Update on Revisions to the Massachusetts Drought Management Plan

July 13, 2017

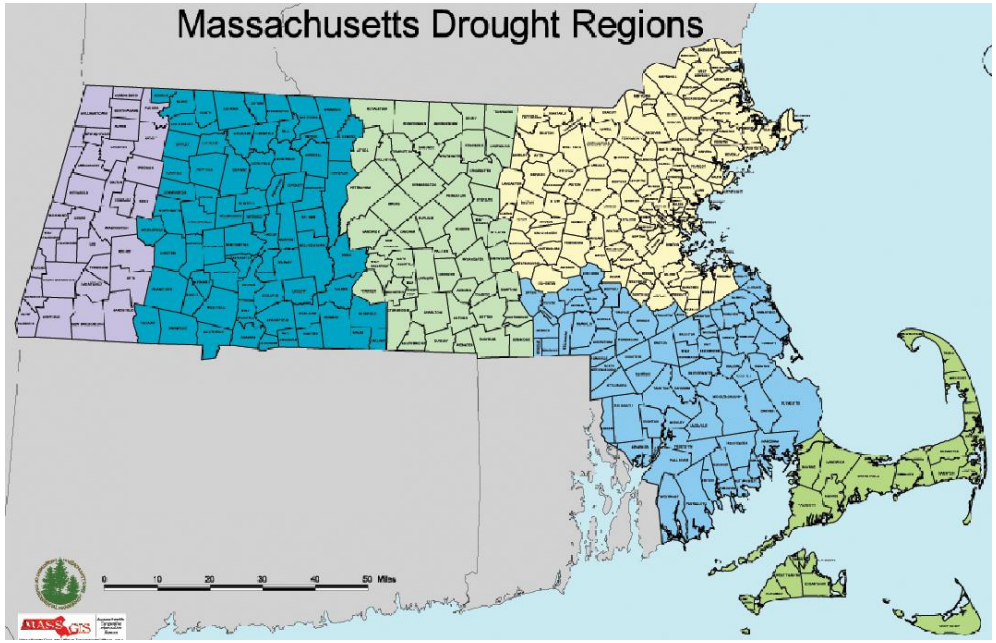
Presentation Overview

- Review key components of current plan
  - Drought Regions, Indicators and Levels
  - What data do we use and how?
  - History of drought declarations
- Update on revisions to drought plan
  - Feedback from stakeholders
  - Anticipated revisions to Indicators
  - Anticipated addition of Actions
  - Include enhanced section on Communications
- Next Steps

MA Drought Management Plan (DMP), 2001 (revised 2013)

Drought Indicators
Precipitation
Streamflow
Groundwater
Reservoirs
Crop Moisture
Fire Danger

Drought Levels
Normal
Advisory
Watch
Warning
Emergency



Western
Connecticut River Valley
Central
Northeast
Southeast
Cape and Islands

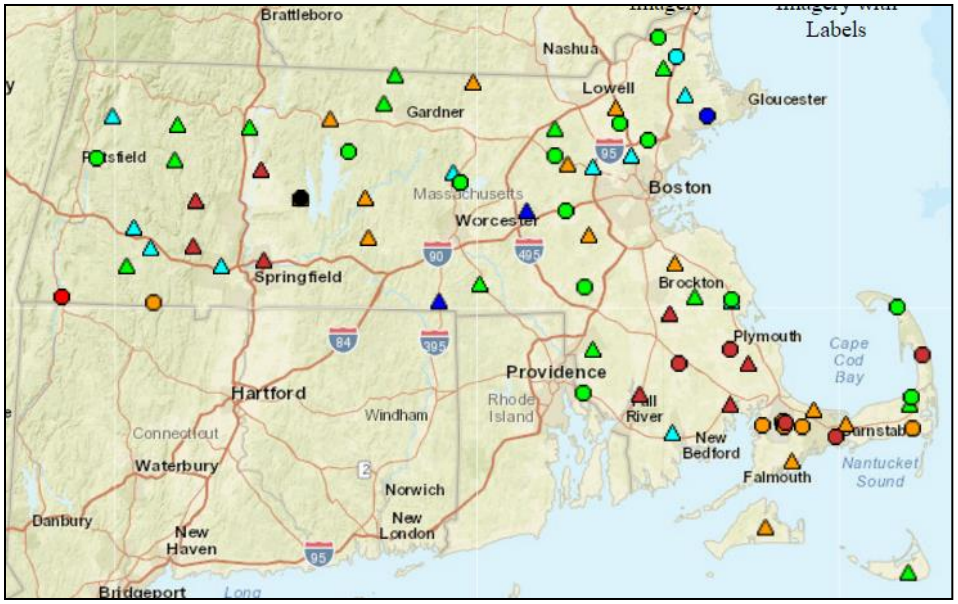
www.mass.gov/eea/wrc-dmtf

Summary of Current Methods

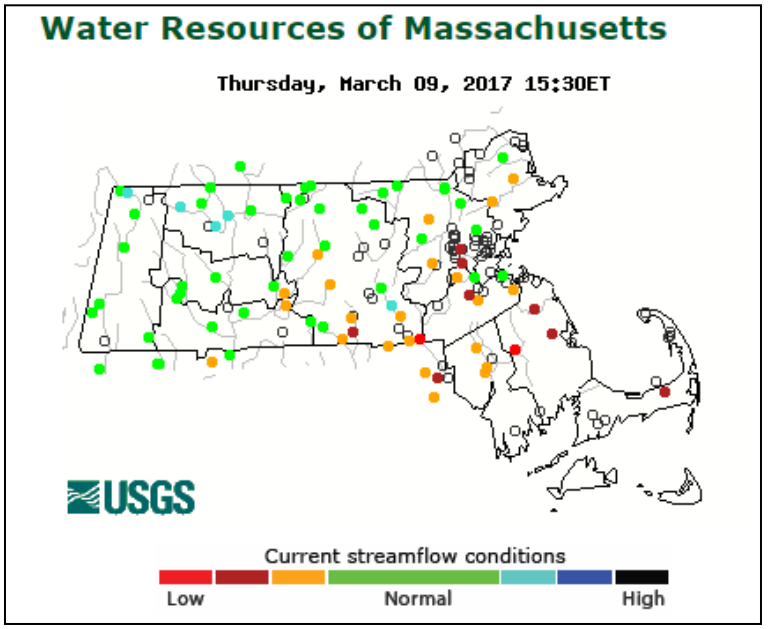
- Precipitation – cumulative months (2,3,6,12) below thresholds
  - SPI – normalized standard deviation
  - Percent of normal –specific percent thresholds
- Streamflow and Groundwater
  - Count of months below 25th percentile of historical values
- Reservoirs – size of reservoir below average
- KBDI (Fire Danger) – 0 to 800 units
- Crop Moisture Index – standard deviations

Groundwater & Streamflow Networks

Groundwater



Streamflow

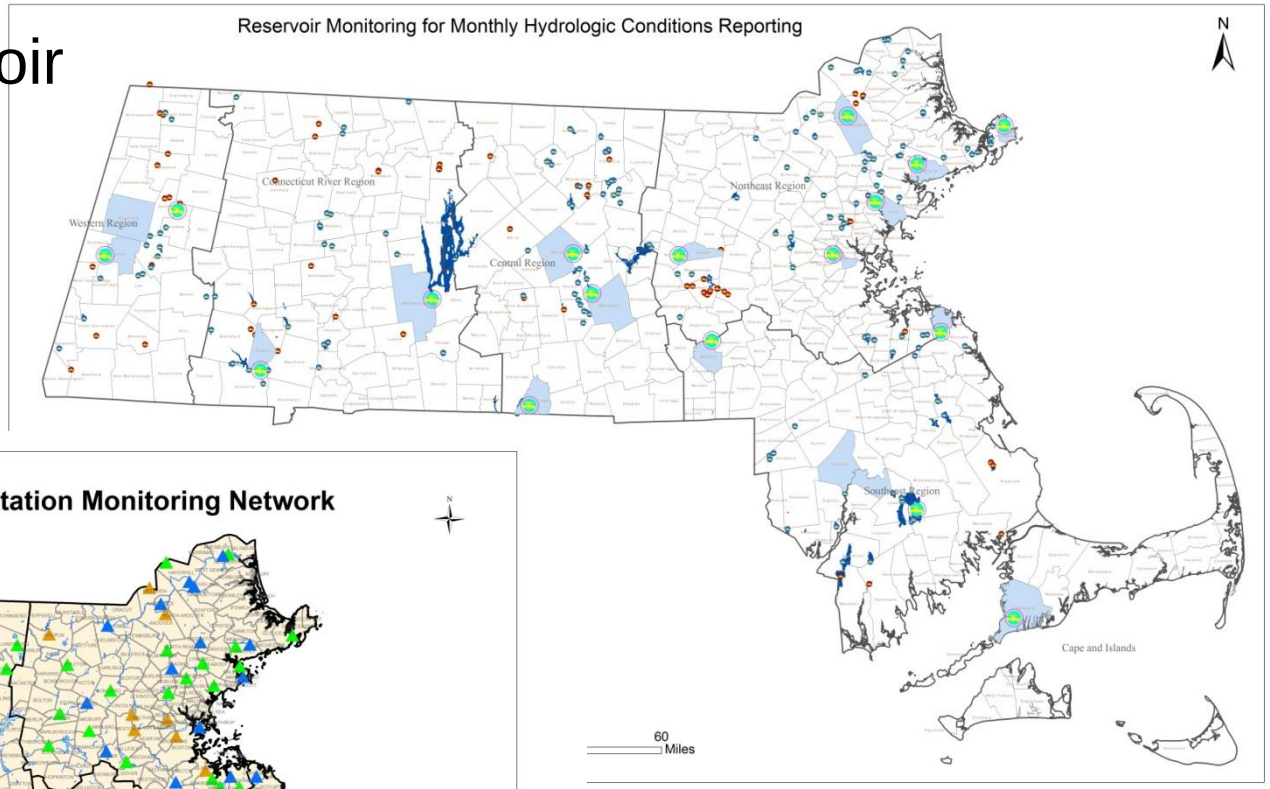


Explanation - Percentile classes (symbol color based on most recent measurement)							
Low	<10 Much Below Normal	10-24 Below Normal	25-75 Normal	76-90 Above Normal	>90 Much Above Normal	High	Not Ranked

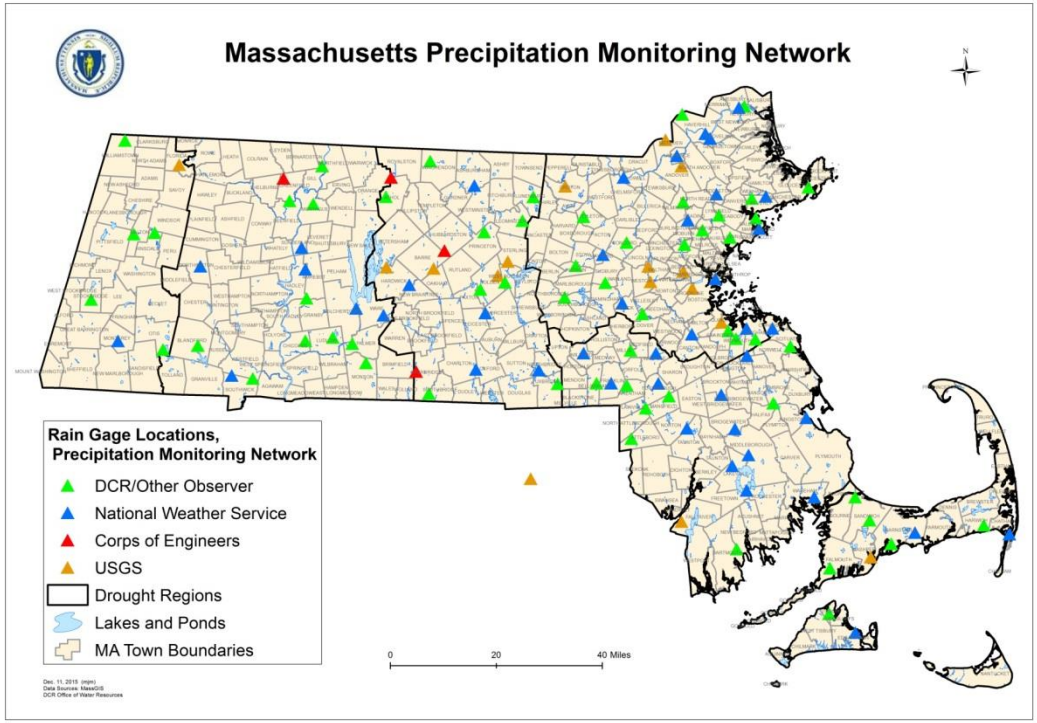
Wells	Springs
○ Real-Time	■
□ Continuous	◪
△ Periodic Measurements	◪

Precipitation and Reservoir Networks

Reservoir

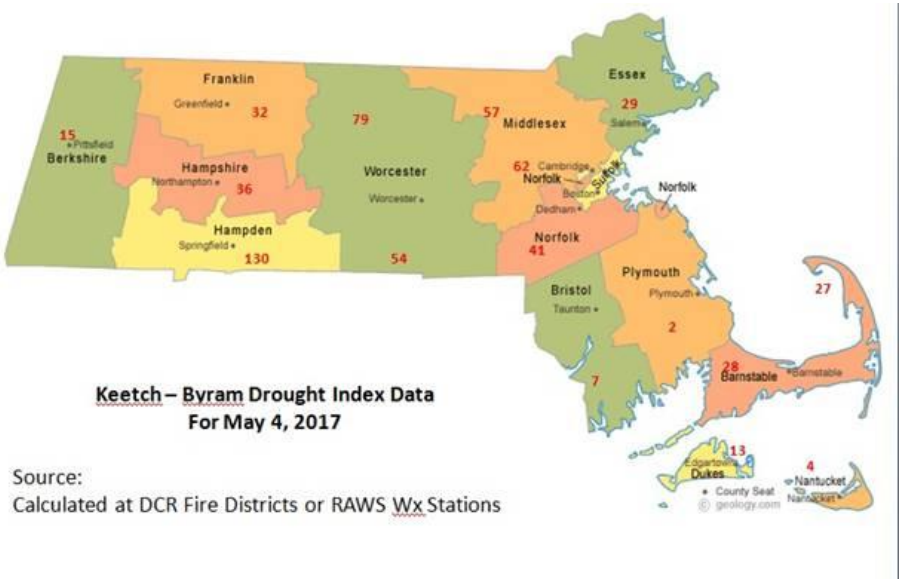


Precipitation



KBDI and Crop Moisture

KBDI



Keetch – Byram Drought Index Data
For May 4, 2017

Source:
Calculated at DCR Fire Districts or RAWS Wx Stations

Crop Moisture

-3.0 or less (Severly Dry)
-2.0 to -2.9 (Excessively Dry)
-1.0 to -1.9 (Abnormally Dry)
-0.9 to +0.9 (Slightly Dry/Favorably Moist)
+1.0 to +1.9 (Abnormally Moist)
+2.0 to +3.0 (Wet)
3.0 and above (Excessively Wet)

Data Points for Decision Making

Region	West	CT Valley	Central	North-east	South-east	Cape & Islands	Totals
Precipitation	4	6	6	6	6	3	31
Groundwater	5	11	10	17	12	13	68
Streams	6	11	16	19	6	n/a	58
Reservoirs	2	2	4	7	3	1	19
Totals	17	30	36	49	27	17	176

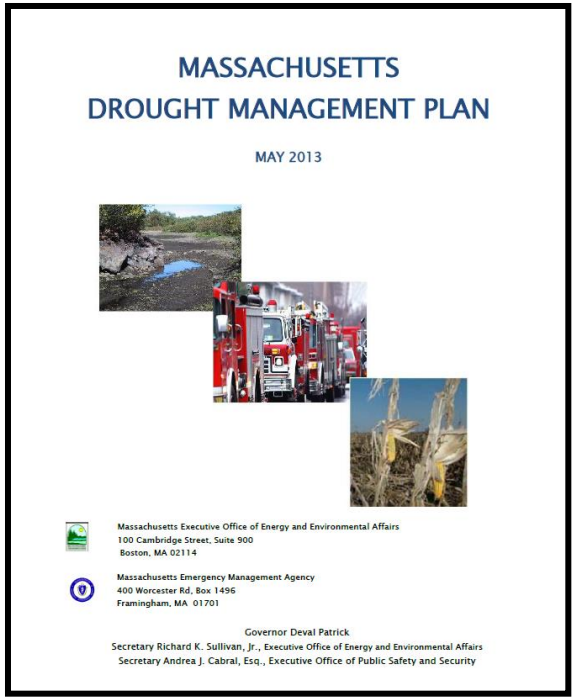
Detail on Drought Years

RECENT DROUGHT HISTORY									
					Drought Level by Regions				
Year	Begin Date	End Date	Comment	Western	CT River	Central	Northeast	Southeast	Cape & Islands
	12/28/2001	**1/31/2003**							
2001	**12/28/2001**			Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			February 2002	Advisory	Watch	Watch	Watch	Advisory	Advisory
2002			March 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			April 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			May 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			June 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			July 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			August 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			September 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			October 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			December 2002	Normal	Normal	Normal	Normal	Normal	Advisory
2003		**1/31/2003**	As of January 31, 2003	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2007	**3/18/2008**							
2007	**10/1/2007**			Normal	Advisory	Advisory	Advisory	Advisory	Normal
2008		**3/18/2008**	As of March 18, 2008	Normal	Normal	Normal	Normal	Normal	Normal
	8/1/2010	**11/19/2010**							
2010	**8/1/2010**			Normal	Normal	Advisory	Advisory	Normal	Normal
			October 2010	Normal	Advisory	Advisory	Advisory	Normal	Normal
2010		**11/19/2010**	As of November 19, 2010	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2014	**11/30/2014**							
2014	**10/1/2014**			Normal	Normal	Normal	Normal	Advisory	Advisory
2014		**11/30/2014**	As of December 1, 2014	Normal	Normal	Normal	Normal	Normal	Normal
	7/1/2016								
2016	**7/1/2016**		June 2016	Normal	Advisory	Watch	Watch	Advisory	Normal
			July 2016	Advisory	Watch	Warning	Warning	Watch	Advisory
			August 2016	Advisory	Watch	Warning	Warning	Warning	Watch
			September 2016	Watch	Warning	Warning	Warning	Warning	Watch
			October 2016	Warning	Warning	Warning	Warning	Warning	Advisory
			November 2016	Warning	Warning	Warning	Warning	Warning	Advisory
			December 2016	Warning	Warning	Warning	Watch	Warning	Advisory
			January 2017	Watch	Warning	Watch	Advisory	Warning	Advisory

Revisions to DMP

The Need for Revision

- 2016/17 Drought 1st time MA hit Warning - we learned a lot
- Plan not “operationalized”, per MEMA
- Plan lacks actions
- Some indicators didn’t track severity
- Indicators did not catch early drought onset
- Need better communication
- Drought level names unclear



Revision Process

- Intent to revise announced in fall of 2016 with request for comment letters from DMTF and stakeholders
- Listening sessions held with key stakeholders:
  - Water Suppliers (Jan 2017)
  - Mass Rivers Alliance Members (Feb 2017)
  - Agricultural Community members (April 2017)
  - DMTF Meetings
  - 8 comment letters received
- Drought Indicators Technical Workgroup
  - EEA staff + NWS + USGS; 8 meetings to date
- Drought Actions workgroup
  - EEA staff, 4 meetings to date

Stakeholder Comments on Indices

- Naming of drought levels
- Drought regions
- Timing of drought declarations especially at onset
- Meet human and environmental needs for water
- Longer look back periods
- Indices should reflect severity not just duration
- Consider effect of inaccurate data or outliers

Indicators Workgroup

Goal: To accurately and comprehensively provide information on onset, severity and end of droughts.

1. Indicator review
   - Do we have the right indicators?
   - Are the data networks sufficient for our indicators?
2. Method review
   - Consider US Drought Monitor (USDM) methods which indicates severity better, standardizes data,
   - Compare to previous droughts and historic data
3. What to call the drought levels for clarity
   - Current nomenclature doesn't convey condition or order of severity
4. How to "roll up" each indicator within a region
   - Majority/median/mean per region? Weighted for worst condition?
5. How to make overall drought determination by region
6. Review of drought region boundaries

Indicator Review

- Keep only one precipitation index to eliminate double weighting
  - SPI for drought determination, add 9, 24 month lookbacks
  - Report percent of normal for public communication
- Replace Crop Moisture Index with an index that better reflects effect of temperature & ET on precipitation
  - CMI comes from national scale modeling with few Massachusetts data points
  - Still reviewing alternatives
- All other indices remain (KBDI, streamflow, reservoirs, groundwater)

Data Network Review

- Monitoring networks
  - Looked at spread of all data points across all regions
  - USGS conducting network analysis for groundwater and streamflow
  - Need to expand geographic coverage of networks, especially reservoirs
  - Increase real-time data and/or timeliness of data

Method Review

- Following USDM approach, use percentiles for all indicators to,
  - Standardize data independent of indicators' distributions
  - Improve capture of severity which also allows for earlier detection of drought onset
- Keep 4 drought levels but re-name for clarity and mostly align with USDM percentiles

U.S. Drought Monitor (USDM), est. 1999

Names	Recurrence	Percentiles
D0: Abnormally Dry	once per 3 to 5 years	21 to 30
D1: Moderate	once per 5 to 10 years	11 to 20
D2: Severe Drought	once per 10 to 20 years	6 to 10
D3: Extreme Drought	once per 20 to 50 years	3 to 5
D4: Exceptional Drought	once per 50 to 100 years	0 to 2

- Evidence based (not a model)
- Looks at climatic, hydrologic and soil conditions
  - Does not consider groundwater and reservoirs for Northeast
- 11 rotating Authors from NOAA, USDA, NDMC

USDM Methods, cont.

- Frequency-based drought levels and indicators
  - Percent of time a value or range of values is experienced
  - Experience most of the time → intuitive "normal"
  - Puts on common scale

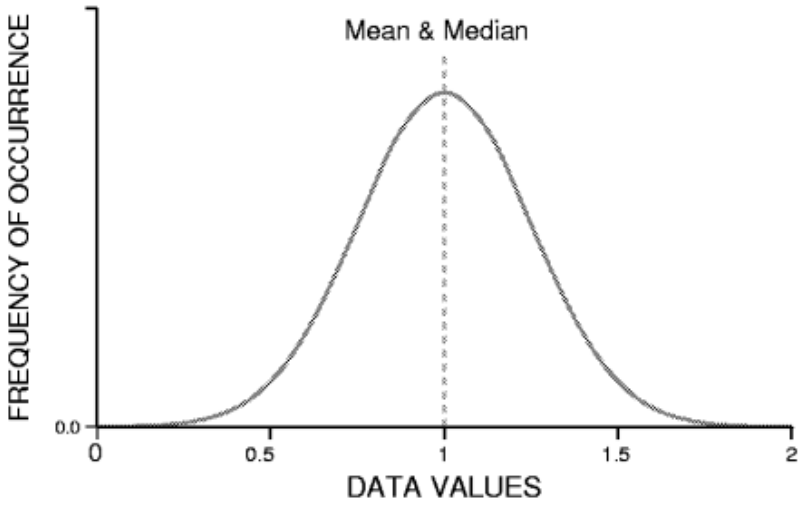


Figure 1.2 Density Function for a Normal Distribution

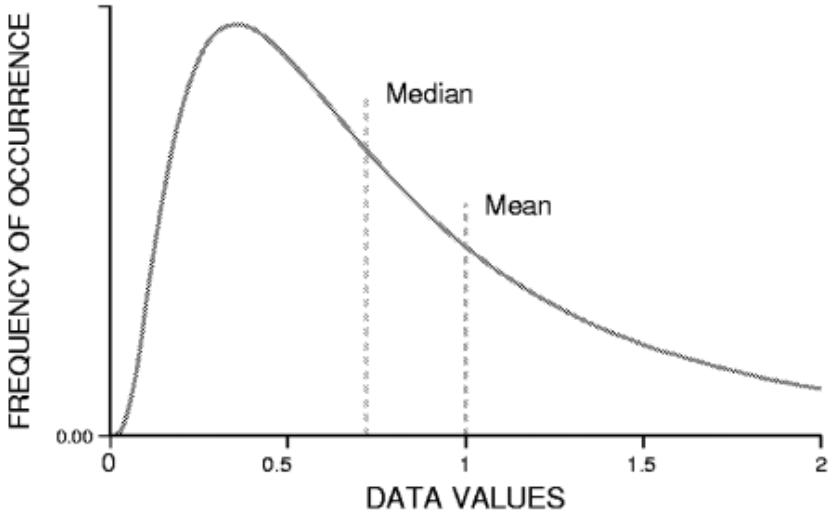


Figure 1.1 Density Function for a Lognormal Distribution

USDM Methods, cont.

- "…the final drought category tends to be based on what the majority of the indicators show and on local observations.
- The analysts producing the map also weigh the indices according to how well they perform in various parts of the country and at different times of the year.
- It is this combination of the best available data, local observations and experts' best judgment that makes the U.S. Drought Monitor more versatile than other drought indicators."

Proposed MA Drought Levels

US DROUGHT MONITOR

Names	Recurrence	Percentile Range
D0: Abnormally Dry	once per 3 to 5 years	21 to 30
D1: Moderate	once per 5 to 10 years	11 to 20
D2: Severe Drought	once per 10 to 20 years	6 to 10
D3: Extreme Drought	once per 20 to 50 years	3 to 5
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PROPOSED STATE DROUGHT LEVELS

Level	Percentile Range	US Drought Monitor Equivalence	New Nomenclature	Current State Drought Levels
1	>20 and ≤30%	D0	**Dry**	Advisory
2	>10 and ≤20%	D1	**Very Dry**	Watch
3	>2 and ≤10%	D2 and D3 combined	**Critically Dry**	Warning
4	≤2%	D4	**Emergency**	Emergency

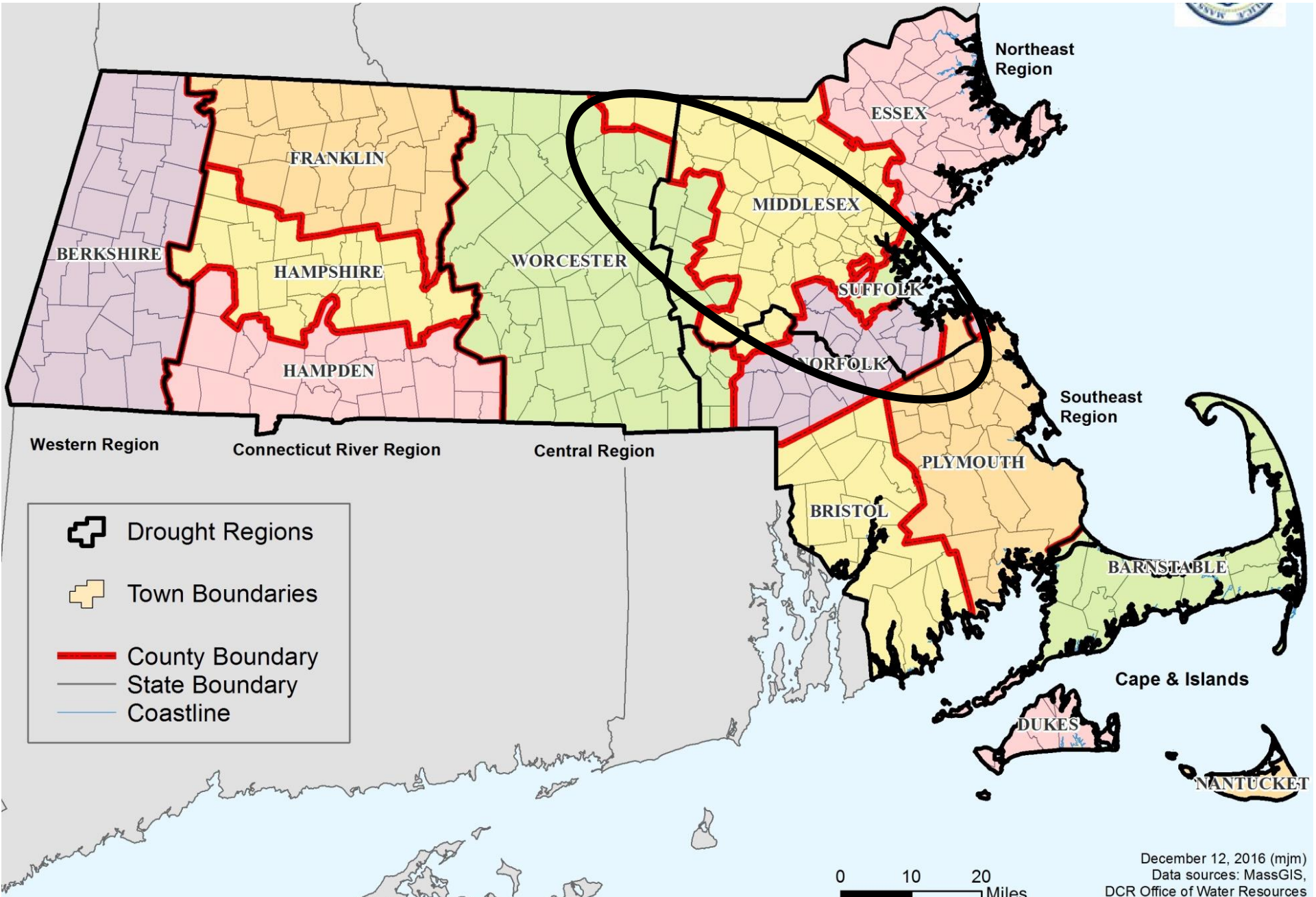
Method Review- region "roll up"

- Options at site (assessed for streamflow & groundwater)
  - Median or mean of daily for month at site
- Options within a region
  - Median/50th percentile across sites
  - 25th percentile across sites
- Evaluated sensitivity of methods to drought levels using streamflow and groundwater data
  - Compared new options vs. current method for historical droughts
- Preliminary selection
  - Median of month and 25th percentile across region to provide earlier indication of emerging conditions

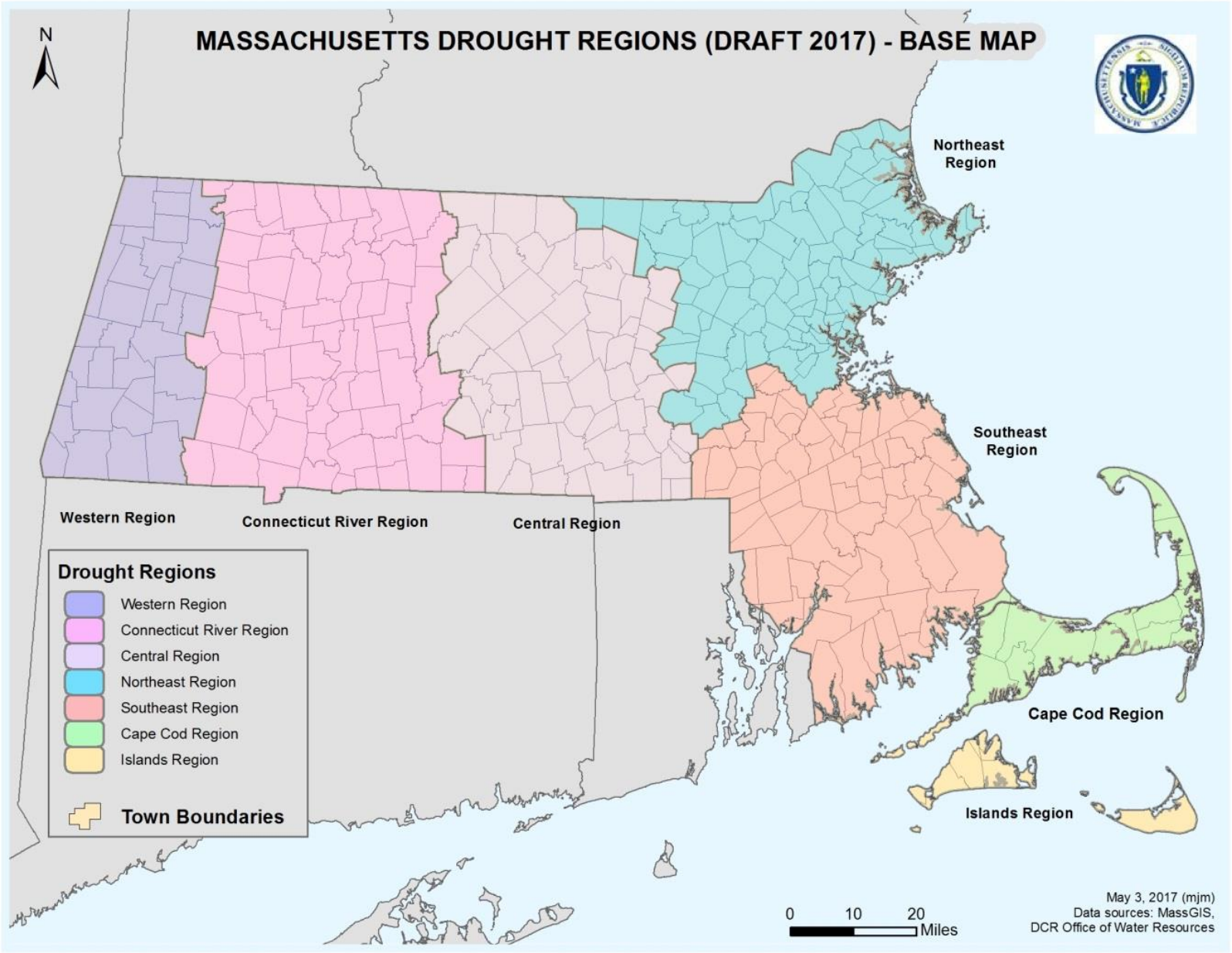
Method Review- Overall Drought Determination

- For each region, roll up indices to overall drought determination
  - DMTF to consider all indices available for the time of year
  - ONSET: Expect to see precipitation, streamflow and soil moisture to show deficits first
  - END: Maintain requirement to see recovery in long term precipitation and/or groundwater levels
  - DMTF uses their professional expertise to make recommendation to Secretary

Drought Regions – Align with Counties



7 Drought Regions



Next steps on Indices

- Complete assessment of new soil moisture/ET index
- Calculate all indices using new methods for all available historical data
- Assess implications on drought levels - number and severity of droughts

Actions Overview

Feedback we received:

- Current plan lacks specific actions, especially local
- Plan is not “operationalized”
- Plan should include preparedness, not just response
- Some actions should be mandatory, plan needs authority
- Public outreach (more from State, enable local)
- Technical & financial assistance

Process included review of:

- Drought plans across the nation
- Materials from national associations
- Massachusetts policies and guidelines

Proposed Changes:

1. Add Local and State Preparedness to plan
2. Expand Local and State Response Actions during drought
3. User friendly format with menu of options and resources

Menu of Local Preparedness Actions

Major Themes:

1. Local Drought Management Plan (DMP) as part of Emergency Response Plan (including supply side actions)
2. Land Use Planning to Minimize Water Use & Increase Recharge
3. Water Conservation Program (WCP)
4. Water Rates
5. Nonessential Outdoor Water Use Restrictions

Q: We think these are the most important actions to prepare for drought… what do you think?

Example Local Drought Response Matrix

	State Drought Level and Description	Level 1: Dry	Level 2: Very Dry	Level 3: Critically Dry	Level 4: Emergency
	Reservoir Trigger(s)	Fill in if establishing local reservoir triggers for staged drought response			
	Groundwater Trigger(s)	Fill in if establishing local groundwater triggers for staged drought response			
Demand Management Actions	Nonessential Outdoor Watering	1 day per week watering, before 9 am and after 5 pm.	Hand-held watering only, before 9 am and after 5 pm.	No nonessential outdoor water use	No nonessential outdoor water use
	New sod, seeding, and landscaping	Follow best management practices for efficient watering.	Installation of new sod, seeding, and landscaping is discouraged	Installation of new sod, seeding, and landscaping is strongly discouraged.	Installation of new sod, seeding, and landscaping is prohibited.
	Water Savings Goal	55 gallons per person per day, or reduce use by __%	50 gallons per person per day, or reduce use by __%	45 gallons per person per day, or reduce use by __%	40 gallons per person per day, or reduce use by __%
Water Supply Actions	Interconnection/Backup and Emergency Supplies	n/a	Prepare activation of interconnections/ backup supplies	Activate interconnections/backup supplies	Activate interconnections/backup supplies
Communication Actions	Website/Press/Social Media	Update website/social media with latest information on drought status and restrictions/tips	Weekly Tweets on Water Conservation	Press Events and Weekly Social Media Updates	Daily Communication using all tools
Coordination Actions	Drought Management Team	Convene Drought Team, Monthly Meetings	Weekly Drought Team Meetings	Weekly or Daily Drought Team Meetings	Daily Drought Team Meetings

Statewide Guidance: Avoid Watering During a Drought

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.

State Drought Level	Nonessential Outdoor Water Use Restrictions
Level 1 (Dry)	1 day per week watering, after 5 p.m. or before 9 a.m. (to avoid evaporative losses)
Level 2 (Very Dry)	Outdoor watering should be limited to hand held hoses or watering cans, to be used only after 5 p.m. or before 9 a.m.
Level 3 (Critically Dry)	Ban on all nonessential outdoor water use
Level 4 (Emergency)	Ban on all nonessential outdoor water use

Menu of Local Actions During Drought

"Top Ten"

1. Adopt and implement the state's nonessential outdoor water use restrictions – **This should be included in all plans.**
2. Limit or prohibit:
   - installation of new sod, seeding, and/or landscaping
   - watering during or within 48 hours after rainfall
   - washing of hard surfaces (sidewalks, patios, driveways, siding)
   - personal vehicle or boat washing
   - operation of non-recirculating fountains
   - filling of swimming pools, hot tubs, and rinks
3. Promote or offer loans or rebates for removal of high-water-use plants
4. Provide incentives for installing efficient irrigation technologies
5. Establish water-use reduction targets for all water users
6. Implement drought surcharge or seasonal water rates
7. Targeted outreach to top water users to help curb their use
8. Reduce or eliminate hydrant flushing, unless essential for public safety
9. Implement or increase incentives for indoor and/or outdoor water audits
10. Provide assistance with installation of water-efficient fixtures and appliances, and leak repair

State Actions- Key Functions

- Data gathering and analysis
  - Automate analysis, increase real-time data & reporting frequency
- Communication and Public Outreach
  - Develop Communications Strategy, Drought Portal, impact reporting
- Demand Management
  - Improve water-use efficiencies at state facilities
- Supply Management
  - Review Emergency Plans in light of drought
- Technical Assistance
  - Support local development of DMPs, WCPs
- Policy
  - Review/update WCS and DMP every 5 years, consider new policies

Tell us how we can best assist

Communication

- Include enhanced set of communication strategies
  - Ongoing actions during normal conditions
  - Enhanced actions during a drought
- Target communication strategies to four sectors:
  - The General Public
  - Cities & Towns
  - Media
  - Businesses, including Agriculture

Next Steps

- July/August 2017: Proposed Revisions will be presented to the Drought Management Task Force
- Fall 2017: Draft Report release for comment anticipated
- Winter 2017: Final Report
- Spring 2018: begin implementing preparedness

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