

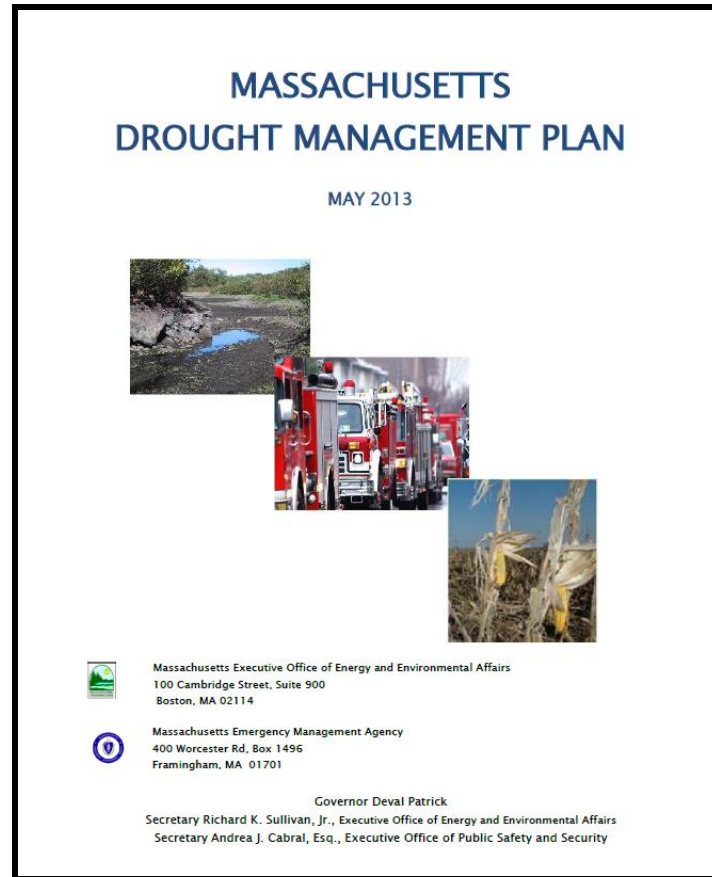
Current Hydrologic Conditions in Massachusetts

Drought Management Task Force

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DCR Office of Water Resources
Division of Water Supply Protection

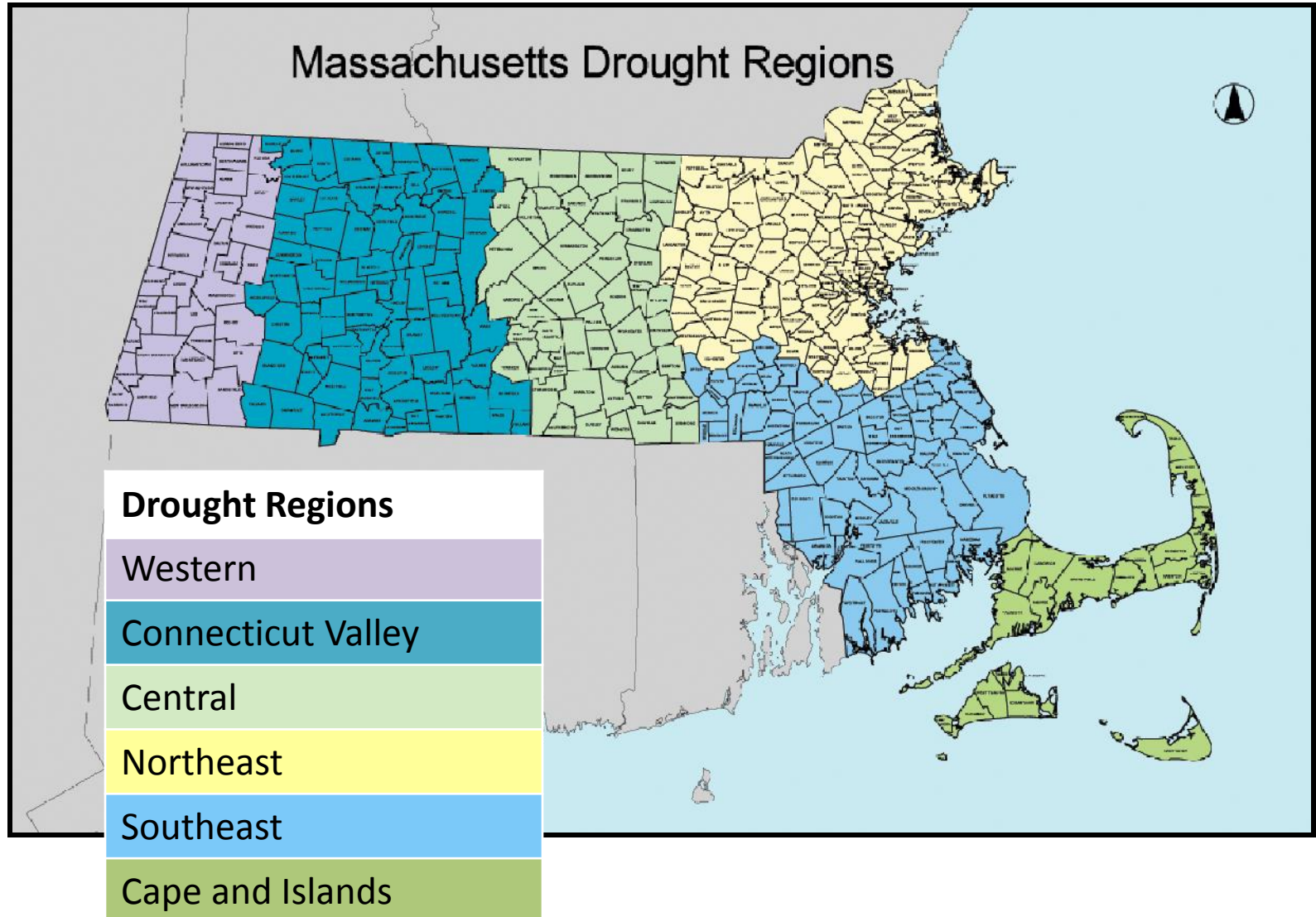
July 7, 2016

MA Drought Management Plan Summary / Review



<http://www.mass.gov/eea/docs/eea/wrc/droughtplan.pdf>

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 Indices

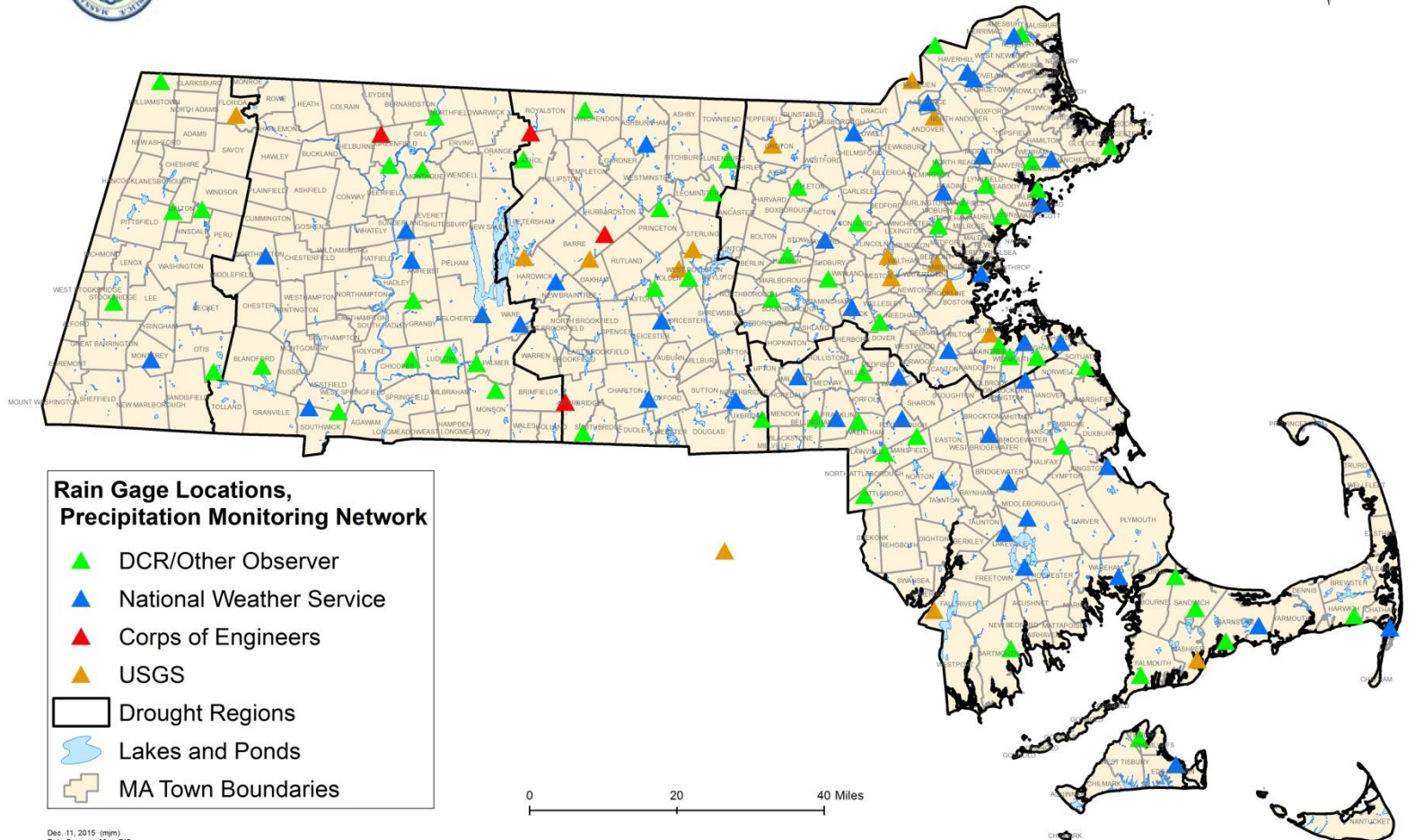
Drought Level	Standardized Precipitation Index (SPI)	Precipitation Percent Below Normal
Normal	3-month > -1.5 <u>or</u> 6-month > -1.0 <u>or</u> 12-month > -1.0	1 month below normal
Advisory	3-month = -1.5 to -2.0 <u>or</u> 6-month = -1.0 to -1.5 <u>or</u> 12-month = -1.0 to -1.5	2 month cumulative below 65% of normal
Watch	3-month < -2 <u>or</u> 6-month = -1.5 to -3.0 <u>or</u> 12-month = -1.5 to -2.0	1 of the following criteria met: 3 month cum. < 65% or 6 month cum. < 70% or 12 month cum. <70%

From Table 3, MA Drought Management Plan

Precipitation Data Sources



Massachusetts Precipitation Monitoring Network



Rain Gage Locations, Precipitation Monitoring Network

-  DCR/Other Observer
-  National Weather Service
-  Corps of Engineers
-  USGS
-  Drought Regions
-  Lakes and Ponds
-  MA Town Boundaries

0 20 40 Miles

Standardized Precipitation Index

REGION	3-Month SPI	6-Month SPI	12-Month SPI
Western Region	-0.55	0.04	0.08
Connecticut River Region	-1.34	-1.25	-0.51
Central Region	-1.42	-1.33	-1.43
Northeast Region	-1.08	-1.06	-1.19
Southeast Region	-0.62	-0.58	-0.49
Cape & Islands	-0.85	-0.17	-0.09

Monthly Precipitation Composite Estimate, June 2016

June-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	3.74	2.80	75	-0.94	-3.87	-1.58	78	-2.31	79	-2.96	87	-4.55	90
Cape Cod and Islands	4.02	0.58	14	-3.44	2.23	-3.30	52	-2.93	73	-1.05	95	-0.14	100
Central	3.83	1.77	46	-2.06	-7.45	-3.03	59	-4.17	63	-5.49	76	-9.95	79
Connecticut River	3.57	2.04	57	-1.53	-6.05	-3.10	61	-4.44	61	-5.36	75	-3.23	93
Northeast	3.61	1.42	39	-2.19	-7.65	-3.18	54	-3.97	62	-5.06	76	-9.22	79
Southeast	3.91	1.78	46	-2.13	-3.18	-1.60	76	-2.04	81	-2.66	88	-4.02	91
Western	3.52	3.46	98	-0.06	-1.81	-1.23	85	-1.48	87	0.42	102	0.36	101

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

Precipitation

Region	June Estimated Rainfall: Composite Sites Reporting (inches)	Departure from Normal (inches)	MA Drought Management Plan Levels	
			Standardized Precipitation Index	Percent of Normal Index
Cape Cod & Islands	0.58	-2.81	Normal	Advisory
Central	1.77	-2.00	Advisory	Watch
Connecticut River	2.04	-1.91	Advisory	Watch
Northeast	1.42	-2.01	Advisory	Watch
Southeast	1.78	-1.60	Normal	Normal
Western	3.46	-0.69	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

Reservoir Monitoring

Drought Regions	Reservoir	Size Class	Drought Level
Western	Lenox	Small	Normal
Western	Pittsfield	Medium	Normal*
Connecticut Valley	Springfield	Medium	Normal
Connecticut Valley	Quabbin	Large	Normal**
Central	North Brookfield	Small	Normal
Central	Southbridge	Medium	Below Normal
Central	Worcester	Medium	Below Normal

* Reported “normal” but waiting for % full number

**Entered “below normal” stage early July but not meeting MWRA drought plan advisory level

Reservoir Monitoring, cont.

Drought Regions	Reservoir	Size Class	Drought Level
Northeast	Breakheart/Pierce	Small	Below Normal
	Cambridge	Medium	Below Normal
	Hudson	Medium	Normal
	Lynn	Medium	Below Normal
	North Andover	Medium	Normal
	Rockport	Small	Normal
	Salem/Beverly	Medium	Below Normal
Southeast	Assawompsett	Medium	Normal*
	Cohasset	Small	Below Normal
	Milford	Medium	Below Normal
Cape and Islands			Normal

* 0.2% above normal

Reservoirs

General Reservoir Levels in Massachusetts at the end of June 2016		
Region	Reservoir Levels	MA Drought Management Plan Reservoir Index
Cape Cod & Islands	Normal	Normal
Central	Medium Below Normal	Watch
Connecticut River	Normal	Normal
Northeast	Medium Below Normal	Watch
Southeast	Medium Below Normal	Watch
Western	Normal	Normal

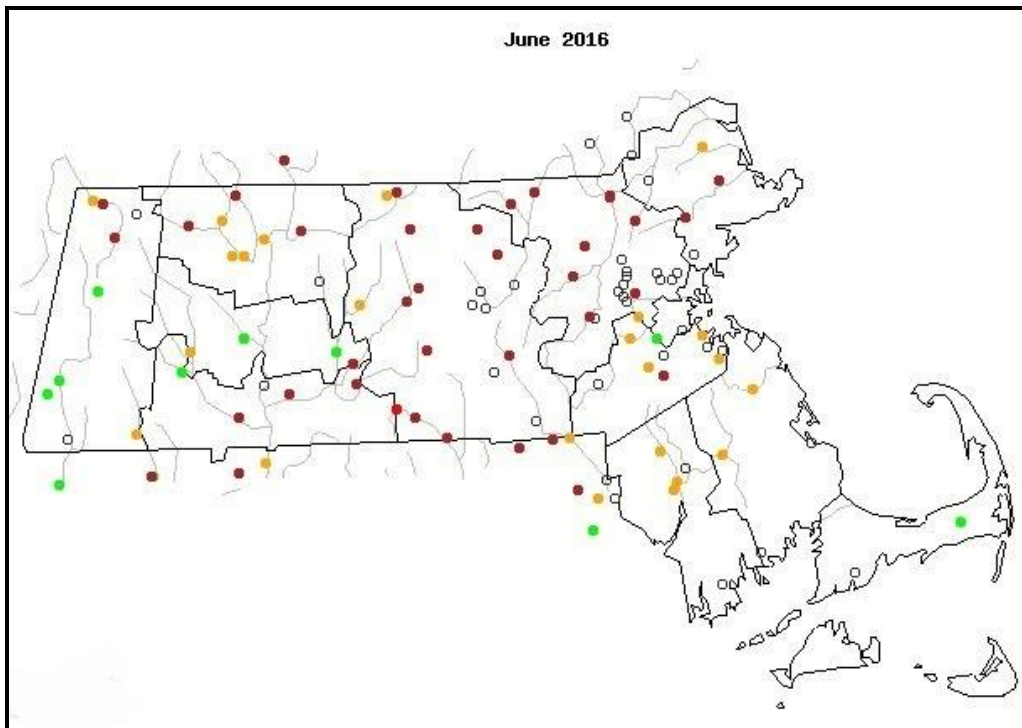
Streamflow Index

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

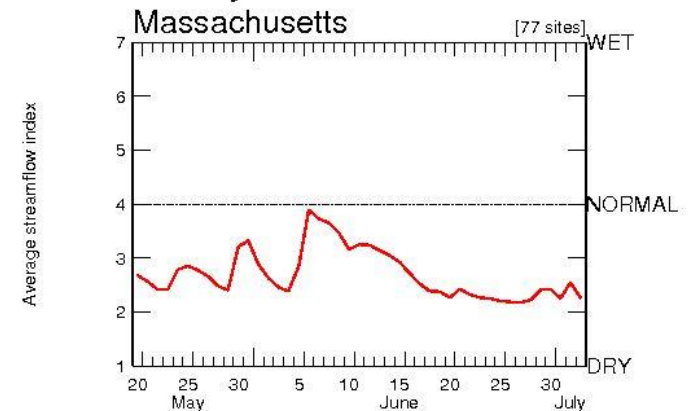
Map of June 2016 Streamflow Compared to Historical Streamflow for June



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

Real-Time Streamflow Compared to Historical Streamflow for the Day of the Year

Last 45 Days



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

Streamflow

General Streamflow Conditions in Massachusetts June 2016		
Region	Streamflow Conditions	MA Drought Management Plan Streamflow Index
Cape Cod & Islands	Not Applicable	Not Applicable
Central	Below Normal	Watch
Connecticut River	Below Normal	Advisory
Northeast	Below Normal	Watch
Southeast	Below Normal	Normal
Western	Below Normal	Advisory

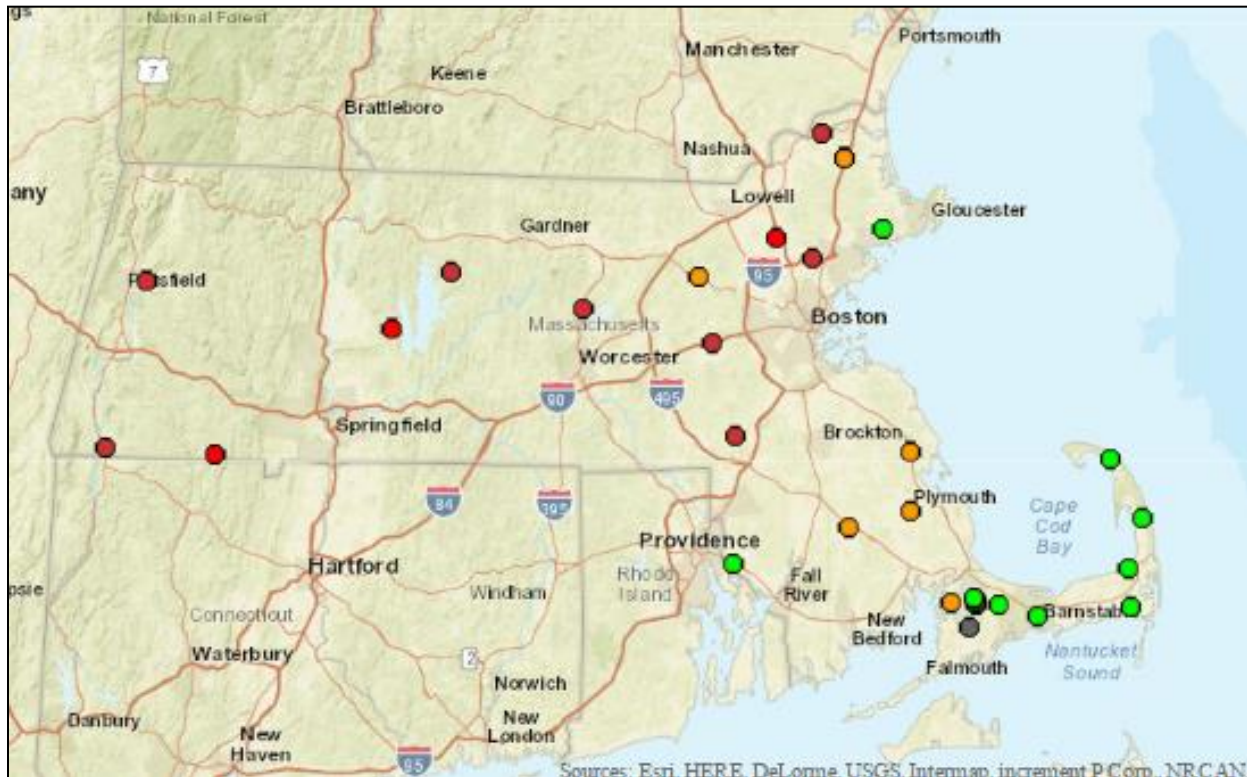
Groundwater Index

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

June 30 2016 Real-Time Groundwater Conditions



Explanation - Percentile classes

New								Real Time
Low	<10 Much Below Normal	10-24 Below Normal	25-75 Normal	76-90 Above Normal	>90 Much Above Normal	New High	Not Ranked	Continuous Periodic Measurements

Groundwater Monitoring – Western

Drought Regions	Well	Frequency	<25% Status
Western	Cheshire	Monthly	Mar, Apr, May, June*
Western	Becket	Monthly	-----
Western	Otis	Monthly	Mar, Apr, May, June*
Western	Sheffield	Continuous	Aug '15 - June
Western	Pittsfield	Continuous	March - June
Western	TOTAL		4/5

* June data not available. Assumes continuation of very low groundwater from previous months and lack of rainfall.

Groundwater Monitoring – Connecticut Valley

Drought Regions	Well	Frequency	<25% Status
Connecticut Valley	Pelham	Continuous	July '15 – June
Connecticut Valley	Sunderland	Monthly	Apr, May, June*
Connecticut Valley	Deerfield	Monthly	-----
Connecticut Valley	Chicopee	Monthly	July '15-May, June*
Connecticut Valley	Westfield	Monthly	-----
Connecticut Valley	Montgomery	Monthly	Mar, Apr, May, June*
Connecticut Valley	Hawley	Monthly	-----
Connecticut Valley	Cummington	Monthly	Mar, Apr, May, June*
Connecticut Valley	Blandford	Monthly	-----
Connecticut Valley	Granville	Continuous	Apr, May, June
Connecticut Valley	TOTAL		7/11

* June data not available. Assumes continuation of very low groundwater from previous months and lack of rainfall.

Groundwater Monitoring - Central

Drought Regions	Well	Frequency	<25% Status
Central	Hardwick	Monthly	Apr, May, June*
Central	West Boylston	Continuous	Apr, May, June
Central	Sterling	Monthly	Apr, May, June*
Central	Templeton	Monthly	Apr, May, June*
Central	Northbridge	Monthly	June
Central	Winchendon	Monthly	Apr, May, June*
Central	West Brookfield	Monthly	Nov '15 – May, June*
Central	Townsend	Monthly	Apr, May, June
Central	Webster	Monthly	-----
Central	Petersham	Continuous	Apr, May, June
Central	Orange	Monthly	Mar, Apr, May, June
Central TOTAL			9/11

* June data not available. Assumes continuation of very low groundwater from previous months and lack of rainfall.

Groundwater Monitoring - Northeast

Drought Regions	Well	Frequency	<25% Status
Northeast	Wayland	Continuous	May, June
Northeast	Southborough	Monthly	June
Northeast	Acton	Continuous	May, June
Northeast	Concord	Monthly	Mar, Apr, May, June*
Northeast	Westford	Monthly	Mar, Apr, May, June*
Northeast	Wilmington	Continuous	Apr, May, June
Northeast	Andover	Monthly	July '15 – May, June*
Northeast	Wakefield	Continuous	May, June
Northeast	Haverhill	Continuous	Mar, Apr, May, June
Northeast	Newbury	Continuous	May, June
Northeast	Georgetown	Monthly	Oct '15 – May, June*
Northeast	TOTAL		6/11

* June data not available. Assumes continuation of very low groundwater from previous months and lack of rainfall.

Groundwater Monitoring - Southeast

Drought Regions	Well	Frequency	<25% Status
Southeast	Norfolk	Continuous	May, June
Southeast	Attleboro	Monthly	Mar, Apr, May, June*
Southeast	Freetown	Monthly	Mar, Apr, May, June*
Southeast	New Bedford	Monthly	Mar, Apr, May, June*
Southeast	Wareham	Monthly	Mar, May, June*
Southeast	Plymouth	Continuous	June
Southeast	Plymouth 494	Monthly	-----
Southeast	Duxbury	Continuous	June
Southeast	Weymouth	Monthly	Apr, May, June*
Southeast	East Bridgewater	Monthly	Mar, Apr, May, June*
Southeast	Hanson	Monthly	Mar, Apr, May, June*
Southeast	Lakeville	Continuous	June
Southeast	TOTAL		7/12

* June data not available. Assumes continuation of very low groundwater from previous months and lack of rainfall.

Groundwater

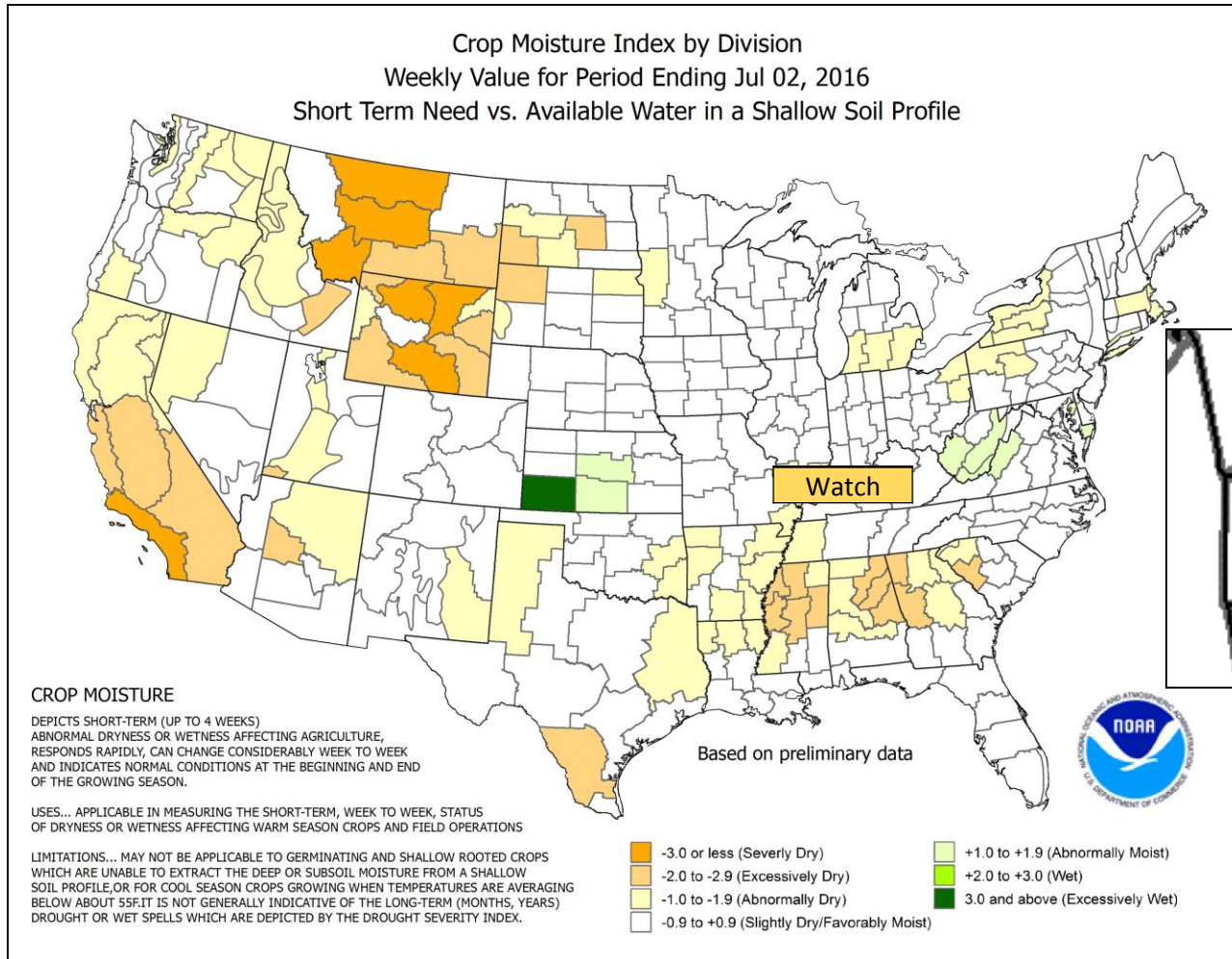
General Groundwater Conditions in Massachusetts June 2016		
Region	Groundwater Conditions	MA Drought Management Plan Groundwater Index
Cape Cod & Islands	Normal	Normal
Central	Below Normal	Advisory
Connecticut River	Below Normal	Advisory
Northeast	Below Normal	Advisory
Southeast	Below Normal	Advisory
Western	Below Normal	Watch

Crop Moisture and Fire Danger Indices

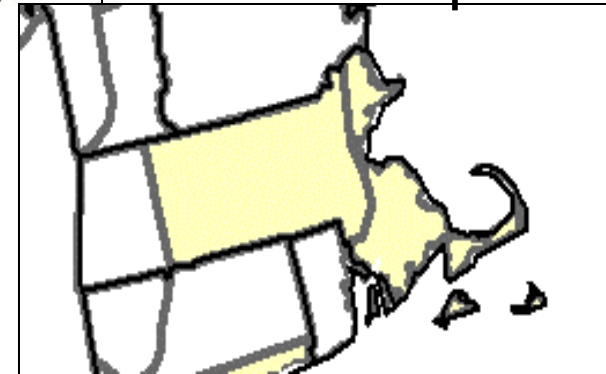
Drought Level	Crop Moisture Index*	Keetch-Byram Drought Index (KBDI)
Normal	0 to -1.0 Slightly dry	less than 200
Advisory	-1 to -1.9 Abnormally dry	200 to 400
Watch	-2 to -2.9 Excessively dry	400 to 600
Warning	< -2.9 Severely dry	600 to 800
Emergency	< -2.9 Severely dry	600 to 800

* 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



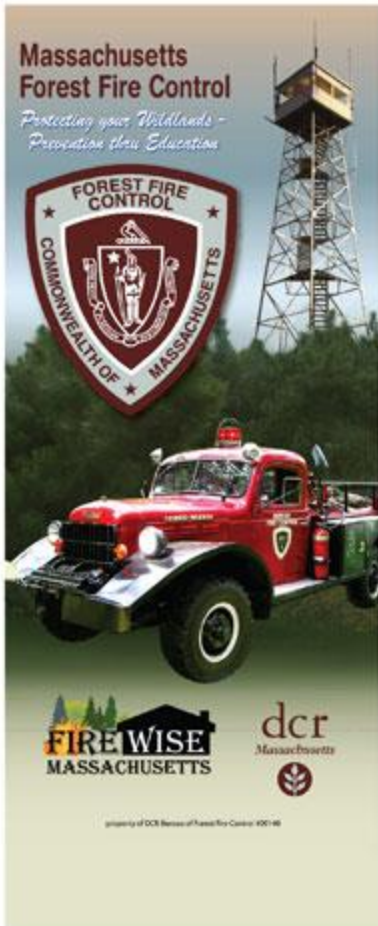
MA close up



All Regions except West: Advisory

West Region: Normal

Keetch-Byram Drought Index




- Long-term indicator of fuel moisture
- Recommended by DCR Chief Warden of Forest Fire Control
- Calculated weekly for MA Fire Districts
- Values indicate amount of rain needed to return soil to saturated condition
- Less variable than daily Fire Danger

All Regions except Central: Advisory

Central Region: Watch

Summary of Drought Indices

Drought Indicator	Drought Regions					
	West	CT River	Central	Northeast	Southeast	Cape and Islands
Standardized Precipitation Index (SPI)	Normal	Advisory	Advisory	Advisory	Normal	Normal
Precipitation % Below Normal	Normal	Watch	Watch	Watch	Normal	Advisory
Streamflow Months Below Normal	Advisory	Advisory	Watch	Watch	Normal	Not Applicable
Groundwater Months Below Normal	Watch	Advisory	Advisory	Advisory	Advisory	Normal
Size of Reservoir Below Normal	Normal	Normal	Watch	Watch	Watch	Normal
Crop Moisture Index	Normal	Advisory	Advisory	Advisory	Advisory	Advisory
Keetch-Byram Drought Index	Advisory	Advisory	Watch	Advisory	Advisory	Advisory

A dramatic sky with a large, bright, billowing cloud formation over a dark blue ocean. The cloud is illuminated from below, creating a strong contrast with the darker sky and sea. The text "Agency Input and Discussion" is centered over the image.

Agency Input and Discussion