

**2017**

# **Hydrologic Conditions in the Delaware River Basin**



**Delaware River Basin Commission**  
DELAWARE • NEW JERSEY  
PENNSYLVANIA • NEW YORK  
UNITED STATES OF AMERICA

**Prepared by Operations Staff**

**June 2018**

# Hydrologic Conditions in the Delaware River Basin Annual Report 2017

## Hydrologic Highlights

At the start of 2017, the Delaware River Basin (DRB) was in a basin-wide drought watch which had been in effect since November 23, 2016. Precipitation and snowmelt during January refilled the reservoirs and the drought watch was lifted on January 18, 2017.

State-declared drought watches and warnings lingered into 2017 for DRB counties in New York, New Jersey and Pennsylvania. After a wet spring, the basin's counties were returned to normal status by the following dates:

April 12, 2017 - all New Jersey counties in the DRB except for Hunterdon County where storage in Round Valley and Spruce Run reservoirs remained below capacity.

May 1, 2017 - all New York counties

May 16, 2017 - all Pennsylvania counties

August 11, 2017 - Hunterdon Co., New Jersey

For additional details regarding DRBC and state drought actions during 2017, refer to the [2016-17 Chronology of Drought in the Delaware River Basin](#) section at the end of the report.

## Precipitation

Most of the basin's counties averaged below-normal precipitation for 2017<sup>1</sup>. Annual precipitation totals ranged from 39.7 inches in Lancaster Co., Pennsylvania to 49.8 inches in Schuylkill Co., Pennsylvania. Departures from the annual normal precipitation ranged from 7.0 inches below normal in Morris Co., New Jersey to 4.8 inches above normal in Chenango Co., New York. [Figure 1](#) presents a map showing the annual precipitation by county in the DRB.

The precipitation amounts at Montague, Trenton and Wilmington are used to represent the regional precipitation throughout the DRB<sup>2</sup>. The average observed precipitation above Montague, New Jersey for 2017 was 46.03 inches, or 0.74 inches above normal. Similarly, observed precipitation above Trenton, New Jersey was 45.30 inches, or 2.70 inches below normal. Precipitation at Wilmington, Delaware was 39.90 inches, or 3.81 inches below normal. [Figures 2 through 7](#) present normal and observed monthly precipitation totals at selected locations in the DRB for 2017.

---

<sup>1</sup>This information is based on precipitation data from the National Weather Service Middle Atlantic River Forecast Center (NWS MARFC) for 38 of the 42 counties located either partially or completely in the Delaware River Basin. Data for four counties is not available. The NWS uses several precipitation gages in each county to calculate the average precipitation for each county. Annual precipitation departures are calculated by DRBC staff using the NWS MARFC data.

<sup>2</sup> Selected precipitation data were provided by the National Weather Service and the Delaware River Master's Office. Annual precipitation departures are calculated by DRBC staff using the data provided for 2017. Normal data is based on historical records for the period 1981-2010.

## Streamflow

Observed monthly mean streamflows along the main stem of the Delaware River and its two-largest tributaries, the Lehigh and Schuylkill rivers, were generally normal to below normal during the first quarter of the year. A combination of rainfall and melting snow increased flows in early April, producing the highest daily mean flows of the year on the mainstem Delaware River at Montague and Trenton. On April 7, the daily mean flow at Montague was 40,900 cubic feet per second (cfs). Similarly, at Trenton, the flow on April 8 was 65,400 cfs.

Flows in the basin generally remained in the normal to above-normal range through September. Drier conditions during late fall and early winter resulted in below-normal flows throughout the basin. The lowest average monthly flows of 2017 occurred in December, when many streams were less than 50% of the normal flow. Along the main stem, the Delaware River at Montague and Trenton were 44% and 32% of normal, respectively. The Lehigh River at Bethlehem and the Schuylkill River at Philadelphia were both only 32% of normal during December

[Figure 8](#) presents observed monthly mean streamflow at selected stations for 2017. [Figure 9](#) and [Figure 10](#) present annual hydrographs for 2017 at Montague, New Jersey and Trenton, New Jersey, respectively.

## Reservoir Storage and Releases

### Lower Basin

After being depleted to drought warning levels during autumn 2016, Beltzville Reservoir (located on the Pohopoco Creek, a tributary of the Lehigh River) refilled during the first two months of the year. Except for this refill period, Beltzville and Blue Marsh (located on the Tulpehocken Creek, a tributary of the Schuylkill River) maintained normal storage during 2017. Consequently, the Delaware River Basin Commission's (DRBC) lower basin drought operating plan was not implemented. Also, the Commission was not required to make releases from the Lower Basin reservoirs during 2017 to maintain the streamflow objective of 3,000 cubic feet per second (cfs) at Trenton, NJ. [Figure 11](#) and [Figure 12](#) present 2017 reservoir elevations for Beltzville and Blue Marsh Reservoirs, respectively.

No releases were made from Merrill Creek Reservoir during 2017. Storage in Merrill Creek Reservoir, located in Phillipsburg, New Jersey, is used to replace evaporative losses caused by power generation when the basin is under DRBC-declared drought operations and the equivalent average daily flow target at Trenton, New Jersey is below 3,000 cfs.

### Upper Basin

The three New York City (NYC) Delaware reservoirs, Cannonsville, Pepacton and Neversink, are in the upper DRB and are operated under the Flexible Flow Management Program (FFMP)<sup>3</sup>. On January 18, 2017, DRBC terminated the basin-wide drought watch which had been in effect since November 23, 2016. The termination occurred after precipitation and snowmelt raised the combined storage in the three NYC Delaware reservoirs 15 BG above the drought watch threshold for five consecutive days.

---

<sup>3</sup> Beginning in October 2007, the NYC reservoirs were operated in accordance with the FFMP, a temporary operations plan to be codified as per Resolution 2007 on 9/26/2007.

Storage continued to recover during the early months of the year and increased to the long-term median by March. The reservoirs refilled to usable capacity by early April, one month ahead of the normal May 1 refill date. Combined storage remained at or above the long-term median through late November, when accumulating precipitation deficits caused storage to decline below the median. [Figure 13](#) presents NYC reservoir storage levels for 2017.

The Delaware River Master directed approximately 31 BG<sup>4</sup> of water from the NYC reservoirs during the period August through December of 2017 to meet the minimum flow objective at the Delaware River at Montague, New Jersey. Most of these releases were made during a dry period in September and October. In comparison, the River Master directed 61.5 BG in 2016 and 101 BG in 2001, a drought year.

### **Groundwater**

Groundwater levels in the basin's observation wells were seasonally variable during 2017. Most wells recharged during the spring after receiving snowmelt and normal to above-normal precipitation and declined during the summer months when demand for water was high. Below-normal precipitation during November and December impeded the typical recovery period during the last quarter of the year. Many wells remained below the long-term median at the end of December.

[Figures 14-17](#) present the historical groundwater levels as the median of the daily mean, as well as the observed daily mean for 2017, in selected observation wells in the Delaware River Basin.

### **Salt Front**

The salt front is defined as the 250 parts-per-million isochlor. The seven-day average location of the salt front is used by DRBC as an indicator of salinity intrusion in the Delaware Estuary. The salt front's location fluctuates along the main stem Delaware River as streamflow increases or decreases in response to inflows, diluting or concentrating chlorides in the river. Long-term median mid-month locations range from river mile 67 in April (two miles downstream of the Delaware Memorial Bridge) to river mile 76 in September (two miles downstream of the Pennsylvania-Delaware State line).<sup>5</sup>

The farthest upstream location of the salt front during 2017 was river mile 79 in late October. This location is one mile upstream of the Pennsylvania-Delaware State line. By comparison, the farthest recorded upstream location of the salt front measured during the 1960's drought of record was river mile 102. [Figure 18](#) presents the 7-day average location of the 250-PPM isochlor during 2017.

---

<sup>4</sup> Directed release information supplied by the Office of the Delaware River Master.

<sup>5</sup> The normal salt front location has been updated based on data from January 1998-February 2013.

## **2016-17 Chronology of Drought in the Delaware River Basin**

- March 1, 2016 NJ DEP lifts the Drought Watch that has been in effect for portions of 12 counties since September 2015. The entire state now in normal status. Five NJ counties located in the DRB are returned to normal status: Hunterdon, Mercer, Monmouth, Morris and Ocean.
- June 1, 2016 Ability of New Jersey to take water from the D&R Canal impeded by the presence of submerged aquatic vegetation in the canal. This resulted in the increased use of Spruce Run and Round Valley Reservoirs.
- July 15, 2016 New York State Department of Environmental Conservation (NYSDEC) issues a drought watch for the entire state, impacting all eight counties located totally or partially within the Delaware River Basin (DRB).
- July 25, 2016 NJ DEP issues a drought watch for most of northern NJ, including DRB counties Sussex, Warren, Hunterdon, Mercer and Morris.
- August 2, 2016 The PA DEP issues a drought watch for six DRB counties: Berks, Carbon, Lehigh, Northampton, Schuylkill and Lebanon.
- September 6, 2016 The PA DEP expands the drought watch to include three more DRB counties under drought watch: Chester, Delaware and Philadelphia. A total of nine DRB counties in PA are under drought watch status.
- October 5, 2016 NJ DEP expands the drought watch to include Burlington, Camden, Gloucester, Monmouth, Ocean and Salem counties. A total of 11 NJ counties located totally or partially or in the DRB are under drought watch.
- October 21, 2016 NJ DEP upgrades drought status to drought warning in Hunterdon, Mercer, Monmouth, Morris, Ocean, Sussex and Warren counties. A drought watch remains in effect for Burlington, Gloucester, Camden and Salem. The only three counties in normal status are Atlantic, Cumberland and Cape May counties. Rainfall over the past few months in these counties remains normal to above normal.
- October 26, 2016 Beltzville Reservoir drops below the 615' drought warning elevation. A Lower Basin Drought Warning would only be triggered when Blue Marsh storage falls below 283 feet.
- November 3, 2016 PA DEP upgrades drought status to drought warning in Carbon, Lehigh, Monroe and Northampton counties. Drought watch status is expanded to include Bucks, Luzerne, Lackawanna, Lancaster, Montgomery, Pike and Wayne counties. All PA DRB counties are under either a drought watch or drought warning status.
- November 9, 2016 In response to declining reservoir storage and increasing rainfall deficits, DRBC holds a drought hearing to accept public input about drought issues impacting the basin.

November 22, 2016	The elevation in Blue Marsh Reservoir is 283.78 feet, only slightly above the 283 feet drought elevation threshold. A Lower Basin Drought Warning will be triggered, for only the second time in DRBC history, if storage falls below 283 feet.
November 23, 2016	<p>DRBC holds a special meeting to issue Resolution 2016-7. The resolution allows for coordinated operation of regional reservoirs, out-of-basin diversions and Delaware River Flow Objectives.</p> <p>As a result of the resolution, the entire DRB is under a basinwide drought watch status based on storage in the NYC reservoirs. The flow targets at Montague and Trenton are reduced to 1,650 cubic feet per second (cfs) and 2,700 cfs, respectively. Conservation releases are reduced from the NYC reservoirs as well as from Beltzville and Blue Marsh reservoirs in the lower basin. A bank of water of 1.48 BG or 2,300 cfs-days, established by the Decree Parties to offset higher NJ water supply diversion amounts than are stated in Table 1 of Resolution No. 2016-7, becomes available for use.</p>
November 28, 2016	Merrill Creek Reservoir begins releases to make-up for consumptive use by members of the Merrill Creek Owners Group.
November 29, 2016	The basin receives heavy rainfall and storage in the Lower Basin Reservoirs begins to increase.
December 1, 2016	Storage in Blue Marsh Reservoir increases to normal winter pool elevation 285 feet. Storage in Beltzville Reservoir is still below the drought warning line but is increasing.
January 18, 2017	DRBC terminates basinwide drought watch due to precipitation and snow melt that raised the combined storage in the three NYC Delaware reservoirs 15 BG above the drought watch threshold for five consecutive days. Numerous state drought declarations remain in effect.
February 14, 2017	On February 14 drought declaration changes were made for eight DRB counties in Pennsylvania. Carbon, Lehigh, Monroe, and Northampton counties were downgraded from drought warning to drought watch and Luzerne, Lackawanna, Pike and Wayne counties moved from drought watch to normal status.
March 9, 2017	Beltzville Reservoir refills to normal capacity (elevation 628 feet) for the first time since early September 2016. At its lowest in late November 2016, the reservoir was nearly 18' below the normal capacity.
March 29, 2017	Blue Marsh Reservoir fills to normal summer pool elevation 290 feet.
April 6, 2017	The basin receives three to five inches of rain over a 14 day-period. The rain, combined with snow melt, causes NYC reservoirs to refill to 271 BG. The normal refill date is May 1.
April 6, 2017	PA DEP returns Schuylkill, Carbon and Monroe counties to normal status.

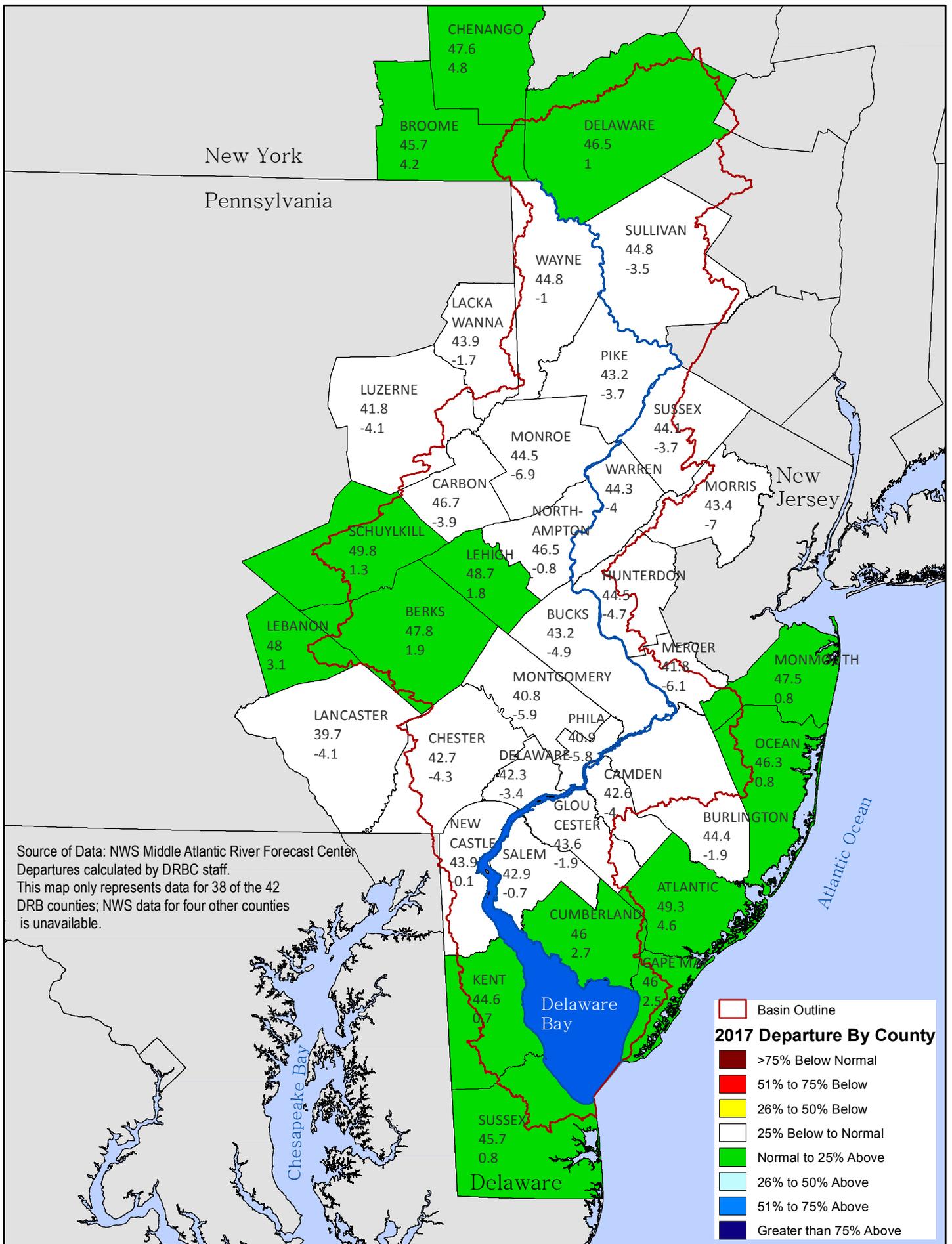
April 12, 2017 NJ DEP returns 13 of the 14 basin counties to normal status. Hunterdon Co. remains in drought warning because Round Valley and Spruce Run Reservoirs remain below normal capacity.

May 1, 2017 All New York counties, including those in the DRB, are returned to normal status due to return to normal precipitation and improved groundwater, streamflow and lake levels.

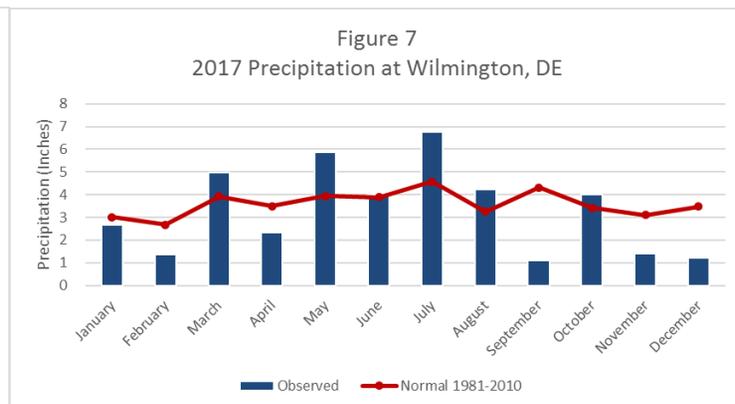
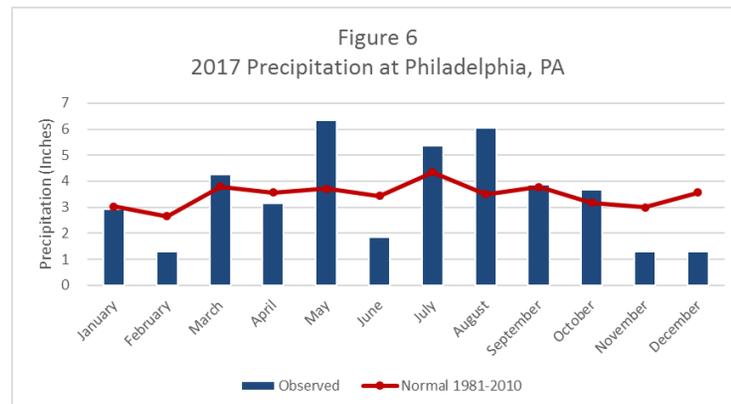
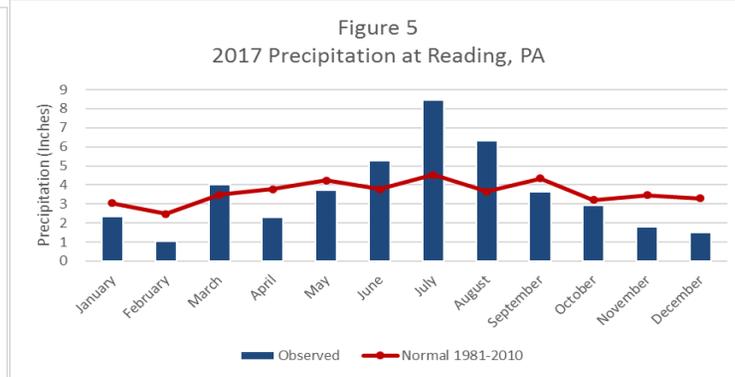
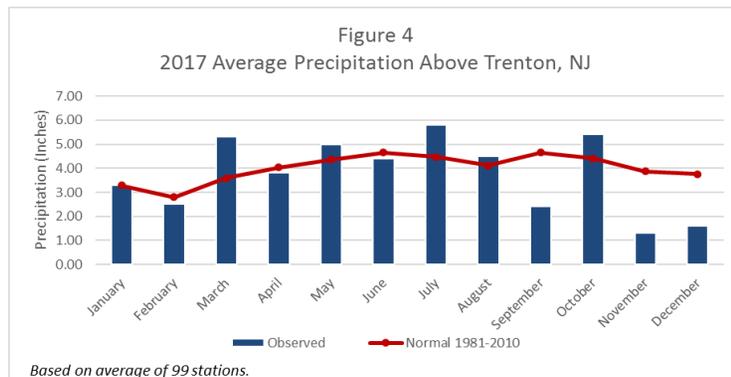
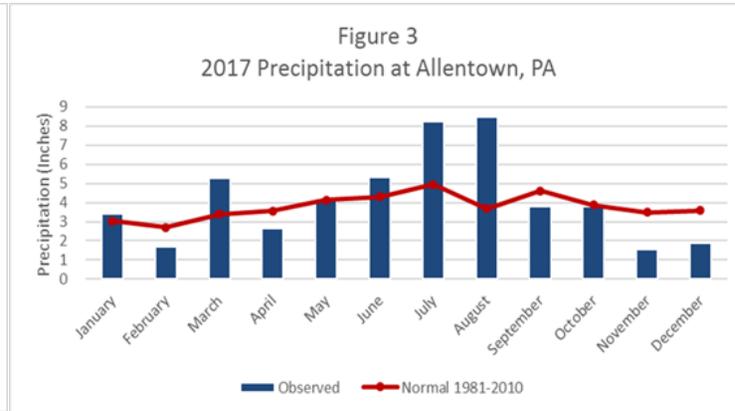
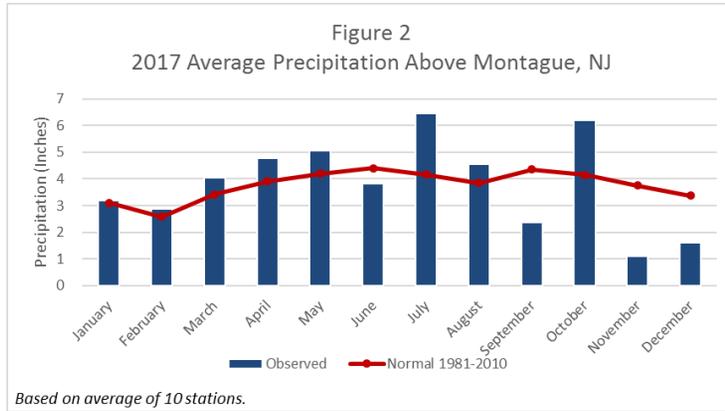
May 16, 2017 Due to the wet spring, all Pennsylvania counties are returned to normal status. The drought watch is lifted from DRB counties Berks, Bucks, Chester, Delaware, Lancaster, Lebanon, Montgomery, Northampton and Philadelphia.

August 11, 2017 NJ DEP returns Hunterdon County to normal status. Ample rainfall during spring and summer significantly increased storage in the central NJ reservoirs to 81 percent of capacity.

Figure 1: 2017 Annual Precipitation in the Delaware River Basin  
 Total Precipitation (top) and Total Departure from Normal (bottom) in Inches

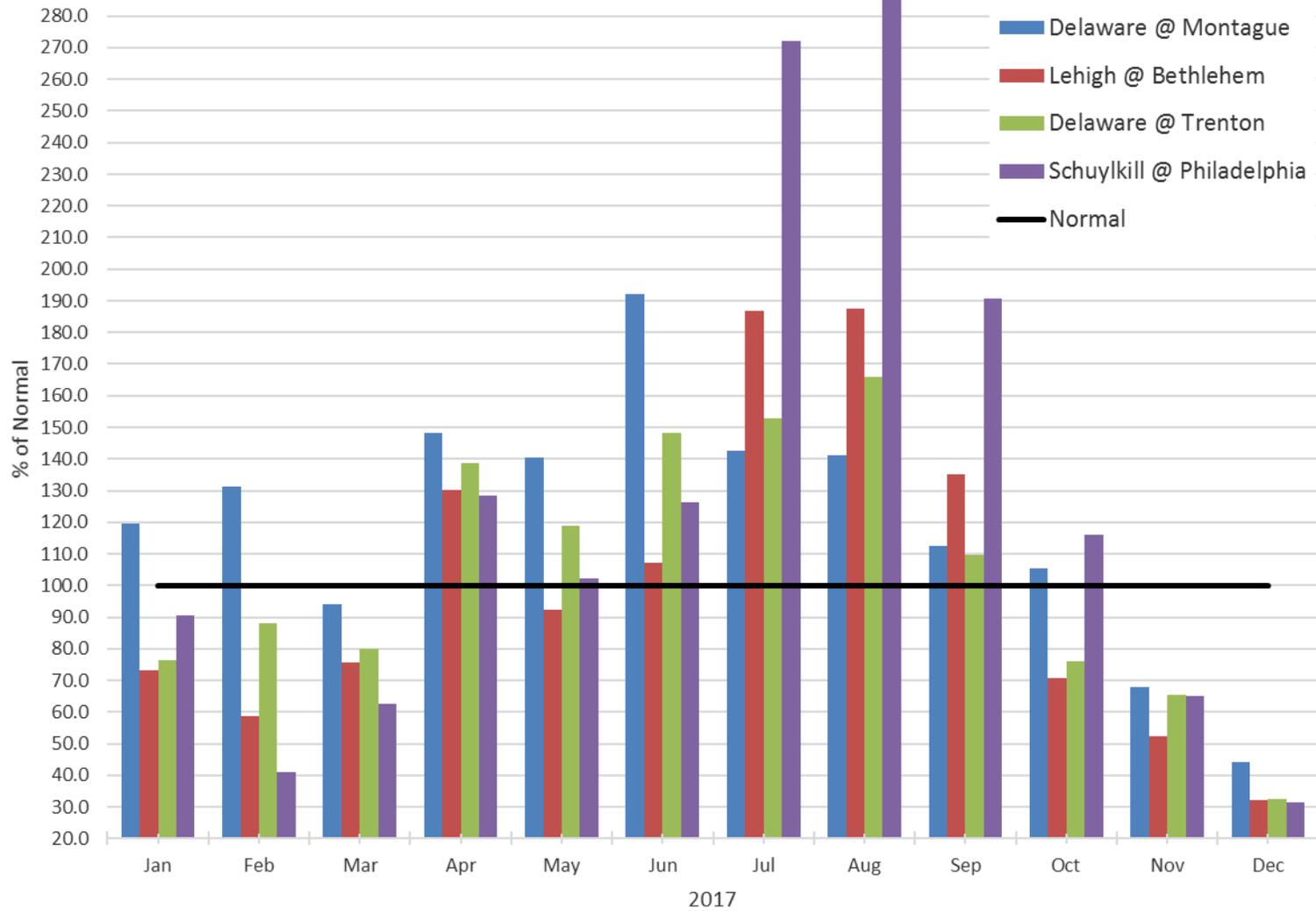


## FIGURES 2 - 7 2017 PRECIPITATION AT SELECTED STATIONS IN THE DELAWARE RIVER BASIN



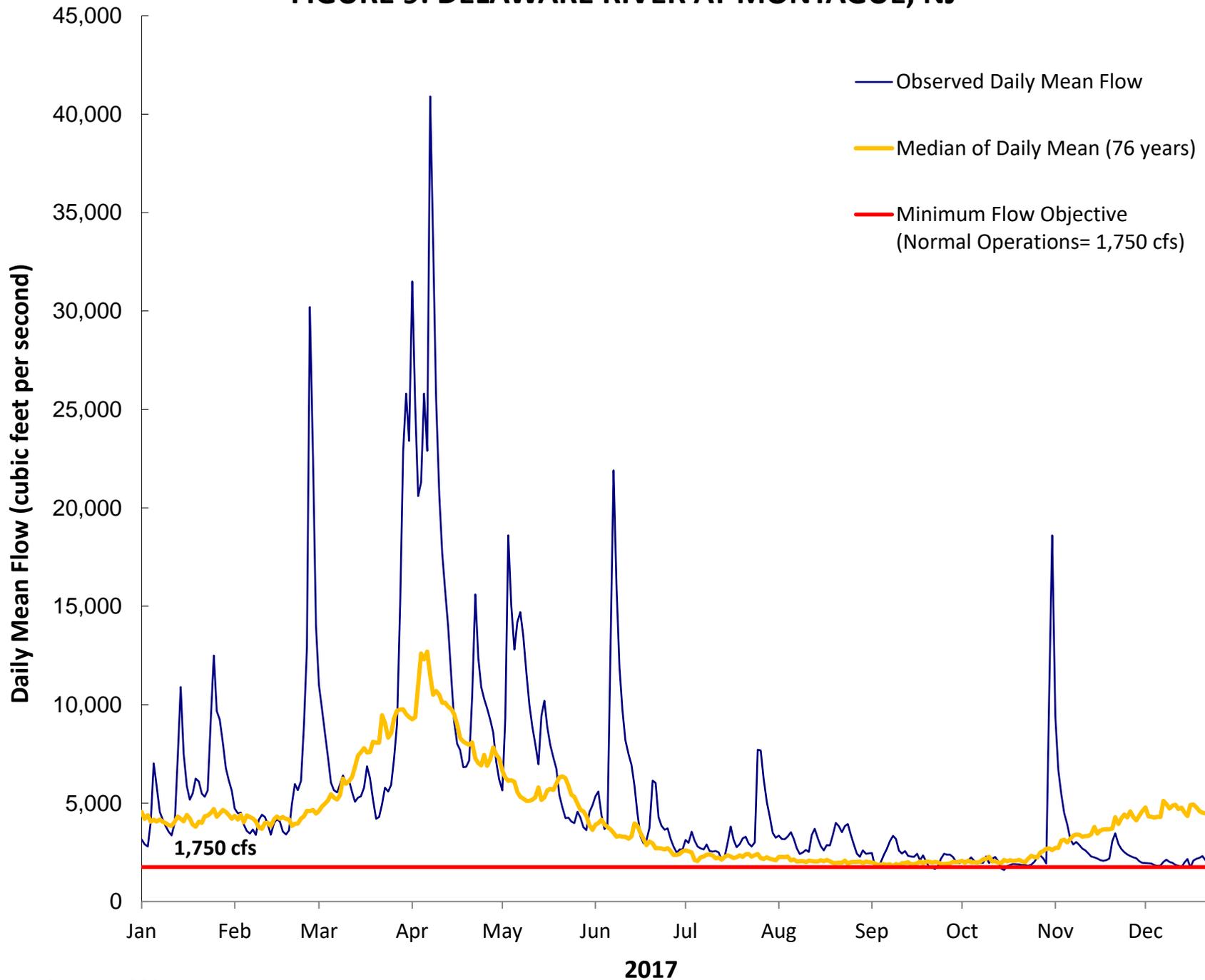
Data Sources: National Weather Service and the Delaware River Master. All data is provisional and subject to change.

**FIGURE 8: 2017 OBSERVED MONTHLY MEAN STREAMFLOW**  
*% of Normal*



Data Source: USGS. Graphic prepared by DRBC staff.

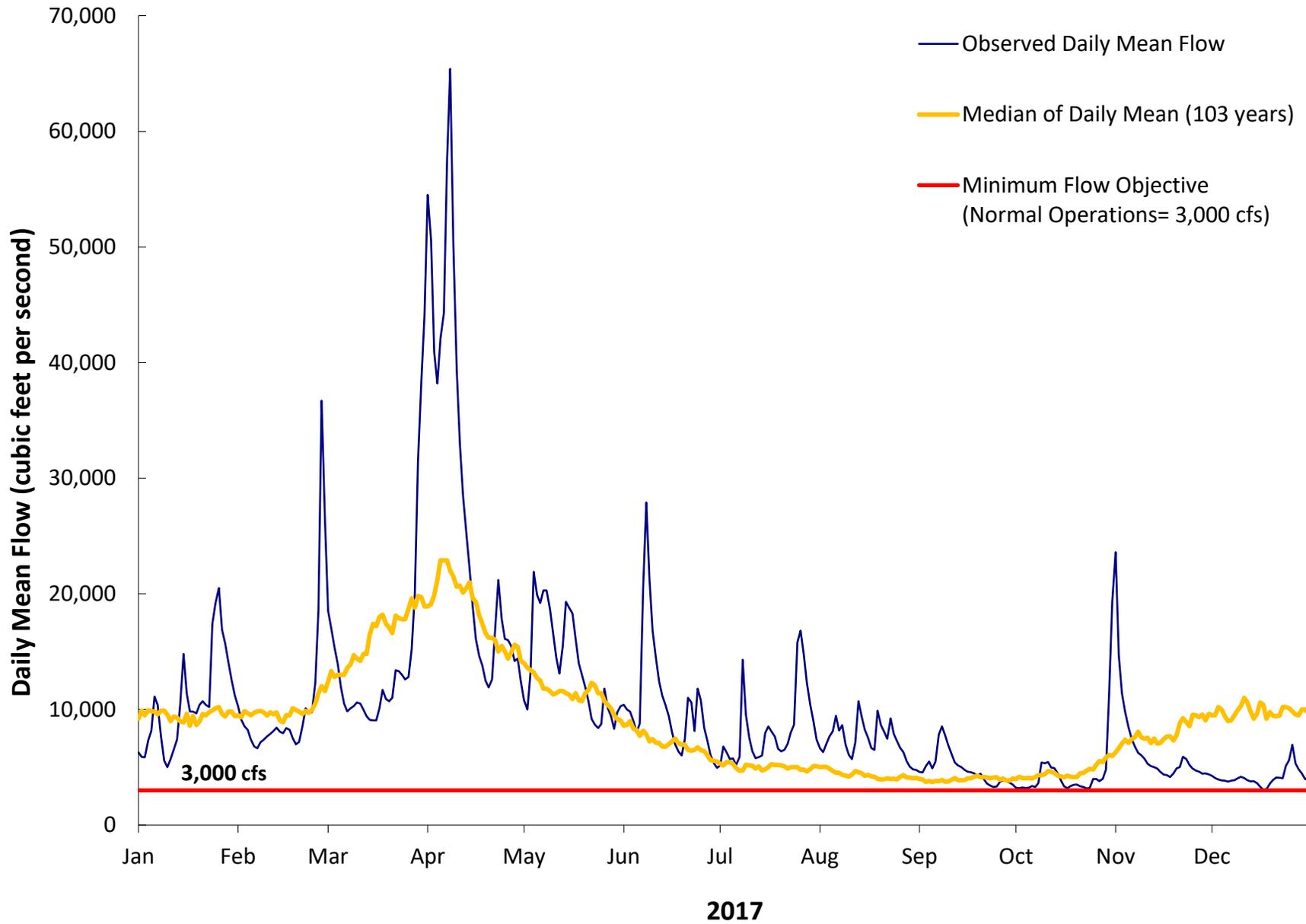
**FIGURE 9: DELAWARE RIVER AT MONTAGUE, NJ**



Data Source: USGS

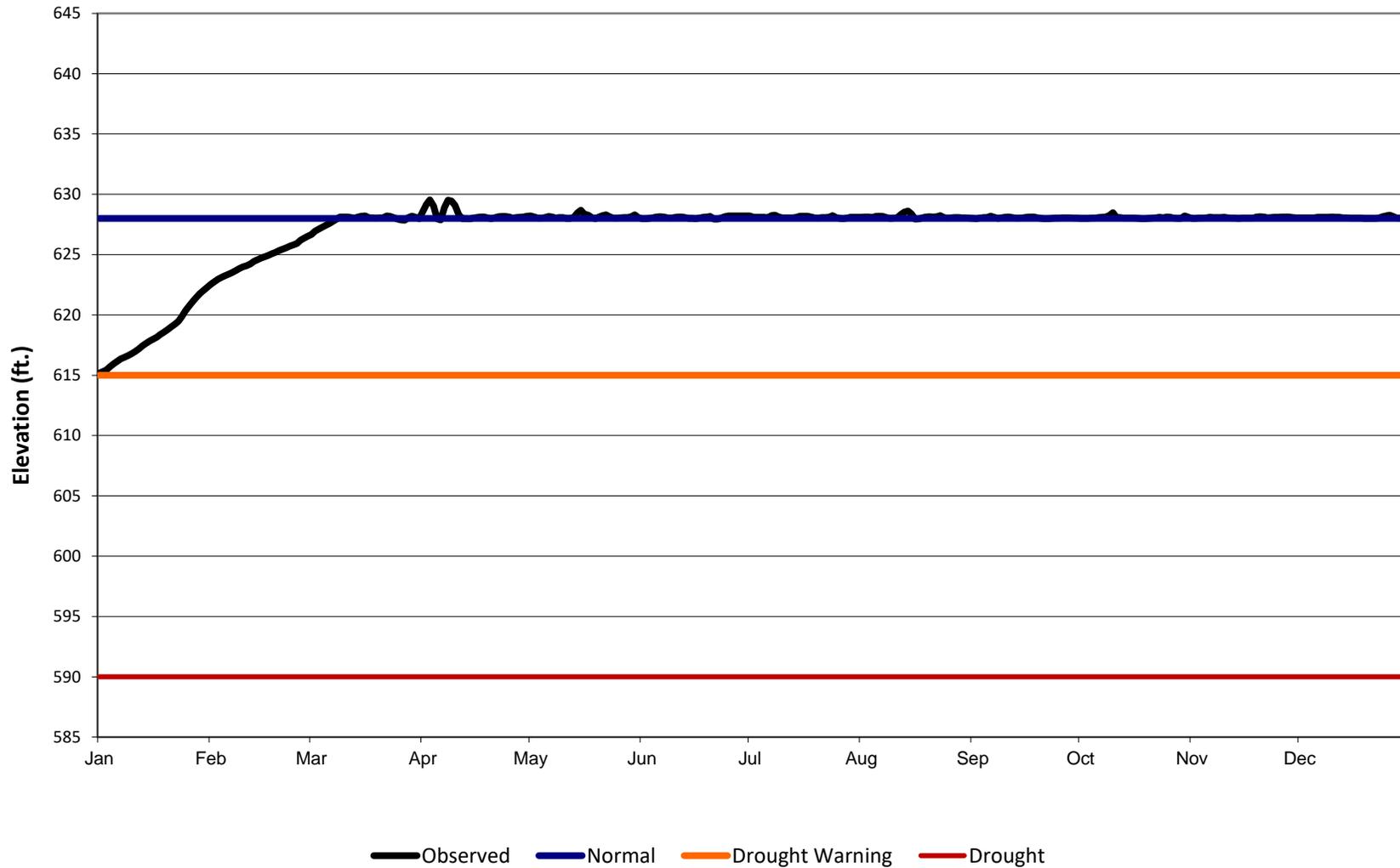
Graph generated by DRBC staff.

**FIGURE 10: DELAWARE RIVER AT TRENTON, NJ**



Data Source: USGS  
Graph generated by DRBC staff.

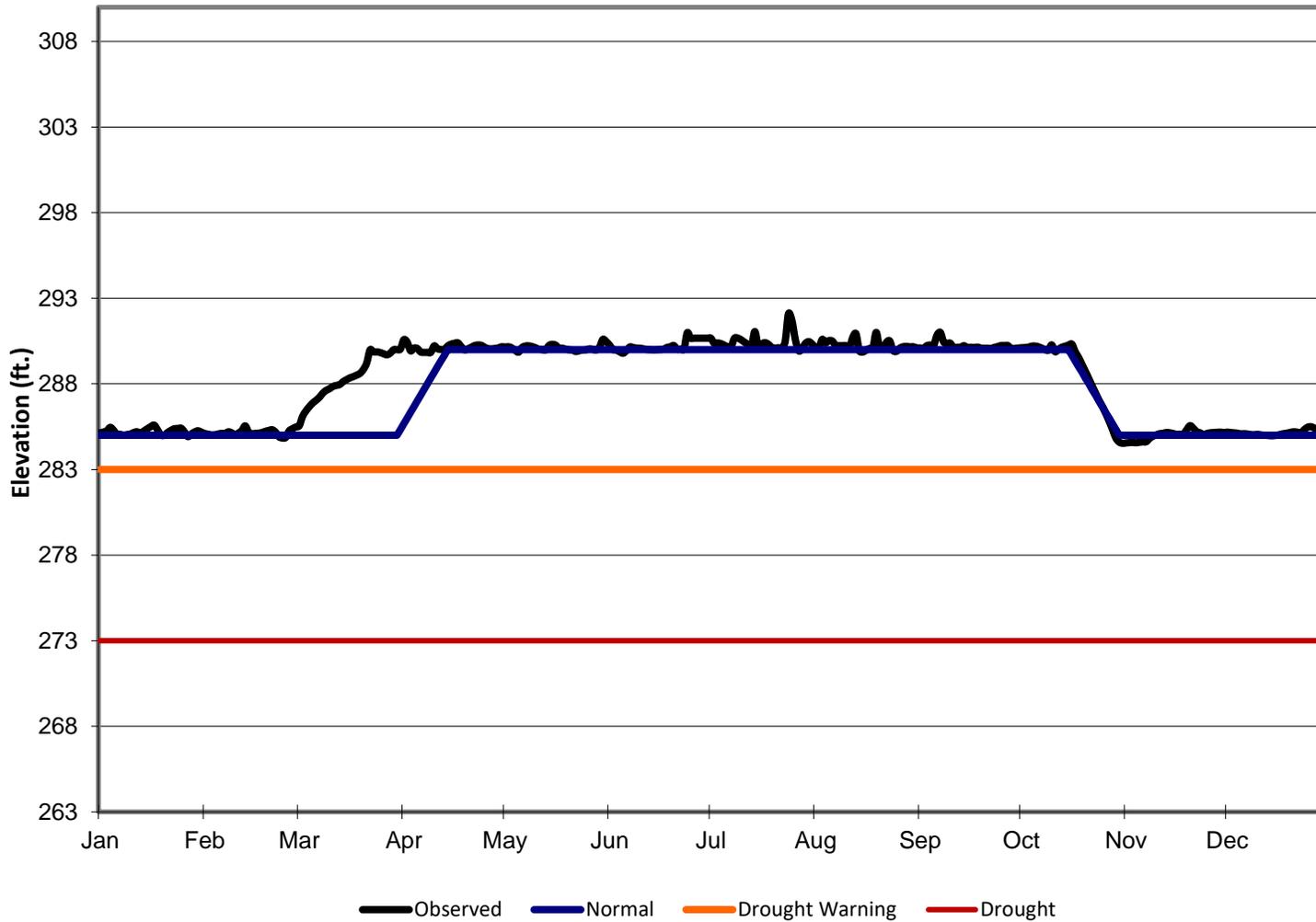
# FIGURE 11: BELTZVILLE RESERVOIR ELEVATION 2017



**Notes:**

1. The normal pool elevation is 628 feet.
2. Data was provided by the Army Corps of Engineers (8 am value). Graph generated by DRBC staff.

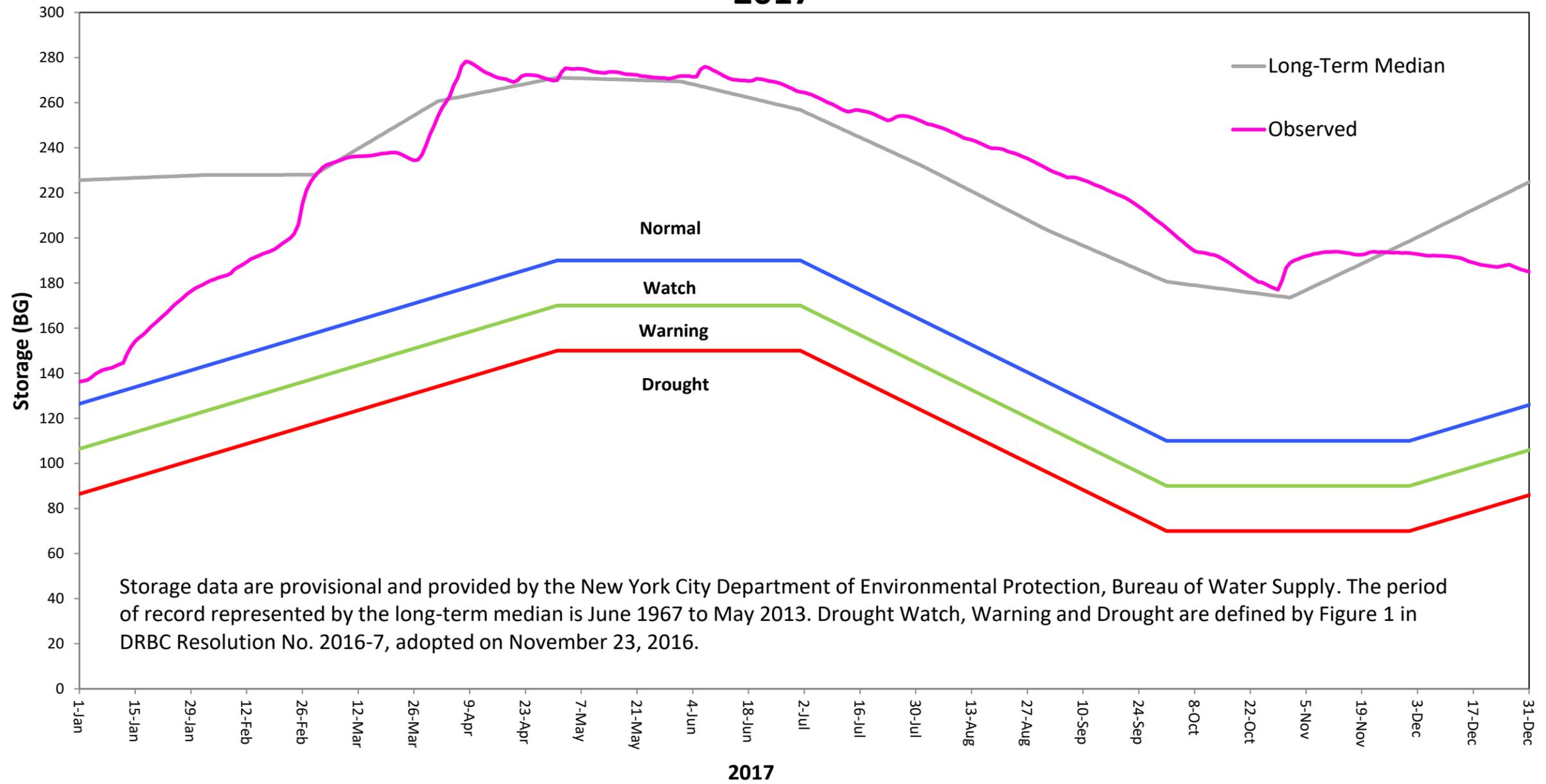
**FIGURE 12: BLUE MARSH RESERVOIR ELEVATION  
2017**



**Notes:**

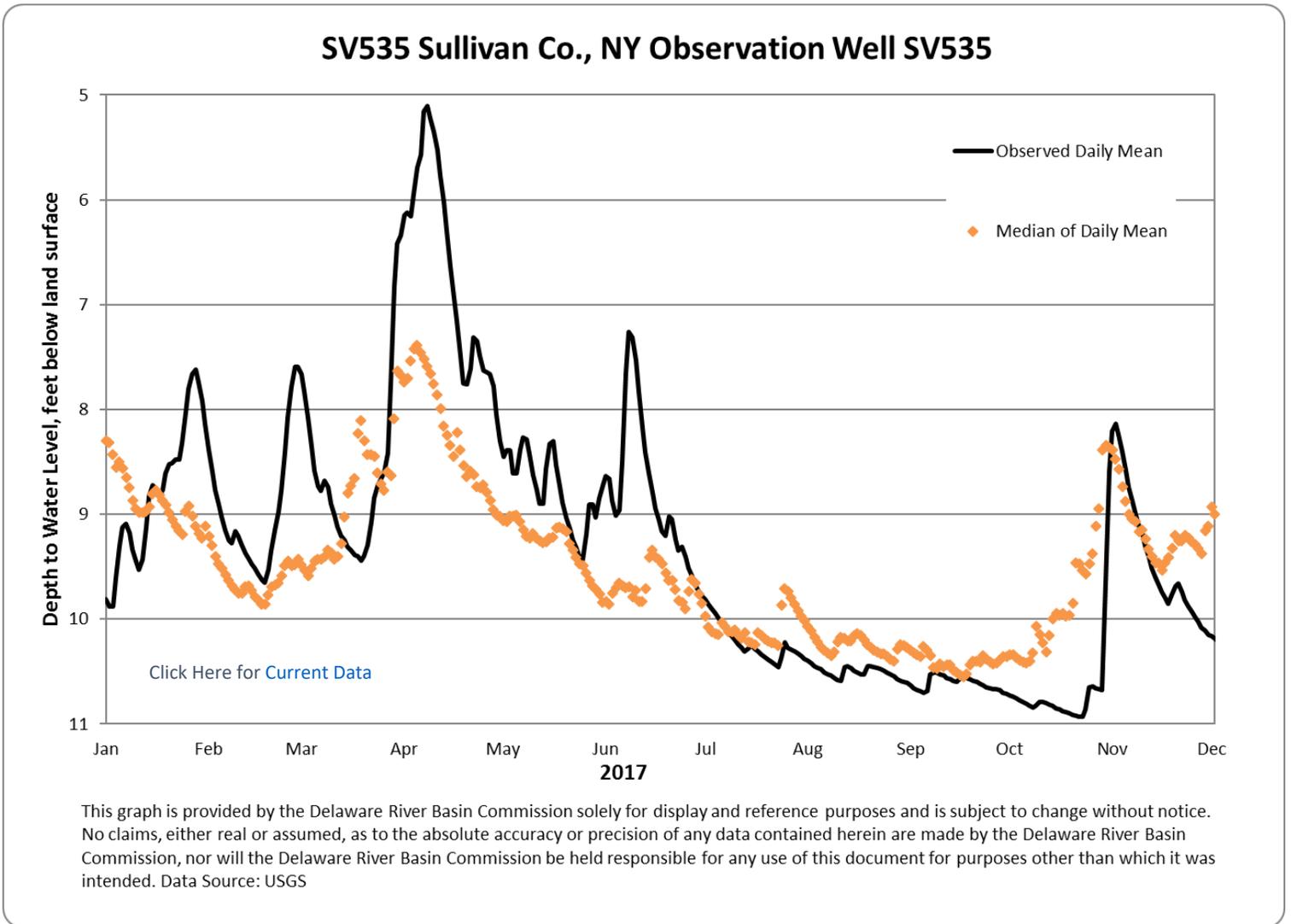
1. Winter Pool=285 feet (October- March)/Summer Pool= 290 feet (April-September).
2. Data was provided by the Army Corps of Engineers (8 am value). Graph generated by DRBC staff.

# FIGURE 13: NEW YORK CITY DELAWARE RIVER BASIN STORAGE 2017



# Groundwater Levels in Observation Wells in the Delaware River Basin

## FIGURE 14: USGS WELL-SULLIVAN CO., NEW YORK 2017 Observations of Depth to Water



# FIGURE 15: FIVE USGS OBSERVATION WELLS LOCATED IN PENNSYLVANIA 2017 Observations of Depth to Water

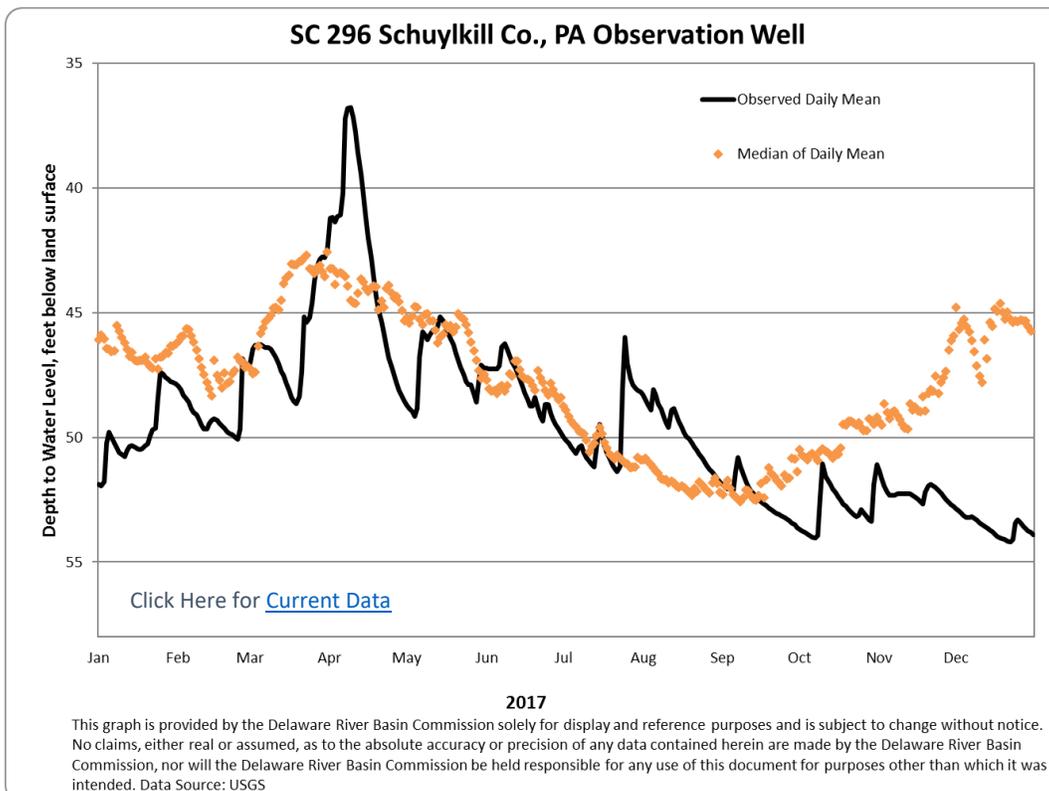
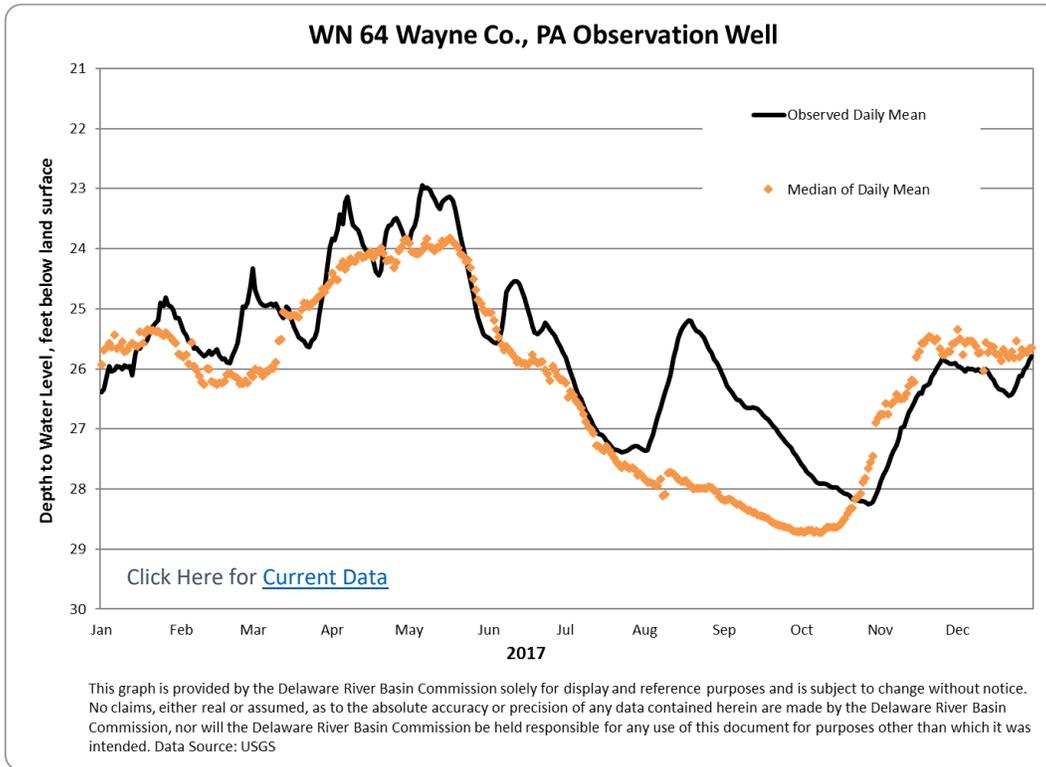


Figure 15 Continued

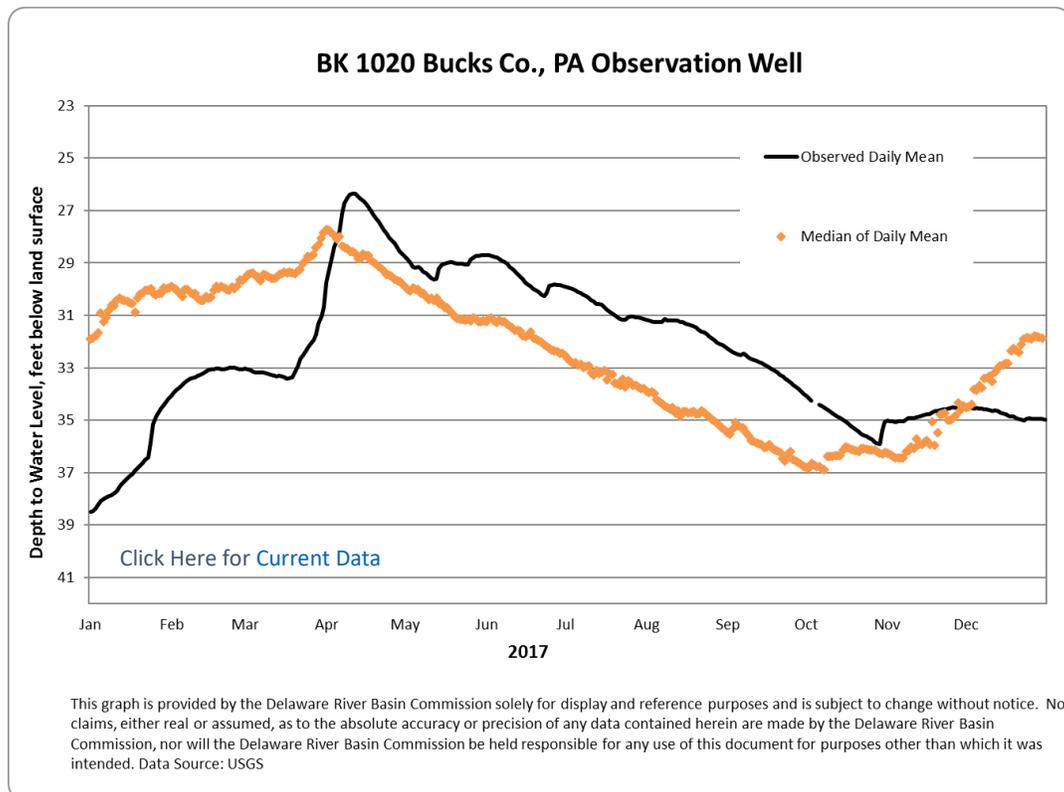
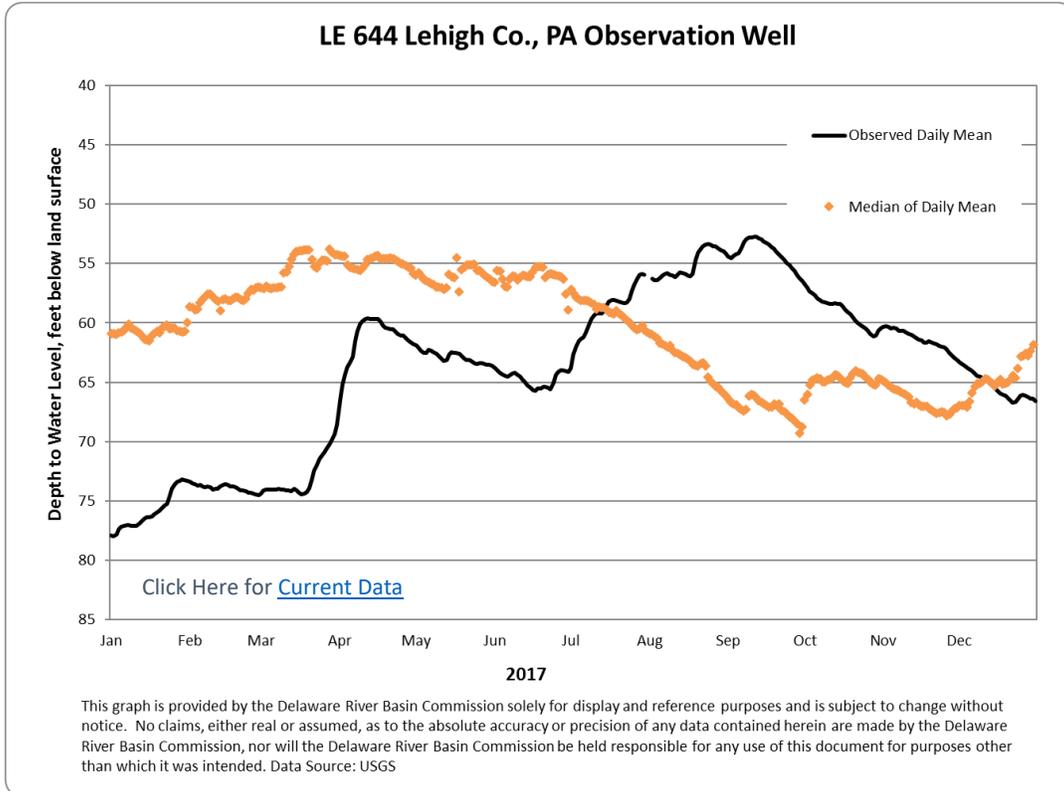
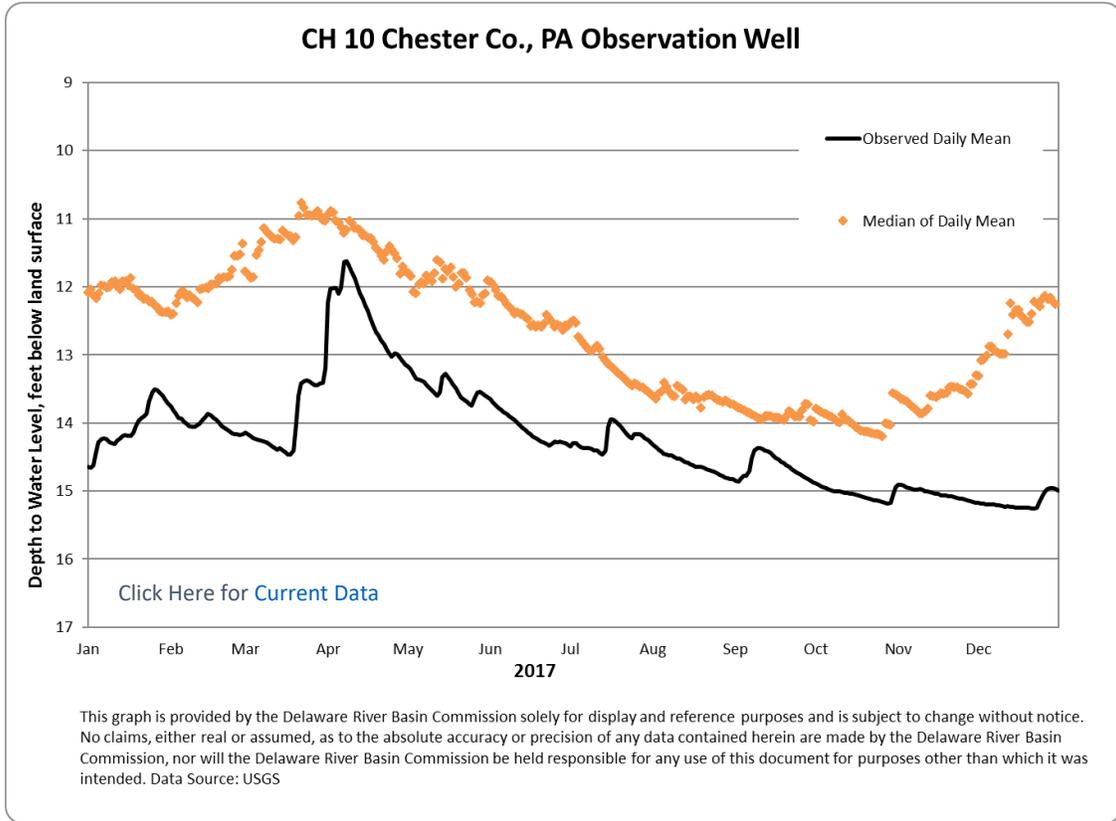
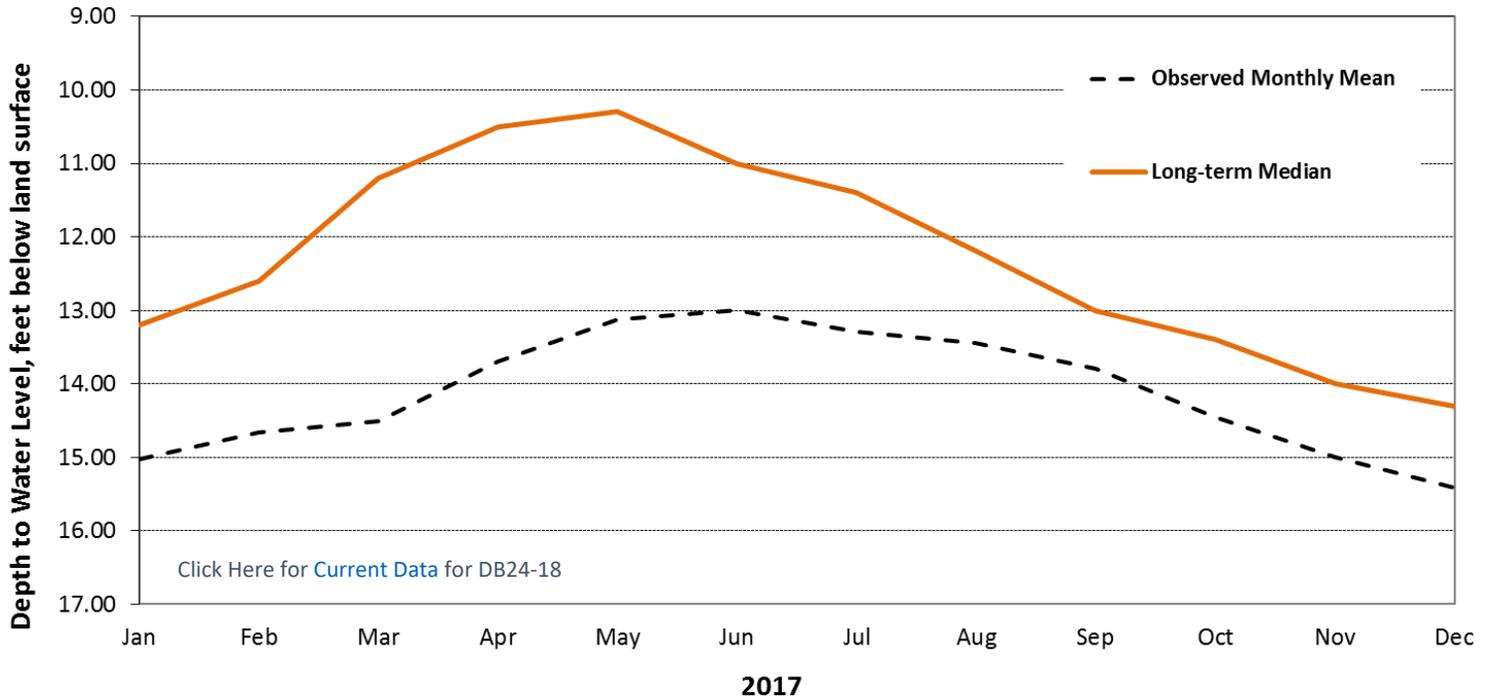


Figure 15 Continued



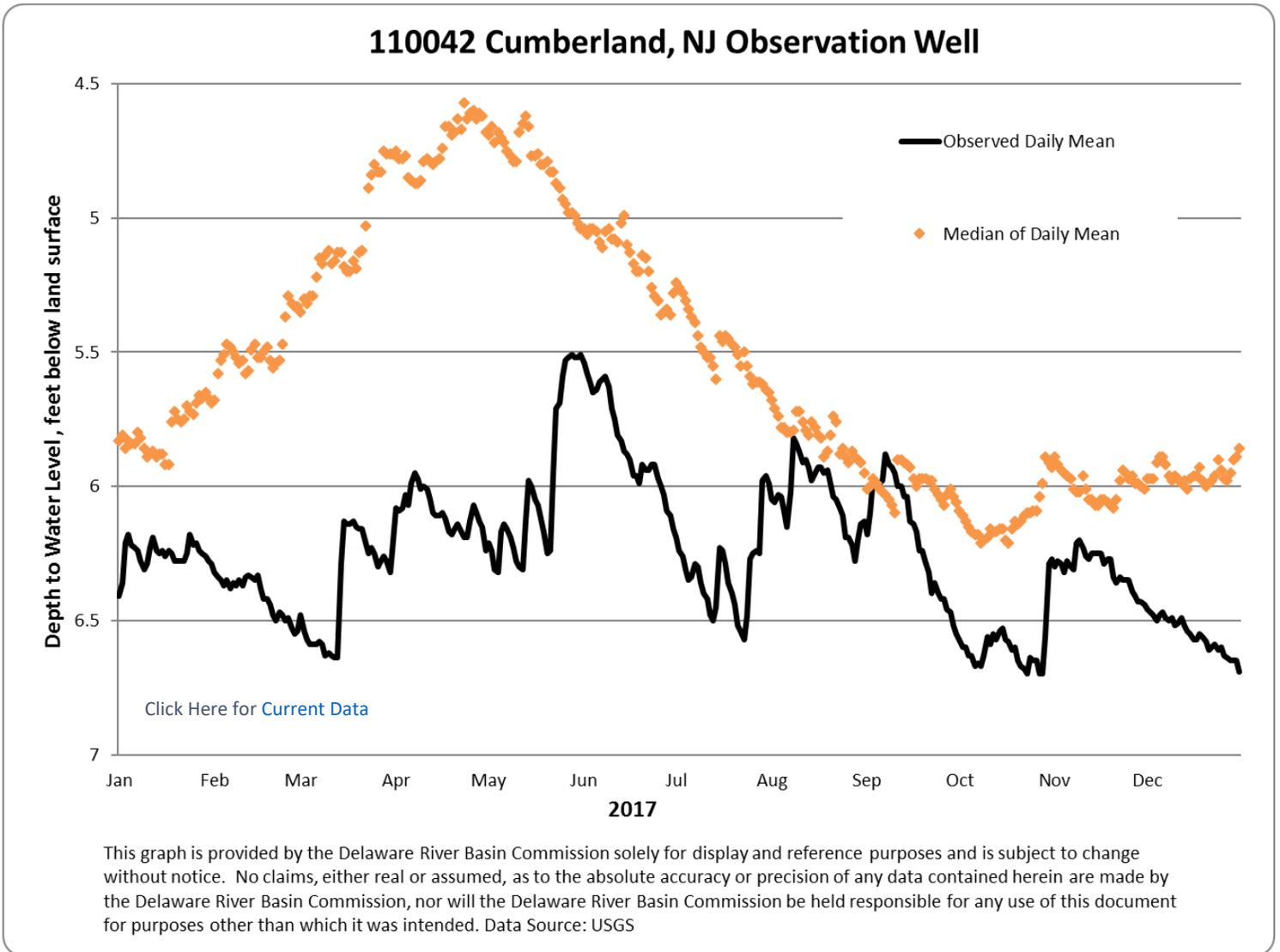
**FIGURE 16: DGS Well- NEW CASTLE CO., DE  
2017 Observations of Depth to Water**

**DGS WELL-NEW CASTLE CO., DELAWARE**

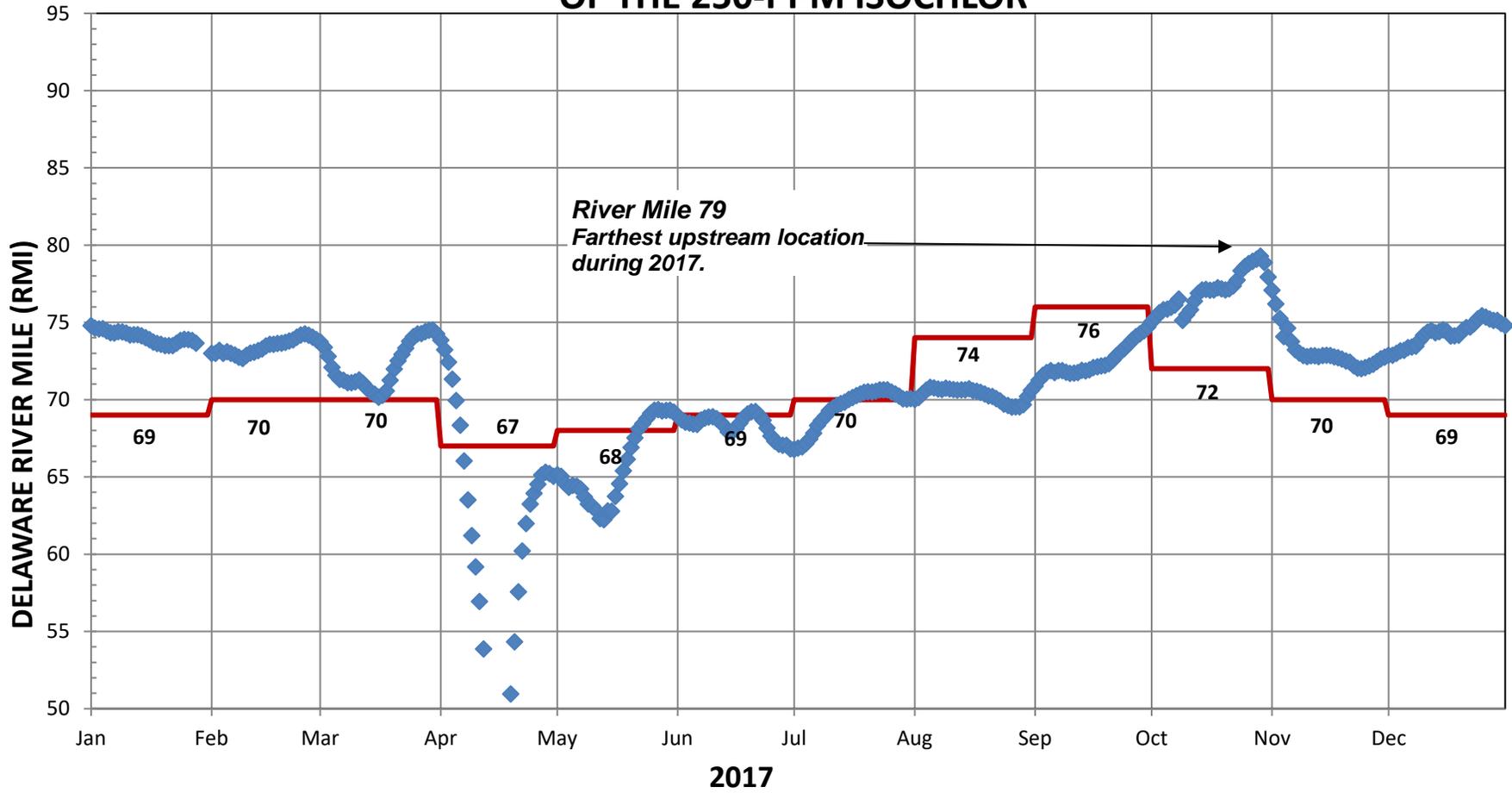


This graph is provided by the Delaware River Basin Commission solely for display and reference purposes and is subject to change without notice. No claims, either real or assumed, as to the absolute accuracy or precision of any data contained herein are made by the Delaware River Basin Commission, nor will the Delaware River Basin Commission be held responsible for any use of this document for purposes other than which it was intended.

**FIGURE 17: USGS WELL-Cumberland Co., NJ  
2017 Observations of Depth to Water**



**FIGURE 18: 7-DAY AVERAGE LOCATION OF THE 250-PPM ISOCHLOR**



— Normal Mid-Month Location      ◆ Daily Location of 7-day Average 250-PPM Isochlor

**Notes:**

1. DRBC does not estimate locations below river mile 54.
2. The normal mid-month location of the salt line represents the median location based on data from January 1998 through February 2013.
3. Data sources are USGS and Kimberly Clark Corporation.