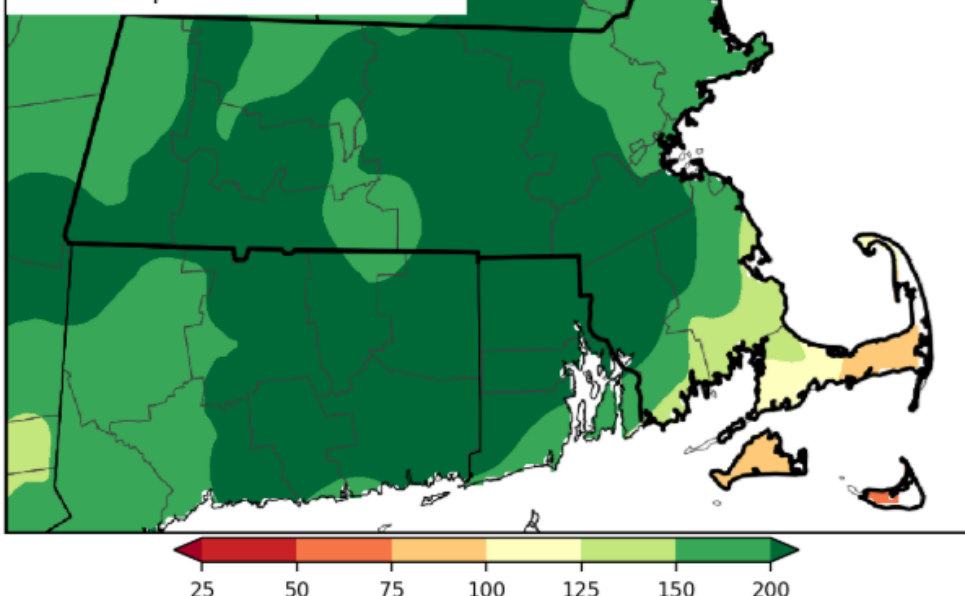
September 2018 Hydrologic Conditions in Massachusetts

SUMMARY OF CONDITIONS

- For average temperatures since 1895, this was the third warmest September.
- Both Precipitation Indices are Normal for all regions. This was the eighth wettest September since 1895.
- Streamflow, Groundwater, and Reservoir Indices are Normal for all regions with many record high values.
- The Fire Index has returned to Normal in all regions except the Cape and Islands which is at the Advisory.
- The Crop Moisture Index is Normal for all regions.
- NOAA's forecast for October projects a moderate probability of above normal temperatures, a slight probability for above normal precipitation for most of the State except for the Southeast and Cape and Islands where equal chances are projected for below normal, normal, or above normal precipitation.
- Appendix I presents indices not shown in the main report and additional details about precipitation. Appendix II presents the drought level thresholds for all indices.

PRECIPITATION

Percent of Normal Precipitation
September 2018



September precipitation was significantly above normal for the second month except on the Cape and Islands.

The Cape and Islands are barely above normal for the three-month look-back period.

Map from the Northeast Regional Climate Center. <http://www.nrcc.cornell.edu/regional/monthly/monthly.html>

Region	Estimated Rainfall (inches)	Departure from Average Sept. (inches)	MA Drought Plan Levels	
			Standardized Precipitation Index (SPI)	Percent of Normal Index
Western	7.51	3.44	Normal	Normal
CT River Valley	8.52	4.58	Normal	Normal
Central	8.44	4.65	Normal	Normal
Northeast	6.72	3.25	Normal	Normal
Southeast	9.08	5.36	Normal	Normal
Cape Cod & Islands	3.09	-0.71	Normal	Normal

Key to Drought Plan Levels

Normal
Advisory
Watch
Warning
Emergency

STREAMFLOW

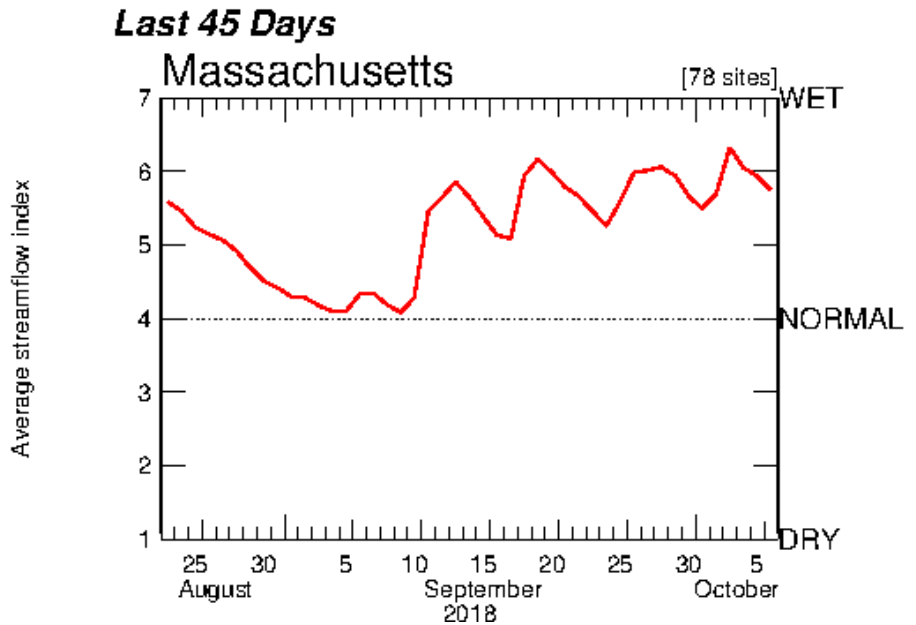
Streamflows were above normal for the entire month of September. 45 of 56 gages averaged 90th percentile or greater flows including 5 record highs. For the first time since February, all gages were above normal (i.e., greater than the 25th percentile).

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

This plot depicts data for the 45-day period ending in early October.

KEY:

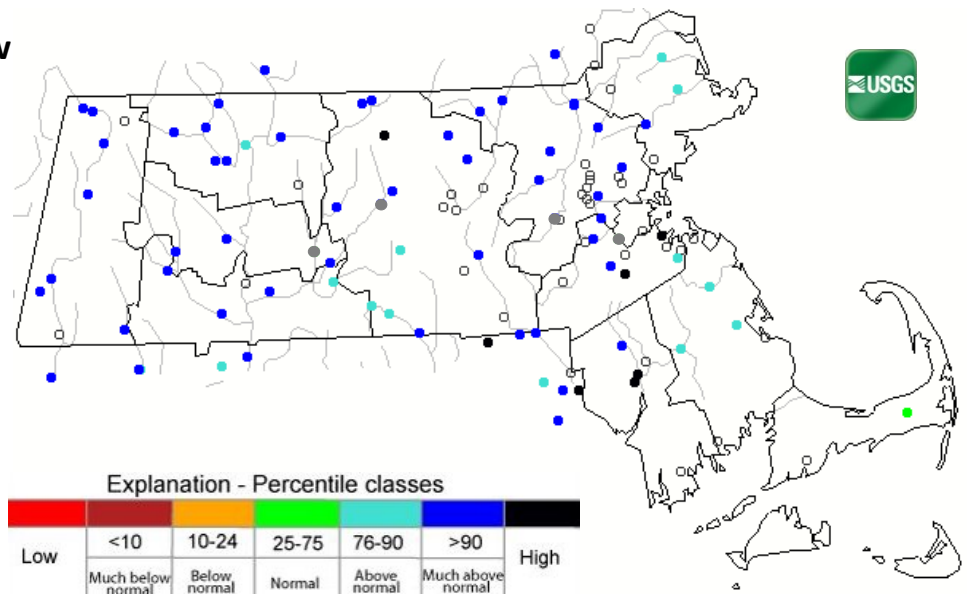
- 1 = New record low for day
- 2 = < 10th percentile
- 3 = 10th – 24th percentile
- 4 = 25th – 74th percentile
- 5 = 75th – 89th percentile
- 6 = > 90th percentile
- 7 = New record high for day



Average September 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				>90th percentile flow	MA Drought Plan Index/# of consecutive months majority below 25th percentile
	Total Reporting for September	<25th to 10th percentile	<10th percentile to above record low	Record low		
Western	7	0	0	0	7	Normal/0
CT River Valley	14	0	0	0	12	Normal/0
Central	11	0	0	0	8	Normal/0
Northeast	18	0	0	0	15	Normal/0
Southeast	6	0	0	0	3	Normal/0

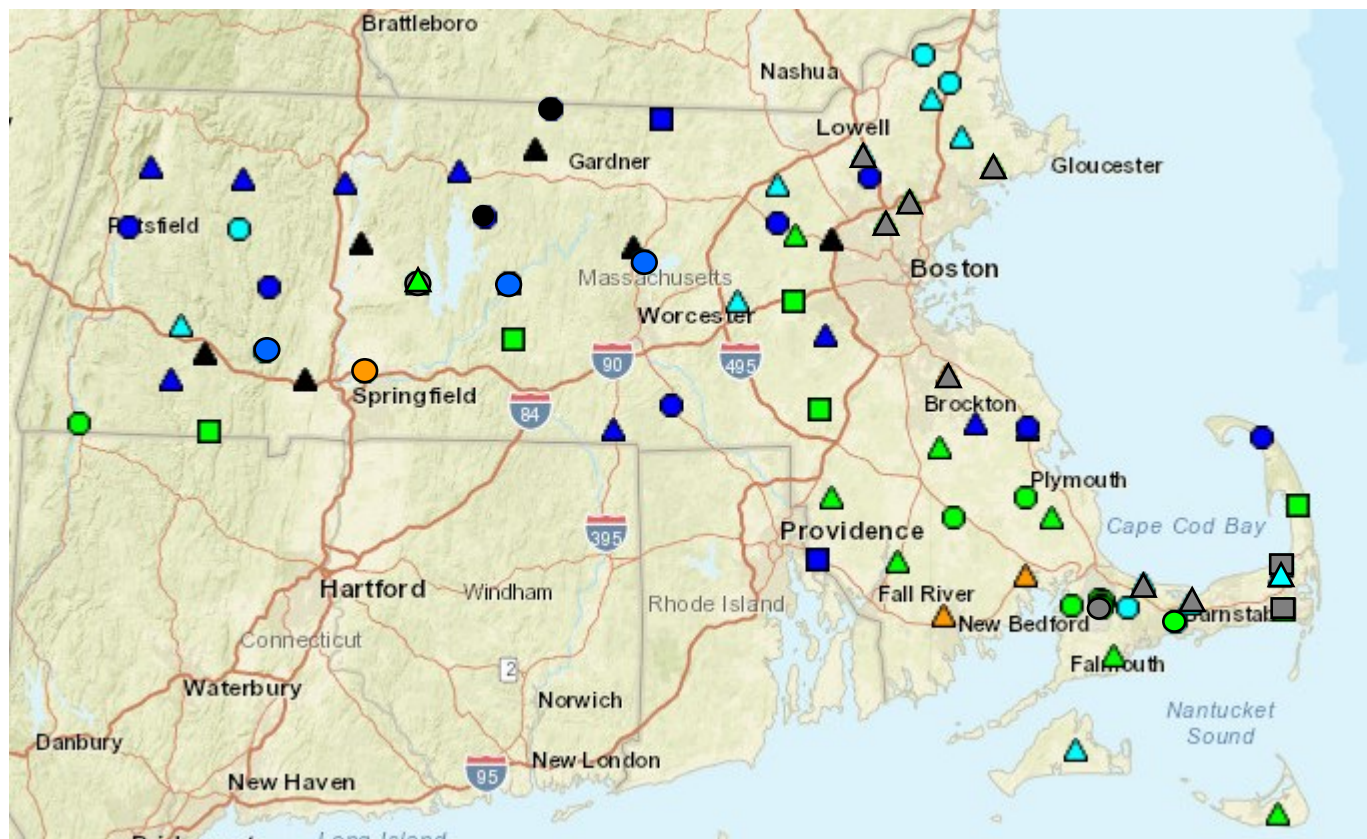
Notes: Gage counts are non-cumulative except for "total reporting". Not all gages report in all months due to ice, beaver dams or other conditions. Streamflow index is not applicable to Cape Cod and the Islands.

GROUNDWATER

Groundwater levels are showing recharge from continued storm events that started in mid-July. Recharge in July, August and September is unusual, and as such 24 wells are at or higher than the 90th percentile water level for September including 8 record highs. Only two wells in the Southeast region are slightly below normal.

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

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



Region	Number of wells					MA Drought Plan Index /# consecutive months majority below
	Total Reporting for September	<25th to 10th percentile	<10th percentile to above record low	Record low	> 90th percentile	
Western	5	0	0	0	3	Normal/0
CT River Valley	10	0	0	0	7	Normal/0
Central	10	0	0	0	9	Normal/0
Northeast	9	0	0	0	2	Normal/0
Southeast	10	2	0	0	2	Normal/0
Cape and Islands	8	0	0	0	1	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 September all reporting reservoirs were above the threshold of one-standard-deviation-below-average .

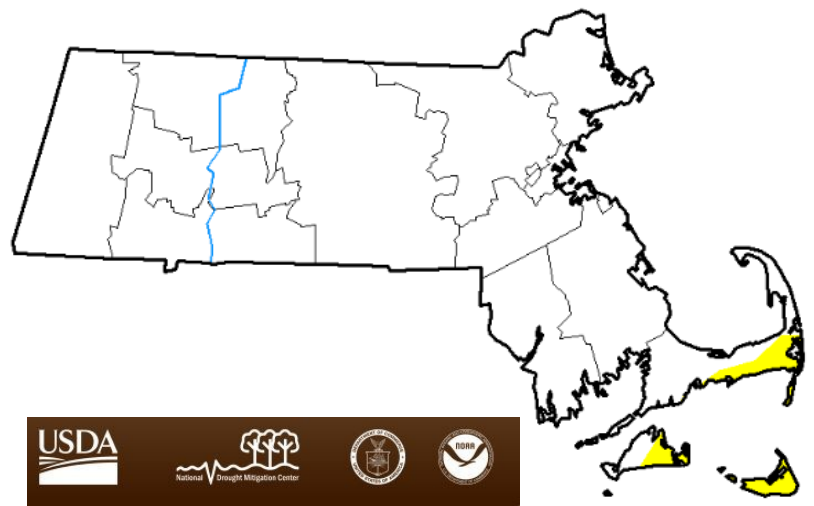
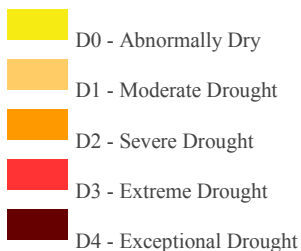
Region	Total Reporting for September	Reservoir Levels	MA Drought Management Plan Reservoir Index
Western	2	Normal	Normal
CT River Valley	2	Normal	Normal
Central	3	Normal	Normal
Northeast	7	Normal	Normal
Southeast	2	Normal	Normal
Cape Cod & Islands	1	Normal	Normal

DROUGHT CONDITIONS AND FORECASTS BY NOAA AND PARTNERS

U.S. Drought Monitor: Drought Conditions as of October 4, 2018

Summary: The USDM map shows small remaining areas of Abnormally Dry conditions on the Cape and Islands. All other regions remain normal.

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: Temperature and Precipitation Outlook

October: The outlook projects a 40-50 percent probability of above normal temperatures across the State. Precipitation is projected to be above normal for most of the State at 33-40 percent probability except for the Southeast and Cape and Islands where equal chances are projected for below normal, normal, or above normal precipitation.

October through December: The outlook projects a 40-50 percent probability of above normal temperatures and 33-40 percent probability of above normal precipitation.





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

DROUGHT CONDITIONS AND FORECASTS BY NOAA AND PARTNERS, cont.

NOAA Climate Prediction Center: Monthly and Seasonal Drought Outlook

The outlooks do not project drought conditions.

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

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

Valid for October 2018

Valid September 20 - December 31, 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 October 1, 2018 show that all regions have returned to Normal except the Cape and Islands region, which is at an Advisory level.

<u>Region</u>	<u>KBDI</u>	<u>Fire Index Level</u>
West	38	Normal
CT River Valley	28, 10, 48	Normal
Central	30, 10	Normal
Northeast	54, 46	Normal
Southeast	17, 17	Normal
Cape and Islands	233, 266, 314	Advisory

Crop Moisture Index for the Week Ending October 6, 2018

The index is Normal for all regions with average to wet conditions.

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 September 2018

				Percent Excess/	-----Excess or Deficit Since Last-----								
	Normal	Actual	Normal	Deficit	10/1/2017	2 Months	% Norm	3 Months	% Norm	6 Months	% Norm	12 Months	% Norm
State	3.77	7.61	202	3.84	10.90	6.15	180	7.27	164	7.57	134	10.90	124
Western	4.07	7.51	185	3.44	14.68	7.54	192	9.33	175	9.70	140	14.68	133
Connecticut River	3.94	8.52	216	4.58	14.13	8.52	205	12.09	198	12.70	153	14.13	131
Central	3.79	8.44	223	4.65	14.41	8.32	206	10.67	192	11.03	148	14.41	131
Northeast	3.47	6.72	194	3.25	7.45	4.79	168	5.20	150	6.11	129	7.45	117
Southeast	3.72	9.08	244	5.36	8.45	6.01	179	5.21	148	5.08	123	8.45	119
Cape Cod and Islands	3.80	3.09	81	-0.71	4.75	-2.01	74	-3.68	66	-4.57	79	4.75	110

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 September 2018

REGION	3-Month SPI	6-Month SPI	12-Month SPI
Western Region	2.14	1.76	1.89
Connecticut River Region	2.52	2.12	1.82
Central Region	2.44	2.06	1.84
Northeast Region	1.53	1.29	1.04
Southeast Region	1.44	1.05	1.12
Cape & Islands	-0.97	-0.85	0.71

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>).