STAFF SUMMARY

TO: Board of Directors
FROM: Frederick A. Laskey, Executive Director
DATE: January 18, 2017
SUBJECT: Report on 2016 Water Use Trends and Drought Status

COMMITTEE: Water Policy & Oversight
Carolyn Fiore, Deputy Chief Operating Officer
Daniel Nvule, Senior Program Manager
Stephen Estes-Smarigiai, Director, Planning
Preparer/Title

While the severe drought has continued into the winter, Quabbin storage volumes have stabilized at just under 80 percent, leaving the MWRA system in Below Normal status. Even if the driest conditions seen since the creation of Quabbin were to occur over the next 12 months, the system is unlikely to drop into Drought Warning status. Adequate supply exists in Quabbin and Wachusett Reservoirs to meet the needs of MWRA fully and partially supplied water communities and also, if needed, to continue to augment the supplies of some of the adjacent stressed communities. While no water use restrictions are required for MWRA fully supplied customers, MWRA has been and will continue to urge consumers to use water wisely and is continuing to provide conservation information to communities and customers. Despite the drought, water use in 2016 was up only slightly over 2015, with total sales up by only 2.1 percent. Within the metropolitan area, excluding emergency sales to Cambridge, total sales were actually down by 0.4 mgd (0.2 percent) showing that customers have been responding to regional and statewide drought messaging.

RECOMMENDATION:
For information only. Each January, staff provide the Board with a review of the previous year's water use data and discuss trends.

DISCUSSION:
Despite the severe drought, Calendar Year 2016 water use and reservoir withdrawals were only slightly higher than in 2015. The largest component of the increase was the drought emergency supplies for Cambridge and Worcester. Base or indoor demand also seemed to increase very slightly, possibly due to the improving regional economy and growing population out-pacing on-going incremental improvements to water efficiency from appliances and fixtures.

Water Consumption by MWRA Communities

Calendar Year 2016 water consumption by all MWRA communities of 200.7 million gallons per day (mgd) was about 4.2 mgd (2.1 percent) higher than 2015, as shown on Figure 1 on the next page. Included is a combined increase of 4.6 mgd by Cambridge and Worcester which normally
Figure 2: Daily System Demand

System demand, the lowest single day demand since the creation of the MWRA. Figure 2 below shows daily extreme Christmas Day had the lowest demand for the year at 1,468 mgd setting a record for July 26th. Not since August 2005 have the maximum day demand been this high. The opposite System wide, 2016 had a maximum day demand of 3,153 mgd (7.0 percent higher than 2015).
A local regression (LOESS) was used that assigns less weight to data that is further away from the local point.

Over time, water use reductions have been in both base (or indoor) use, defined as water use from November to March, and outdoor use (or seasonal use), defined as the increase over the fall and spring. The level not seen since before 1990 (see Figure 3 below), 65.5 mgd, which is slightly higher than last year, was still at a 6.3% percent, but still only about 0.2 mgd.
Figure 4: Fully-Supplied Communities (1999 to 2016)
Figure 5: Fully-Supplied Communities: Annual Seasonal Demand (labels show demand in mgd)

Figure 6: Fully-Supplied Communities Annual Base and Seasonal Demand

Outdoor
Indoor
Figure 7: Partially Supplied Communities - MWRA Supplied Demand

Communities was only about 1.5 mgd (12 percent) higher than 2015. Compared to 2015, the demand in Cambridge and Woburn was 6.5 mgd higher (41 percent). When Woburn's annual demand was supplied well, the graph shows the proportion of MWRA water used by pumping from Siwanoy of the Quabbin Tunnel in the month of July. This is the month when the Quahog Reervoir, or downstream of the reservoir, is pumped to Camden's Water Supply Special (down) to around 11 percent, and had to resort to pumping at Quahog Reservoir. On the other hand, the rehabilitation of a storage reservoir was done in 2015, but MWRA's construction projects and increased demand by the City of Cambridge withdrawing water in 2013 and 2014 were not enough to meet the needs of the communities. The demand in those communities increased in 2013 and 2014, but the demand was still lower than the peak demand in 2015. Given the drought, the graph shows the trend of MWRA sales to the partially supplied communities.
The 300-mdaf safe yield is based on the drought of the 1960s, i.e., the loss considered the 20-year recurrence drought, as allowed by DWR. The result in a safe yield at a high of 350 mdaf. MWA's Water Management Act.

Drought Warning Status.

Central and Connecting River Valley regions where MWRB reservoirs are located remain in the drought warning, according to the forecast. The forecast, which includes the water levels at key reservoirs, indicates that the drought warning will remain in effect for the remainder of the year.

On January 5, Secretary Peter Reifler warned the Northern California region, which includes the Sacramento Valley, to be prepared for the possibility of a severe drought this year. "We are seeing conditions that are similar to what we experienced in 2015," he said.

Figure 8: Total Reservoir Withdrawals - Five-Year Average 1980 to 2016

The figure shows the five-year average of withdrawals from 1980 to 2016, with a peak in 2013. The average is calculated by taking the five highest daily withdrawal volumes over the past five years and dividing by five. This provides a more accurate representation of the typical withdrawal volumes over the past five years.

In water use, it is important to consider the long-term trend. The graph shows a gradual decline in average withdrawal volumes from 1980 to 2016. This decline is evident as the trend line moves downward over the years. The data suggests that the long-term trend is downward, indicating a reduction in average withdrawal volumes over the past three decades.

In conclusion, the data indicates that the long-term trend in water use is downward, and it is important to monitor this trend. The graph provides a useful visual representation of the average withdrawal volumes over the past five years, which can be used to make informed decisions about water management.

Reservoir withdrawals are the net amount used to compete the 300-mdaf safe yield of the MWA's Water Management Act. The net amount is used to meet the 300-mdaf safe yield.
Drought Warming
Below Normal
Normal
Operation

Stage 1
12 month Minimum
12 month P5
12 month median
% Full
0
10
20
30
40
50
60
70
80
90
100

Figure 6: Quabbin Reservoir, Storeage 12-Month Simulation

Successful communities, and also, if needed, to continue to augment the supplies of some of the affected
Wachusett Reservoirs to meet the needs of MWRA'sfall and winter supply needs. The system exists in Quabbin and
is unlikely to drop into drought Warming. Adequate supply exists in Quabbin and
conditions since the creation of Quabbin were 10 ocular over the next 12 months. The system
under conditions of low yield, despite the demands being wellbelow 50th yield. With average
The modeling shows that the slow recovery of a multi-year storage reservoir such as Quabbin

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Table 1: Quabbin Reservoir Storages with Various Reservoir Yield Scenarios

Looking Forward from January 1, 2017

I-Month
3-Months
6-Months
12-Months

D5 (75th)

D7 (Percentile)

D1 (Record)

Median Yield

Below:

Includes a potential 10 mgd increase from current annual demand levels, as shown in Table I
2017 given varying yield conditions, and an annual demand of 220 mgd (conservatively
Quabbin Reservoir levels have been modeled for the next 12 months (January 2017 - December

ATTACHMENT:

Community Water Use Data

MVRA also provided 334.4 Mgal of MWRA water to Cambridge earlier in the calendar year due

use resulted in $4.8 million dollars in revenue.

the Town of Ashland to supplement local supplies in Calendar Year 2016. This additional water
of Cambridge, 847 in. to the City of Worcester, 79 in. to the Town of Burlington, and 3.2 in. to
Due to drought conditions, MVRA provided 515.2 million gallons (Mgal) of water to the City of

BUDGET/FISCAL IMPACT:
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**Table Notes:**
- Column 1: Description of the first column.
- Column 2: Description of the second column.
- Column 3: Description of the third column.
- Column 4: Description of the fourth column.

**Additional Information:**
- Row 1: Detailed analysis of the first row.
- Row 2: Detailed analysis of the second row.
- Row 3: Detailed analysis of the third row.
Report on 2016 Water Use Trends and Drought Status

January 18, 2017
Total Consumption by MWRA Communities (1980 to 2016)

mgd


2016 -- 200.7 mgd
Boston Water Use (1900 to 2016)

2016 average = 65.5 mgd
Fully Supplied Communities Demand (2000 to 2016)
Fully Supplied Communities (Annual Base and Outdoor Use)

![Bar chart showing annual base and outdoor use from 2000 to 2016. The y-axis represents mg in 250 increments, and the x-axis represents years from 2000 to 2016. The bars are divided into two sections: blue for indoor and red for outdoor use.]

- Indoor
- Outdoor
Partially Supplied Communities

Annual demands shown as barplots, while daily is shown as a linegraph on this composite plot.
Reservoir Withdrawals – 5 Year Running Average

5-year average withdrawal = 204.3 mgd
Massachusetts Drought Status Designations

MASSACHUSETTS DROUGHT STATUS
As of January 1, 2017

NOTE: The MWRA/DCR water system has an individual Drought Management Plan. Some partially supplied member communities are subject to regional drought status.
It Has Continued To Be Dry In the Service Area

Two year cumulative daily total

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<tr>
<th>2015</th>
<th>2016</th>
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<tr>
<td>5%</td>
<td>95%</td>
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<tr>
<td>50%</td>
<td>75%</td>
</tr>
<tr>
<td>25%</td>
<td></td>
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<tr>
<td>5%</td>
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### Driest Summer on Record

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<th></th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>Annual</th>
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<tr>
<td>Long-term Average</td>
<td>3.64</td>
<td>3.36</td>
<td>4.01</td>
<td>3.57</td>
<td>3.37</td>
<td>3.46</td>
<td>3.04</td>
<td>3.40</td>
<td>3.29</td>
<td>3.44</td>
<td>4.01</td>
<td>4.09</td>
<td>42.7</td>
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<tr>
<td>2016 Total</td>
<td>3.27</td>
<td>4.18</td>
<td>3.17</td>
<td>2.91</td>
<td>2.83</td>
<td><strong>1.33</strong></td>
<td>0.87</td>
<td><strong>1.72</strong></td>
<td>1.38</td>
<td>5.46</td>
<td>2.7</td>
<td>3.25</td>
<td>33.07</td>
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Driest summer ever recorded. Total only 3.92 inches

Inches of Precipitation at Logan Airport
Quabbin Watershed - Cumulative Yields
<table>
<thead>
<tr>
<th></th>
<th>1-Month</th>
<th>3-Months</th>
<th>6-Months</th>
<th>12-Months</th>
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<td><strong>Median Yield</strong></td>
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<tr>
<td><strong>Dry (75th Percentile)</strong></td>
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<td>Below Normal</td>
<td>Below Normal</td>
<td>Normal</td>
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<tr>
<td><strong>Driest (of Record)</strong></td>
<td>Below Normal</td>
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## Communities That Received Emergency Drought Assistance in 2016

<table>
<thead>
<tr>
<th>Community</th>
<th>Amount Supplied (Million Gallons)</th>
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<tbody>
<tr>
<td>Worcester</td>
<td>847.3</td>
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<tr>
<td>Cambridge</td>
<td>515.2</td>
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<tr>
<td>Burlington</td>
<td>7.9</td>
</tr>
<tr>
<td>Ashland</td>
<td>3.2</td>
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Summary

- Quabbin Reservoir remains in Below Normal status
- There is sufficient water to meet MWRA member community demand
- Plus help adjacent communities that are stressed by the drought