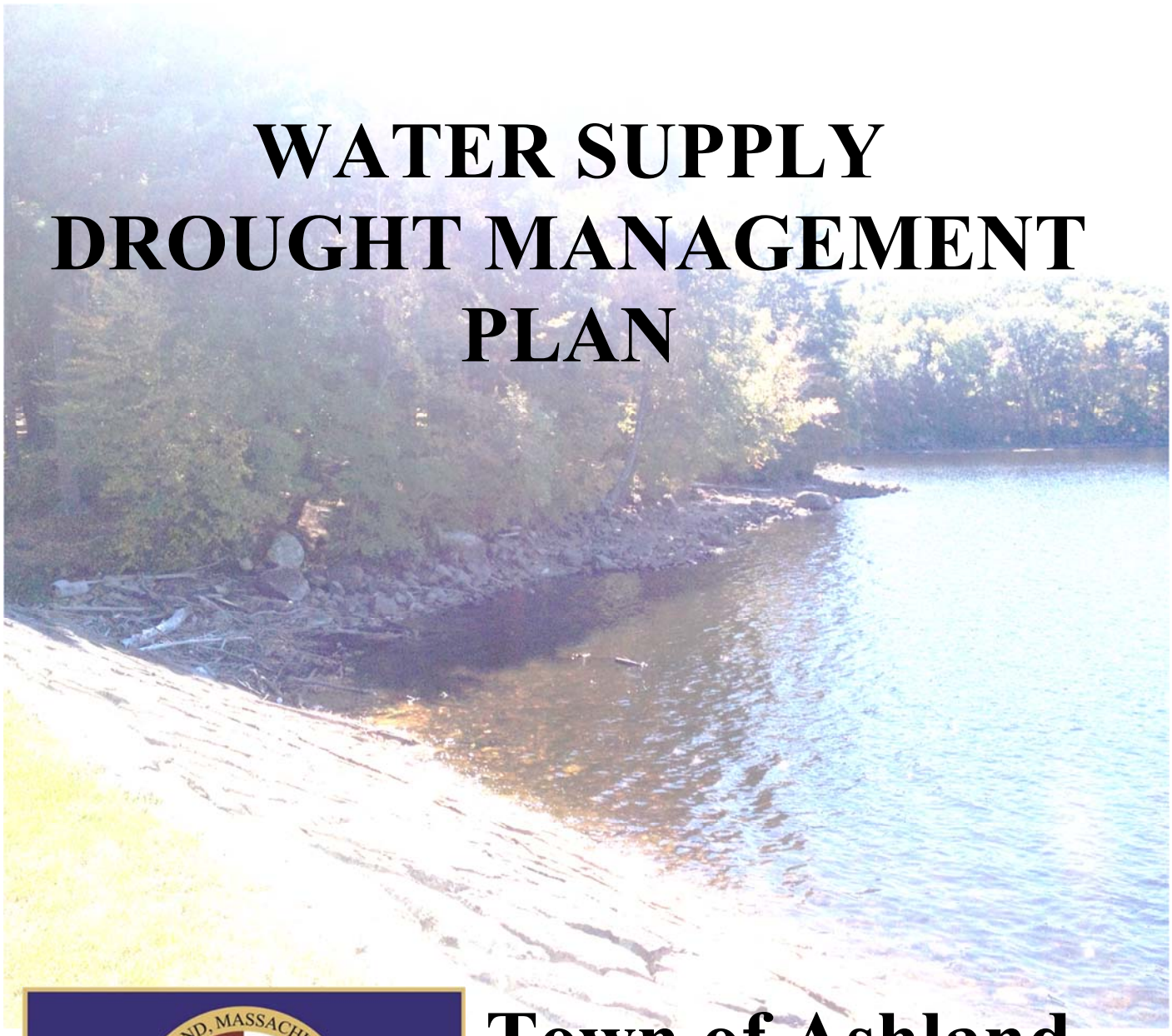
WATER SUPPLY DROUGHT MANAGEMENT PLAN



Town of Ashland

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1.0 MISSION STATEMENT

The Ashland Drought Management Plan (DMP) is a document that is intended to provide a level of protection for the environment while preserving essential public services, public health and safety, typical lifestyles for the Town of Ashland and economic activities.

Drought conditions are out of the control of the water supplier, the DMP provides tools for Ashland to minimize adverse impacts of the drought condition on the Town of Ashland water customers and the environment.

2.0 AUTHORITY

Ashland has adopted a town By-Law that restricts water use during certain drought conditions. In that By-Law several drought indices are described. The By-Law is included under Chapter 270 of the town's By-Laws and can be viewed online at https://ecode360.com/13018247. Additionally, the following authorization text is found in Section 8 of the 2013 Massachusetts Drought Management Plan.

Local Municipal Governments: *Local governments are critically important to managing drought situations and assessing the impact of drought situations. Municipal governments that own, operate or oversee a public water supply are responsible for putting in place either voluntary or mandatory water use restrictions. State level response to droughts is premised on the assumption that local authorities are taking all necessary action to manage drought situations and to protect public health and the environment.*

Municipalities are authorized to adopt and implement bylaws in appropriate circumstances. For example, they may regulate public water supply pipes or to manage their prudential affairs and preserve peace and good order under their police powers, pursuant to G.L. c. 40, § 21, and c. 41, § 69B. Municipalities, which have established water supply or distributing systems, may regulate through such bylaws the use of water from the municipal system. Further, when MassDEP determines that an emergency exists in the case of a drought or disaster, a municipality may, following appropriate notice, regulate or otherwise restrain the use of water on public or private property (regardless of whether the supply source is public or private) pursuant to G.L. c. 40, § 41A. Municipalities, particularly those that experience chronic water shortages, are encouraged to promulgate bylaws to address necessary rules for responding to an actual or threatened drought condition.

In the event of a declared emergency, a municipality may, generally, raise, appropriate, and expend money for the purposes of maintaining, distributing and providing at reasonable rates a sufficient supply of the common necessities of life, which includes water.

3.0 INTRODUCTION

The Ashland DMP is a document that the Ashland Department of Public Works will implement through their Water and Sewer departments. Ashland's ability to meet system water demand has been impacted by drought conditions over the years.

In 2005 severe drought conditions caused the gravel packed wells to "dry-up", FOR THE FIRST TIME, during the late summer-fall season. The water level in the wells dropped to severe low level where the vertical turbine pumps had to be shut down to allow recovery during the day. Ashland implemented a strict water ban on the community to preserve essential public services, public health and safety, economic activities and more importantly fire protection. As a result of the severe drought condition, Ashland declared a Water State of Emergency and received approval from the Massachusetts Department of Environmental Protection Agency (DEP) to install an emergency water interconnection with the Town of Southborough. The interconnection allowed Ashland to meet system demand patterns while allowing the Howe Street gravel packed wells to recover on a daily basis.

The emergency connection was activated on several occasions for short durations during drought conditions, which allowed them to meet system demand.

Ashland has exhausted all options for finding additional water supply sources within the Town borders that would provide a reliable water supply during the drought conditions, especially in the fall season. The one remaining option that would guarantee water availability under any condition, including severe drought conditions, is an interconnection with Southborough, to operate as a supplemental water supply to the Howe Street wells during severe drought and low groundwater conditions.

The Ashland DMP will provide the Town with a tool box for minimizing drought condition effects on Ashland water supplies, groundwater and surface water. The DMP will provide actions to take in response to drought conditions that may or have caused a water emergency. Examples of drought conditions (indicators) for Ashland include but not limited to decreasing Hopkinton reservoir water levels, groundwater water supply well levels, water storage reservoir levels, precipitation conditions. Each of the conditions (indicators) discussed above can have triggers to provide warning signals or benchmarks for impending water shortage.

The tool box will also identify actions that Ashland can implement to minimize the effects of a drought on the environment including ground and surface waters.

4.0 OVERVIEW OF ASHLAND'S WATER SUPPLY

Ashland's present water supplies reside at the shores of the Hopkinton Reservoir in the form of five (5) gravel packed wells that serves the municipal water distribution system. In addition to the Ashland public water supplies, there are a number of private wells utilized by individual properties for domestic water use.

Ashland has obtained approval to construct an Indirect MWRA water connection through the Southborough water system. It is anticipated that that connection will be constructed during 2019.

4.1 Howe Street Water Supplies

Howe Street water supply consists of five (5) gravel packed groundwater wells located along the shore of the Hopkinton reservoir. The water supplies discharge to the Howe Street water treatment facility prior to entering the Ashland and Hopkinton water distribution system.

The water supplies have registration and permit authorized withdrawal limits under the Water Management Act as summarized below.

<table>
<tr><th rowspan="2">WELL NO.</th><th rowspan="2">AUTHORIZATION TYPE</th><th colspan="2">REGISTRATION LIMIT</th><th colspan="4">WMA PERMIT LIMITS</th></tr>
<tr><th>AVERAGE DAILY (MGD)</th><th>ANNUAL MAX. (MGY)</th><th>AVERAGE DAILY (MGD)</th><th>MAX DAILY (MGD)</th><th>ANNUAL MAX (MGY)</th><th>WTP MAX DAILY (MGD)</th></tr>
<tr><td>4</td><td>Registration</td><td rowspan="2">1.23</td><td rowspan="2">448.95</td><td></td><td></td><td></td><td rowspan="5">5.9</td></tr>
<tr><td>5</td><td>Registration</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>WMA Permit</td><td></td><td></td><td rowspan="3">0.95</td><td>0.86</td><td rowspan="3">164.25</td></tr>
<tr><td>7</td><td>WMA Permit</td><td></td><td></td><td>2.16</td></tr>
<tr><td>8</td><td>WMA Permit</td><td></td><td></td><td>2.16</td></tr>
</table>

Each well is a gravel packed well with depths in the range of 36ft to 40 ft below ground level. Typical well water levels in each well, when pumping is 7-14 feet below typical Hopkinton Reservoir water levels.

Static water levels are relatively equal to the water levels in the Hopkinton reservoir, Typical static well water levels are approximately 20 feet above the pump inlet.

Each well utilizes a vertical turbine pump to deliver water to the Howe Street water treatment plant. Variable frequency drives control the power to each pump motor to allow operators to control the pump discharge rates.

4.2 Howe Street Water Treatment Plant

The site includes a Water Treatment Plant to treat groundwater wells and utilizes high lift pumps to deliver water to Ashland and Hopkinton

- The Howe Street water supply well field retains an authorized maximum daily withdrawal limit of 5.9 MGD

Howe Street WTP utilizes a SCADA system for 24/7 monitoring, controlling and alarm monitoring. This includes well water level, discharge pressure, water storage tank water levels and Hopkinton Reservoir water levels.

Ashland utilizes a private firm to operate and maintain the Howe Street WTP through a Water Treatment Plant Contract Operations contract. Operators are on site 7 days per week 6:00 a.m. to 2:00 p.m. Typical staffing is between 2-3 operators.

4.3 Ashland Water Storage Facilities

The Ashland water system includes two water storage facilities to maintain system pressure and fire protection.

The Woodridge Reservoir is a concrete reservoir constructed in 1989 with a capacity of 4.3 million gallons, wall height of 22 feet and diameter of 182 feet.

The Cedar Street Standpipe is a welded steel structure constructed in 1968 with a capacity of 2.6 million gallons, wall height of 87 feet and diameter of 72 feet.

Woodridge water tank water level is used to control the “on-off” cycling of the Howe Street WTP high lift pumps.

- 17.3 ft – pumps on
- 21.3 ft – pumps off
- 21.5 ft overflow

Woodridge Reservoir
4.3 MG

Cedar Street Standpipe
2.6 MG

4.4 Relationship Between Water Supply And Water Storage

The Howe St. WTP delivers water to the Ashland water customers and maintains water levels in both water storage facilities. As demand decreases, storage facility levels increase until WTP is not needed. Water demand is satisfied by storage facilities until the level decreases to the "on" set point for the high lift pump(s) at the WTP.

The MWRA indirect water connection through Southborough, when constructed, will include a control valve that will be connected to the Ashland SCADA system. The SCADA will open and close the valve based on tank levels. All controls are automated through a computer-based SCADA system that monitors and controls the water system 24/7.

Fire demand is satisfied by the water storage facilities and Howe St WTP high lift pump and in some cases the MWRA indirect water connection.

Inability to meet peak demand with Howe Street WTP and water storage facilities will result in one or more of the following.

- Severe decrease in Water Storage Facility water levels;
- Decrease in Water System Pressure; and
- Decrease in available Fire Protection.

4.5 Distribution System

The Ashland distribution system consists of approximately 80 miles of water mains to distribute water their water customers, fire hydrants and the two water storage facilities.

Ashland's distribution system consists of approximately 80 miles of water mains from 2" diameter to 18" diameter and various materials from asbestos cement pipe to cat iron to ductile iron. Records indicate the oldest water mains were installed in 1957.

Ashland reads 7,158 total user accounts with 6,933 residential water meters.

In 2018, the Howe Street water supply discharged an average daily volume of 1.70 mgd through the water treatment plant with a maximum day of 3.164 mg and an annual volume of 569.509 mgd. The Town's water demand in 2018 consisted of 327.44 mgy for residential use, followed by 28.73 mgy for commercial, 4.88 mgy for municipal/institutional/non-profit and 21.04 mgy for industrial.

The 2018 Annual Statistical Report listed 33.0 mgy of unaccounted for water or 7.7%. The 2018 Residential Gallons per Capita Day water use was 54 gallons per day.

5.0 DROUGHT MANAGEMENT HISTORY

5.1 General

Ashland has implemented drought management tools over the years; however a written document was not prepared until this document was required by the Environmental Notification Form process for the construction of an indirect water connection to the Massachusetts Water Resources Authority (MWRA).

The Town operates the Howe Street Treatment plant 365 days a year and the volume discharged to the water system depends on the Ashland water consumer demand patterns for any given day. Presently there are no alternative viable water supplies available to meet Ashland water demands during all seasonal conditions including low groundwater conditions. Therefore, Ashland implemented strict outdoor water use restrictions that goes above and beyond the typical MassDEP Water Management permit "use restriction" conditions, to reduce water demand to maintain adequate water supply to its customers during all seasonal conditions, especially low groundwater periods. Ashland also encourages other water conservation efforts to reduce overall water use throughout the year.

5.2 Water Conservation Measures

Water Conservation Measures incorporated into this Drought Management Plan encourage water conservation and protection of water resources. Ashland's Water Conservation Measures that play an active role in the Ashland Drought Management Plan include, but not limited to, the following.

1. UAW Reduction Program – Leak Detection
2. Water use restrictions based on environmental conditions
3. Public buildings maintaining low volume fixtures
4. Rain barrel program
5. Public Education
6. Tiered water rate structure to promote water conservation
7. Zoning restrictions
8. New Development Controls

UAW Reduction Program: Ashland utilizes the services of a sub-contractor to conduct system wide leak detection annually. A leak report is generated, and the Town makes arrangements to fix the identified leaks in-house or contract out for larger repairs the same year. Ashland endeavors to have a leak detection survey completed annually on the entire distribution system and fix the repairs in a timely manner. Table 5-1 summarizes the last 5 years of leak detection results.

Table 5.1 Leak Detection Historical Summary

YEAR	NO. OF LEAKS IDENTIFIED	NO. OF LEAKS REPAIRED	GALLONS ASSOCIATED WITH THE LEAKS (MGY)
2018	8	8	31
2017	NA	NA	NA
2016	5	5	21.1
2015	10	9	105.00
2014	9	9	32.12

NA: Leak detection was not conducted during 2017

Ashland continues to conduct leak detection and apply funds towards water main replacement projects and an effort to reduce and eventually eliminate the large amount of asbestos cement water pipe in the system.

Ashland reports Un-Accounted for Water (UAW) on their Annual Statistical Report (ASR). The following table summarizes the UAW Ashland reported for last four (4) years. As seen in the data, the UAW has consistently dropped to below the performance standard of 10%. Ashland performs leak detection annually and repairs all of the leaks found. Because leak detection relies on the use of hydrants to "listen" to leaking water, the Town is also performing an investigation of cross-country easements where traditional leak detection is not as effective. To

better measure actual water used by customers, the Town appropriates funds each year to replace non-radio read meters, approximately 6,800 remaining, to bring all meters up to date and reduce un-metered water through use meters. To replace all meters the estimated costs is over $1 million, which at this time is not feasible for the Town of Ashland at this time. The reduction in UAW can be directly related to the meter replacement program and an aggressive leak detection, leak repairs, meter replacement and water use restrictions. Table 5-2 summarizes the UAW data included in the Ashland ASRs.

Table 5-2 Ashland Historical UAW

Year	UAW %	Gallons (MG)
2018	7.7	33.0
2017	8.2	35.1
2016	8.7	38.7
2015	15.6	75.6
2014	16.3	80.2

Water Use Restriction: Ashland holds a Water Management Permit for the Howe Street wells, which includes water use restrictions. Ashland has modified the restriction to be more aggressive toward reducing non-essential water use through restricting water usage for outdoor purposes year-round. Ashland imposes year-round water use restrictions regarding irrigation on an odd-even basis. The Ashland Water Use restriction By-Law has increasing restrictions depending on two further stages of water restrictions. The water use restrictions are posted on the Town's website. The current reservoir level is updated at the following web page: http://www.ashlandmass.com/167/Water-Conservation-and-Restrictions

During the STAGE 1 and STAGE 2 restrictions The Town publishes information through an electronic message board at the center of the town and signage at major primary roads notifying public about the restrictions on water usage. Ashland posts a public notice in local newspaper and the Town's websites. The Town also provides information about water usage violations and penalties by providing a link to the Town By-law.

Public Building Low Flow Fixtures: All Town public buildings have low flow plumbing fixtures, these include: Toilets, sinks, urinals and in some buildings showers as well.

Rain Barrels Program: The Town collaborates with the Great American Rain Barrel Company and provides discounts for barrel purchases through the Town's DPW. Ashland has available, for the public, water conservation pamphlets at the Town offices.

Public Education: Ashland has developed a public education program to educate water users on how to conserve water and the benefits of conserving water. Educational materials for water users include information concerning the use of rain barrels by advertising every year on "Green-up" day in early spring. The Town provides information to promote water conservation and the use of water conserving devices in the local newspaper "Ashland Directions

Low Flow Fixture Program: Ashland has developed a program to supply low flow fixtures to residential customers. The Town of Ashland hosts "Green – up" day every year and the Town has a booth set up to distribute the Massachusetts Water Resources Authority information on low flow plumbing fixtures and samples.

In addition to the fixture program, every building in town goes through a plumbing inspection per code when built, renovated or added. The Town of Ashland Plumbing inspector handles all inspections. The Town of Ashland Water General Foreman inspects to ensure plumbing is per code at all finals when properties are sold.

Water Rate Structure: Ashland water and sewer rates are set to recover the full cost of providing water and sewer service to their customers. The present sewer rates are set to recover not only Ashland operation and maintenance costs related to the sewer system, but also the MWRA assessed costs for sewer discharge. Ashland will set new water rates when the MWRA connection is approved and placed into service. The new rates will be set to cover all water related costs including MWRA related sewer usage charges.

Ashland presently maintains a tiered water rate structure intended to encourage reduction in non-essential water use, especially lawn watering. The tiered rate program has the highest rate ($6.37 per 100 CF) more than twice the lowest rate ($3.03 per 100 CF) to encourage water conservation. It also uses the highest rate for secondary (irrigation) meters. Ashland also bills their customers quarterly, which also encourages water conservation, as customers see their bills more often. The present rate structure is summarized in Table 5-3.

Table 5-3 Water Rates Effective July 1, 2018

Service	Base Fee	1st 999 CF	Next 3,000 CF	Next 5,000 CF	Excess over 9,000 CF
Water	$16.00	$3.03/unit	$3.46/unit	$5.14/unit	$6.37/unit

1 unit = 100 cubic feet (CF) = 748 gallons

Zoning Restrictions: Ashland has adopted measures to protect their water supply sources currently serving the receiving area that meet the requirements of the Department of Environmental Protection wellhead protection regulations in 310 CMR 22.21. Source water protection recommendations per the Mass DEP were implemented in the Town of Ashland through a Groundwater Protection Overlay District (GPOD). See ***Error! Reference source not found.*** for the Ashland GPOD zoning by-law and zoning Map.

New Development Controls: Ashland, in 2007 adopted a Stormwater By-Law to regulate activities that result in disturbance of land to safeguard the health, safety, and welfare of the general public and protect the natural resources of the Town. The regulation requires new development, redevelopment and all land conversion activities maintain the after-development runoff characteristics as equal to or less than the predevelopment runoff characteristics.

6.0 DROUGHT INDICES

Ashland has developed five drought indicators for this DMP; 1) Hopkinton Reservoir Water Level, 2) Howe Street Water Supply Water Level, 3) Water Storage Tank Water Level, 4) water System Demand and 5) State Drought Indices. Ashland has been dependent on indices 1&2 for past drought condition responses prior to the development of this written DMP. Prior to this written DMP Ashland had procedures in place to modify operations to minimize drought condition impacts. In addition, they had developed procedures to reduce overall water system demand to minimize impacts from drought conditions.

6.1 Hopkinton Reservoir Drought Index

Ashland's Howe Street water supplies are located along the shores of the Hopkinton Reservoir. The water supplies are groundwater wells that reflect water level changes in the Hopkinton reservoir. Although not proven that the groundwater wells draw 100% of the water from the Hopkinton reservoir it can be said that a larger percentage of the water is drawn through the bottom of the reservoir with the remaining coming from the overall groundwater aquifer.

The Hopkinton reservoir inflow consists of precipitation, surface runoff and groundwater aquifer. Hopkinton reservoir outflow consists of evaporation, release to the Ashland State beach, release to Indian Brook and groundwater well withdrawals.

Drought Triggers (Indicators) for the Hopkinton Reservoir are water levels in the Hopkinton reservoir as measured by an electronic water level transducer installed near the Howe Street water treatment plant. WTP operators maintain the level transducer that allows the level to be displayed on the computer system at the WTP. This allows the operators to monitor the reservoir level on a continuous basis, both actual and historical levels.

The picture shows the control gate structure in the earthen dam at the Hopkinton Reservoir, which is the location where the WTP operators manually measure reservoir water level and report same to DCR.

Table 6-1 identifies historical reservoir levels that caused significant concern for public health, fire protection, and infrastructure damage.

Table 6-1 Hopkinton Reservoir Historical Levels

Water Use History – Contd.

YEAR	Reached 295.85 or lower (Stage 1)	Reached 295.35 or lower (Stage2)	Reached 293 or below – Stress on the wells at the plant
2007	7/28/07	8/6/07	9/11/2007 until 1/16/2008
2008-Early09	1/18/09	1/20/09	Not reached
2009-Early10	1/15/10	Did not reach Stage2	Not reached
2010	7/23/10	8/2/10	9/20/2010 until 12/06/2010
2011-Early12 (Spot data only)	2/22/12	3/08/12	Not reached
2012	8/1/12	8/8/12	Not Available
2013	8/14/13	8/21/13	10/21/13 to 12/24/13
2014	8/10/14	8/31/14	Not reached
2015	8/28/15	9/1/15	Not reached
2016	7/25/16	8/2/16	9/25/16 to 10/26/16

2007

2010

2013

2016

Times when the reservoir levels caused significant concern for public health, fire protection, and infrastructure damage

Hopkinton Reservoir Index is the primary trigger for drought condition. The actual triggers will be discussed later in Section 7.

6.2 Howe Street Water Supply Wells

Ashland maintains five (5) groundwater supply well at the Howe Street site (wells 4-8) along the shores of the Hopkinton Reservoir. At the time of this DMP preparation, the Howe Street Water Treatment Plant, located at the Hopkinton Reservoir, is Ashland's only non-emergency water source. The water supplies are groundwater wells that reflect water level changes in the Hopkinton reservoir. Although not proven that the groundwater wells draw 100% of the water from the Hopkinton reservoir, it is possible that a larger percentage of the water is drawn through the bottom of the reservoir with the remaining coming from the overall groundwater aquifer.

Ashland's Howe Street Water Management Act permit includes seasonal restrictions to manage groundwater and surface water quantity and quality in and around the Hopkinton Reservoir. The 2001 permit had "2 Major" conditions: Water Use Restriction & Well Shut Down. Quantity of water in the Hopkinton Reservoir determines type/duration of use restriction and well shut down.

- As precipitation reduces, surface/ground water levels reduce
- June to August, DCR attempts to maintain the reservoir at 296.35' (2 ft below spillway).
- Reservoir level is continuously monitored by WTP operators and the Levels are reported to Water Division and DCR staff.
- Use restrictions vary depending on reservoir levels
- Water use restrictions at 295.85' reservoir level. Permit includes Well # 7 & #8 to be shut down at 295.35' reservoir level – 3 feet below spillway.

Howe St groundwater wells draw water in from the surrounding aquifer. The aquifer also supplies storage for the Hopkinton Reservoir. The aquifer recharges from precipitation (Stormwater run-off) and Hopkinton Reservoir (surface water).

As precipitation reduces, and drought conditions begin, surface water and ground water levels reduce. Ashland monitors the water level in each groundwater well through a SCADA system. The operators can review historical trends for each well to identify the Groundwater Well drought trigger. Ashland has experienced groundwater well levels where they had to shut down well pumps due to low groundwater levels. In some cases, days are required to allow a well to recover before pumping.

The groundwater well water level is a secondary index, as the primary index is the Hopkinton Reservoir water levels. The reservoir triggers will be activated before the groundwater well levels become an issue. Water use restrictions would be in place ahead of the low groundwater levels. The water supply well index is a trigger for activation of an emergency water connection to a neighboring community water system. Once the MWRA indirect connection is completed the water supply index will be one trigger to activate the MWRA connection. See section 7.2 for description of the By-Law that controls the use of the MWRA indirect water connection.

6.3 Water Storage Tank Water Level Index

Ashland utilizes two water storage tanks with the Woodridge reservoir water level controlling the operation of the Howe Street high lift water pumps that discharges water into the water distribution system. As the system demands draw down the water levels in both water storage facilities, the Howe Street high lift pumps are turned on to meet demand and fill the water storage facilities and maintain water pressure in the water system.

The Woodridge water storage facility water level typically drops to 17.3 ft and the computer system turns on the gravel packed well and WTP high lift pump to meet demand and refill the water storage facilities.

Ashland water distribution system provides drinking water to residential, commercial, industrial and municipal properties. A majority of the water meters are for residential accounts. Ashland is a bedroom community with a small amount of industrial and commercial buildings.

Variation in water demand is reactive to seasonal variations, as demand drops during the fall to early spring months (November through April) and increases during the May through October months.

As demand increases the WTP output is increased in response to the demand. The WTP operators monitor the water storage facility water levels on a daily basis. If demand increases to a point where the water storage facilities do not fill during the night time period due to decrease well capacity, the operators shall alert the Ashland Department of Public Works that the Water Storage Tank Drought Index may be triggered.

The Water Storage Tank Index is a secondary index, as the primary index is the Hopkinton Reservoir water levels. The reservoir triggers will be activated before the water tank levels become an issue. Water use restrictions would be in place ahead of the low tank levels. Additionally, if the water storage tank levels are low that is an indication that the groundwater water levels are low thus reducing the WTP output. The Water Storage Tank index is a trigger for activation of an emergency water connection to a neighboring community water system. Once the MWRA indirect connection is completed the Water Storage Tank index will be one of the triggers to activate the MWRA connection. See section 7.2 for description of the By-Law that controls the use of the MWRA indirect connection.

6.4 Water System Demand

Ashland provides water to a majority of the town for municipal, residential, commercial and industrial users. Ashland's water demand peaks during the summer months as with typical northeast communities. To meet this demand Ashland presently utilizes five groundwater wells at the Hopkinton Reservoir site. Ashland is in the process of receiving approval to construct a indirect connection to the MWRA Water System.

The MWRA indirect connection will be utilized, per Ashland By-Law, during emergency conditions where the Howe Street water supplies cannot meet system demand due to a variety of reasons, including drought related or equipment failures. If certain thresholds are reached, Ashland would activate the MWRA indirect water connection to supplement Howe Street water supplies to meet system demand.

It is worth noting that Ashland's Summer to Winter Use factor is very low for a New England municipality, which is a testament to Ashland's water conservation efforts. Table 6-2 summarizes the last three years of Summer to Winter use factors. The months for the factor calculation are June to September for Summer and November to February for Winter.

Table 6-2 Ashland Summer to Winter Use Factors

Year	Summer Month (MG)	Winter Month (MG)	Use Factor
2018	165.36	134.36	1.23
2017	168.09	122.99	1.37
2016	183.13	131.27	1.4

Ashland demand patterns over the last three years are summarized in Table 6-3. The usage patterns for Maximum Daily during summer months and the seven-day average daily use during summer months can be utilized as a Drought trigger for Ashland. Ashland will compare the two historical patterns against the present paterns to determine if there is a Drought condition trigger for demand pattern. We will discuss the triggers in section 7.

Table 6-3 Ashland Water Demand Patterns

Service	2018	2017	2016
Max. Day (MGD) Summer Months June to September	2.111	2.314	2.509
Seven-Day Average Summer Month (MGD) June to September	1.36	1.376	1.509

The Water System Demand Index is a secondary index, as the primary index is the Hopkinton Reservoir water levels. The reservoir triggers will be activated before the water system demand become an issue. In most cases, water use restrictions would be in place ahead of the impacts from a water demand increase that will exceed available water supply capacity. Additionally, if the water demand exceeds pumping capacity, that is an indication that the pumping capacity has decreased due to low groundwater water levels. Assuming the top water use restrictions are in place, the Water Demand Index is a trigger for activation of an emergency water connection to a neighboring community water system due to low system pressure. Once the MWRA indirect water connection is completed the Water Demand Index will be one of the triggers to activate the MWRA indirect water connection. See section 7.2 for description of the By-Law that controls the use of the MWRA indirect water connection.

6.5 Massachusetts State Drought Indices

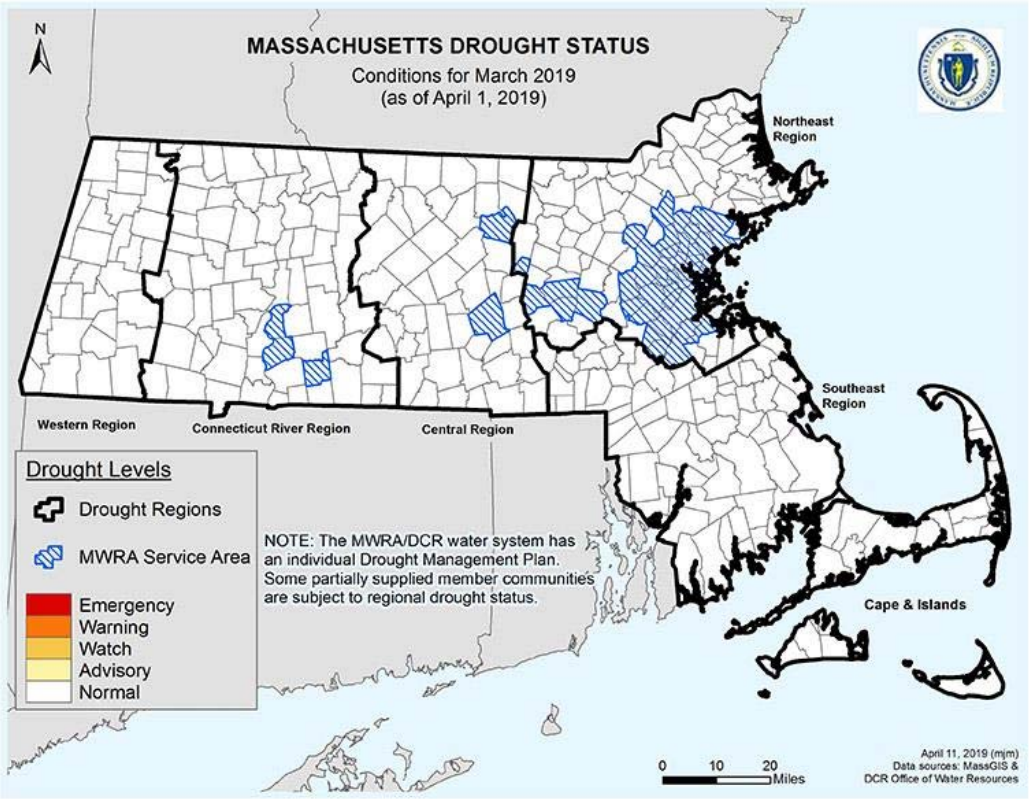
Massachusetts has prepared a draft Massachusetts Drought Management Plan in January 2019. Information has been referenced in this Ashland DMP. Ashland will utilize certain aspects of the plan, when fully adapted, including Drought Levels, Drought Regions, Drought Indices, Precipitation, Streamflow, Groundwater, Lakes and Impoundments and Weather Forecasts. Massachusetts and the United stated USGS have web pages setup for monitoring data that is directly related to drought conditions. Data provided in those web pages will be considered by Ashland as a drought indicator for their DMP. The State Drought Indices will not be utilized solely by Ashland when activating their DMP, but will play a part in being aware of impending drought conditions and allow the town to be proactive as opposed to reactive to drought conditions.

The state drought indices and forecasts are located on the Massachusetts home page at

https://www.mass.gov/drought-management .

The USGS web page at https://www.usgs.gov/centers/water-dashboard/ground?state=ma .

The following map is the drought status map for March 2019, found on the Massachusetts home page. The map shows a normal drought level condition for the entire state.



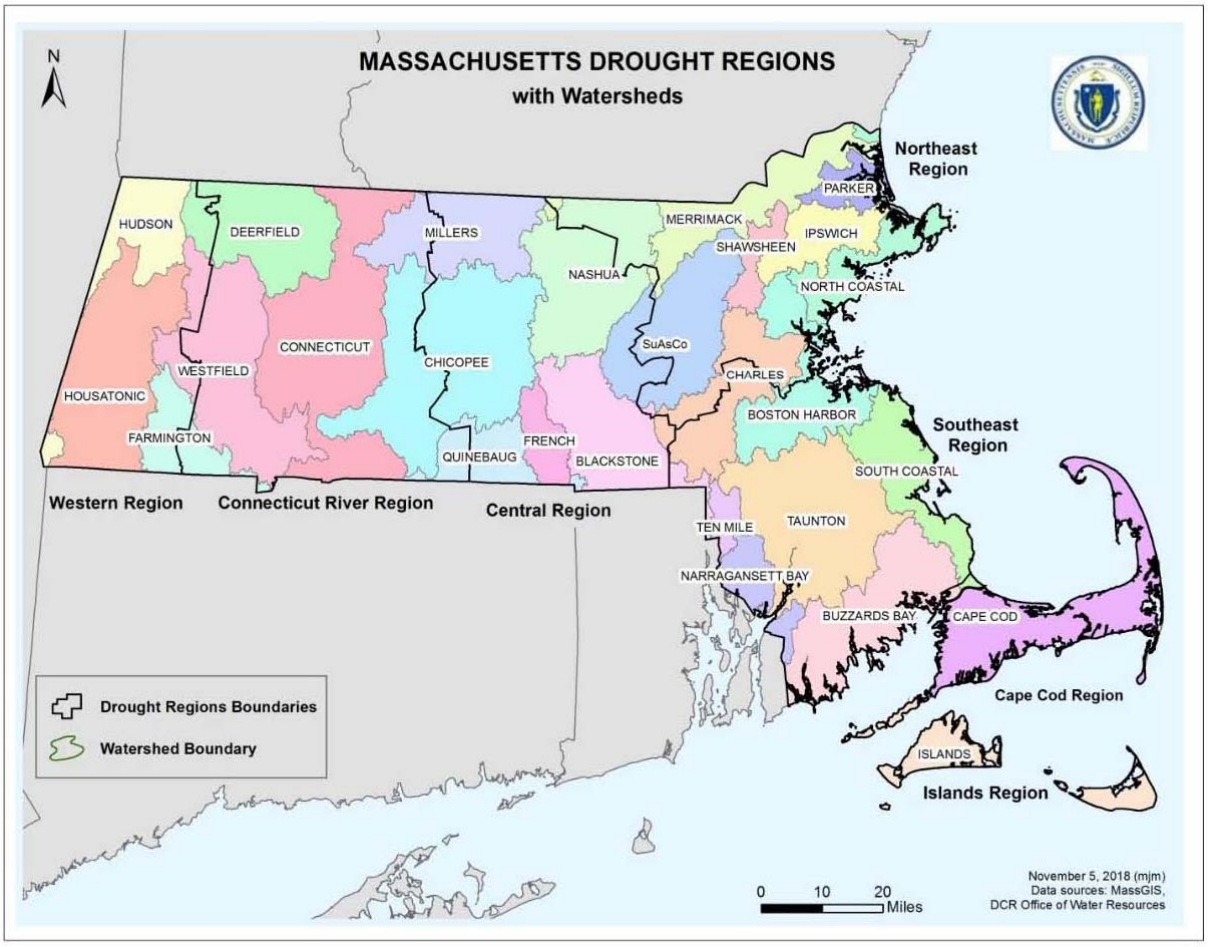
The draft Drought Management Plan will change the Drought Levels as identified in Table 6-4. Drought conditions will be classified into five levels based on six drought indices, observed impacts to various resources and forecasts.

Table 6-4 Drought Level Terminology Change

Existing	Proposed
Emergency	Level 4 – Emergence Drought
Warning	Level 3- Critical Drought
Watch	Level 2 – Significant Drought
Advisory	Level 1- Mild Drought
Normal	Level 0 - Normal

Ashland will monitor the web sites for changes in drought levels as noted above. As levels change Ashland will monitor their own drought indices and adjust operations accordingly. Additionally, Ashland holds a WMA permit for three wells at the Howe Street site, which will have additional restrictions applied to the operation of the wells should the drought levels change.

The State developed Drought Regions in the State DMP, with Ashland residing in the Middlesex Region. Below is the Massachusetts Drought Regions map with watersheds boundaries. Ashland resides in the Sudbury-Assabet-Concord (SuAsCo) watershed .



Ashland is anticipating changes in the drought management conditions in their WMA permit as part of the permit renewal process, based on new drought conditions established in the draft Massachusetts Drought Management Plan (MDMP). The new conditions may change when water use restrictions must be implemented and when it can be lifted.

Ashland presently established water use restrictions based on their own more stringent drought indicators, as discussed previously in this section. Ashland will utilize the DMTF drought condition reporting to react to impending water shortages in an effort to reduce the negative impacts of the water shortage or possibly avoid the water shortage through increase water conservation measures.

Precipitation levels can be a signifier of potential drought conditions. The Department of Conservation and Recreation (DCR) publish composite precipitation data for Massachusetts on the MA. Government website at.

https://www.mass.gov/service-details/precipitation-composite-estimates

Ashland will monitor the web site for precipitation patterns and utilize that data along with other indices discussed previously in this plan. Additional, Ashland maintains a rain gauge at the Howe Street water treatment plant for real time data. The figure below is from the Mass.Gov website and is the DCR's March 2019 Monthly Precipitation Compilate Estimate. The figure displays comparison to previous months to provide a precipitation pattern that Ashland can use along with their drought indices.

Department of Conservation and Recreation
Water Resources Data Collection and Analysis Program

March 2019

Massachusetts Monthly Precipitation Composite Estimate

March-19			Percent	Excess/	Excess or Deficit Since Last								
	Normal	Actual	Normal	Deficit	10/1/2018	2 Months	% Norm	3 Months	% Norm	6 Months	% Norm	12 Months	% 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 Islands	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.

7.0 DROUGHT TRIGGERS

The Ashland DMP was developed with the understanding that Ashland has implemented water conservation standards that are effective in reducing water use, including but not limited to reduction in unaccounted for water, enforcement of low flow fixture installation, conservation-based water rates and water smart public education.

Historically Ashland has seen demand increases during the summer months followed by extreme low groundwater tables in the fall that impacts the ability to pump water. As water demand increases in the summer months and groundwater levels drop mainly due to increasing evaporation rates; groundwater recharge and surface water runoff to streams, river and the Hopkinton reservoir is reduced.

Ashland's historical summer to winter use ratio is below 1.5, which indicates a strong water use restriction policy. Establishing a DMP ties all indices together to allow for the maximum protection of the Ashland water customers, when considering fire protection capacity and water quality.

Ashland's water system is reliant on one source to meet all demands until the MWRA indirect connection is established. The Ashland DMP maintains one primary Drought Index, Hopkinton Reservoir Water Level Index. This index is the basis for triggering the various water use restriction levels. The other indices are secondary indices for monitoring the status of the drought condition and whether to activate the supplemental MWRA indirect water connection. The secondary indices are interrelated to each other and all are secondary to the Hopkinton reservoir Level Index. Certain indices, such as low groundwater levels and low water supply rates are directly related but the Hopkinton Reservoir Levels are a precursor. The same is true for water storage tank levels and low well pumping rates.

7.1 Hopkinton Reservoir Water Level Trigger

Ashland's outdoor water use restriction by-law goes beyond the typical WMA permit condition for non-essential outside water use restriction and bans. Ashland's non-essential outdoor water use restriction is directly related to the Hopkinton Reservoir Level Triggers. As the Hopkinton reservoir water level drops, Ashland imposes more strict outdoor non-essential water use restrictions. Table 7.1 summarizes the water use restriction based on each drought trigger.

Table 7-1 Hopkinton Water Level Triggers

Trigger	Reservoir Water Level (Ft)	Water Use Restriction
Stage 0	Above 295.85	a. Handheld watering allowed any day at any time. b. Odd/Even unattended watering schedule.
Stage 1	Level Below 295.85 between June 1 to August 31	1.Unattended watering using municipally-supplied water is prohibited. 2. Car washing: Car or vehicle washing using municipally-supplied water is prohibited. 3. Washing of structures: Washing of structures including but not limited to buildings, houses, sheds, driveways, sidewalks, decks, fences, or patios using municipally supplied water is prohibited. 4. Swimming Pools: Filling and topping off of swimming pools larger than 300 gallons, using municipally-supplied water is prohibited

Stage 2	Level Below 295.35	1. Handheld watering using municipally-supplied water is prohibited 2. All other Stage 1 Restrictions apply. 3. The Town, acting through the Board of Selectmen as water commissioners, retains the right to impose additional restrictions with due notice to residents.

7.2 Water Storage Tank Level Trigger

Ashland maintains two water storage tanks in the distribution system. The tanks maintain system pressure when the Howe Street water treatment is not running. The Woodridge storage tank controls the WTP high lift pumps on-off cycle. If the water storage drops below the low level, that is an indication of either pump or WTP equipment failure of the well water levels have dropped to an extremely low level prohibiting the use of the wells. In addition, wells 7&8 could be shut down due to the Water Management permit condition.

The Water Storage Tank Level Index is a secondary trigger designed to allow activation of the MWRA indirect water connection. This index is a drought indicator, however the precursor to this index trigger is the primary index “Hopkinton Reservoir Water Level”.

WTP operators will monitor the water tank levels and inform the Ashland General Foreman about water level patterns in the water storage tanks. Water storage tank water levels are directly related to water well pumping rates and thus groundwater levels. Water use restrictions would be in place before the water tank levels drop to a trigger point.

Therefore, water tank water level trigger points will be utilized for activation of the MWRA indirect water connection to supplement the Howe Street wells to maintain adequate water levels in the water storage tanks to maintain safe pressure and water quality in the distribution system. In accordance with Ashland By-Law “SubSection 270-13, MWRA Supplemental Water Use”, one or more of the following triggers shall be met before the Ashland Water Department is authorized to open the supplemental MWRA indirect water conenction.

1. *Hopkinton Reservoir at or below 293' for any period of time. This is the lowest reservoir level allowing safe operation of Ashland's wells.*
2. *Ashland has declared Stage 2 state of water supply conservation, and a 10PSI pressure decrease in Ashland's water distribution system (measured at the Russett Hill station) for a continuous period of 10 minutes. Such a pressure drop signifies distribution system damage, such as a water main rupture.*
3. *Ashland's water distribution system pressure has dropped below 20PSI (measured at the Russett Hill station) or the Cedar Street water tank drops below an elevation of 46.2' for any period of time. This pressure level signifies the lowest recommended level for fire protection.*

7.3 Water Supply Well Trigger

Each well is a gravel packed well with depths in the range of 36ft to 40 ft below ground level. Typical well water levels in each well, when pumping is 7-14 feet below typical Hopkinton Reservoir water levels.

Static water levels are relatively equal to the water levels in the Hopkinton reservoir, Typical static well water levels are approximately 20 feet above the pump inlet.

Each well utilizes a vertical turbine pump to deliver water to the Howe Street water treatment plant. Variable frequency drives control the power to each pump motor to allow operators to control the pump discharge rates.

As groundwater levels decrease during the summer months the treatment plant operators will monitor each well water level on the SCADA computer. Adjustments will be made to prevent well water levels to drop where air will be drawn into the pump.

Table 7-2 summarizes the trigger points for groundwater levels for the operators to start reducing the pump output rate to control well water levels. These are not triggers for other procedures, however reduced pumping rates could lead to low water storage tank levels.

Table 7-2 Howe Street Well Water Levels

Trigger	Water Level Above Pump (Ft)
Level 0	10 or more
Level 1	9
Level 2	8
Level 3	7
Level 4	5

7.4 Water Demand Pattern Trigger

Ashland's water demand has a history of a very low summer to winter use factor, less than 1.5. This indicates a very effective water conservation program and drought management. Reducing this factor by reducing summer usage is a very difficult proposition as the one main toll for reduced summer usage is water use restrictions. Ashland enforces water use restriction typically every summer and fall. Therefore, the summer winter pattern will not be utilized as a drought trigger.

The demand patterns that Ashland will monitor is the 7-day average use during summer months. Utilizing the State's drought levels, Table 7-3 was prepared for measuring 7-day average demand against potential drought conditions. Ashland has the authorization to withdraw up to 2.18 mgd average daily rate and 5.9 mgd maximum daily rate from the Howe Street water supply site. Historical pumping records indicate maximum daily rates have been in the range of 3.0 to 3.6, which indicates controlling withdrawals to remain under authorized limits is not a factor in this Drought Management Plan.

However, in the past Ashland has experience inability to meet system demand due to pumping deficiency. The deficiency was low groundwater levels preventing the raw water wells from pumping at normal rates. Therefore, Ashland has developed the 7-day trigger as a measure of the potential drought condition. As demand increases above each trigger level, Ashland will start monitoring all drought triggers especially water supply well water levels and Hopkinton Reservoir Levels to determine if water use restrictions or more stringent water use restrictions are required to provide adequate pressure and water quality to the water customers. Table 7-3 summarizes the 7-Day average Demand triggers.

Table 7-3 Range for 7-Day Average Demand

Trigger	7-Day Average Water Use (MGD)
Level 0	1.7 or less
Level 1	1.9
Level 2	2.0
Level 3	2.1
Level 4	2.2

7.5 Massachusetts Drought Indices

As previously discussed, Massachusetts has enacted a drought management plan that issues drought indices data through the DCR website, MassGov web site and the USGS website.

These indices are considered secondary indices for the purpose of Ashland's DMP. Table 7.4 was prepared to summarize the appropriate state and federal data to be monitored during a drought condition in Ashland. This information can also be utilized to determine when a drought condition has been cleared.

Table 7-4 State and Federal Secondary Indices

Ashland Stage	MassDCR Drought Status	Mas DCR 3- Mth Precipitation Deficit (in)
Level 0	Normal	<0.5
Level 1	Advisory	0.5-1.5
Level 2	Watch	1.5-2.5
Level 3	Warning	2.5-3.0
Level 4	Emergency	>3.0

7.6 Summary

Ashland's DMP is based on a primary index, Hopkinton Reservoir Water Level. Secondary indices will also be monitored in order to respond accordingly to drought conditions. Table 7-5 is summary table for the primary and secondary indices.

Table 7-5 State and Federal Secondary Indices

Ashland Stage	Hopkinton Reservoir Water Level (Ft)	7-Day Average Water Use (MGD)	Water Supply Well Water Levels (Ft)	MassDCR Drought Status	Mas DCR 3- Mth Precipitation Deficit (in)
Stage 0	Above 295.85	Below 1.7	10 or more	Normal	<0.5
Stage 1	Level Below 295.85 (June 1 to August 31)	1.9	9	Advisory	0.5-1.5
Stage 2	Level Below 295.35	2.0	8	Watch	1.5-2.5
Stage 3	N/A	2.1	7	Warning	2.5-3.0
Stage 4	N/A	2.2	5	Emergency	>3.0

7.7 End of Drought Condition

Ashland will monitor the drought indices that were triggered during a drought condition. Once the trigger(s) have been released; either due to weather changes, water demand decrease, or seasonal change, Ashland will communicate this information to the Selectmen and associated department heads. This message should not only include an update on the current conditions but should communicate the need for continued conservation measures. At that time the Selectmen will determine if there is a water use restriction change that is warranted. Monitoring of the DCR drought status will continue until the drought condition is released.

In most scenarios, the absence of a drought trigger should occur for a minimum of five days before the drought condition is considered released.

END OF PLAN