

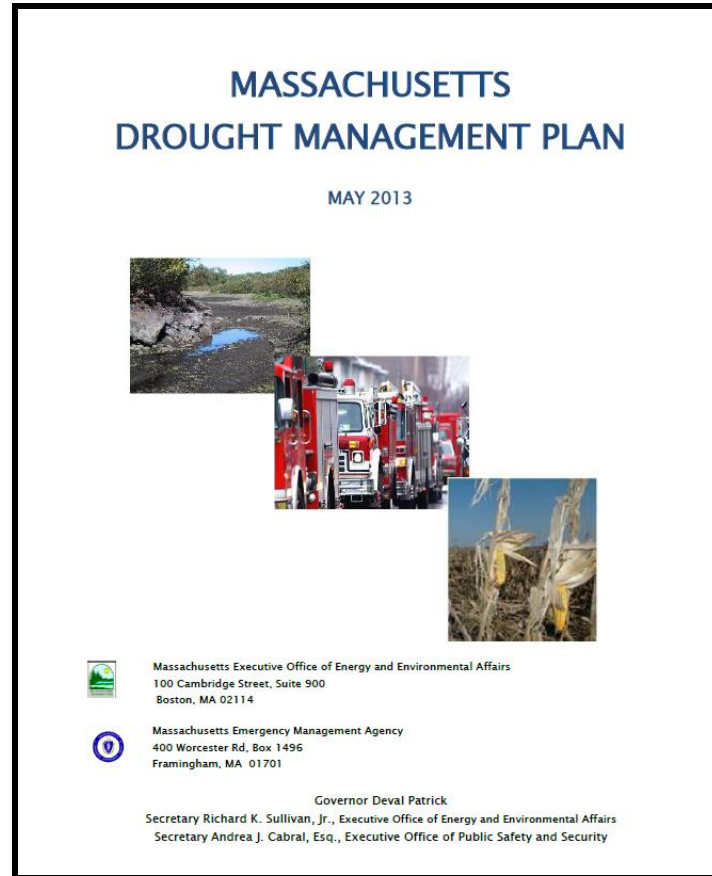
Current Hydrologic Conditions in Massachusetts

Drought Management Task Force

Jonathan Yeo and Anne Carroll
DCR Office of Water Resources
Division of Water Supply Protection

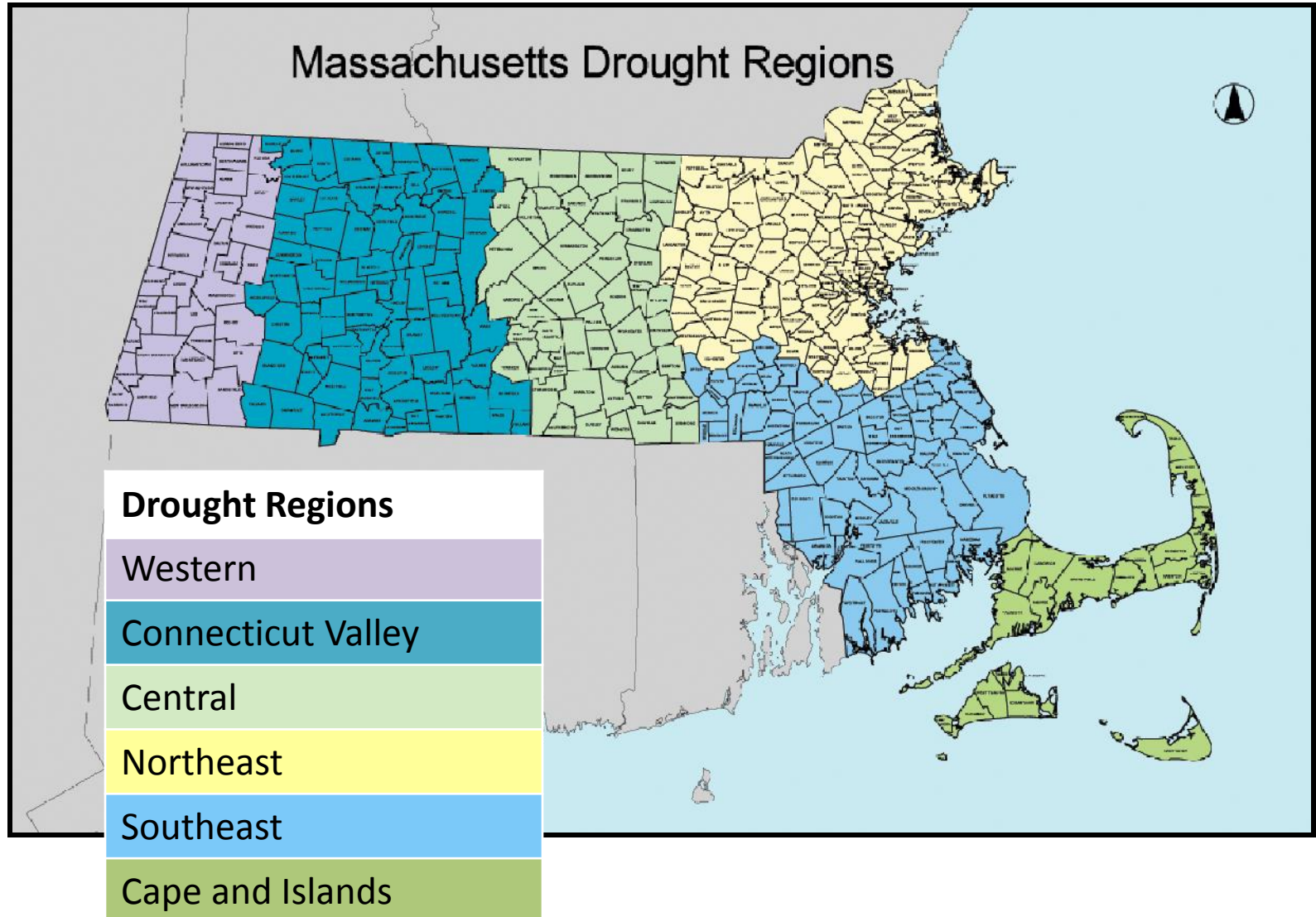
October 5, 2016

MA Drought Management Plan Summary / Review



www.mass.gov/eea/wrc-dmtf

Massachusetts Drought Regions



Massachusetts Drought Indicators and Levels

Drought Indicator	Indicator Type
Standardized Precipitation Index	Precipitation
Precipitation Percent Below Normal	Precipitation
Streamflow Months Below Normal	Streamflow
Groundwater Level Months Below Normal	Groundwater
Size of Reservoir (S, M, L) Below Normal	Reservoirs
Crop Moisture Index	Crop Moisture
Keetch-Byram Drought Index	Fire Danger

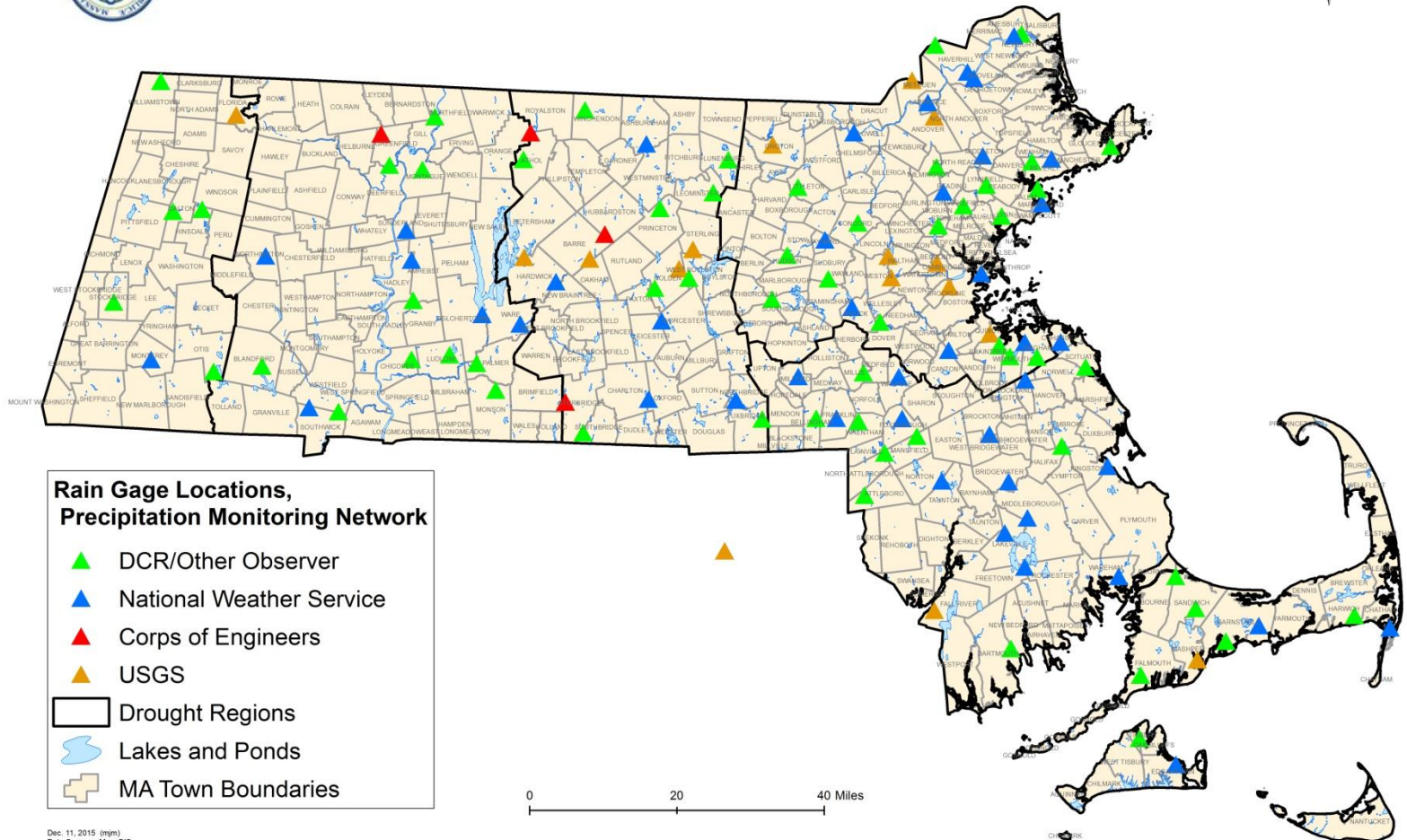
Drought Levels:
Normal
Advisory
Watch
Warning
Emergency

Drought declaration based on majority of indices

Precipitation Data Sources



Massachusetts Precipitation Monitoring Network



Monthly Precipitation Composite Estimate, September 2016

September-16	Normal	Actual	Percent Normal	Excess/Deficit	-----Excess or Deficit Since Last-----								
					10/1/2015	2 Months	% Norm	3 Months	% Norm	6 Months	% Norm	12 Months	% Norm
State	3.78	2.42	64	-1.36	-7.99	-2.52	67	-4.12	64	-6.43	71	-7.99	82
Cape Cod and Islands	3.81	3.00	79	-0.81	-2.22	-3.99	49	-4.73	56	-7.38	66	-2.22	95
Central	3.80	2.67	70	-1.13	-10.31	-1.25	84	-3.03	74	-7.03	69	-10.31	78
Connecticut River	3.94	2.92	74	-1.02	-9.40	-1.50	82	-3.27	74	-7.79	67	-9.40	79
Northeast	3.48	1.77	51	-1.71	-12.84	-3.13	56	-5.23	50	-9.16	56	-12.84	70
Southeast	3.74	1.90	51	-1.84	-8.81	-3.91	49	-5.57	49	-7.67	65	-8.43	82
Western	4.08	2.69	66	-1.39	-4.40	-1.65	80	-2.10	83	-4.07	83	-4.40	90

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

Precipitation

Region	SEPTEMBER Estimated Rainfall: Composite Sites Reporting (inches)	Departure from Normal (inches)	MA Drought Management Plan Levels	
			Standardized Precipitation Index (SPI)	Percent of Normal Index
Cape Cod & Islands	3.00	-0.81	Advisory	Watch
Central	2.67	-1.13	Watch	Watch
Connecticut River	2.92	-1.02	Watch	Watch
Northeast	1.77	-1.71	Warning	Emergency
Southeast	1.9	-1.84	Watch	Warning
Western	2.69	-1.39	Normal	Normal

Reservoir Index

Drought Level	Reservoir Index*
Normal	Reservoir levels at or near normal for the time of year
Advisory	Small index reservoirs below normal
Watch	Medium index reservoirs below normal
Warning	Large index reservoirs below normal
Emergency	Continuation of previous month's conditions

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

Reservoirs

General Reservoir Levels in Massachusetts at the end of September 2016			
Region	Number of Reservoirs Monitored	Reservoir Levels (majority)	MA Drought Management Plan Reservoir Index
Cape Cod & Islands	1	Normal	Normal
Central	3	Below Normal	Watch*
Connecticut River	2	Normal	Normal
Northeast	6	Below Normal	Watch*
Southeast	3	Below Normal	Watch
Western	2	Normal	Normal

*At least 1 reservoir at 2 standard deviations below normal

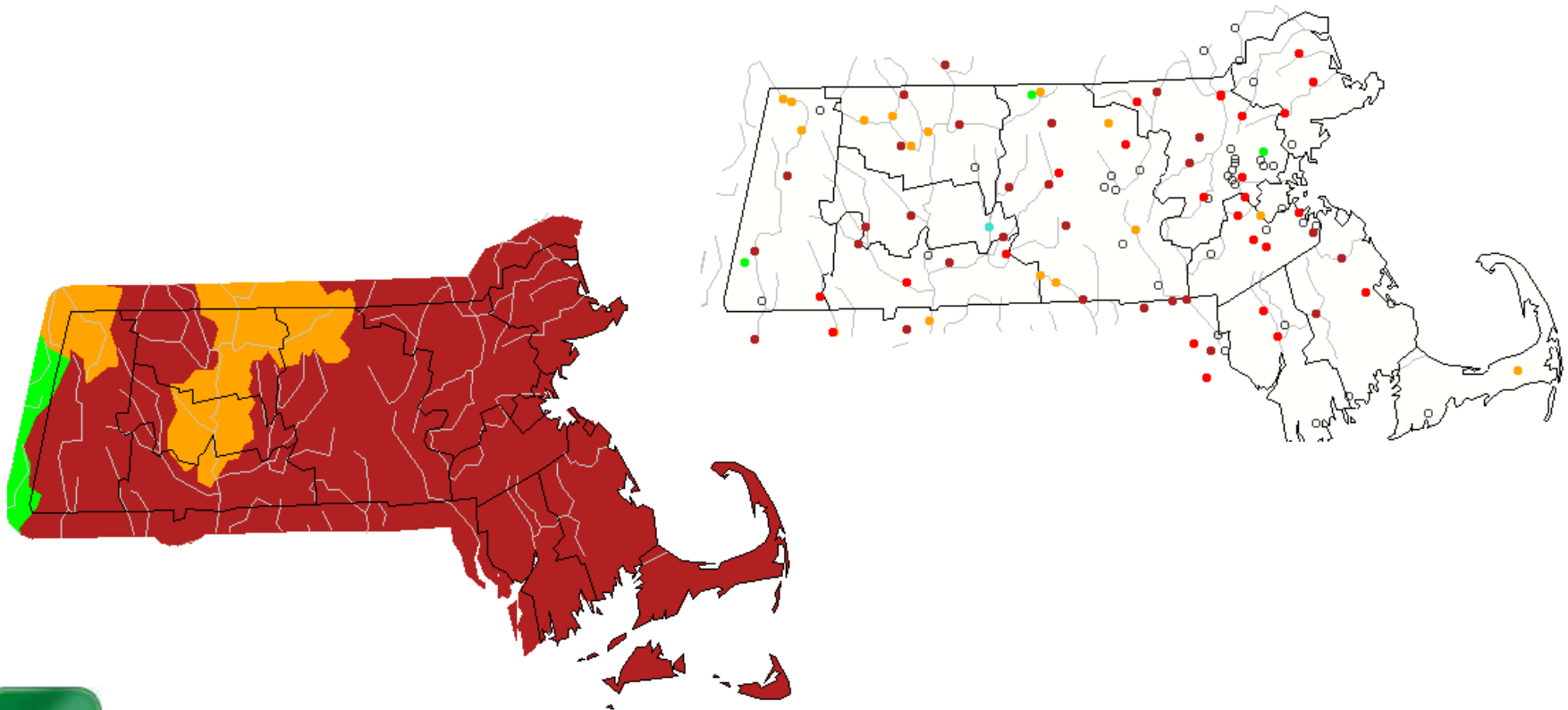
Streamflow Index

Drought Level	Streamflow Index
Normal	1 month below normal*
Advisory	At least 2 out of 3 consecutive months below normal*
Watch	At least 4 out of 5 consecutive months below normal*
Warning	At least 6 out of 7 consecutive months below normal*
Emergency	Greater than 7 months below normal*

*Below normal for streamflow is defined as being within the lowest 25th percentile of the period of record

Streamflow

Monthly Streamflow Compared to Historical Streamflow for September



Explanation - Percentile classes

Low	<10	10-24	25-75	76-90	>90	High
	Much below normal	Below normal	Normal	Above normal	Much above normal	

Stream Pictures



Ipswich River, 9/11/16



Third Herring Brook, 9/28/16

Stream Pictures



Mattapoisett River, 9/1/16



Mattapoisett River, 9/1/16

Streamflow

General Streamflow Conditions in Massachusetts September 2016

Region	Number of stream gages	MA Drought Plan Index (# months majority below 25 th percentile)	Number of gages below 10 th percentile for Sept	Number of gages at Record Low for Sept
Central	16	Warning (7 months)	8	3
Connecticut River	16	Warning (6 of 7 months)	12	3
Northeast	19	Warning (7 months)	13	6
Southeast	5	Warning (6 of 7 months)	4	2
Western	7	Watch (5 of 7 months)	4	1

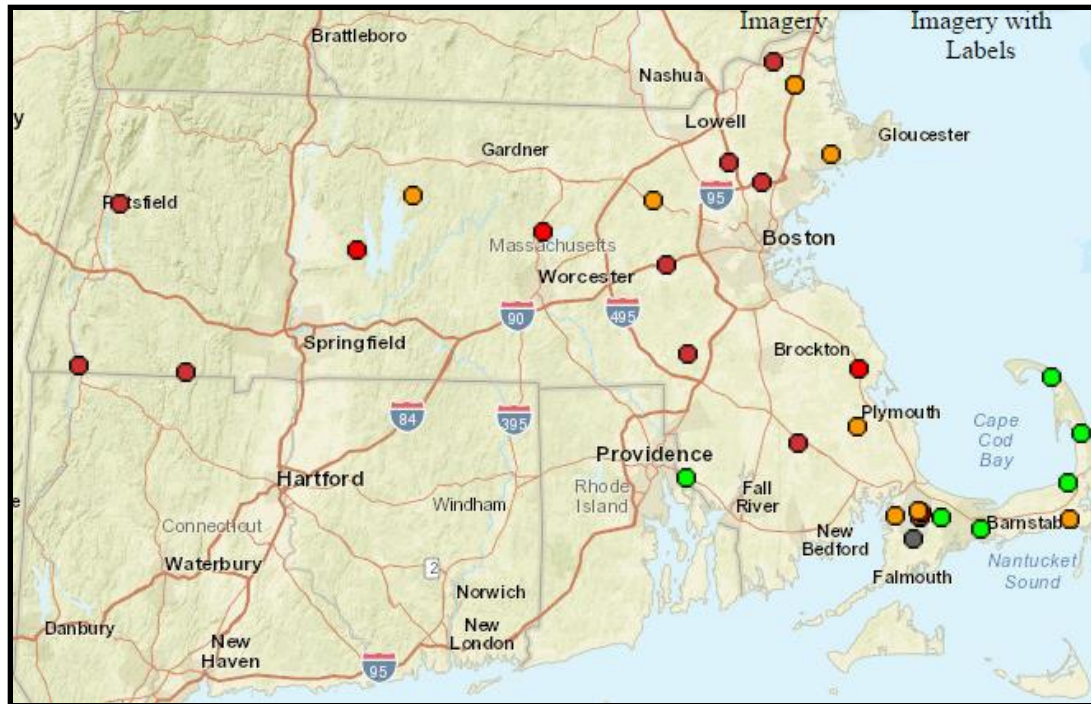
Groundwater Index

Drought Level	Groundwater Index
Normal	2 consecutive months below normal*
Advisory	3 consecutive months below normal*
Watch	4 to 5 consecutive months below normal*
Warning	6 to 7 consecutive months below normal*
Emergency	Greater than 8 months below normal*

*Below normal for groundwater is defined as being within the lowest 25th percentile of the period of record

Groundwater

October 4, 2016 Real-Time Groundwater Conditions



Explanation - Percentile classes								
								○ Real Time
New Low	<10	10-24	25-75	76-90	>90	New High	Not Ranked	□ Continuous
	Much Below Normal	Below Normal	Normal	Above Normal	Much Above Normal			△ Periodic Measurement



Groundwater

General Groundwater Conditions in Massachusetts September 2016

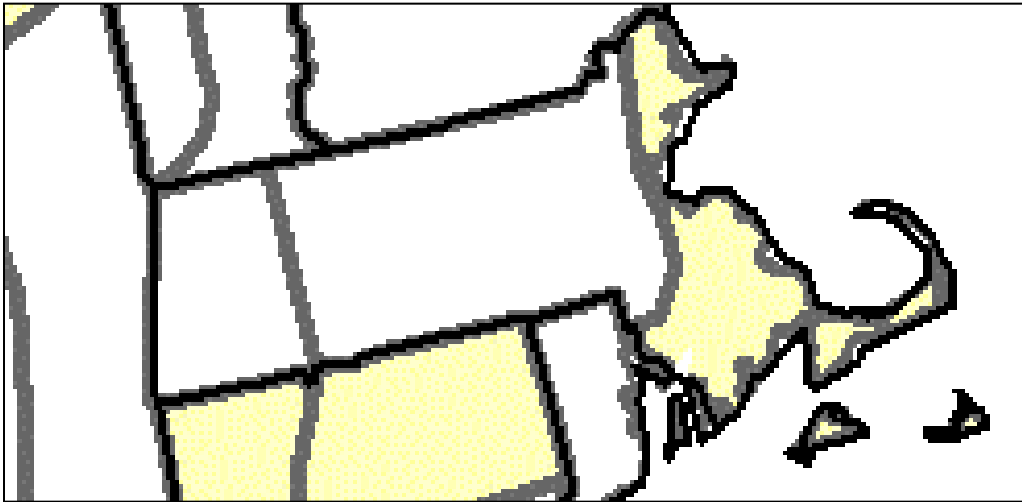
Region	Number of groundwater wells	MA Drought Plan Index (# consecutive months majority below 25 th percentile)	Number of wells below 10 th percentile for Sept	Number of wells at Record Low for Sept
Cape & Islands	13	1	1	0
Central	10	6	2	0
CT River	11	6	7	5
Northeast	17	6	14	5
Southeast	12	5	10	3
Western	5	7	4	1

Crop Moisture and Fire Danger Indices

Drought Level	Crop Moisture Index*	Keetch-Byram Drought Index (KBDI)
Normal	0 to -1.0 Slightly dry	less than 200
Advisory	-1 to -1.9 Abnormally dry	200 to 400
Watch	-2 to -2.9 Excessively dry	400 to 600
Warning	< -2.9 Severely dry	600 to 800
Emergency	< -2.9 Severely dry	600 to 800

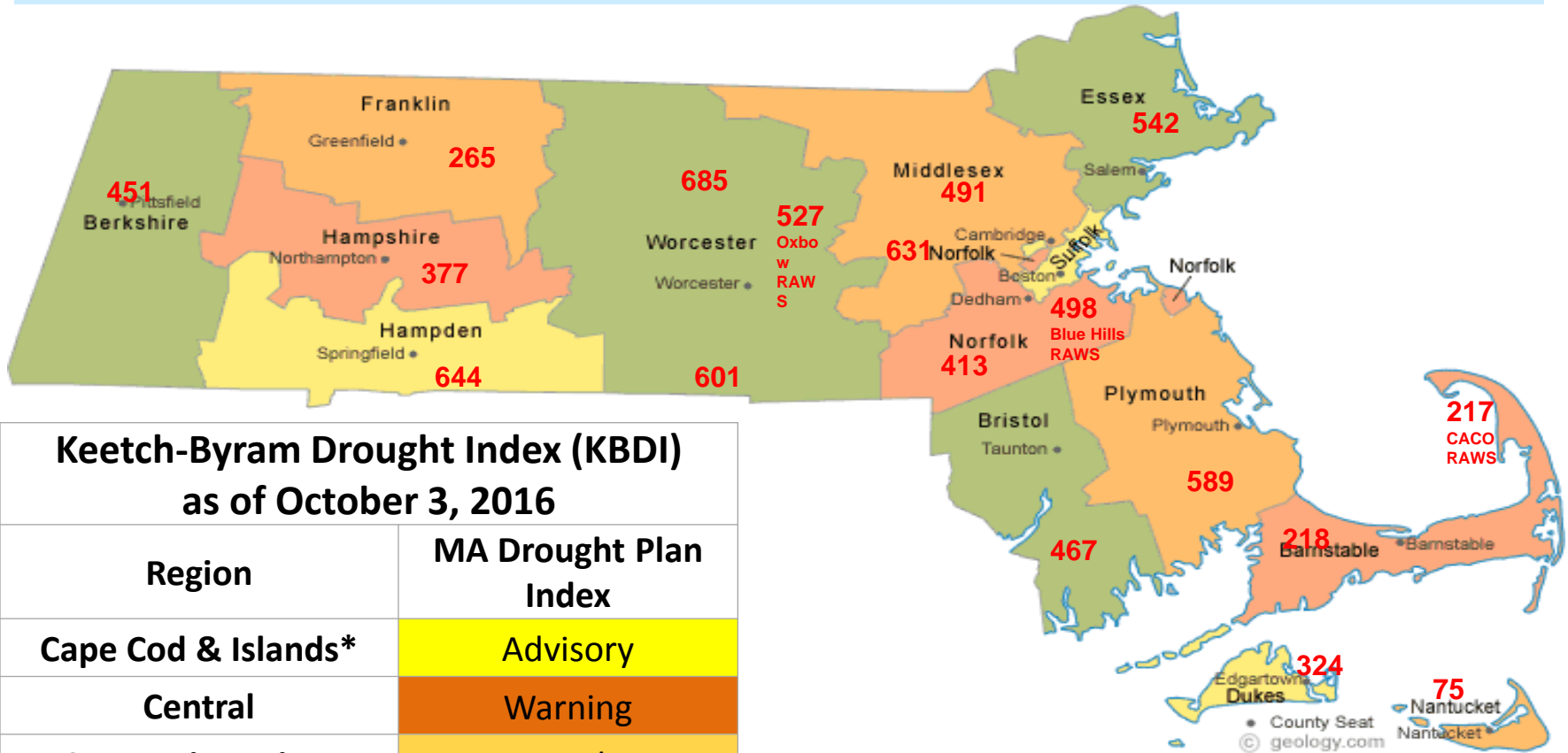
* The Crop Moisture Index is subject to frequent change. The drought level for this indicator is determined based on the repeated or extended occurrence at a given level.

Crop Moisture



Region	September Index
Cape & Islands	Advisory
Central	Normal
CT Valley	Normal
Northeast	Advisory
Southeast	Advisory
West	Normal

Keetch-Byram Drought Index



Keetch-Byram Drought Index (KBDI) as of October 3, 2016	
Region	MA Drought Plan Index
Cape Cod & Islands*	Advisory
Central	Warning
Connecticut River	Watch
Northeast	Watch
Southeast	Watch
Western	Watch

* Nantucket is Normal

US Drought Monitor

U.S. Drought Monitor Massachusetts

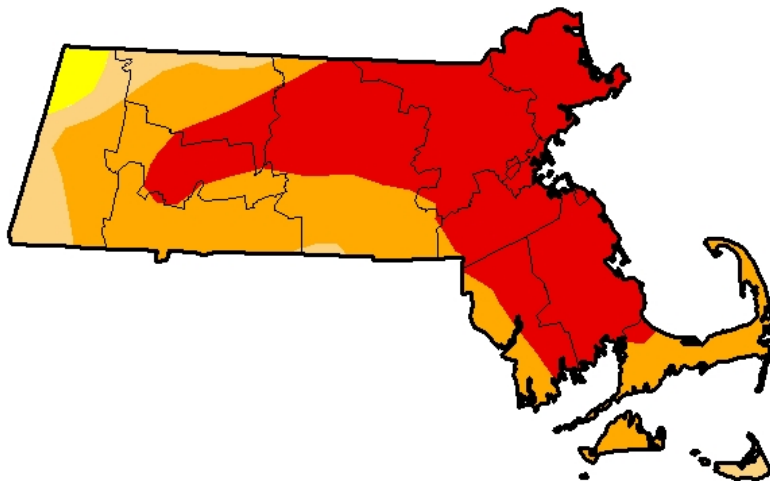
September 27, 2016

(Released Thursday, Sep. 29, 2016)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	98.15	89.95	52.13	0.00
Last Week <i>9/20/2016</i>	0.00	100.00	98.15	89.95	52.13	0.00
3 Months Ago <i>6/28/2016</i>	3.60	96.40	38.91	0.00	0.00	0.00
Start of Calendar Year <i>12/29/2015</i>	22.85	77.15	26.34	0.00	0.00	0.00
Start of Water Year <i>9/29/2015</i>	12.90	87.10	30.43	0.00	0.00	0.00
One Year Ago <i>9/29/2015</i>	12.90	87.10	30.43	0.00	0.00	0.00



Intensity:

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

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

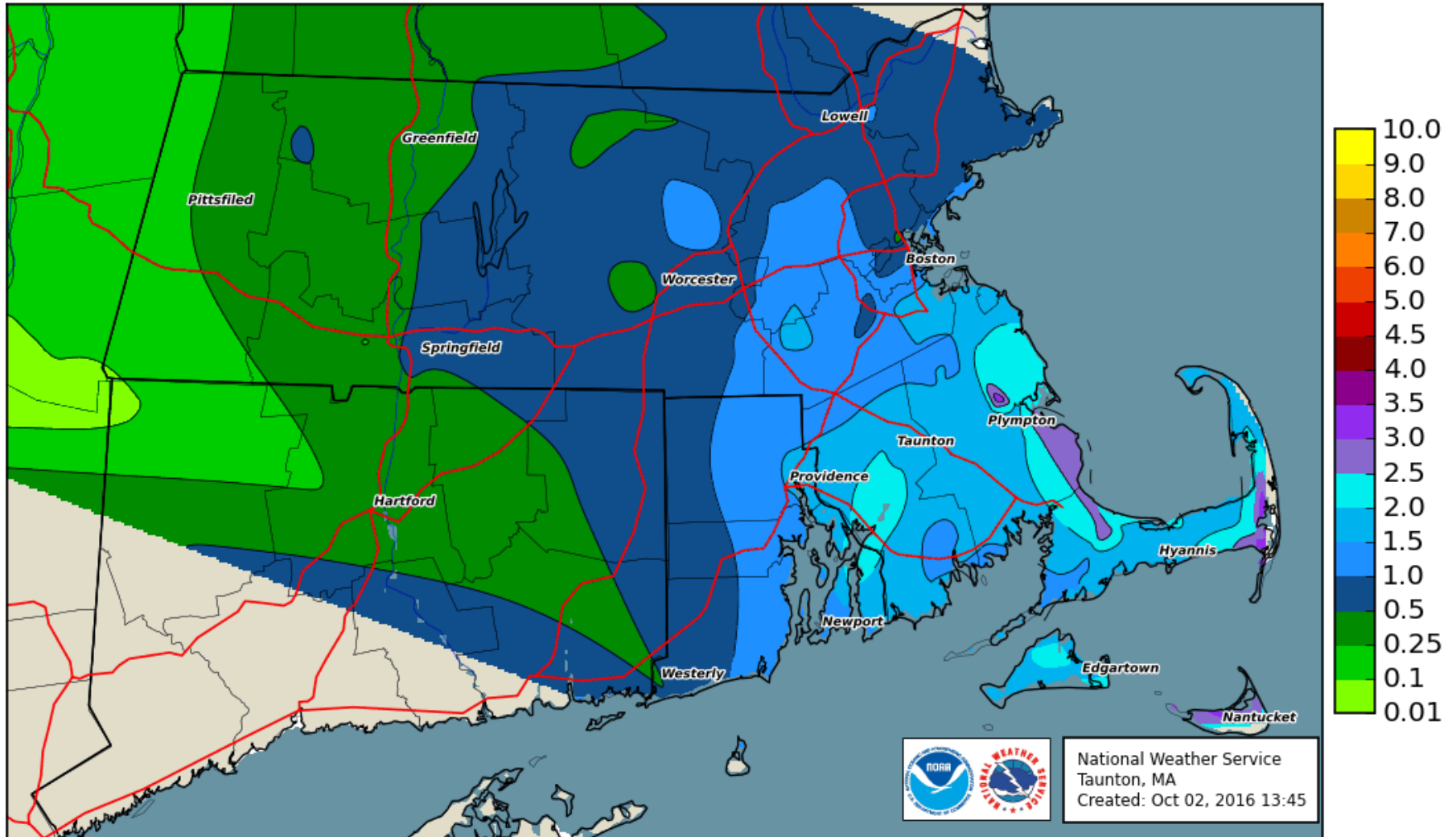
Author:

Chris Fenimore
NCEI/NESDIS/NOAA



October Precipitation

Observed Storm Total Precipitation (inches) - Latest - 1050 AM EDT SUN OCT 02 2016



Avoid Watering During a Drought¹

Limits on outdoor water use are critical to help ensure that enough water is available for essential needs, including drinking water and fire protection, crop irrigation, and our natural resources.

Drought Level	Recommended Water Use Restrictions for Everyone ^{1,2}
Advisory	<i>1 day per week at the most, outside the hours of 9AM – 5PM</i>
Watch	<i>hand-held only or drip irrigation outside the hours of 9AM – 5PM</i>
Warning	<i>Outdoor water use should be banned</i>

1. Certain water uses are not subject to mandatory restrictions, such as water used:

- for health or safety reasons;
- for the production of food and fiber;
- for the maintenance of livestock;
- to meet the core functions of a business (for example, irrigation by plant nurseries as necessary to maintain stock).

2. If your water supplier has stricter restrictions in place, abide by those.

Summary of Drought Indices as of October 1, 2016

Drought Indicator ²	Indicator Type	Drought Regions						Key to Levels
		West	CT River	Central	Northeast	Southeast	Cape and Islands	
Standardized Precipitation Index (SPI)	Precipitation	Normal	Watch	Watch	Warning	Watch	Advisory	Normal
Precipitation % Below Normal	Precipitation	Normal	Watch	Watch	Emergency	Warning	Watch	Advisory
Months Below Normal	Streamflow	Warning	Warning	Warning	Warning	Warning	N/A ⁴	Watch
Months Below Normal	Groundwater	Warning	Warning	Warning	Warning	Watch	Normal	Warning
Size of reservoir below normal	Reservoirs	Normal	Normal	Watch	Watch	Watch	Normal	Emergency
Crop Moisture Index	Crop Moisture	Normal	Normal	Normal	Advisory	Advisory	Advisory	
Keetch-Byram Drought Index	Fire Danger	Watch	Watch	Warning	Watch	Watch	Advisory	

This summary is provided for informational purposes. No changes in drought status are official until the Drought Management Task Force convenes and makes a recommendation accepted by the Secretary of the Executive Office of Energy and Environmental Affairs.

August to September Comparison

	August	September
Indicator Type	West	West
Precipitation (SPI)	Normal	Normal
Precipitation (% below normal)	Normal	Normal
Streamflow	Watch	Warning
Groundwater	Warning	Warning
Reservoirs	Normal	Normal
Crop Moisture	Advisory	Normal
Fire Danger	Watch	Watch

	August	September
Indicator Type	CT River	CT River
Precipitation (SPI)	Watch	Watch
Precipitation (% below normal)	Watch	Watch
Streamflow	Watch	Warning
Groundwater	Watch	Warning
Reservoirs	Normal	Normal
Crop Moisture	Watch	Normal
Fire Danger	Watch	Watch

	August	September
Indicator Type	Central	Central
Precipitation (SPI)	Advisory	Watch
Precipitation (% below normal)	Normal	Watch
Streamflow	Warning	Warning
Groundwater	Watch	Warning
Reservoirs	Watch	Watch
Crop Moisture	Watch	Normal
Fire Danger	Watch	Warning

August to September Comparison

	August	September	August	September	August	September
Indicator Type	Northeast	Northeast	Southeast	Southeast	Cape and Islands	Cape and Islands
Precipitation (SPI)	Watch	Warning	Watch	Watch	Watch	Advisory
Precipitation (% below normal)	Warning	Emergency	Watch	Warning	Watch	Watch
Streamflow	Warning	Warning	Watch	Warning	N/A ⁴	N/A ⁴
Groundwater	Watch	Warning	Watch	Watch	Normal	Normal
Reservoirs	Watch	Watch	Watch	Watch	Normal	Normal
Crop Moisture	Warning	Advisory	Warning	Advisory	Warning	Advisory
Fire Danger	Warning	Watch	Warning	Watch	Watch	Advisory