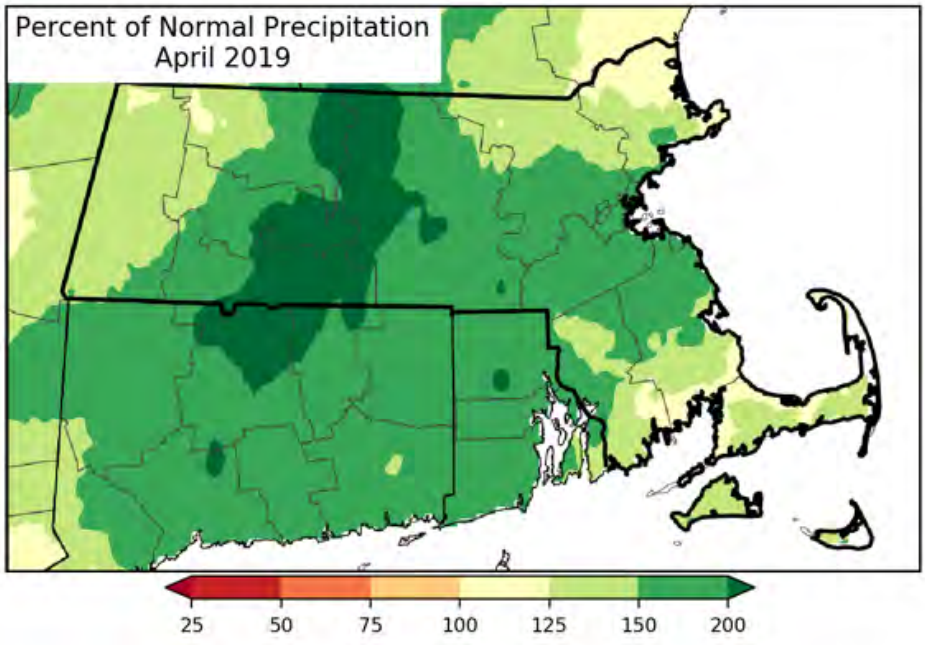
MASSACHUSETTS WATER RESOURCES COMMISSION

April 2019 Hydrologic Conditions in Massachusetts

SUMMARY OF CONDITIONS

- Monthly average temperatures were 1 to 3 degrees Fahrenheit higher than average.
- Both precipitation indices are Normal for all regions. Precipitation was significantly above average, especially in the Connecticut River Valley and Central regions.
- Streamflow, Groundwater, and Reservoir Indices are Normal for all regions. Streamflow and groundwater levels increased over the month ending significantly above normal throughout the state.
- With wet conditions, both the Crop Moisture Index and Keetch-Byram Drought Index are Normal for all regions.
- NOAA's forecast for May projects 33-40% chance of above normal temperatures, and equal chances for above normal, normal, or below 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



Precipitation was above average for April across the state particularly in the Connecticut River Valley and Central regions where twice the normal rain fell.

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

Region	Estimated Precipitation (inches)	Departure from Average April (inches)	MA Drought Plan Levels	
			Standardized Precipitation Index (SPI)	Percent of Normal Index
Western	5.83	2.31	Normal	Normal
CT River Valley	7.26	3.68	Normal	Normal
Central	7.55	3.72	Normal	Normal
Northeast	6.27	2.64	Normal	Normal
Southeast	6.98	3.05	Normal	Normal
Cape Cod & Islands	4.95	0.90	Normal	Normal

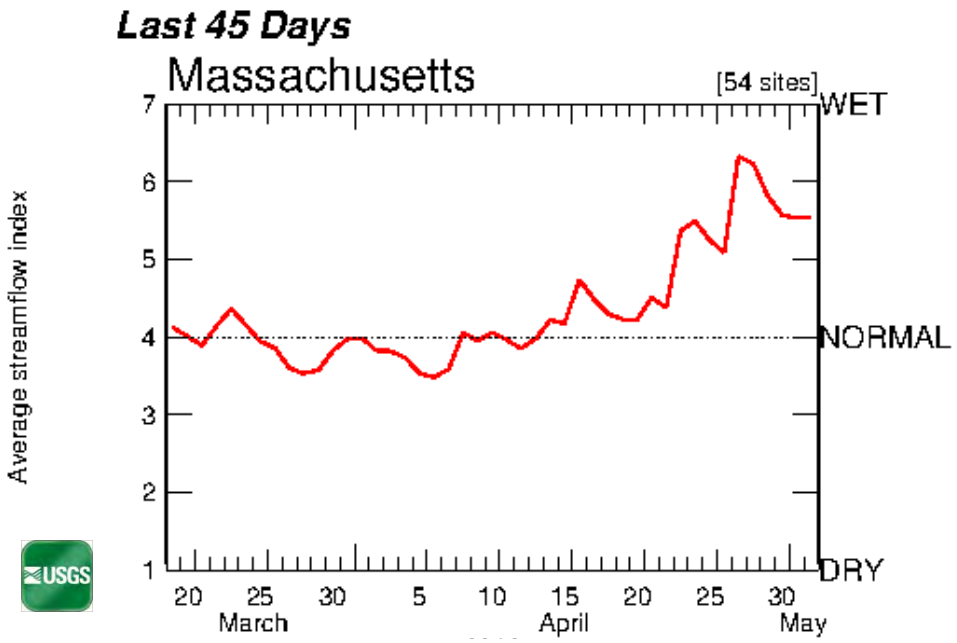
Key to Drought Plan Levels
Normal
Advisory
Watch
Warning
Emergency

STREAMFLOW

Overall, monthly average streamflows were about average but average daily flows increased through the month ending well above average.

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

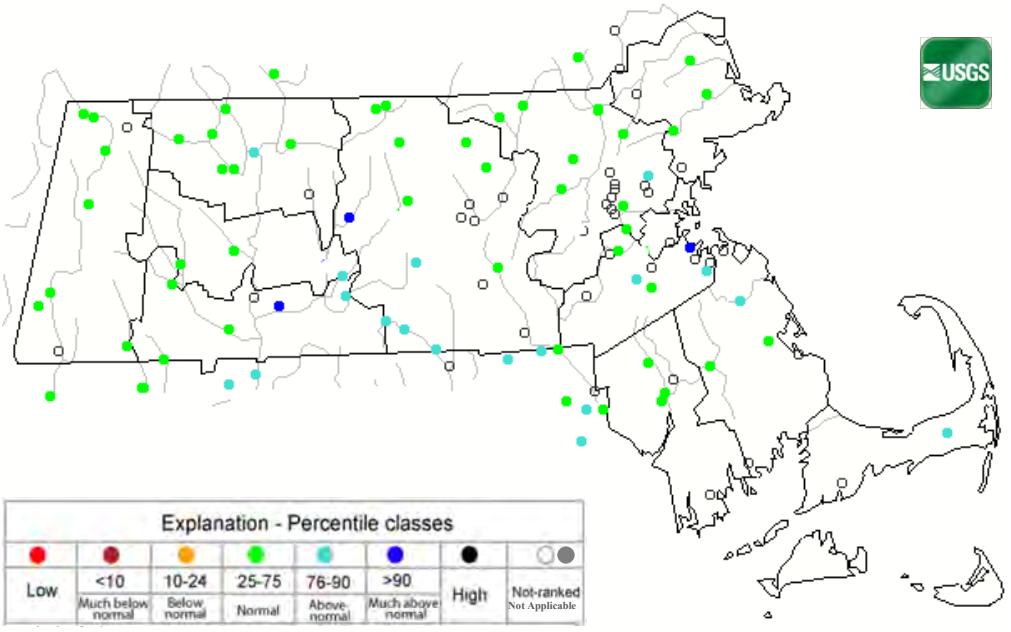
KEY:
1 = New record low for day
2 = < 10th percentile
3 = 10th – 24th percentile
4 = 25th – 74th percentile
5 = 75th – 89th percentile
6 = > 90th percentile
7 = New record high for day



Average April 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 April	<25th to 10th percentile	<10th percentile to above record low	Record low		
Western	7	0	0	0	0	Normal/0
CT River Valley	14	0	0	0	1	Normal/0
Central	11	0	0	0	1	Normal/0
Northeast	17	0	0	0	1	Normal/0
Southeast	6	0	0	0	0	Normal/0

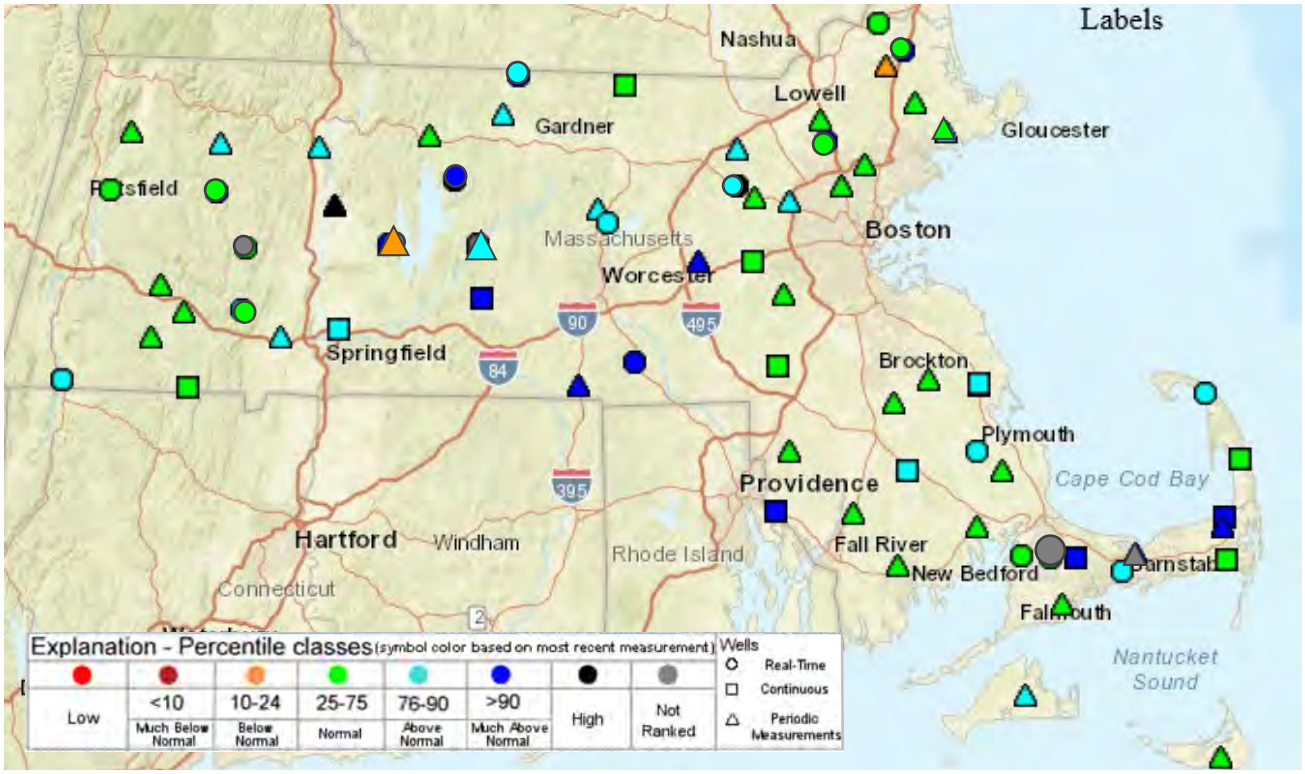
Notes: Gage counts are non-cumulative except for "total reporting". Not all gages report in all months due to ice, beaver dams or other conditions. Streamflow index is not applicable to Cape Cod and the Islands.

GROUNDWATER

In general, groundwater levels rose throughout the month but levels continue to vary across the state from below normal to record high. 10 of 65 reporting wells are greater than their respective 90th percentile values and 2 wells are below their respective 25th percentile values.

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

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



Region	Number of wells					MA Drought Plan Index /# consecutive months majority below 25th percentile
	Total Reporting for April	<25th to 10th percentile	<10th percentile to above record low	Record low	> 90th percentile	
Western	5	0	0	0	0	Normal/0
CT River Valley	11	**1**	0	0	**1**	Normal/0
Central	10	0	0	0	**4**	Normal/0
Northeast	16	**1**	0	0	**1**	Normal/0
Southeast	12	0	0	0	**1**	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 April, many reporting reservoirs were full. The Quabbin reservoir continues to spill.

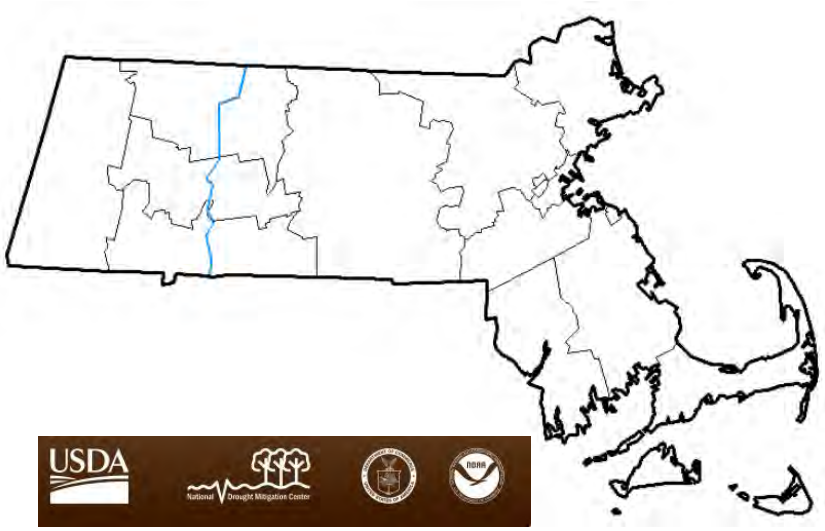
Region	Total Reporting for April	Reservoir Levels	MA Drought Management Plan Reservoir Index
Western	1	Normal	Normal
CT River Valley	2	Normal	Normal
Central	3	Normal	Normal
Northeast	6	Normal	Normal
Southeast	3	Normal	Normal
Cape Cod & Islands	1	Normal	Normal

DROUGHT CONDITIONS AND FORECASTS BY NOAA AND PARTNERS

U.S. Drought Monitor: Drought Conditions as of April 30, 2019

Summary: The USDM map shows all regions as normal.

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



D0 - Abnormally Dry
D1 - Moderate Drought
D2 - Severe Drought
D3 - Extreme Drought
D4 - Exceptional Drought

NOAA Climate Prediction Center: Temperature and Precipitation Outlook

May: The outlook projects 33-40% chance of above normal temperatures, and equal chances for above normal, normal, or below normal precipitation.

May through July: The outlook projects 50-60% chance of above normal temperatures and equal chances for below normal, normal, or above normal precipitation.
https://www.cpc.ncep.noaa.gov/

NOAA Climate Predication Center: Monthly and Seasonal Drought Outlook

The monthly outlook for May and seasonal outlook valid through July do not project drought conditions.
http://www.cpc.ncep.noaa.gov/products/Drought/

Appendix I: Additional Information

Keetch-Byram Drought Index (KBDI)

KBDI values are less than 50 across the state, resulting in the index being Normal for all regions.

Crop Moisture Index (CMI)

The CMI map for the week ending April 27, 2019 shows wet to excessively wet conditions across the state, resulting in the index being Normal for all regions.

The CMI shows the short-term need versus available water in a shallow soil profile and responds quickly to changing conditions. 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. https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/cmi.gif

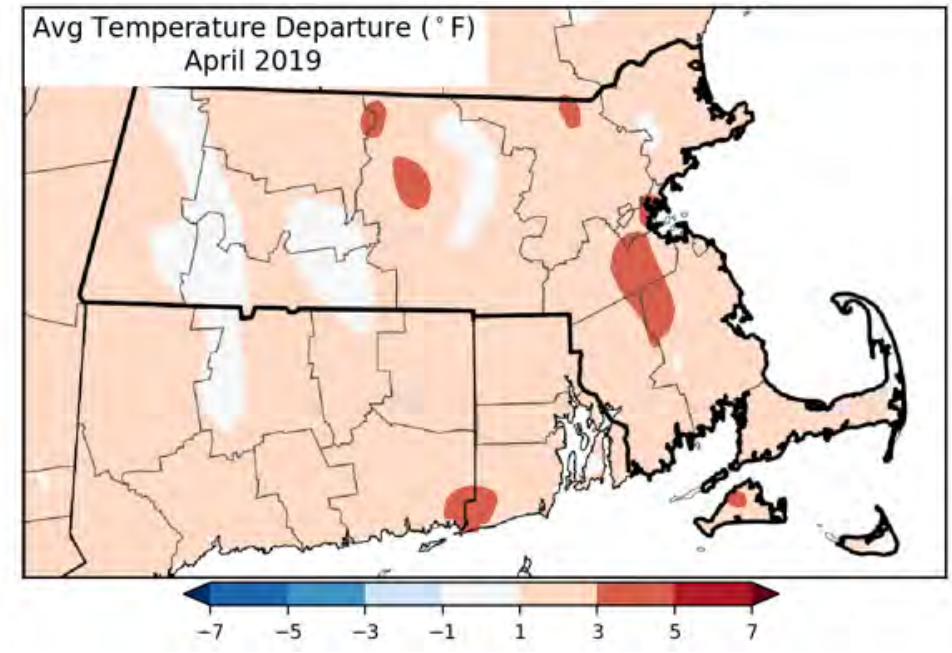
Season-to-date Snowfall Departure and Snow Cover

Information provided seasonally.

Temperature

Monthly average temperatures were mostly above historical average for most of the state with 1 to 3 degrees Fahrenheit above average. http://www.nrcc.cornell.edu/regional/monthly/monthly.html

Boston daily temperatures ranged from 30 to 77 degrees Fahrenheit. Deviation from historical daily average temperatures were –7.3 to +20.6 degrees Fahrenheit, respectively. https://w2.weather.gov/climate/index.php?wfo=box



This report was prepared by the Massachusetts Department of Conservation and Recreation. Data may be preliminary. Additional information, previous reports, and drought management information can be found at https://www.mass.gov/water-data-tracking.

Appendix I: Additional Information, continued

Percent of Average Historical Precipitation

April-19			Percent	Excess/	Excess or Deficit Since Last								
	Normal	Actual	Normal	Deficit	10/1/2018	2 Months	% Norm	3 Months	% Norm	6 Months	% Norm	12 Months	% Norm
State	3.75	6.69	178	2.94	10.28	1.65	121	1.69	115	8.67	139	16.56	137
Western	3.52	5.83	166	2.31	8.36	0.49	107	0.77	108	6.98	135	18.73	142
Connecticut River	3.58	7.26	203	3.68	10.82	1.67	123	2.03	119	9.98	147	22.71	150
Central	3.83	7.55	197	3.72	9.27	2.14	127	1.76	115	8.42	136	18.70	140
Northeast	3.63	6.27	173	2.64	8.89	1.52	120	1.84	117	7.94	136	13.42	131
Southeast	3.93	6.98	178	3.05	12.60	1.86	123	1.84	116	9.38	139	15.22	134
Cape Cod and Islands	4.05	4.95	122	0.90	10.83	1.13	114	0.68	106	7.78	132	6.32	114

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 March 2019

REGION	3-Month SPI	6-Month SPI	12-Month SPI
Western Region	0.37	1.82	2.57
Connecticut River Region	0.69	2.22	2.90
Central Region	0.64	1.86	2.40
Northeast Region	0.66	1.69	1.81
Southeast Region	0.61	1.80	1.89
Cape & Islands	0.29	1.55	0.93

DCR Precipitation Monitoring Composite Reports and SPI are available at:
https://www.mass.gov/service-details/precipitation-composite-estimates-1

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

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 **or** 6-month > -1.0 **or** 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 **or** 6-month = -1.0 to -1.5 **or** 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 **or** 6-month = -1.5 to -3.0 **or** 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% **or** 6 month cum. < 70% **or** 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 **or** 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%, **or** 6 month cum. <65% and 12 month cum. <65%, **or** 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).