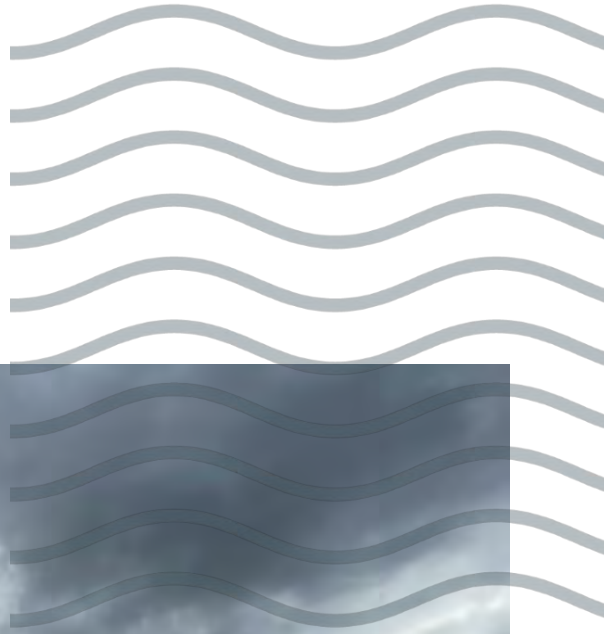


MASSACHUSETTS WATER RESOURCES COMMISSION

SEPTEMBER
2022 **HYDROLOGIC
CONDITIONS**



The Commonwealth of Massachusetts
Charles D. Baker, Governor
Bethany A. Card, Secretary, Executive Office of Energy and Environmental Affairs

SEPTEMBER 2022 HYDROLOGIC CONDITIONS

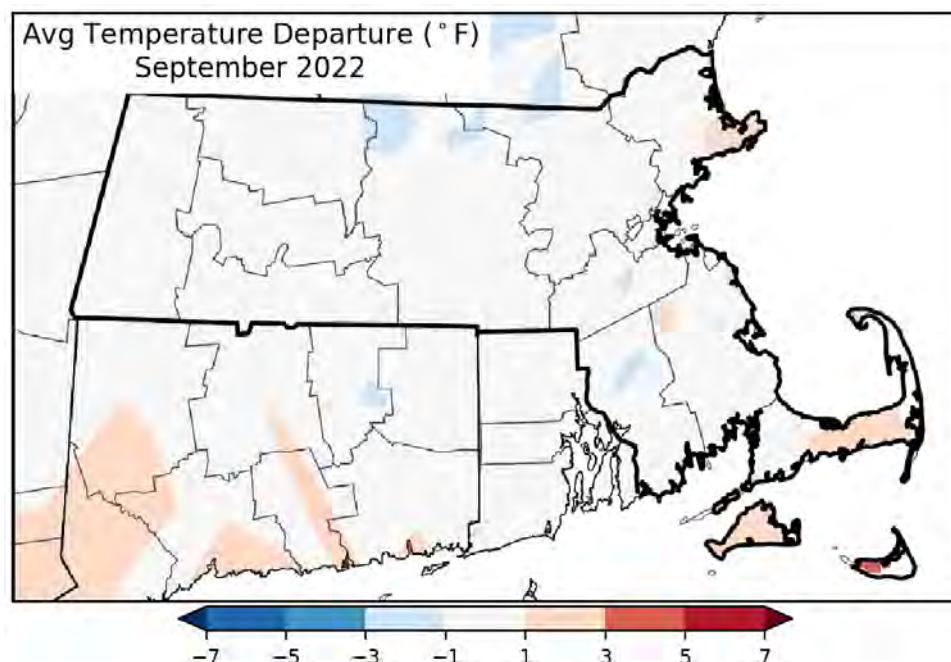
SUMMARY OF CONDITIONS

- Monthly average temperatures were normal.
- Precipitation was normal to above normal. Index Severity Levels (ISL) remain elevated at look-back periods beyond 1-month for several Regions.
- Streamflow was mostly normal with some gages still below normal. The Cape Cod Region is at ISL 2.
- Groundwater levels ranged from below normal to above normal. The CTRV, Northeast, and Cape Cod Regions are at ISL 1, and the Islands Region at ISL 2.
- Lake and impoundment levels varied across the state with many levels below their 30th percentile. All Regions are at an elevated ISL except the Western Region.
- The Keetch-Byram Drought Index was elevated across eastern parts of the state with all Regions except the Western and CTRV at an ISL of 1 or 2.
- The Evaporative Demand Drought Index for September was elevated in areas of the Northeast, Cape, and Islands Regions.
- NOAA's October outlook shows chances leaning for below-normal temperatures in the western parts of the state, no strong signal for temperature in the eastern parts, and no strong signal for precipitation for the entire state.
- NOAA's 3-month outlook shows chances for above-normal temperatures and equal chances for below-normal, normal, or above-normal precipitation.
- Appendix II provides information on the Massachusetts Drought Management Plan (DMP).

TEMPERATURE

Monthly average temperatures were mostly normal across most of the state.

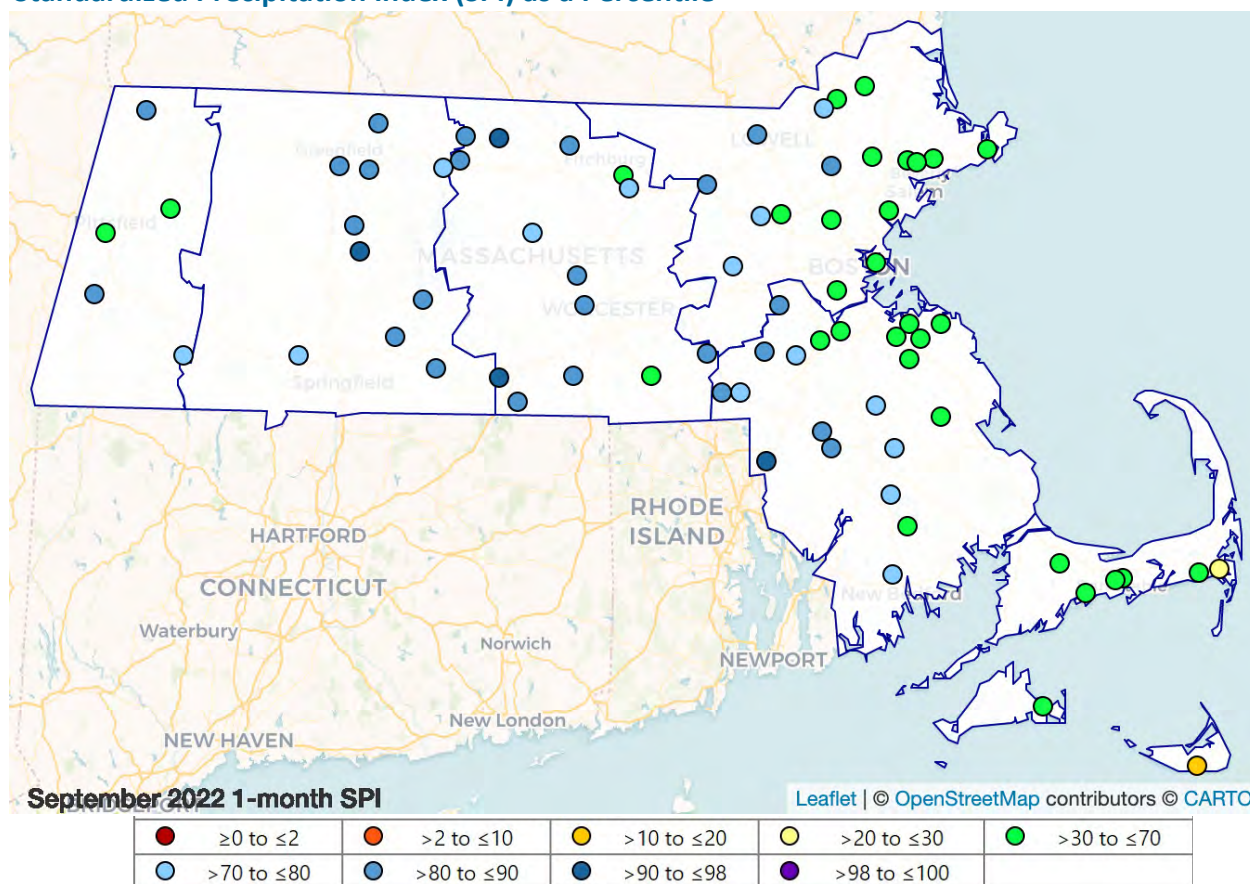
<http://www.nrcc.cornell.edu/regional/monthly/monthly.html>



PRECIPITATION

September precipitation was normal to above normal. Most stations in the Western, CTRV, Central, and Southeast Regions received above-normal precipitation. While the above-normal precipitation furthered drought improvement in these Regions, areas along the coast did not benefit from above-normal precipitation with most stations in the Northeast, Cape Cod, and Islands Regions receiving normal precipitation. Index Severity Levels remain elevated at look-back periods beyond 1-month for several Regions. In addition to the table below, Appendix I provides all look-back periods.

Standardized Precipitation Index (SPI) as a Percentile



REGION	NUMBER OF SITES REPORTING	SEPTEMBER MONTHLY AVERAGE (IN)	DEPARTURE FROM HISTORICAL (IN)	SPI PERCENTILE 1-MONTH	SPI PERCENTILE 3-MONTH	SPI PERCENTILE 6-MONTH
WESTERN	5	6.03	1.74	78	45	35
CTRV	10	6.64	2.66	86	56	34
CENTRAL	14	6.14	2.19	84	54	36
NORTHEAST	18	4.06	0.49	65	17	10
SOUTHEAST	21	5.30	1.40	75	45	19
CAPE COD	6	3.55	-0.16	49	6	14
ISLANDS	2	2.46	-1.06	38	9	12

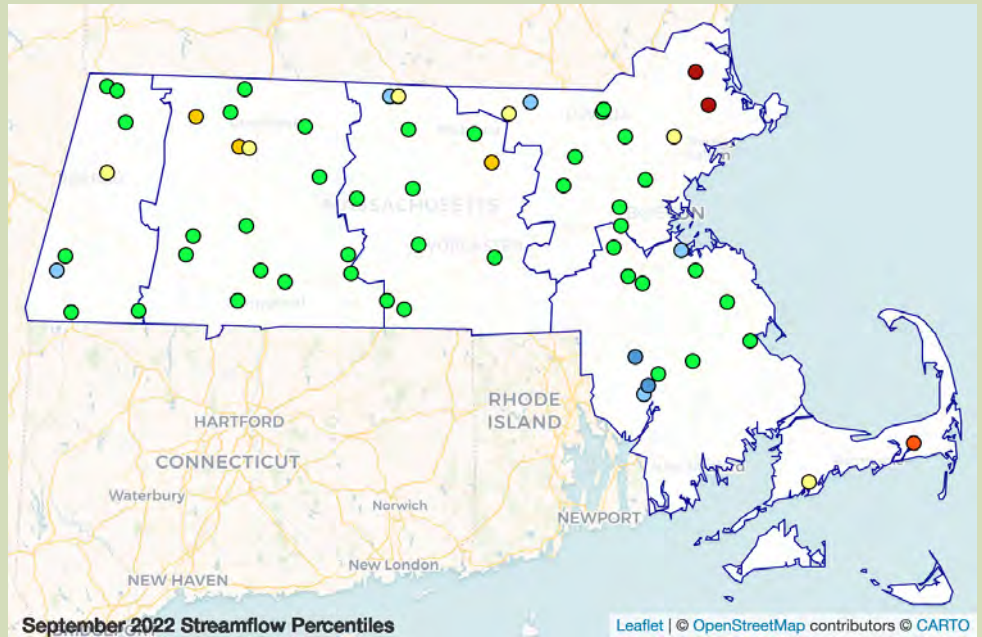
SPI is the Standardized Precipitation Index used in the Drought Management Plan (DMP) expressed here as a percentile and represents the variation, in standard deviations, from long-term precipitation averages.

DMP Index Severity Levels			
1	2	3	4

STREAMFLOW

During September, percentiles of individual streamflow gages varied across the state from significantly below normal to above normal. Overall streamflow improved during September, but monthly percentiles were in the below-normal range for gages in the northern parts of the state and in the Cape Cod Region. The Cape Cod Region is at Index Severity Level 2.

Median Monthly Streamflow Percentiles Compared to Historical Values



●	≥0 to ≤2	●	>2 to ≤10	●	>10 to ≤20	●	>20 to ≤30	●	>30 to ≤70
●	>70 to ≤80	●	>80 to ≤90	●	>90 to ≤98	●	>98 to ≤100		

REGION	NUMBER OF GAGES REPORTING	≥0 TO ≤2 PERCENTILE	>2 TO ≤10 PERCENTILE	>10 TO ≤20 PERCENTILE	>20 TO ≤30 PERCENTILE	>90 PERCENTILE	MEDIAN OF INDIVIDUAL GAGE PERCENTILES
WESTERN	8	0	0	0	1	0	61
CTRV	15	0	0	2	1	0	50
CENTRAL	11	0	0	1	1	0	61
NORTHEAST	13	2	0	0	2	0	43
SOUTHEAST	12	0	0	0	0	0	62
CAPE COD	2	0	1	0	1	0	19

Note: Not all gages report in all months due to ice, beaver dams or other conditions. Streamflow index is not applicable to the Islands.

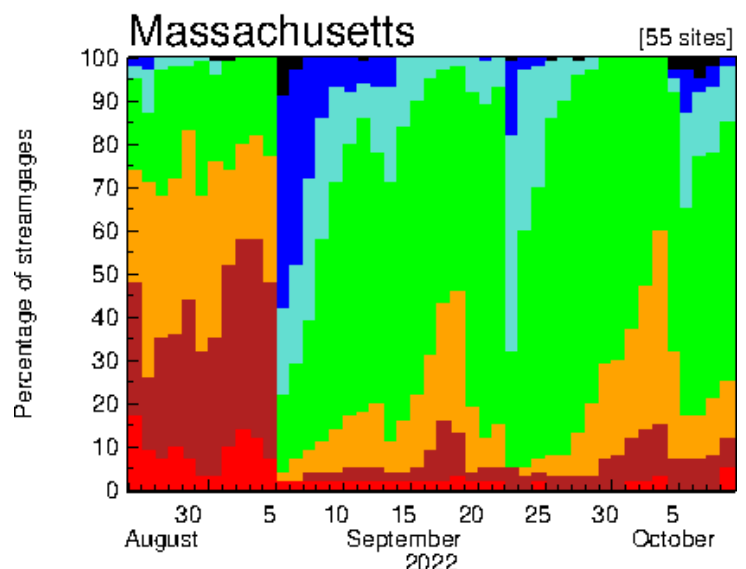
DMP Index Severity Levels			
1	2	3	4

Time Series of the Percent of Gages at Their Respective Percentile Flows for Average Daily Streamflows Compared to Historical Values

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

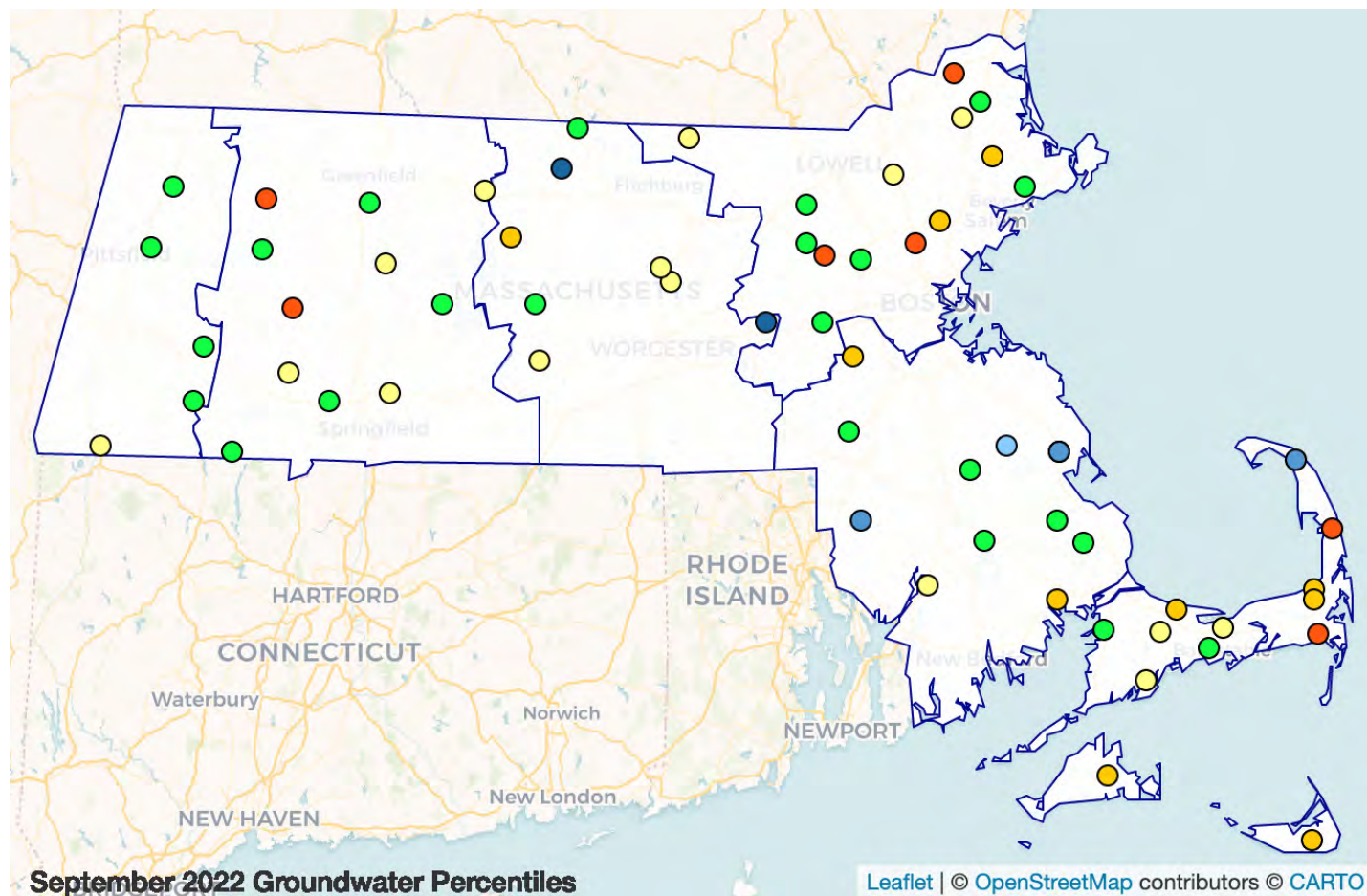
<https://waterdata.usgs.gov/nwis/sw>

Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	No Data
	Much below normal	Below normal	Normal	Above normal	Much above normal		



GROUNDWATER

September groundwater levels ranged across the state from below normal to above normal. Regional medians of individual well percentiles improved as compared to August in all Regions except the Islands. The CTRV, Northeast, and Cape Cod Regions are at Index Severity Level 1 and the Islands Region is at Index Severity Level 2.



● ≥ 0 to ≤ 2	● > 2 to ≤ 10	● > 10 to ≤ 20	● > 20 to ≤ 30	● > 30 to ≤ 70
● > 70 to ≤ 80	● > 80 to ≤ 90	● > 90 to ≤ 98	● > 98 to ≤ 100	

REGION	NUMBER OF WELLS REPORTING	≥ 0 TO ≤ 2 PERCENTILE	> 2 TO ≤ 10 PERCENTILE	> 10 TO ≤ 20 PERCENTILE	> 20 TO ≤ 30 PERCENTILE	> 90 PERCENTILE	MEDIAN OF INDIVIDUAL WELL PERCENTILES
WESTERN	5	0	0	0	1	0	41
CTRV	11	0	2	0	4	0	29
CENTRAL	8	0	0	1	3	2	33
NORTHEAST	14	0	3	2	3	0	27
SOUTHEAST	12	0	0	2	1	0	45
CAPE COD	11	0	2	3	3	0	22
ISLANDS	2	0	0	2	0	0	14

DMP Index Severity Levels			
1	2	3	4

LAKES AND IMPOUNDMENTS

REGION	NUMBER OF SITES REPORTING	MEDIAN OF INDIVIDUAL PERCENTILES OR PERCENT FULL
WESTERN	1	38th
CTRV	2	19th
CENTRAL	4	30th
NORTHEAST	7	24th
SOUTHEAST	2	27th
CAPE COD	1	15th

At the end of September, lake and impoundment levels varied across the state with many levels below their 30th percentile. All Regions are at an elevated Index Severity Level except the Western Region.

DMP Index Severity Levels do not necessarily reflect water supply status.

DMP Index Severity Levels			
1	2	3	4

REGION	NUMBER OF SITES REPORTING	HIGHEST OF SITE VALUES
WESTERN	3	192
CTRV	6	136
CENTRAL	6	468
NORTHEAST	3	567
SOUTHEAST	6	377
CAPE COD	4	474
ISLANDS	2	450

KEETCH-BYRAM DROUGHT INDEX (KBDI)

At the end of September, KBDI values were elevated across eastern portions of the state. All Regions are at an elevated Index Severity Level of either 1 or 2 except for the Western and CTRV Regions.

EVAPOTRANSPIRATION (ET) INDEX

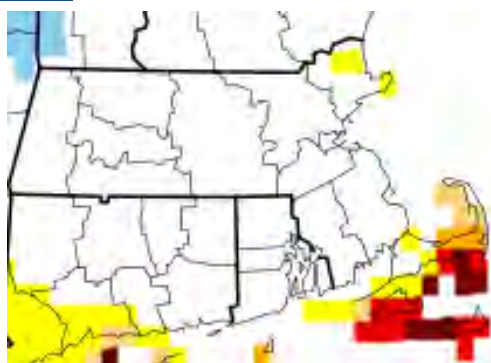
Crop Moisture Index (CMI) - 2019 Drought Management Plan

At the end of September CMI values were in the Slightly Dry/Favorably Moist range across the state. All Regions are at Index Severity Level 0.

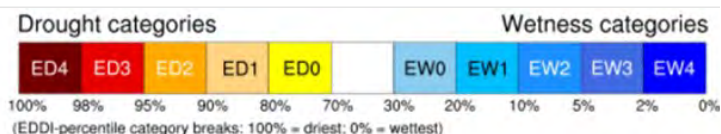
https://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml

Evaporative Demand Drought Index (EDDI) - proposed 2022 Drought Management Plan

The 1-month EDDI shows areas of elevated ET in the Northeast, Cape, and Islands Regions.



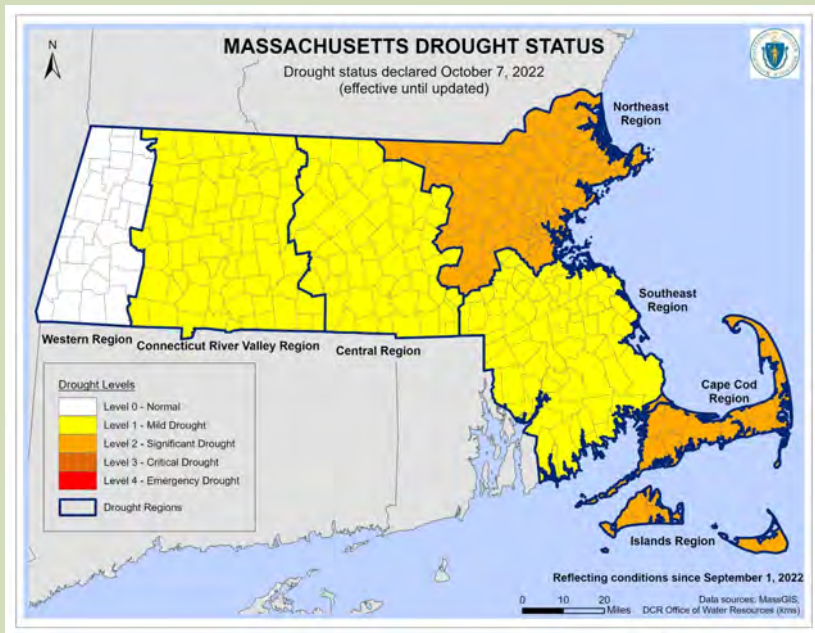
Map dated September 30th



SNOWFALL

Reported seasonally.

DROUGHT CONDITIONS AND FORECASTS



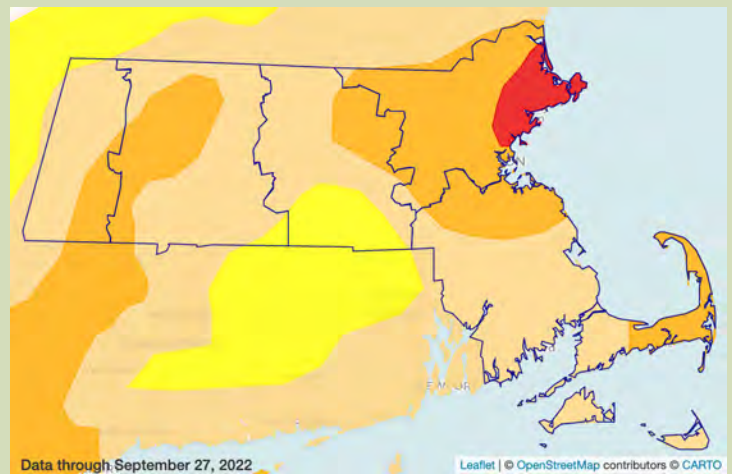
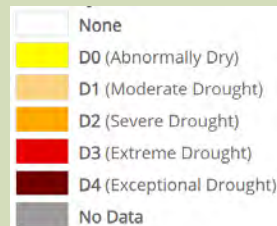
Massachusetts Drought Status

On October 7th Massachusetts Energy and Environmental Affairs (EEA) Secretary Bethany A. Card declared a Level 0 Normal Conditions for the Western Region; Level 1 Mild Drought for the CTRV, Central, and Southeast Regions; and Level 2 Significant Drought for the Northeast, Cape Cod, and Islands Regions. This status remains in effect until further updated.

U.S. Drought Monitor (USDM)

At the end of September, the USDM showed areas of D0, D1, D2, and D3 drought conditions in Massachusetts. These are equivalent to Massachusetts Drought Levels 1, 2, and 3.

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



NOAA Climate Prediction Center

Temperature and Precipitation Outlook

October: The outlook issued 9/30 shows a 33-40% chance of below-normal temperatures for the western part of the state, and equal chances for above-normal, normal, or below-normal temperatures for the eastern part. For precipitation, there are equal chances for above-normal, normal, or below-normal precipitation.

October through December: The outlook issued 9/15 shows a 40-50% chance in the Western Region and a 50-60% chance in the rest of the state of above-normal temperatures and equal chances for above-normal, normal, or below-normal precipitation. <https://www.cpc.ncep.noaa.gov/>

Monthly and Seasonal Drought Outlook

The monthly outlook for October released on 9/30 shows drought persisting across most of the state with some drought removal on Cape Cod. The seasonal outlook for October through December issued on 9/30 shows a mix of drought removal and drought remaining but improving across the state.

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

This report was prepared by the Massachusetts Department of Conservation and Recreation. Data may be preliminary. Analysis reflects automated calculations done 10/10/2022. Additional information, previous reports, and the Massachusetts Drought Dashboard with weekly updates to the drought indices can be found at: <https://www.mass.gov/drought-monitoring>

APPENDIX I – ADDITIONAL PRECIPITATION DATA

Standardized Precipitation Index—September 2022 as percentiles

REGION	NUMBER OF SITES	1-mo	2-mo	3-mo	6-mo	9-mo	12-mo	24-mo	36-mo
WESTERN	5	78	44	45	35	32	49	82	76
CTRV	10	86	66	56	34	30	33	79	69
CENTRAL	14	84	61	54	36	41	40	86	77
NORTHEAST	18	65	29	17	10	13	16	73	73
SOUTHEAST	21	75	67	45	19	23	26	73	65
CAPE COD	6	49	27	6	14	29	27	51	26
ISLANDS	2	38	17	9	12	16	10	27	27

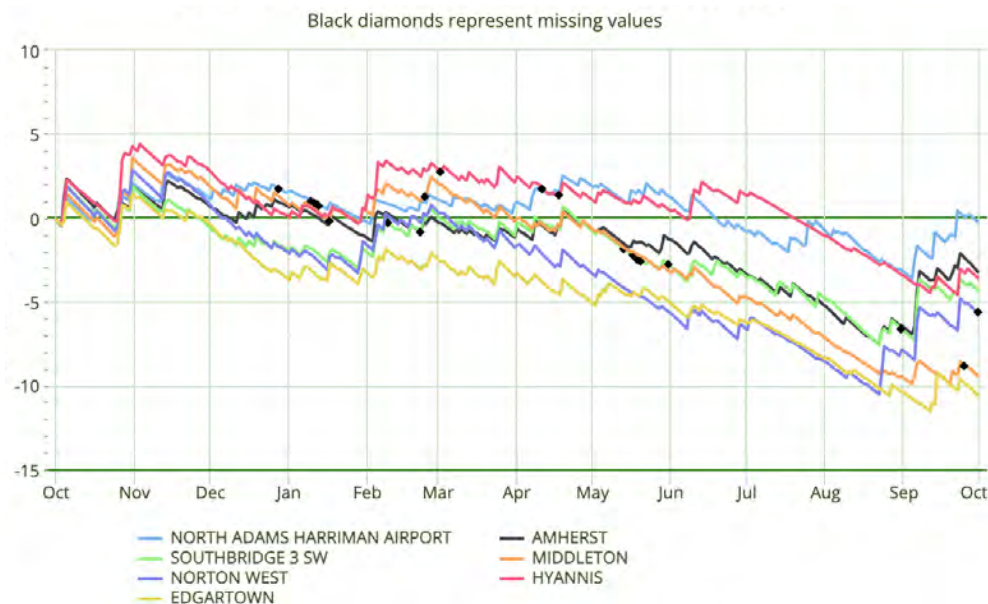
DMP Index Severity Levels			
1	2	3	4

Percent of Average Historical Precipitation—September 2022

REGION	NUMBER OF SITES REPORTING	HISTORICAL AVERAGE	SEPTEMBER AVERAGE (IN)	DEPARTURE FROM HISTORICAL AVERAGE (IN)	PERCENT OF NORMAL
WESTERN	5	4.29	6.03	1.74	141%
CTRV	10	3.98	6.64	2.66	167%
CENTRAL	14	3.95	6.14	2.19	155%
NORTHEAST	18	3.57	4.06	0.49	114%
SOUTHEAST	21	3.90	5.30	1.40	136%
CAPE COD	6	3.71	3.55	-0.16	96%
ISLANDS	2	3.52	2.46	-1.06	70%

Accumulated Precipitation Departure from 30-Year Normals in Inches

Graph does not consider starting condition's wetness/dryness; does not show summer heat waves with high evapotranspiration; and shows only one station per Drought Region. <https://xmacis.rcc-acis.org/>



APPENDIX II – DROUGHT MANAGEMENT PLAN INFORMATION

The Massachusetts Drought Management Plan (DMP) can be found at <https://www.mass.gov/doc/massachusetts-drought-management-plan/download>. The document provides details on the Drought Indices, how Drought Levels are determined, and actions associated with each drought level.

Drought Levels (Section 3.1 of the DMP)

- Level 0** Normal
- Level 1** Mild Drought
- Level 2** Significant Drought
- Level 3** Critical Drought
- Level 4** Emergency Drought

Index Severity Levels (Section 3.4 of the DMP)

SEVERITY LEVEL	STANDARDIZED PRECIPITATION INDEX (SPI)	STREAMFLOW	LAKES AND IMPOUNDMENTS	GROUNDWATER	KEETCH-BRYAM DROUGHT INDEX (KBDI)	CROP MOISTURE INDEX
0	> 30th percentile				< 200	> -1.0
1	≤ 30 and > 20				200-400	≤ -1.0 and > -2.0
2	≤ 20 and > 10				400-600	≤ -2.0 and > -3.0
3	≤ 10 and > 2				600-700	≤ -3.0 and > -4.0
4	≤ 2				700-800	≤ -4.0

