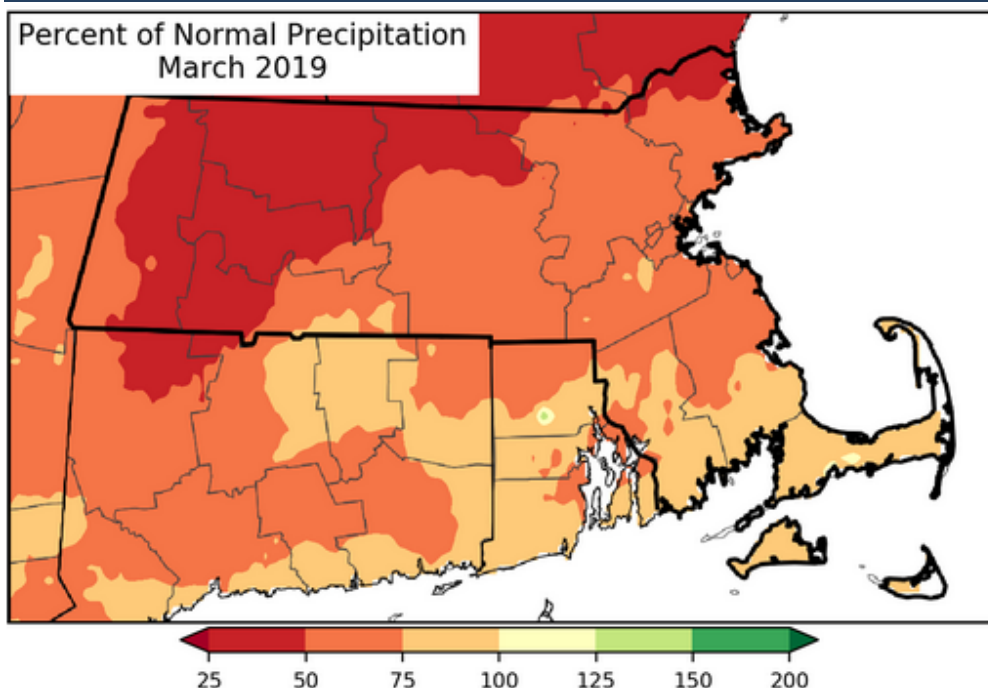


March 2019 Hydrologic Conditions in Massachusetts

SUMMARY OF CONDITIONS

- Monthly average temperatures were 1 to 3 degrees Fahrenheit lower than average.
- Precipitation was significantly below average, especially in the West and Connecticut River Valley regions; however, since this is the first full month below normal, index severity levels were not triggered.
- Streamflow, Groundwater, and Reservoir Indices are Normal for all regions. In the West region, the majority of streamflow gages were below normal, however, since this is the first full month below normal, index severity levels were not triggered.
- Crop Moisture Index and Keetch-Byram Drought Index are both Normal.
- NOAA's forecast for April projects 40-60% chance of above normal temperatures and a mix of equal chances for above, normal, or below to 40% chance of above normal precipitation in different regions.
- 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 significantly below average for March across the state with less than 50 percent of average in the West and Connecticut River Valley.

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

Region	Estimated Precipitation (inches)	Departure from Average March (inches)	MA Drought Plan Levels	
			Standardized Precipitation Index (SPI)	Percent of Normal Index
Western	1.63	-1.76	Normal	Normal
CT River Valley	1.74	-1.98	Normal	Normal
Central	2.44	-1.71	Normal	Normal
Northeast	3.04	-0.89	Normal	Normal
Southeast	3.34	-0.90	Normal	Normal
Cape Cod & Islands	4.14	-0.15	Normal	Normal

Key to Drought Plan Levels

Normal
Advisory
Watch
Warning
Emergency

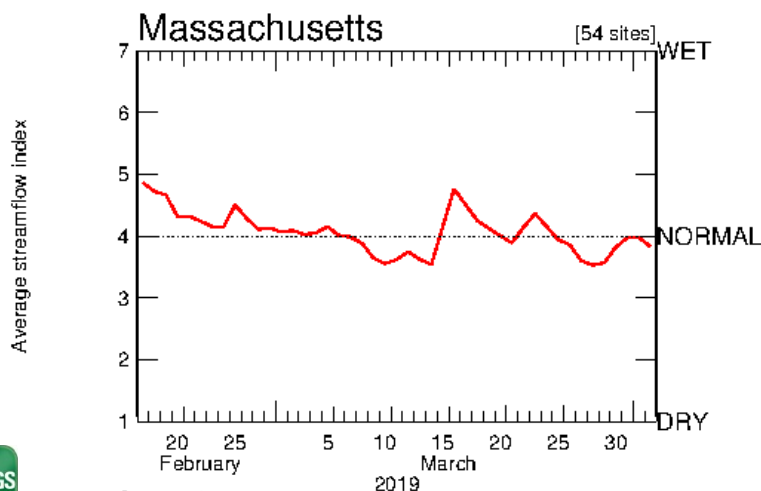
STREAMFLOW

Average monthly streamflows were around average relative to historical data except in the West and Connecticut River Valley regions where multiple gages were below the 25th percentile average flow. In the West region more than half of the gages were below the 25th percentile value resulting in the count of one month below “normal”. Two months below “normal” are required before an index severity level is triggered.

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

KEY:

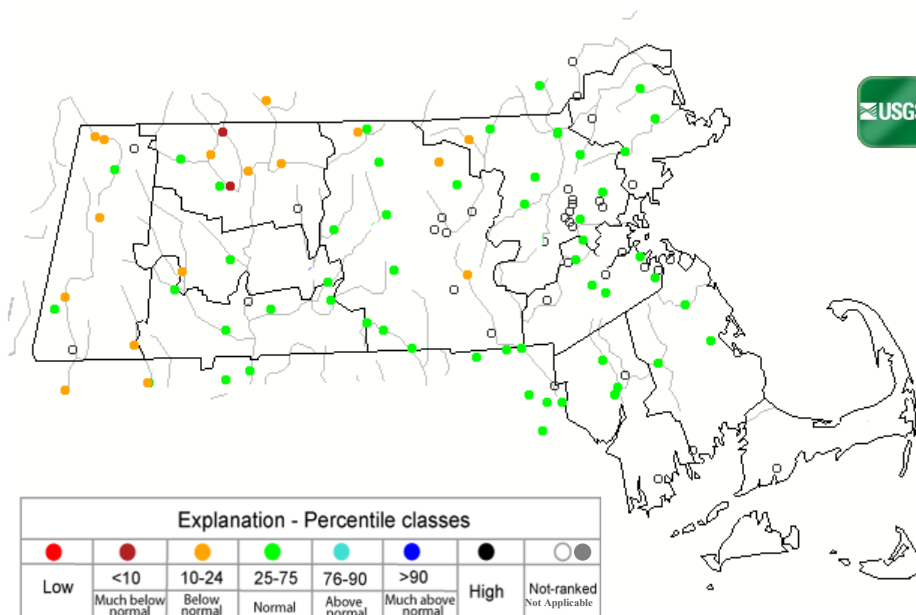
- 1 = New record low for day
- 2 = < 10th percentile
- 3 = 10th – 24th percentile
- 4 = 25th – 74th percentile
- 5 = 75th – 89th percentile
- 6 = > 90th percentile
- 7 = New record high for day



Average March 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>



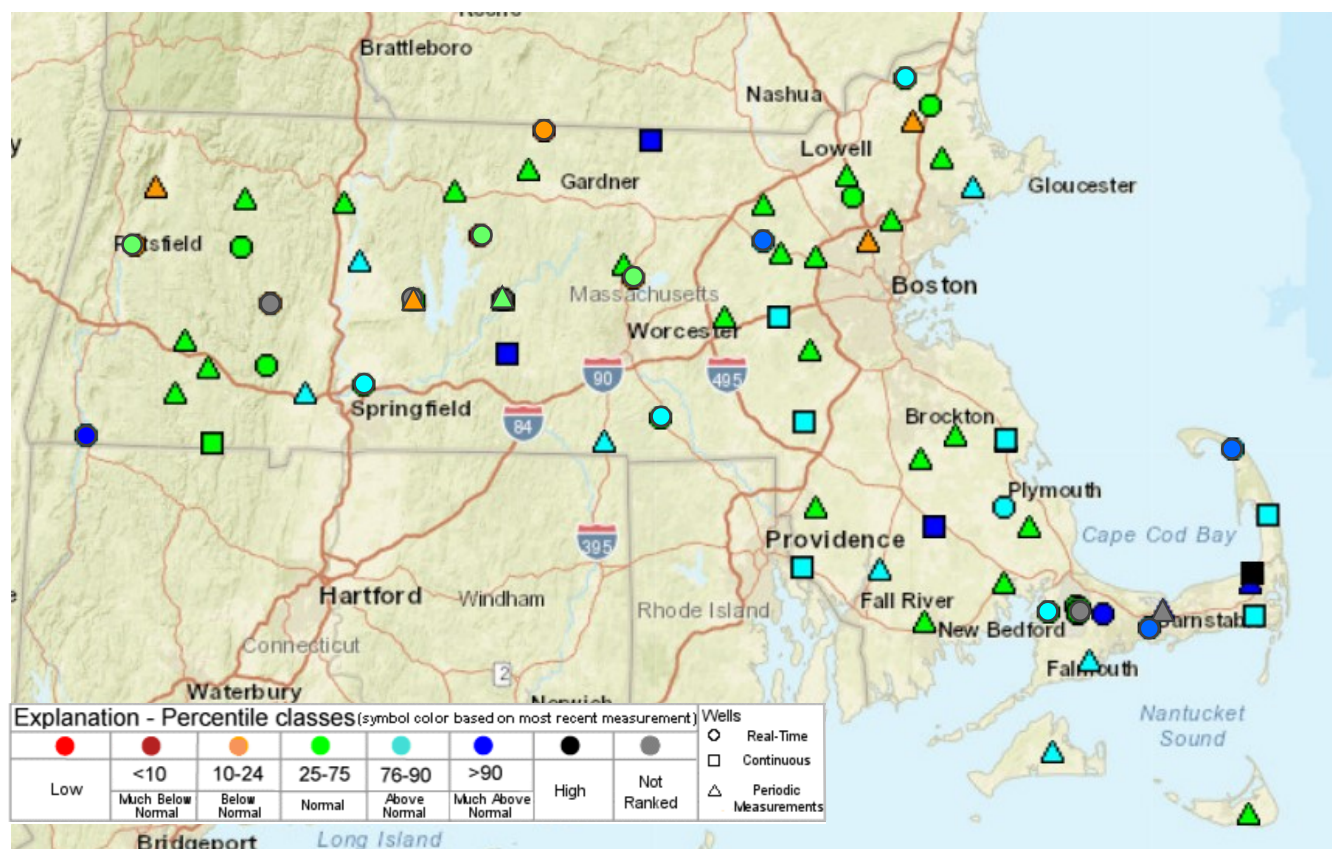
Region	Number of Gages				>90th percentile flow	MA Drought Plan Index/# of consecutive months majority below 25th percentile
	Total Reporting for March	<25th to 10th percentile	<10th percentile to above record low	Record low		
Western	7	5	0	0	0	Normal/1
CT River Valley	14	4	2	0	0	Normal/0
Central	11	3	0	0	0	Normal/0
Northeast	17	1	0	0	0	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

Groundwater levels continue to vary across the state from below normal to record high. 9 of 65 reporting wells are greater than their respective 90th percentile values. 5 wells are below their respective 25th percentile values.

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



Region	Number of wells					MA Drought Plan Index /# consecutive months majority below 25 th percentile
	Total Reporting for March	<25th to 10th percentile	<10th percentile to above record low	Record low	> 90th percentile	
Western	5	1	0	0	0	Normal/0
CT River Valley	11	1	0	0	0	Normal/0
Central	10	1	0	0	2	Normal/0
Northeast	16	2	0	0	1	Normal/0
Southeast	12	0	0	0	1	Normal/0
Cape and Islands	11	0	0	0	5	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 March, most reporting reservoirs were significantly above normal, with some reservoirs spilling.

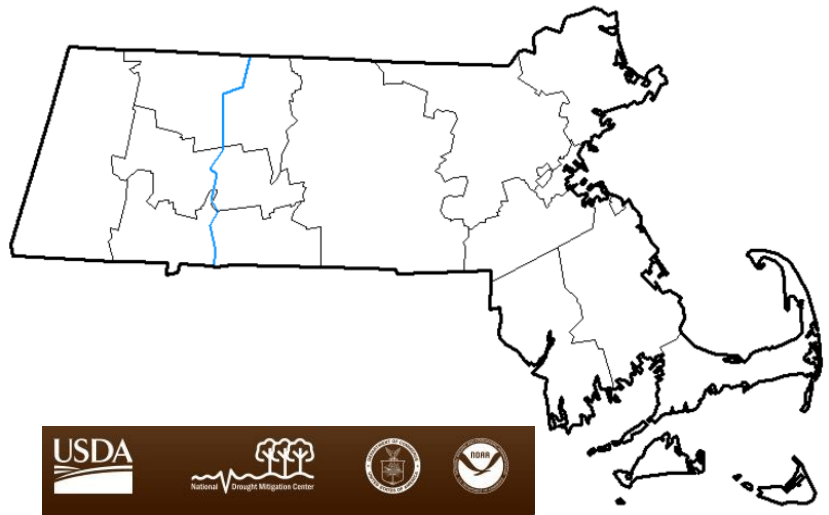
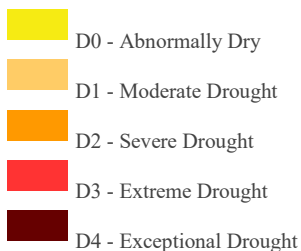
Region	Total Reporting for March	Reservoir Levels	MA Drought Management Plan Reservoir Index
Western	2	Normal	Normal
CT River Valley	2	Normal	Normal
Central	2	Normal	Normal
Northeast	7	Normal	Normal
Southeast	3	Normal	Normal
Cape Cod & Islands	1	Normal	Normal

DROUGHT CONDITIONS AND FORECASTS BY NOAA AND PARTNERS

U.S. Drought Monitor: Drought Conditions as of March 26, 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>



NOAA Climate Prediction Center: Temperature and Precipitation Outlook

April: The outlook projects 40-60% chance of above normal temperatures, and equal chances for above, normal, or below to 40% chance of above normal precipitation in different regions.

April through June: The outlook projects 40-60% chance of above normal temperatures and equal chances for below normal, normal, or above precipitation.

<https://www.cpc.ncep.noaa.gov/>

NOAA Climate Prediction Center: Monthly and Seasonal Drought Outlook

The monthly outlook for April and seasonal outlook valid through June do not project drought conditions.

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

Appendix I: Additional Information

Keetch-Byram Drought Index (KBDI)

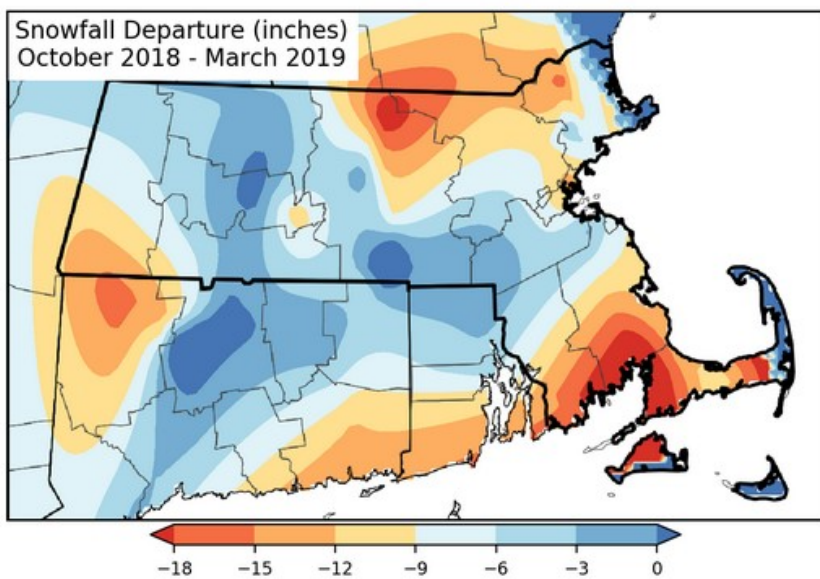
KBDI values are less than 200 across the state resulting in the index being Normal for all regions.

(Note: Fire danger ratings are elevated across the state. These values reflect day to day surface conditions, projected weather and other factors compared to KBDI which reflects moisture deficit to 8 inches below ground surface.)

Crop Moisture Index (CMI)

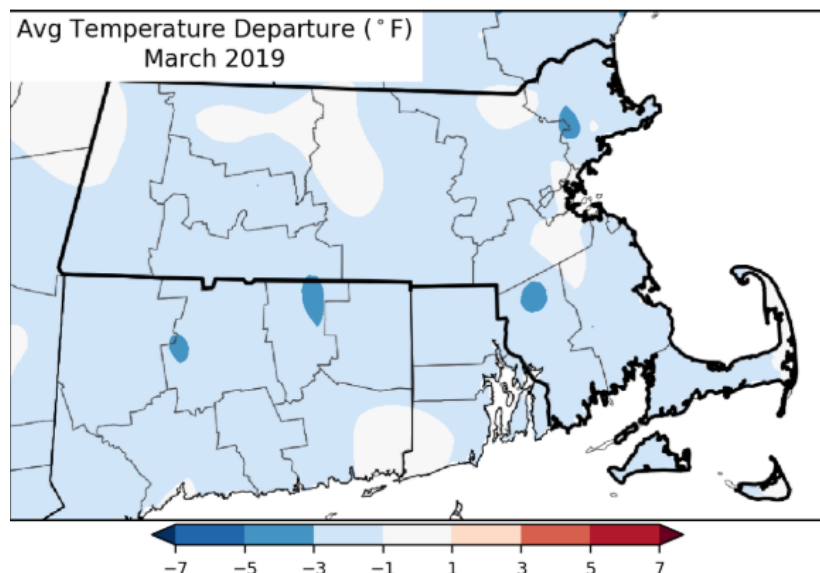
The CMI map for the week ending March 30, 2019 shows slightly dry/favorably moist conditions across the state resulting in the index being Normal for all regions.

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: Seasonal snowfall totals varied significantly throughout the state as shown in the map at left. (<http://www.nrcc.cornell.edu/regional/monthly/monthly.html>)

Snow Cover: As of the end of March, snow cover remains only in the mountains of the northwest corner of the state. (<https://www.noahrs.noaa.gov/interactive/html/map.html>)



Average Temperature Departure

Monthly average temperatures were slightly below historical average for most of the state with -1 to -3 degrees Fahrenheit below average.

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

Boston daily temperatures ranged from 15 to 70 degrees Fahrenheit. <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

March-19	Nor-	Actu-	Per-	Excess/	-----Excess or Deficit Since Last-----									
					10/1/2018	2 Months	% Norm	3 Months	% Norm	6 Months	% Norm	12	% Norm	
State	3.98	2.69	68	-1.29	7.37	-1.22	83	0.32	103	7.37	133	14.99	133	
Western	3.39	1.63	48	-1.76	6.11	-1.48	76	0.54	106	6.11	131	17.05	139	
Connecticut River	3.72	1.74	47	-1.98	7.17	-1.62	77	0.23	102	7.17	133	20.26	144	
Central	4.15	2.44	59	-1.71	5.42	-2.09	73	-0.87	92	5.42	123	16.15	135	
Northeast	3.93	3.04	77	-0.89	6.40	-0.65	91	-0.16	99	6.40	129	12.89	130	
Southeast	4.24	3.34	79	-0.90	9.84	-0.92	88	1.01	109	9.84	142	14.14	131	
Cape Cod and Is-	4.29	4.14	97	-0.15	9.55	-0.60	92	1.86	116	9.55	140	5.58	112	

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

<u>REGION</u>	3-Month SPI	6-Month SPI	12-Month SPI
Western Region	0.32	1.56	2.46
Connecticut River Region	0.13	1.65	2.70
Central Region	-0.22	1.18	2.19
Northeast Region	-0.05	1.34	1.80
Southeast Region	0.40	1.86	1.82
Cape & Islands	0.68	1.91	0.85

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 <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/docs/wrc/droughtplan.pdf>).