

Lincoln Water Department

# Drought Management Plan

8/8/2017

## 1.0 INTRODUCTION

### 1.1 Purpose

The purpose of this report is to develop a Drought Management Plan (DMP) for the Town of Lincoln Water Department (LWD) based upon specific factors related to the Town's water system. A DMP is a necessary tool for a public water supplier to control increased water demands and diminished supplies often associated with a drought condition.

Drought conditions can occur any time of year when a water system experiences an increase in demand so that demand exceeds water supply. Many reasons can be found for increases in water demand, but in general they include deficiencies in precipitation, population growth, climate change, and changes in use (outside watering). Balancing the needs of the Town's residents in regard to water demands can be difficult. The goal of the DMP is to identify a clear descriptive process in which anticipation of an unbalanced condition in the water supply and system demand is identified and measures required to prevent a failure of the water system are implemented.

In simplest terms a DMP provides a series of escalating controls based upon the demand of the users exceeding the amount of water available. This plan is necessary in order to withstand the hottest and driest years while meeting essential water demands. The DMP should be implemented at any time of the year that increased demands, water supply reductions, emergency conditions, catastrophic system failures, or drought conditions occur.

### 1.2 Water Sources

With the exception of a few houses using private wells, the Town of Lincoln's residents and businesses are served by the Town's municipal drinking water supply drawn from a combination of two water sources. Each of these sources is discussed below.

#### 1.2.1 Flint's Pond

Flint's Pond (also known as Sandy Pond) is the Town of Lincoln's primary drinking water supply. Raw water from the pond is conveyed via the Sandy Pond Pump Station to the Sandy Pond Water Treatment Facility (WTF). The WTF is a membrane microfiltration plant with a capacity of 1.6 million gallon per day (MGD) or 1,150 gallons per minute (gpm). The raw water intake structure is 250 feet from the shoreline of the pond and the top of the intake is 10 feet below full reservoir level. Full reservoir level (233.2 feet above mean sea level, 1927 NGVD) represents the use of three 2x6-inch pressure treated stop logs in the concrete dam.

#### 1.2.2 Tower Road Well

The Town also operates the Tower Road Well. The gravel-packed well is used to supplement the Flint's Pond source. It generally is used on the weekends and to meet peak demands during the summer. Its vertical turbine pump has a capacity of approximately 0.61 MGD (470 gpm), however the Department's Water Management Act permit limits withdrawals to 0.48 MGD. The well is a 24-inch diameter, 46-foot deep well with a 10-foot screen.

### **1.3 Treatment and Distribution Systems**

The LWD provides water to approximately 5,030 residents and a number of commercial and municipal customers in the Town of Lincoln. As a municipal water supplier, the LWD is responsible for providing a safe and reliable drinking water supply at all times. The LWD's water infrastructure consists of the Flint's Pond surface water source and the associated microfiltration plant, the Tower Road groundwater well, one 1.2 million gallon water storage tank, and approximately 58 miles of water distribution mains ranging in size from 4-inch to 16-inches in diameter. The water system has a single service zone with a hydraulic grade line of 393 feet above mean sea level (overflow level of the Bedford Road storage tank) with ground elevations ranging from approximately 150 feet to 340 feet above mean sea level.

### **1.4 Demand History**

The annual average water demand is approximately 0.53 MGD for the whole Town. Winter demand is approximately 0.47 MGD but that demand increases to approximately 0.75 MGD during the summer months and the Town will see daily maximum demands just under 1.2 MGD. These increases are primarily the result of increased outdoor water use.

## 2.0 DROUGHT INDICATORS

### 2.1 Water Supply

Lincoln's water supply is from two sources, Flint's Pond and the Tower Road well. Analyses of the inflow and outflow of water can help to indicate drought conditions. Reservoir inflow includes direct precipitation, surface runoff, and ground water discharge. Outflow consists of withdrawals, evaporation and releases (i.e. overflow of stop logs). Indicators of drought may consist primarily of the level of Flint's Pond, and to a lesser degree, the groundwater level in the Tower Road well. The level of the pond is measured and recorded daily by LWD personnel and water levels in the Tower Road well are recorded continuously via the SCADA system. The level of the pond is measured at the former screen house and is measured with respect to the top of the raw water intake which is approximately 10 feet below the reservoir full level. The groundwater level at the Tower Road well is measured with respect to the number of feet of water above the top of the 10-foot well screen.

### 2.2 Distribution System Demand

Water demand for Lincoln is relatively consistent during the non-growing season, typically represented as November through April; however demand varies significantly during the growing season, May through October. Review of the Lincoln's water use history reveals a strong correlation of spring and summer water use with elevated temperatures and lack of precipitation. For the years 2007 to 2016, the median number of days system demand exceeded 1.0 MGD is three days. During periods of decreased precipitation, especially 2007, 2015 and 2016, the number of days over 1.0 MGD was 10, 8 and 26, respectively. The exceedingly dry summer of 2016 had 23 days where demand was over 1.05 MGD and nine days above 1.1 MGD\*\*. The growing season of 2015 was dry but not excessively hot, and as a result had 113 days of demand above 0.7 MGD as compared to the median value of 62.5 days.

To better analyze the duration of these high demand periods, the seven-day average was calculated for the same data set. For the seven-day average usage above 1.0 MGD, the 2007 and 2016 data had five and 19 events, respectively. The summer of 2016 had nine days when the seven-day average exceeded 1.05 MGD. These periods of elevated system demand tax both the water level in Flint's Pond and the groundwater level at the Tower Road well.

The highest demand in Lincoln is from residential population with about 90% of the total metered finished water volume used, and the second highest demand is from the business customers.

\*\* Note that a complete lawn irrigation ban was issued by LWD on August 22, 2016; without this ban the number of 2016 high demand days would have been even greater

### 2.3 State & Government Agencies

Massachusetts has records and data that are interpreted and examined on a routine basis to provide indices for guidance. The Massachusetts Department of Energy and Environmental Affairs (EEA) is responsible for making declarations on the drought levels throughout the Commonwealth. The declarations, and supporting maps are posted on the Department of Conservation and Recreation's (DCR) webpage. The declarations are the result of a recommendation issued from meetings of the Drought Management Task Force, comprising state, federal and local officials. The Task Force meets monthly to review seven environmental indices in order to determine the appropriate drought declaration.

The National Drought Mitigation Center, in conjunction with two federal agencies, produces the US Drought Monitor map which depicts drought conditions across the country. The Northeast Regional Climate Center, operated out of Cornell University, also compiles drought data and generates maps. The Palmer Drought Index is another resource to use since it can reflect conditions of drought or excess rainfall anywhere in the U.S

The data provided by the state, as well as information provided by other governmental agencies, should be one of the drought indicators used for this DMP. All state and other governmental indices and forecasts are consistently updated on their home page every month. The links to the various websites are listed below.

- DCR Website  
<http://www.mass.gov/eea/agencies/dcr/water-res-protection/water-data-tracking/drought-status.html>
- US Drought Monitor  
<http://droughtmonitor.unl.edu/>
- Northeast Regional Climate Center  
<http://www.nrcc.cornell.edu/>
- Palmer Drought Index  
<http://www.drought.gov/nadm/content/palmer-drought-indices>

## 3.0 DROUGHT STAGES & RESPONSE

### 3.1 Descriptions of Drought Stages

A series of four stages of drought management will be used to guide LWD through the levels of action needed. These are based on the severity of a particular water shortage or drought. A drought stage level can change in one of three ways after it has been reached. If conditions reach one of the criteria for the next drought level, the severity will be increased. If conditions persist, but do not reach the next level, the drought response will remain constant. If conditions improve, the severity can be reduced based on either site-specific information or on progress toward returning to normal. Mitigation measures are described in more detail in the following section.

American Water Works Association (AWWA) recommends managing water demand during a water shortage with a staged or phased approach, with increasing levels of savings in each successive phase. Efforts made to reduce water consumption in the first three stages will save residents and businesses from the potential hardships of extreme water shortages.

**Stage 1 – Voluntary:** The Voluntary Stage will be implemented when dry weather or low groundwater conditions are predicted or likely. Public notices and press releases about the dry weather situation will be increased. The purposes of this phase are to advise customers of the potential for dry weather conditions and to request voluntary conservation measures. Methods to appeal to the public may include: radio, cable television, newspapers, printed flyers, and bill stuffers. The demand reduction goal in this Stage is 10%-15% water use in comparison to the average use for that time of year.

Voluntary conservation measures include but are not limited to:

1. Reduce the watering of lawns and landscaping.
2. Water in the early morning.
3. Raise the height of your mower to 3-inches or more.
4. Use mulch to maintain moisture around plants.
5. Consider planting drought-tolerant plants.
6. Do not hose down your sidewalk or driveway.
7. Verify your home is leak free.
8. Install a water displacement device to reduce the amount of water needed for each flush or replace the toilet with low-flow alternative.
9. Store drinking water in the refrigerator.
10. Don't let the water run while brushing your teeth, shaving or washing your face.
11. Avoid flushing the toilet unnecessarily.
12. Reduce the duration and/or frequency of bathing, and use the shower rather than bathtub.

**Stage 2 – Twice per Week:** The Twice per Week Stage will be implemented when dry weather conditions persist or worsen and the voluntary conservation measures requested in Stage 1 have not reduced water demand or usage to sufficient levels in order to sustain the reliability of LWD’s water resources. The Twice per Week Stage will also be automatically implemented May 1<sup>st</sup> and continue to September 30<sup>th</sup> in accordance with Department’s Water Management Act permit restrictions. The Department-approved twice-per-week irrigating days are listed on the Department’s website. Methods to appeal to the public may include: radio, cable television, newspapers, printed flyers, and bill stuffers. The demand reduction goal in this Stage is 15%-25% water use. The Department will recommend additional and more restrictive voluntary conservation measures. Recommended conservation measures are listed below.

Voluntary conservation measures in Stage 1 will include a press release—plus the following Mandatory Restrictions:

1. Residential and business customers to follow a two-day even/odd watering schedule.
2. Irrigation watering only between 7:00 PM and 7:00 AM on each allowable watering day.
3. Hand watering only between 6:00 PM and 9:00 AM.
4. No day of the week restrictions for new lawns installed in June and September.
5. No washing of vehicles except in a commercial car wash or for operator safety;
6. No washing of exterior building surfaces, parking lots, driveways or sidewalks, except as necessary to apply surface treatments such as paint, stain, or stucco.
7. Newly constructed or existing public and private swimming pools, which include outdoor hot tubs, spas and Jacuzzis, may be filled once upon completion.
  - a. A one-time draining and subsequent refilling of swimming pools is allowed only for repairs if conditions threaten the integrity of the pool and/or its supporting structures.

**Stage 3 – Once per Week:** Implement the Water Use Restriction By-Law adopted by the Town of Lincoln and institute a one-day per week outdoor watering restriction. The by-law establishes enforceable limitations on the use of municipal water during periods of water shortages or drought conditions. The purpose of the by-law is to protect, preserve and maintain public health, safety and welfare when water supply conservation is mandated or water supply emergency has been declared. The demand reduction goal in this Stage is 25%-40% water use. A press release will be sent to all media.

Conservation measures in Stage 1 and Stage 2 plus the following Mandatory Restrictions:

1. Customers will be allowed to water established lawns and landscaping one day per week using in-ground irrigation systems or hose-mounted sprinkler between the hours of 7:00 PM and 7:00 AM.
2. Customers will be allowed to hand water using a hose with a nozzle any day of the week between the hours of 6:00 PM and 9:00 AM.
3. No watering between 9:00 AM and 6:00 PM

4. Exceptions from the watering restrictions for new lawns are allowed only during June and September and will be limited to watering during the first 20 days after installation.
5. Swimming pools may be filled no more than three inches per month.
6. Car washes, including fundraisers, are prohibited.

**Stage 4 –Complete Ban:** The Complete Ban Stage will be implemented when extreme drought conditions have caused significant adverse impacts to the reliability of water resources and the ability of the LWD to adequately supply and meet future demands or usage requirements of its customers, and public health and safety are at risk. The demand reduction goal in this Stage is greater than 40% water use. A press release will be sent to all media.

Conservation measures in Stages 1, 2 and 3 plus the following Mandatory Restrictions:

1. No establishment of new lawns.
2. No use of underground sprinkler & above ground sprinklers attached to hoses (private irrigation wells excluded).
3. No use of soaker hoses.
4. No games or toys with a continuous stream of water, including water slides and sprinklers.
5. No washing vehicles, cleaning outdoor surfaces, cleaning buildings, equipment and machinery and operating ornamental fountains.
6. No topping-off of swimming pools.

#### ALLOWABLE OUTDOOR USES

1. Handheld Hose: Handheld hose watering is permitted from 6:00 PM to 9:00 AM.
2. Drip irrigation systems: Odd/Even watering based on address  
(Check Department website for posted days).
3. Children's Wading Pools: To fill the pool only.

### 3.2 Public Education & Communication

Public education and outreach during a water supply shortage is a critical component of the drought management plan. The dissemination of information regarding the existing water supply shortage and current water demand will help the customers understand the need to curtail water usage so that water-use reduction goals can be achieved. Keep in mind that the water supply situation is unpredictable and may change month-to-month. Even as precipitation increases, the effect on the water supply may not be immediate.

Initially, the Board of Water Commissioners will be notified by the Water Department Superintendent of the need to implement the Drought Management Plan, what actions are recommended, including a

request to all municipal users to curtail water consumption. Frequent briefings to the news media; including postings on the town website, public service announcements, postings on electronic display boards positioned on main roads in town, postings in the local newspapers, and telephone outreach via the Town's Reverse 911 system will be made to ensure timely and accurate communication. Appeals to the general public for water conservation will be made on a regular basis, with updates on the situation of the water supply, proposed actions and actions already taken to mitigate supply shortages, and how well customers are meeting the intended goals.

### **3.3 Drought Plan Enforcement**

Enforcement of the water use restrictions put in place based on Stage 2 through Stage 4 of the Drought Stages will be in accordance with Article 9, Section 14 of the Water Restriction By-Law, which states the following, "any person violating this by-law shall be subject to a warning for the first offense and thereafter shall be liable to the Town in the amount of \$50 for the second violation and \$100 for each subsequent violation...".

In accordance with the Department's Rules & Regulations, the Water Commission may order the supply of water shut off from any water taker found in violation of mandatory water use restrictions.

### **3.4 Variances**

The Water Commissioners may grant Temporary Watering Variances for existing water uses otherwise prohibited under this Drought Management Plan to a customer if one or more of the following conditions are met:

- Failure to grant such a variance would cause an emergency condition adversely affecting health, sanitation, or fire safety for the public or person requesting the variance.
- Compliance with this plan cannot be accomplished due to technical or other limitations.
- Alternative methods that achieve the same level of reduction in water use can be implemented.

Variance applications shall be granted or denied at the discretion of the Water Commissioners. All petitions for variances shall be submitted in writing to LWD at 16 Lincoln Road, Lincoln MA 01773. Applications should include the following information:

- Name and address of petitioner(s)
- Purpose of water use
- Specific provisions from which relief is requested
- Detailed statement of the adverse effect of the provision from which relief is requested

- Description of the relief requested
- Period of time for which the variance is sought
- Alternative measures that will be taken to reduce water use
- Other pertinent information.

Written notification of variance revocation will be issued by the LWD Superintendent if:

- The conditions are no longer applicable
- The terms of the compliance agreement have been violated
- Revocation is necessary to protect health, safety, or welfare of the public or any person.

### **3.5 Termination of Drought Response Stage**

Downgrading or termination of any stage will take place when the percent reservoir capacity of Flint's Pond reaches a level that is five (5) percentage points above that Stage's trigger for that time period (assuming we use a monthly adjusted trigger water level) and remains at least five (5) percentage points above that stage for 30 consecutive days. The Commissioners may vote to modify this rule, at their discretion.

As actual and forecasted supply conditions improve, the Town may move to a lower drought Stage or return to "normal use." The public and water customers will be notified of current drought conditions and the reduction in drought levels. A given drought action level can change when the conditions that led to the specific emergency have ended.

## 4.0 DROUGHT TRIGGERING LEVELS

Conservative indicators are set on numerical values for the drought/demand indicator points in order to prevent a failure of the Town water system and limit the need to introduce elevated restrictions. The greatest demand is during the summer when the weather is warmer and when evapotranspiration is highest. Simultaneously, increased amounts of water are being used for outdoor water uses such as watering lawns. The water consumption in the summer season generally increases by 75-100% compared to the winter season. It is mandatory that consumption be limited during this season or any other time of reduced or limited supply such as an instance of severe fire usage or major water break.

Establishment of the drought indicators is one of the key steps in the DMP. The indicators are set by guidelines in the form of stages that indicate the severity of the drought. Once one of the indicator thresholds is hit, the new stage goes into effect in order for the Town to control water demand to an amount that the Town can reasonably supply during the stressed period, unless the Commissioners decide to modify specific aspects of the drought response. It must be emphasized that the response to a given drought stage is at the discretion of the Commissioners. The guidelines herein will be used by the Commissioners in their deliberations. They are not hard and fast rules to automatically take effect without the decision of the Commissioners.

Since the concept of drought is defined as demand exceeding supply, drought indicators are measurements of both parameters.

### 4.1 Total Water Demand

Lincoln's water demand is critical when establishing the DMP. The DMP is designed to sustain the long-term use of the Town water supplies. The following levels will determine the drought stage that would need to go into effect. For example, if the water demand increases above 0.8 MGD, then the Advisory Stage will take immediate effect. The goal is to remain in an operating zone of less than a 0.8 MGD seven day average water demand.

Stage	Level	Water Use 7-Day Average (MGD)
Stage 1	Voluntary	0.8 - 0.9
Stage 2	Twice per Week	0.9 – 1.0
Stage 3	Once per Week	1.0 – 1.1
Stage 4	Complete Ban	Greater than 1.1

#### 4.2 Flint's Pond Water Level

Flint's Pond is full at 233.2 feet (elevation) and represents the use of three 2x6-inch pressure treated stop logs in the dam. The top of the stainless steel intake structure is 223.0 feet. The various phases of the drought management plan would be triggered based on the level (measured in feet) of the reservoir. See Figure 6-2.

<b>Stage</b>	<b>Drought Level</b>	<b>Trigger Level (7-day average), feet</b>	<b>Gauge Measurement (feet)</b>
Stage 1	Voluntary	230.5 – 230.0	7.5 – 7.0
Stage 2	Twice per Week	230.0 – 229.5	7.0 – 6.5
Stage 3	Once per Week	229.5 – 229.0	6.5 – 6.0
Stage 4	Complete Ban	<229.0	Less than 6.0

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Stage 1	72%	75%	78%	82%	87%	87%	84%	81%	76%	72%	70%	68%
Stage 2	65%	68%	71%	75%	80%	80%	77%	74%	69%	65%	63%	61%
Stage 3	58%	61%	64%	68%	73%	73%	70%	67%	62%	58%	56%	54%
Stage 4	51%	54%	57%	61%	66%	66%	63%	60%	55%	51%	49%	47%
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Stage 1	-2.80	-2.50	-2.20	-1.80	-1.30	-1.30	-1.60	-1.90	-2.40	-2.80	-3.00	-3.20
Stage 2	-3.50	-3.20	-2.90	-2.50	-2.00	-2.00	-2.30	-2.60	-3.10	-3.50	-3.70	-3.90
Stage 3	-4.20	-3.90	-3.60	-3.20	-2.70	-2.70	-3.00	-3.30	-3.80	-4.20	-4.40	-4.60
Stage 4	-4.90	-4.60	-4.30	-3.90	-3.40	-3.40	-3.70	-4.00	-4.50	-4.90	-5.10	-5.30

#### 4.3 Tower Road Well Water Level

The groundwater level at the well with respect to the top of the screened interval is important in order to prevent water being drawdown below the screen level while the well is operating and entraining air into the water supply. Air entrainment also has the potential to damage the well pump. If drawdown gets to 10 feet or below, the Department will determine if an emergency well cleaning is required to potentially increase the specific capacity of the well (i.e. reduce the drawdown).

Stage	Drought Level	Trigger Level, feet above screen
Stage 1	Voluntary	>15
Stage 2	Twice per Week	15
Stage 3	Once per Week	10
Stage 4	Complete Ban	5

#### 4.4 State & Government Agencies

The DCR website lists the current Drought Status, as recommended by the Drought Management Task Force. The Task Force provides drought declarations using the following categories: Normal, Advisory, Watch, Warning, and Emergency. Each category has separate criteria that the seven environmental indices must meet in order to make that declaration.

#### 4.5 Drought Trigger Summary

Below is a summary table for the three drought triggers stated earlier that will be monitored by the Town on a predetermined basis in order to decide the drought stage and corresponding conservation measures to be implemented to achieve the water use reduction goals established by the Town. Local conditions will supersede the general conditions reported by state and federal agencies.

	Drought Level	Total Demand (MGD)	Flint's Pond (feet)	Tower Rd. Well (feet)	Gauge Measure. (feet)	MA DCR Drought Status
Stage 1	Voluntary	0.8 – 0.9	230.5 – 230.0	>15	7.5 – 7.0	Advisory
Stage 2	Twice per Week	0.9 – 1.0	230.0 – 229.5	15	7.0 – 6.5	Watch
Stage 3	Once per Week	1.0 – 1.1	229.5 – 229.0	10	6.5 – 6.0	Warning
Stage 4	Complete Ban	Greater than 1.1	< 229.0	5	< 6.0	Emergency

#### 4.6 Drought Plan Monitoring

Observation periods vary depending on the month of the year and the drought stage the Town is currently in. The recommended observation frequency increases during the summer months due to the increased likelihood of higher demand that is normally associated with this season, therefore it is

important that the data be monitored more frequently. As the Drought Stage changes the frequency of observation also changes.

<b>Drought Stage</b>	<b>Drought Level</b>	<b>Frequency – Flints Pond Level</b>	<b>Frequency – Tower Road Level</b>	<b>Frequency – Daily Flow Total</b>
Stage 1	Voluntary	Daily	Monthly	Monthly
Stage 2	Twice per Week	Daily	Monthly	Monthly
Stage 3	Once per Week	Daily	Daily	Daily
Stage 4	Complete Ban	Daily	Daily	Daily

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