


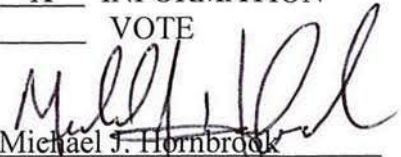
STAFF SUMMARY

TO: Board of Directors
FROM: Frederick A. Laskey, Executive Director 
DATE: January 17, 2018
SUBJECT: Report on 2017 Water Use Trends and Drought Status

COMMITTEE: Water Policy & Oversight

X INFORMATION
 VOTE

Carolyn Fiore, Deputy Chief Operating Officer
Daniel Nvule, Senior Program Manager
Stephen Estes-Smargiassi, Director, Planning
Preparer/Title


Michael J. Hornbrook
Chief Operating Officer

The severe regional drought that started in 2016 came to an end in 2017. The end of the drought reduced the stress on the partially-supplied communities and they required less MWRA water during 2017. Overall system demand was lower by 6.4 percent compared to the previous year. Quabbin levels recovered to normal levels in June and then dipped to just below normal at the very end of 2017. Adequate supply exists in Quabbin and Wachusett Reservoirs to meet the needs of MWRA fully and partially supplied communities.

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:

Calendar Year 2017 saw an end to severe drought conditions in the region and the MWRA service area. However, due to the multi-year storage volume of the Quabbin Reservoir and the continued weather pattern of most significant rain storms bypassing the watersheds, the improvement seen in the service area was not fully matched by a comparable improvement in Quabbin levels. Although Quabbin levels were in the normal range for most of the year, they started and ended the year in Below Normal status, albeit with 24 billion gallons more in storage at year's end.

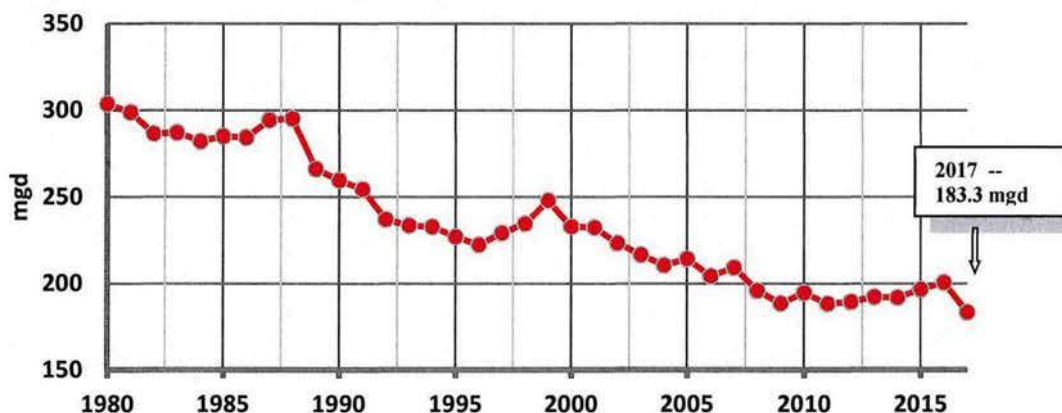
From a watershed yield perspective, 2017 was an interesting year. A wet spring increased storage in both Quabbin and Wachusett Reservoirs, with Wachusett rising to well above MWRA's normal operating range in April. Mindful of the just receding drought conditions, staff held water in Wachusett, rather than releasing the excess to the Nashua River, delaying normal transfers from Quabbin Reservoir. As the year progressed, precipitation within the service area was closer to normal, but many storms seemed to bypass the watersheds, resulting in lower than normal system yields through the summer and most of the fall. In late October, almost nine inches of rain fell over the Quabbin watershed, resulting in a ten-billion-gallon jump in storage volumes in less than two weeks. Then November and December had only about one half the typical rainfall, setting the stage for Quabbin to dip back into Below Normal status on December 30, 2017.

Calendar Year 2017 water use and reservoir withdrawals were lower than in 2016 and 2015 largely because there was no emergency drought use by Cambridge or Worcester and reduced summer demand by the partially supplied communities was reduced.

Water Consumption by MWRA Communities

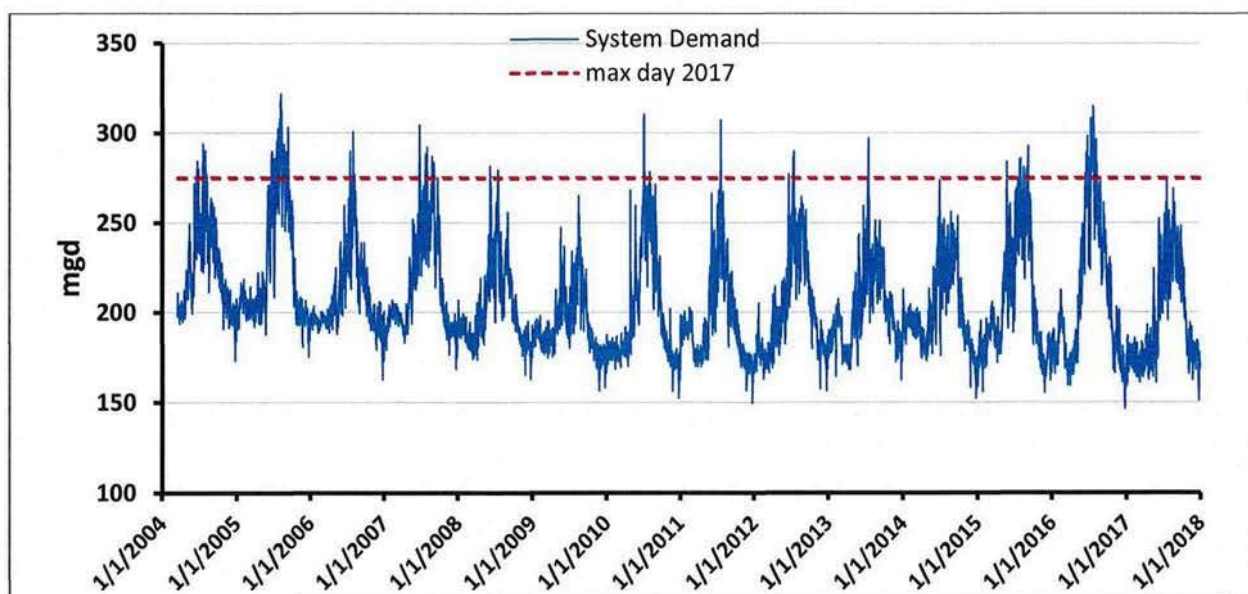
Calendar Year 2017 water consumption by all MWRA communities of 183.3 million gallons per day (mgd) was about 17.2 mgd (8.6 percent) lower than 2016, as shown on Figure 1 below.

Figure 1 – Total Consumption by MWRA Communities (1980 to 2017)



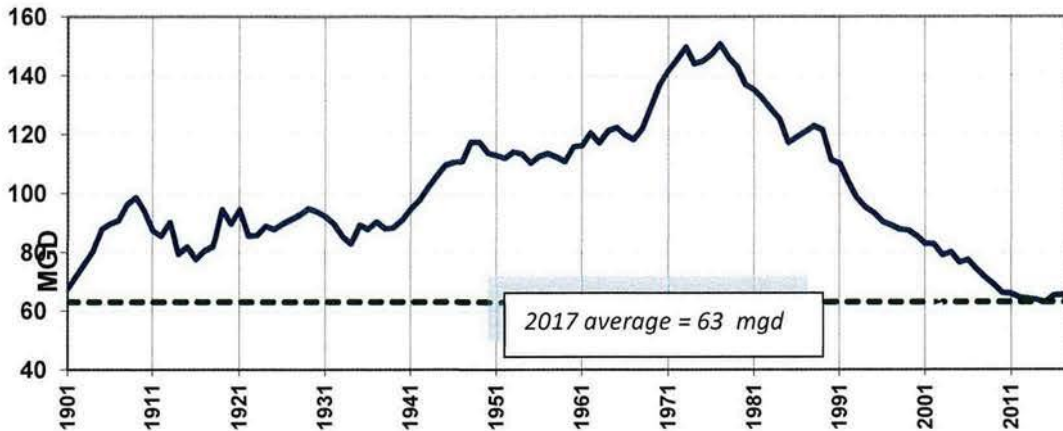
System wide, 2017 had a maximum day demand of 274.65 mgd (12.9 percent lower than 2016) on July 21st. At the opposite extreme, Christmas day had the lowest demand for the year at 151.2 mgd, about 4.4 mgd higher than Christmas 2016 which still has the record for the lowest single day demand since the creation of the MWRA. Figure 2 below shows daily system demand.

Figure 2: Daily System Demand



Demand from MWRA's largest customer, the Boston Water and Sewer Commission, was 63 mgd, which was lower than last year by about 2.5 mgd (3.8 percent). Current Boston demand continues to be lower than demand before 1900.

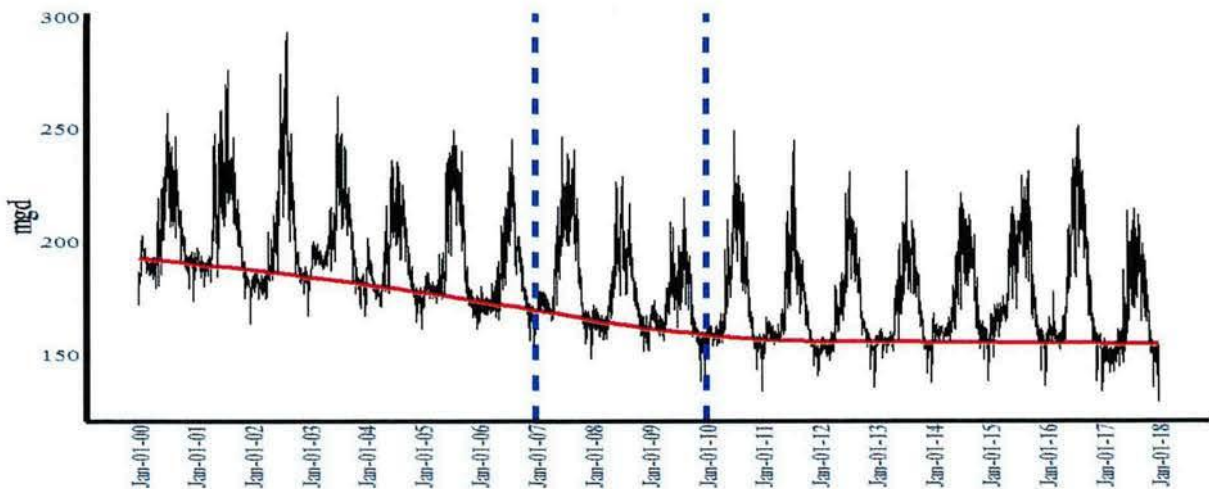
Figure 3: Boston Water Use (1900-2017)



Base or Indoor Demand

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 base demand during the irrigation season of May to September. Indoor water use has dropped substantially over the past several decades. Decreases from 2001 to 2010 ranged from around one to two percent per year. Post-recession, decreases appear to be much slower. This is likely due to the improvements in the efficiency of water use in homes and businesses as water-saving technologies continue to increase market share and consumers react to price increases (as well as reduced pipeline leaks), being counterbalanced by increased use due to the improving regional economy and population growth.

Figure 4: Fully-Supplied Communities Demand (1999 to 2017)



Seasonal or Outdoor Demand

Seasonal water use is more variable than indoor demand and driven in large part by weather during the irrigation season. Factors influencing seasonal use include the total irrigation season precipitation, the number of dry days between rainfall events, temperature, and the total amount of sunshine. Over time, water price also influences seasonal use.

Figures 5 and 6 show the variation in seasonal water use over time, and both the relatively small impact that seasonal demand has on total water use and the longer-term decline in both base and total use. Figure 5 shows a reduction in seasonal use of about 45 percent between 2016 and 2017.

Figure 5: Fully-Supplied Communities' Annual Seasonal Demand
(labels show demand in mgd)

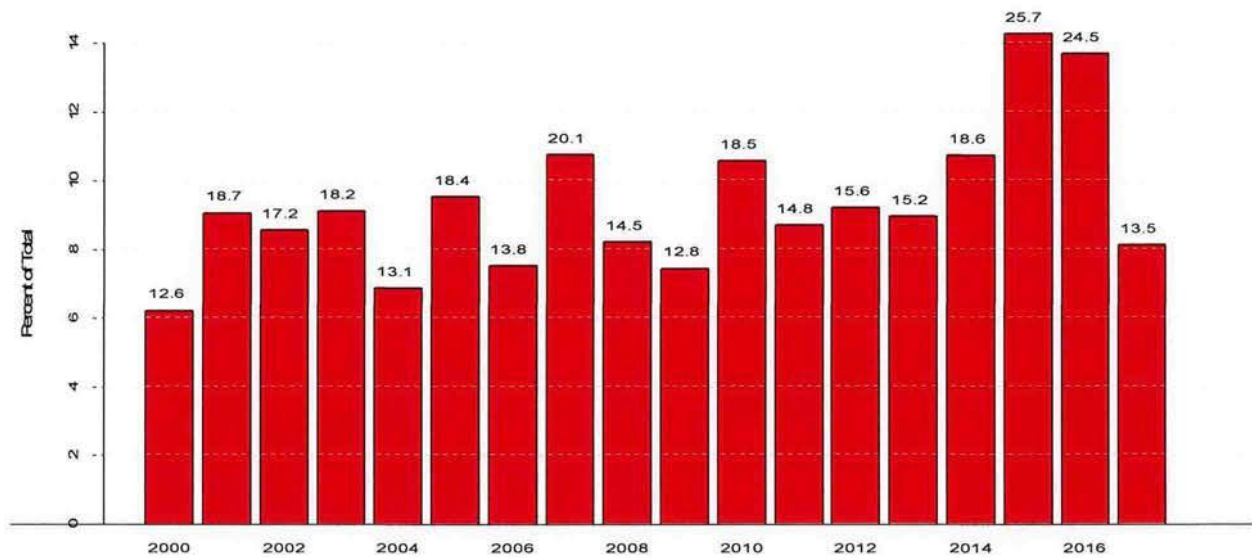
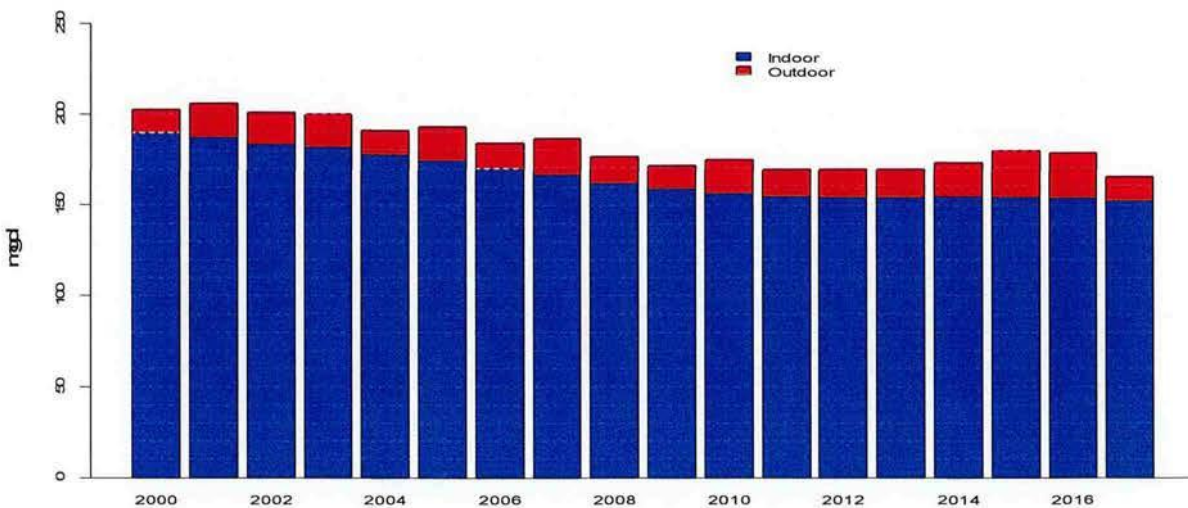


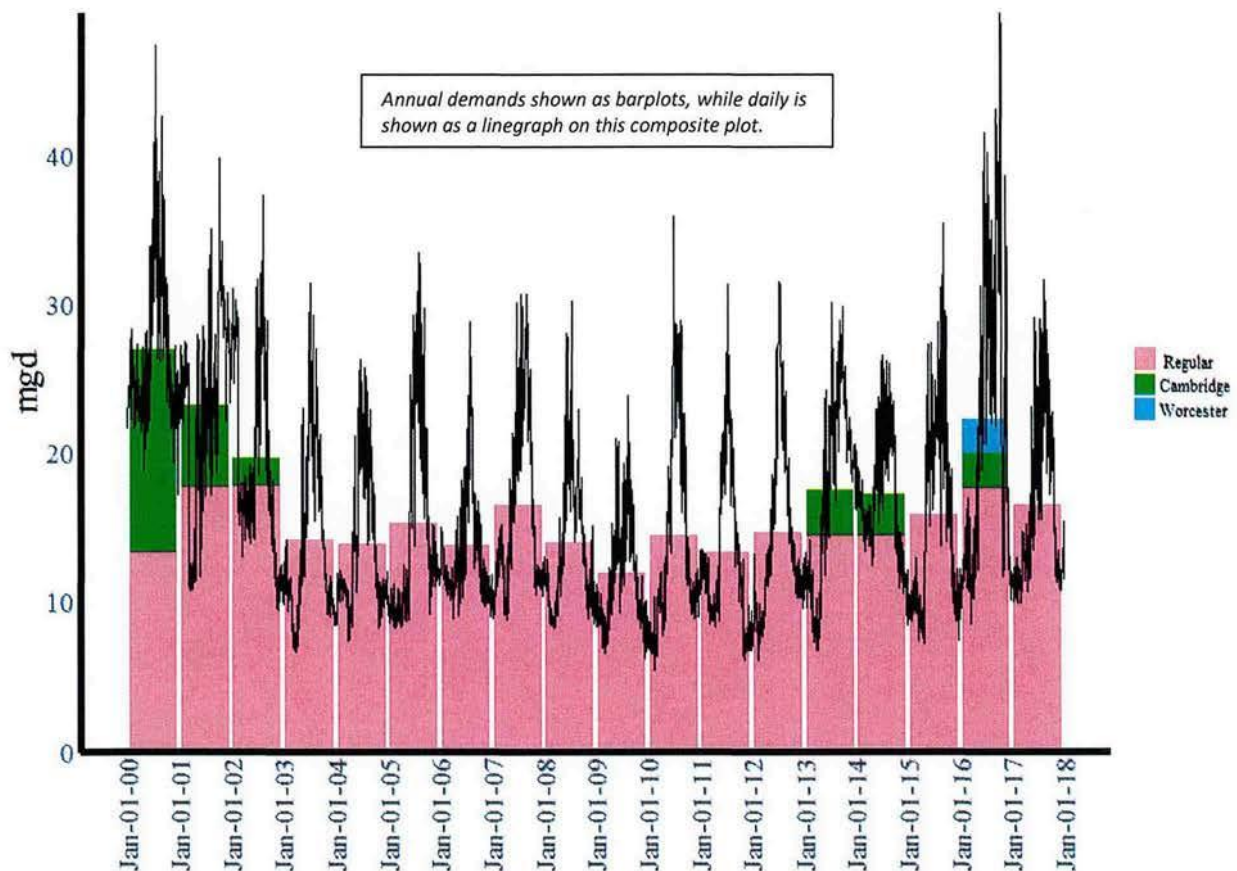
Figure 6: Fully-Supplied Communities Annual Base and Seasonal Demand



Partially Supplied Communities

The absence of the summer drought in 2017 following a year with a dry summer gave staff a rare opportunity to evaluate the impact of drought conditions on the partially supplied communities. This impact can be seen on Figure 7 below. The total reduction between 2016 and 2017 was 26 percent, primarily driven by Worcester and Cambridge. The remaining partial users demand reduced by 7 percent

Figure 7: Partially Supplied Communities – MWRA Supplied Demand (Daily and Annual)



Reservoir Withdrawals and Releases

Reservoir withdrawals are the metric used to compare to the 300 mgd safe yield of the watershed/reservoir system¹. Withdrawals include water sold to MWRA communities, as well as other uses in the watershed and MWRA system. Total MWRA water withdrawals decreased by 6.4 percent in 2017, from 208.94 mgd in 2016 to 195.64 mgd. Worcester, the State's second largest city, pumped 5.22 mgd from its reservoirs in the portion of the Wachusett watershed that it shares with MWRA but pumped no water from Shaft 3 of the Quabbin Tunnel².

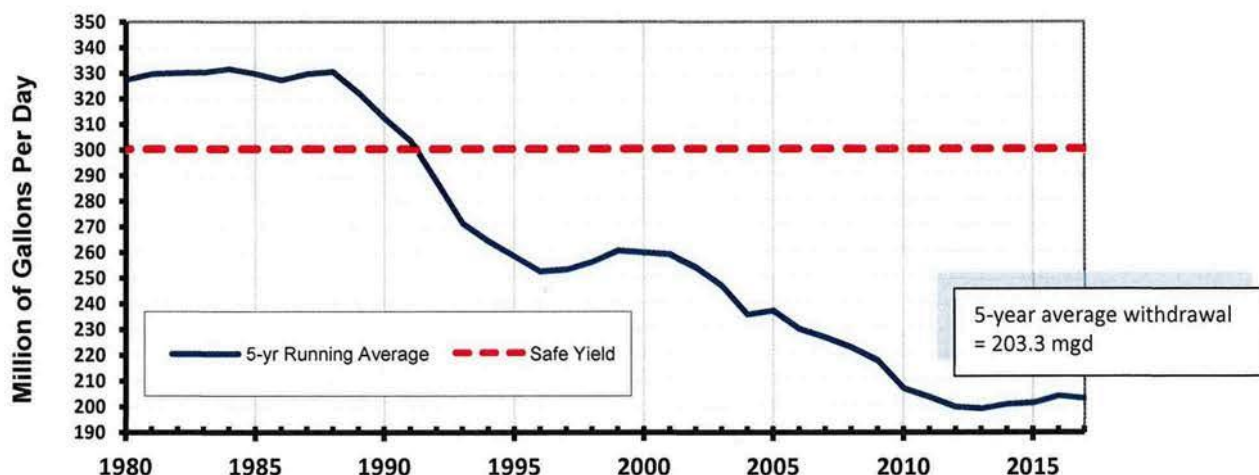
¹ The 300-mgd safe yield is based on the drought of the 1960s. Use of a less conservative 20-year recurrence drought, as allowed by DEP, would result in a safe yield as high as 350 mgd. MWRA's Water Management Act registration is for 312 mgd.

² When Worcester must use water from the Quabbin Aqueduct it is a purchase from MWRA, whereas its

The new pipeline suppling the McLaughlin Fish Hatchery was in service for the entire year, with an average withdrawal of 5.49 mgd. Without that new withdrawal, total reservoir withdrawals in 2017 would have been the lowest since the 1940s.

Figure 8 below shows five-year averages of withdrawals from 1980 to present. The five-year averaging reduces the effects of year-to-year variability due to weather, and provides a good indication of longer-term trends. The average shows a slight decrease from 2016. As the economy continues to stabilize and grow over the next few years, staff will monitor any changes in water use, to see if the longer-term downward trend resumes.

Figure 8: Total Reservoir Withdrawals – Five-Year Running Average 1980 to 2017

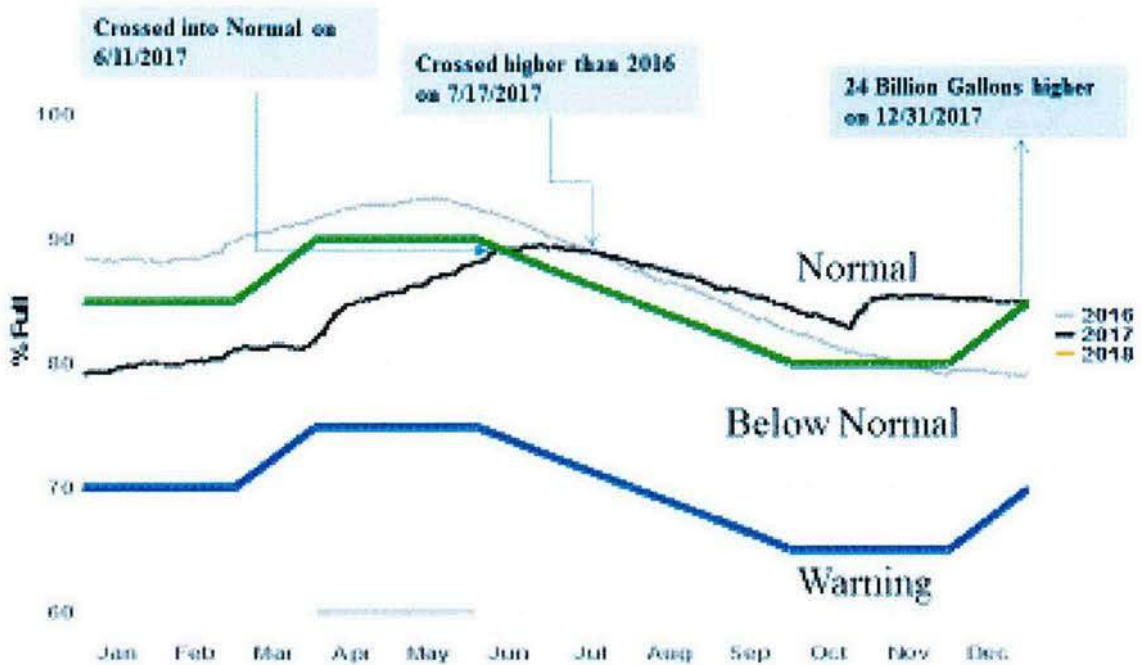


Drought Outlook

On May 11, 2017, Secretary Beaton declared all regions of the Commonwealth to be in Normal status. At the time of the declaration, Quabbin was gradually filling and was at 86.3 percent full, which was about 3.7% below normal for that time of the year. Quabbin levels rose to above normal in June, where they stayed until the end of the year. The reservoir reached its greatest storage volume near the end of June at 89.5 percent full. As is typical, reservoir elevations declined over the summer, then increased during the fall reaching 85.5 percent full just before Thanksgiving, with about 24 billion gallons more in storage than a year earlier. With the somewhat drier end to the year, storage volumes slowly drifted down to just below 85 percent on December 30, still about 24 billion gallons higher than a year earlier. Figure 9 on the next page shows a comparison of Quabbin volume levels between 2016 and 2017.

withdrawals from its Quinapoxet Reservoir system within the Wachusett watershed are not.

Figure 9: Quabbin Reservoir Volumes for 2016 and 2017



Quabbin Reservoir levels have been modeled for the next 12 months (January 2018 – December 2018) given varying yield conditions, and an annual demand of 220 mgd (conservatively includes a potential 20 mgd increase from current annual demand levels). The modeling shows a continuing slow recovery of the multi-year storage at Quabbin Reservoir. Under almost all conditions, the reservoir will likely return to, and remain in, Normal status. Even if the driest conditions seen since the creation of Quabbin were to occur over the next 12 months, the system will likely stay within Below Normal status, and not drop into Drought Warning. 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 augment the supplies of some of the adjacent stressed communities.

ATTACHMENT:

Community Water Use Data.

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Massachusetts Water Resources Authority MWRA Water Supplied (MGD)

Reporting Period: December 2017

ALL DATA SUBJECT TO CHANGE OR ADJUSTMENT PENDING ADDITIONAL MWRA AND COMMUNITY REVIEW

| | Monthly (MGD) | | | YTD (MGD) | | | YTD System Share | | | Totals | |
|--|----------------|----------------|---------------|----------------|----------------|---------------|-------------------------|-------------|----------------------------|----------------|-------------------------|
| | Dec | | Flow Change | YTD | | Flow Change | Flow Share ¹ | | % Change in YTD Flow Share | 2016 | |
| | 2017 | 2016 | | 2017 | 2016 | | 2017 | 2016 | | Ave. Flow mgd | Flow Share ¹ |
| Metro-System Customers | | | | | | | | | | | |
| Arlington | 3,356 | 3,296 | 1.8% | 3,600 | 3,981 | -9.6% | 2.1% | 2.1% | -3.4% | 3,981 | 2.1% |
| Belmont | 1,693 | 1,644 | 3.0% | 1,967 | 2,217 | -11.3% | 1.1% | 1.2% | -5.2% | 2,217 | 1.2% |
| Boston (BWSC) | 58,556 | 60,010 | -2.4% | 63,020 | 65,524 | -3.8% | 36.3% | 35.4% | 2.7% | 65,524 | 35.4% |
| Brookline | 4,001 | 4,030 | -0.7% | 4,866 | 5,192 | -6.3% | 2.8% | 2.8% | 0.1% | 5,192 | 2.8% |
| Canton (P) | 0,824 | 1,288 | -36.0% | 1,296 | 1,936 | -33.1% | 0.7% | 1.0% | -28.5% | 1,936 | 1.0% |
| Chelsea | 3,132 | 3,105 | 0.9% | 3,339 | 3,263 | 2.4% | 1.9% | 1.8% | 9.3% | 3,263 | 1.8% |
| Dedham-Westwood W.D. (P) | 0,017 | 0,021 | -19.4% | 0,107 | 0,226 | -52.7% | 0.06% | 0.12% | -49.5% | 0,226 | 0.1% |
| Everett | 3,648 | 3,839 | -5.0% | 3,779 | 3,953 | -4.4% | 2.2% | 2.1% | 2.1% | 3,953 | 2.1% |
| Framingham | 4,941 | 5,104 | -3.2% | 5,673 | 6,104 | -7.1% | 3.3% | 3.3% | -0.7% | 6,104 | 3.3% |
| Leominster (P) | 0,000 | 0,000 | 0.0% | 0,000 | 0,000 | 0.0% | 0.0% | 0.0% | 0.0% | 0,000 | 0.0% |
| Lexington ² | 3,772 | 3,775 | -0.1% | 4,928 | 5,549 | -11.2% | 2.8% | 3.0% | -5.1% | 5,549 | 3.0% |
| Lynn (LWSC) (P) | 0,199 | 0,226 | -11.7% | 0,221 | 0,249 | -11.1% | 0.13% | 0.13% | -5.1% | 0,249 | 0.13% |
| Lynnfield W.D. | 0,396 | 0,370 | 7.1% | 0,526 | 0,571 | -7.8% | 0.30% | 0.31% | -1.5% | 0,571 | 0.31% |
| Malden | 4,911 | 4,728 | 3.9% | 4,931 | 5,158 | -4.4% | 2.8% | 2.8% | 2.1% | 5,158 | 2.8% |
| Marblehead | 1,354 | 1,296 | 4.5% | 1,750 | 1,884 | -7.1% | 1.0% | 1.0% | -0.8% | 1,884 | 1.0% |
| Marlborough (P) | 3,519 | 3,502 | 0.5% | 4,024 | 3,739 | 7.6% | 2.3% | 2.0% | 15.0% | 3,739 | 2.0% |
| Medford | 4,334 | 4,430 | -2.2% | 4,468 | 4,869 | -8.2% | 2.6% | 2.6% | -2.0% | 4,869 | 2.6% |
| Melrose | 1,805 | 1,778 | 1.6% | 2,003 | 2,177 | -8.0% | 1.2% | 1.2% | -1.7% | 2,177 | 1.2% |
| Milton | 2,259 | 2,354 | -4.0% | 2,445 | 2,666 | -8.3% | 1.4% | 1.4% | -2.0% | 2,666 | 1.4% |
| Nahant | 0,247 | 0,330 | -25.4% | 0,343 | 0,410 | -16.3% | 0.20% | 0.22% | -10.6% | 0,410 | 0.22% |
| Needham (P) | 0,005 | 0,108 | -95.7% | 0,592 | 0,846 | -30.1% | 0.3% | 0.5% | -25.3% | 0,846 | 0.5% |
| Newton | 6,895 | 7,535 | -8.5% | 8,351 | 9,833 | -15.1% | 4.8% | 5.3% | -9.3% | 9,833 | 5.3% |
| Northborough (P) | 0,825 | 0,820 | 0.5% | 0,879 | 0,946 | -7.1% | 0.5% | 0.5% | -0.8% | 0,946 | 0.5% |
| Norwood | 2,336 | 2,451 | -4.7% | 2,810 | 2,825 | -0.5% | 1.6% | 1.5% | 6.3% | 2,825 | 1.5% |
| Peabody (P) | 2,970 | 1,486 | 99.9% | 2,878 | 1,479 | 94.6% | 1.7% | 0.8% | 107.9% | 1,479 | 0.8% |
| Quincy | 7,467 | 8,107 | -7.9% | 8,295 | 9,305 | -10.9% | 4.8% | 5.0% | -4.8% | 9,305 | 5.0% |
| Reading | 1,370 | 1,412 | -3.0% | 1,588 | 1,687 | -5.9% | 0.9% | 0.9% | 0.0% | 1,687 | 0.9% |
| Revere | 3,427 | 3,458 | -0.9% | 3,585 | 3,735 | -4.0% | 2.1% | 2.0% | 2.6% | 3,735 | 2.0% |
| Saugus | 2,599 | 2,594 | 0.2% | 2,777 | 3,016 | -7.9% | 1.6% | 1.6% | -1.6% | 3,016 | 1.6% |
| Somerville | 5,250 | 5,427 | -3.3% | 5,569 | 6,048 | -7.9% | 3.2% | 3.3% | -1.6% | 6,048 | 3.3% |
| Southborough | 0,619 | 0,587 | 5.5% | 0,908 | 1,069 | -15.1% | 0.5% | 0.6% | -9.3% | 1,069 | 0.6% |
| Stoneham | 1,879 | 1,868 | 0.6% | 2,158 | 2,309 | -6.5% | 1.2% | 1.2% | -0.2% | 2,309 | 1.2% |
| Stoughton (P) | 0,137 | 0,200 | -31.6% | 0,112 | 0,194 | -42.4% | 0.1% | 0.1% | -38.4% | 0,194 | 0.1% |
| Swampscott | 1,196 | 1,138 | 5.1% | 1,398 | 1,444 | -3.2% | 0.8% | 0.8% | 3.4% | 1,444 | 0.8% |
| Wakefield (P) | 1,284 | 1,555 | -17.4% | 1,475 | 1,655 | -10.9% | 0.9% | 0.9% | -4.8% | 1,655 | 0.894% |
| Waltham | 5,225 | 5,271 | -0.9% | 6,437 | 6,894 | -6.6% | 3.7% | 3.7% | -0.3% | 6,894 | 3.7% |
| Watertown | 2,292 | 2,353 | -2.6% | 2,555 | 2,584 | -1.1% | 1.5% | 1.4% | 5.6% | 2,584 | 1.4% |
| Wellesley (P) | 0,094 | 0,000 | | 1,027 | 1,329 | -22.7% | 0.6% | 0.7% | -17.4% | 1,329 | 0.7% |
| Weston | 0,860 | 0,971 | -11.5% | 1,724 | 2,150 | -19.8% | 1.0% | 1.2% | -14.4% | 2,150 | 1.2% |
| Wilmington (P) | 0,166 | 0,001 | 12899.7% | 0,348 | 0,592 | -41.3% | 0.20% | 0.32% | -37.2% | 0,592 | 0.32% |
| Winchester (P) | 0,502 | 0,932 | -46.1% | 1,273 | 1,618 | -21.4% | 0.7% | 0.9% | -16.0% | 1,618 | 0.9% |
| Winthrop | 1,148 | 1,121 | 2.4% | 1,174 | 1,232 | -4.7% | 0.7% | 0.7% | 1.8% | 1,232 | 0.7% |
| Woburn (P) | 1,822 | 1,284 | 41.9% | 2,196 | 2,773 | -20.8% | 1.3% | 1.5% | -15.4% | 2,773 | 1.5% |
| Subtotal Metro-System | 153,330 | 165,803 | -1.6% | 173,393 | 185,233 | -6.4% | 100% | 100% | | 185,233 | 100% |
| Chicopee Valley Aqueduct | | | | | | | | | | | |
| Chicopee | 4,636 | 4,252 | 9.0% | 5,026 | 5,339 | -5.9% | 70.7% | 69.3% | 2.1% | 5,339 | 69.3% |
| South Hadley FD #1 | 0,799 | 0,805 | -0.6% | 1,012 | 1,132 | -10.6% | 14.2% | 14.7% | -3.0% | 1,132 | 14.7% |
| Wilbraham | 0,784 | 0,781 | 0.3% | 1,068 | 1,238 | -13.7% | 15.0% | 16.1% | -6.4% | 1,238 | 16.1% |
| Subtotal CVA System | 6,219 | 5,838 | 6.5% | 7,106 | 7,709 | -7.8% | 100% | 100% | | 7,709 | 100% |
| Other Revenue Supply | | | | | | | | | | | |
| Cambridge (P) | 0,000 | 1,202 | -100.0% | 0,000 | 2,320 | -100.0% | | | | 2,320 | |
| Clinton ³ | 1,225 | 1,165 | 5.2% | 1,409 | 1,509 | -6.6% | | | | 1,509 | |
| Worcester (P) | 0,000 | 0,610 | -100.0% | 0,000 | 2,315 | -100.0% | | | | 2,315 | |
| Other Revenue Customers⁴ | 1,453 | 1,441 | 0.8% | 1,363 | 1,427 | -4.5% | | | | 1,427 | |
| Subtotal Other Revenue Supply⁵ | 2,678 | 4,418 | -39.4% | 2,772 | 7,571 | -63.4% | | | | 7,571 | |
| Total Water Supplied | | | | | | | | | | | |
| Fully Supplied Metro Communities | 140,966 | 144,380 | -2.4% | 156,967 | 167,650 | -6.4% | | | | 167,650 | |
| CVA Communities | 6,219 | 5,838 | 6.5% | 7,106 | 7,709 | -7.8% | | | | 7,709 | |
| Partially Supplied Communities | 12,364 | 13,235 | -6.6% | 16,427 | 22,218 | -26.1% | | | | 22,218 | |
| Other Revenue Customers | 2,678 | 2,606 | 2.8% | 2,772 | 2,936 | -5.6% | | | | 2,936 | |
| Total Water Supplied⁶ | 162,227 | 166,059 | -2.3% | 183,271 | 200,513 | -8.6% | | | | 200,513 | |

1) System share for each rate revenue community is the community's share of total MWRA water use for all rate revenue communities. System share for each Chicopee Aqueduct Valley (CVA) community is each CVA community's share of total MWRA water supplied to the CVA system. Water assessments for revenue communities are calculated by allocating the total annual water rate revenue requirement based on each community's share of flow. Water assessments for CVA communities are calculated by allocating the annual CVA rate revenue requirement based on each CVA community's share of CVA flow.

2) Lexington supplies Bedford with partial MWRA water service.

3) The Town of Clinton receives up to 800 million gallons of water per year free of charge and is charged a flat wholesale rate per million gallons for water in excess of 800 million gallons per year.

4) Other Revenue Customers: D.C.R. (Parks & Pools), Stone Zoo, Deer Island WWTP and Department of Youth Services.

5) Other Revenue Customers are charged a flat wholesale rate per million gallons of water supplied.

6) This report includes only water supplied for which revenue is collected in accordance with existing user agreements. It does not include water utilized for system maintenance.

(P) Community is partially supplied by MWRA.

Question's regarding water supplied can be directed to David Liston @ (617) 305-5853 or Leo Norton @ (617) 788-2256.

9-Jan-18