An Overview of Drought in the Delaware River Basin

February 2019

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

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

AN OVERVIEW OF DROUGHT CONDITIONS IN THE DELAWARE RIVER BASIN

The "Drought of Record" was one of the first challenges met by the newly formed Delaware River Basin Commission (DRBC) in the early 1960s. Numerous droughts impacted the basin in the decades that followed and DRBC continued to adapt and develop new strategies, such as drought operating plans, for managing water resources during these critical periods. DRBC's drought operating plans are implemented either basinwide or for the lower basin. The plans complement the drought operating plans of the states, which are developed to respond to local water supply conditions.

This document briefly describes the evolution of DRBC's drought management operations and provides a summary of DRBC drought actions from 1965 through present day.

BASINWIDE DROUGHT OPERATIONS

DRBC's Basinwide Drought Operations are based on storage conditions in three New York City (NYC) reservoirs, located at the headwaters of the Delaware River. These reservoirs include Cannonsville Reservoir on the West Branch of the Delaware River, Pepacton Reservoir on the East Branch of the Delaware River, and Neversink Reservoir on the Neversink River. During drought conditions, when the combined storage of the NYC reservoirs is below normal operations levels, the operating plans require phased reductions in:

- Flow objectives for the Delaware River at Montague, NJ and Trenton, NJ;
- Out-of-basin diversions from the NYC reservoirs and for New Jersey;
- Conservation release rates from the NYC reservoirs, Beltzville, Blue Marsh, FE Walter, and Lake Nockamixon; and
- Replacement of consumptive use (evaporative losses) from thermoelectric utilities.

The purpose of the reductions and of the consumptive use replacement is to conserve water in the basin's reservoirs and to preserve water quality in the Delaware River by controlling the upstream movement of salty water from the Delaware estuary.

DRBC's basinwide drought operations were not always triggered by combined storage in the NYC Delaware Reservoirs. When the DRBC was created in October 1961, Section 10.4 of the Delaware River Basin Compact granted the commission the authority to declare a water supply emergency based on, "a drought or other condition which may cause an actual and immediate shortage of available water". DRBC exercised this authority when it declared an emergency during the Drought of Record in the 1960s. It was not until the following decade that the DRBC began to define drought operations using rule curves that represented combined storage in Neversink, Pepacton and Cannonsville reservoirs.

DRBC's current basinwide drought operating plan had its origin in Docket No. D-77-20, which was approved on May 25, 1977. The docket required the commission to develop a long-range program for reservoir operations in the upper basin with the goals of balancing water supplies and assuring maximum conservation of water during drought periods. In addition to approving a two-year experimental release program for the three NYC reservoirs using a new conservation release schedule, the docket also approved the formation of a task group comprised of the parties to the 1954 Decree[1], the Office of the Delaware River Master and the DRBC, which would be responsible for developing criteria defining the onset and stages of drought. The task group was also comprised of several state environmental agencies, including:

- the Pennsylvania Department of Environmental Resources (PA DER), currently known as the Pennsylvania Department of Environmental Protection,
- New York State Department of Environmental Conservation (NYS DEC),
- New York City Department of Environmental Protection (NYC DEP),
- New Jersey Department of Environmental Protection (NJ DEP), and the
- Delaware Department of Natural Resources and Environmental Control (DE DNREC)

The task group analyzed several reservoir drawdown models used to define phased reductions of diversions and Montague flow objectives during drought conditions. The individual agency conclusions and recommendations were presented to the DRBC for consideration in March 1979 [2].

A few months prior to the task force recommendations, DRBC Resolution 78-20 invited each of the parties to the 1954 Supreme Court Decree to enter "good faith" discussions to make recommendations for management of the waters of the Delaware Basin consistent with the Delaware River Basin Compact. These discussions resulted in 14 recommendations which became known as the Good Faith Recommendations[3]. NYC Delaware Reservoir Operation curves used to define basinwide "normal", "drought warning" and "drought" hydrologic conditions, appear as part of Recommendation 3. On June 29, 1983, the basinwide drought operation curves were approved by Resolution 83-13 and incorporated into the Delaware River Basin Water Code. Docket No. D-77-20 CP (Revised) was revised to include the curves and was approved by the commission on November 30, 1983.

The original drought levels are represented as the operation rule curves in Figure A below. Three levels of drought status are defined by the rule curves: Upper Drought Warning (DW1), which is the storage below the blue curve and above the green dotted curve; Lower Drought Warning (DW2), which is the storage below the green dotted curve and above the red curve; and Drought, which is the area below the red line.

---

[1] The Decree parties include the four basin states of Delaware, Pennsylvania, New Jersey and New York and New York City

[2] Task Group Report DRBC Docket No. D-77-20, *Appraisal of Upper basin Reservoir Systems, Drought Emergency Criteria and Conservation Measures*, March 1979.

[3] *Interstate Water Management Recommendations of the Parties to the U.S. Supreme Court Decree of 1954 to the Delaware River Basin Commission Pursuant to Commission Resolution 78-20* (November 1982)

The curves were revised in May 1999 by DRBC docket D-77-20 Revision 4. The revision included: renaming Upper Drought Warning Stage 1 (DW1) to Drought Watch; renaming Lower Drought Warning (DW2) to Drought Warning and raising the Drought Warning curve by 4 billion gallons. Figure B presents the revised curves. For the ease of comparison in Table 1 *Basinwide Drought Actions* below, Drought Watch is used for DW1 and Drought Warning is used for DW2. These curves are in use today by the Flexible Flow Management Program.

Figure A: Original Drought Operation Curves based on the Combined Storage of Cannonsville, Pepacton and Neversink Reservoirs

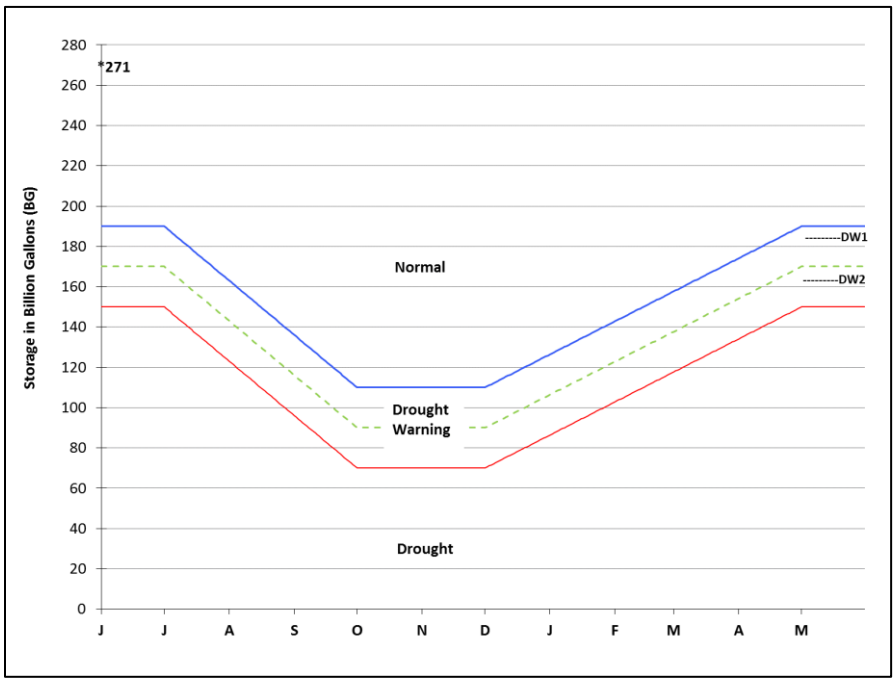
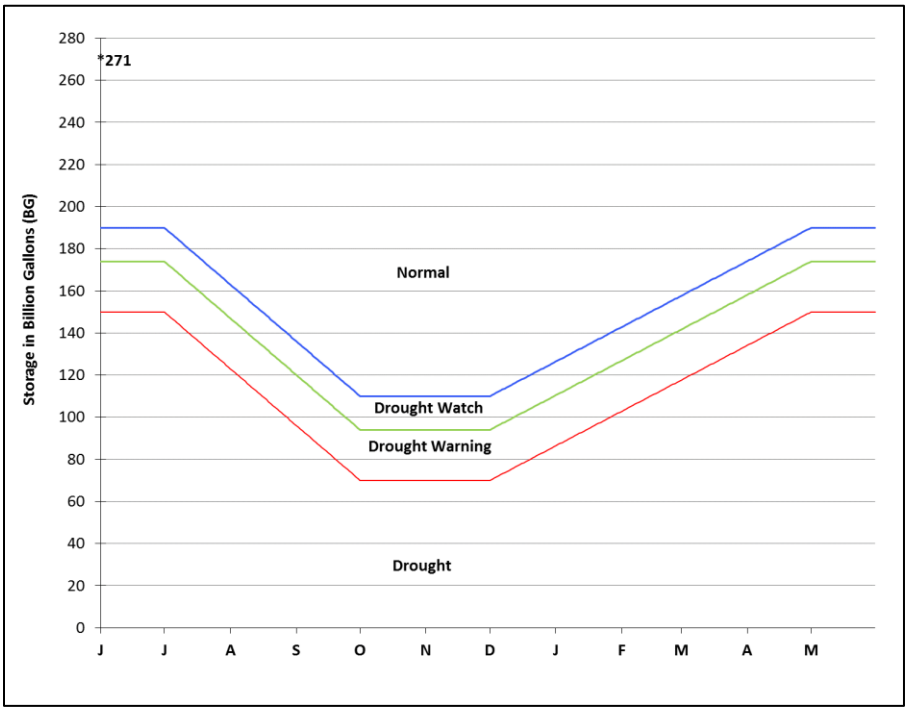


Figure B: Revised Drought Operation Curves based on the Combined Storage of Cannonsville, Pepacton, and Neversink Reservoirs



DRBC's Basinwide Drought Actions

Droughts of varying intensity and length have impacted the basin since the commission was formed in October 1961. DRBC implemented drought operations 13 times over the past six decades. Seven of these droughts were so severe the commission declared a drought emergency (two of these emergency actions were conditional and did not go into effect).

Table 1 below summarizes DRBC basinwide drought actions since the 1960s.

Table 1: Basinwide Drought Actions

	Enter Drought Watch [1]	Enter Drought Warning [2]	End Drought Watch/ Warning	Enter Drought [3]	Declare Drought Emergency	End Drought Emergency
1960s					7/7/65	3/15/67
1980s	10/17/80				1/15/81	4/27/82
	11/13/82		3/27/83			
	11/09/83	--	12/20/83			
	1/23/85	2/7/85			5/13/85	12/18/85
	1/16/89	2/5/89	5/12/89		3/21/89 *Conditional*	
1990s	9/13/91	11/7/91	6/17/92			
	9/21/93	--	12/6/93			
	9/15/95	10/13/95	11/12/95			
	10/27/97	--	1/13/98			
	12/14/98	12/23/98	2/2/99		1/5/99 *Conditional*	
					8/18/99	9/30/99
2000s	10/29/01	11/4/01		12/1/01	12/18/01	11/25/02
2010s	11/23/2016	--	1/18/2017			

Notes:

1. The "Enter Drought Watch" column represents the date combined storage in the NYC reservoirs triggered basinwide drought watch operations. Combined storage must remain below the normal line on the operation curves for five consecutive days before drought watch operations are triggered. Prior to May 1999, this level of drought was labeled "Drought Warning 1 (DW1)" on the operation curves (refer to Figures A and B above).

2. The "Enter Drought Warning" column represents the date combined storage in the NYC reservoirs declined below the drought warning line and triggered basinwide drought warning operations. There is no waiting period to enter this level of drought. Prior to May 1999, this level of drought was labeled "Drought Warning 2 (DW2)" on the operation curves. A "--"in the Enter Drought Warning column means the basin returned to normal operations before drought warning operations were triggered.

3. The "Enter Drought" column represents the date the combined storage in the NYC reservoirs triggered basinwide drought operations. Combined storage must remain below the drought line for five consecutive days before drought operations are triggered.

1960s

The northeastern section of the country experienced the "drought of record" beginning in 1962. Precipitation deficits increased with each passing year. By July 1965, the U.S. Weather Bureau's Palmer Index indicated that

extreme drought conditions existed over 100,000 square miles, extending from the Mid-Atlantic states to New England.

Delaware River in the vicinity of Trenton, NJ in October 1963. The mean flow of the Delaware River at Trenton during October 1963 was 2,110 cfs (USGS). *Photos by DRBC Staff.*

A few of the impacts of the 1960s drought are highlighted below:

- In the Lower Delaware River, two extensive fish kills consisting of shad, alewives, and blueback herring occurred in May 1965, after the dissolved oxygen content in the estuary had decreased to levels too low for the fish to survive. Many of these fish were on the way to upstream spawning areas when they encountered the low oxygen "dead zones" in the river.

- In the upper basin, NYC was concerned that Neversink and Pepacton reservoirs (Cannonsville Reservoir was not fully constructed at the time), upon which the city depended for drinking water, would be empty by late November 1965. It was feared the city could run completely out of water by February 1966 if actions were not taken to preserve the water.[4] To preserve water in their Delaware River Basin reservoirs, NYC ceased downstream releases from storage on June 14, 1965. This action caused alarm among downstream users, who feared declines in water availability and water quality. DRBC held a public hearing on July 7, declaring a water supply emergency. NYC was ordered to resume releases immediately, up to 200 million gallons per day (MGD) from storage.

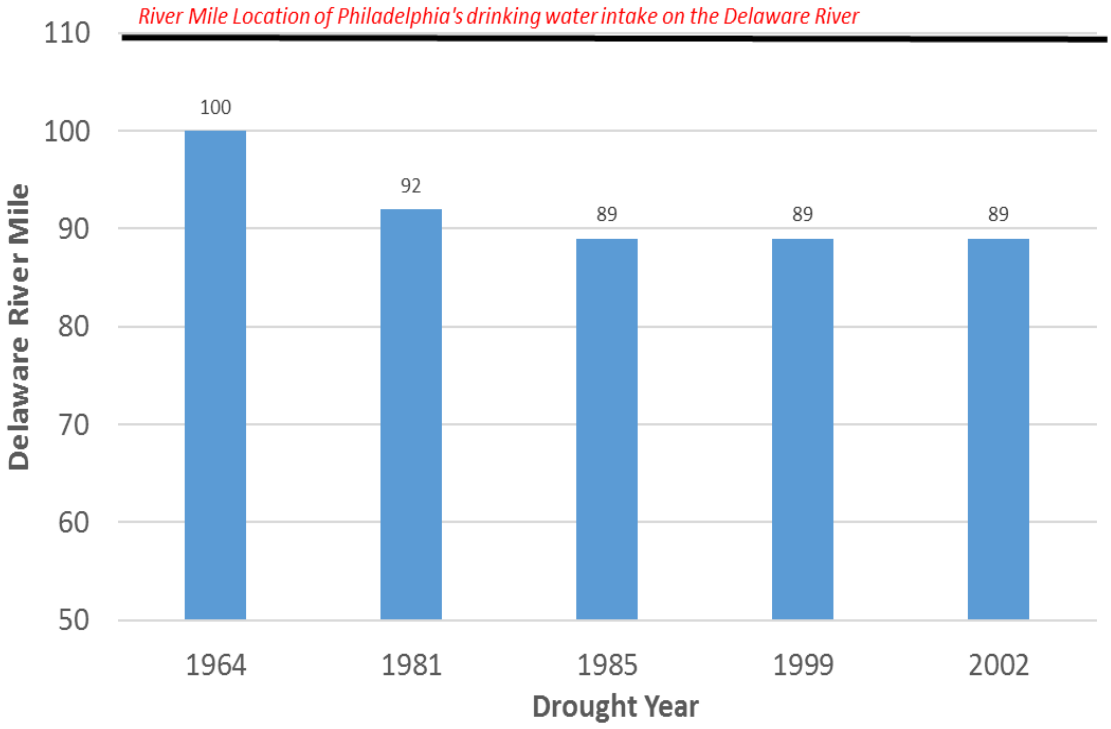
- Businesses that depended on river water were impacted by the higher salt and chloride content in the water due to the low amounts of freshwater contributed from the Delaware River and its tributaries. The higher chloride concentrations caused corrosion and rust problems in boilers and cooling systems resulting in industrial shutdowns in some areas.

- Saltwater intrusion into the estuary threatened the water supplies of Philadelphia and Camden. The saltwater-freshwater interface is called the salt front and is defined as the location of the 7-day

[4] Richard A. Hogarty, *The Delaware River Drought Emergency*, p.25.

average, 250 ppm chloride concentration. The **maximum**[5] recorded upstream location of the salt front during the 1960s drought occurred in November 1964 when the front reached river mile 102. This location is eight miles downstream of Philadelphia's drinking water intake on the Delaware River and within Camden's groundwater recharge area. Despite the high concentration of chlorides in close vicinity to drinking water sources, neither city experienced serious contamination issues. Figure C below compares the farthest upstream salt front locations in the Delaware Estuary experienced during drought emergencies.

Figure C: Farthest Upstream Salt Front Location During Drought Emergency



Source: DRBC estimates of the salt front location are based on USGS and Kimberly Clark Corporation data.
Salt line locations are determined based on 7-day average chloride concentrations.

DRBC declared its first-ever drought emergency in July 1965. On July 7, the commission adopted two resolutions and issued a conservation order. The first resolution, Resolution No. 65-13, declared a water supply emergency for the basin. This declaration predated the Operation Curves in Figure A above but was authorized under Section 10.4 of the Delaware River Basin Compact. The second resolution, Resolution No. 65-14, modified the conditions of the 1954 Supreme Court Decree, with the unanimous consent of the Decree Parties, as follows:

- a reduction in NYC's out-of-basin diversion
- a reduction of the flow objective at Montague to 1,200 cubic feet per second (cfs),

[5] The RMI 102 upstream location was determined using the maximum chloride concentrations in the river. Using a 7-day average, the method DRBC has since used, the salt line would have been as far upstream as river mile 100 during late November 1964.

- a limit to release amounts from Neversink and Pepacton reservoirs to 200 MGD.
- release amounts equivalent to inflow from Cannonsville reservoir.

Conservation Order No. 1 directed Pennsylvania Power and Light Company (Lake Wallenpaupack) and Orange and Rockland Utilities (Rio Reservoir in the Mongaup system) to make releases from their respective reservoirs to augment flows to increase freshwater inflows into the river and ultimately the estuary, and limit the advance of the salt front.

As drought conditions became more severe, DRBC called upon the Federal government for additional storage of water for flow augmentation. On August 6, 1965, by way of Conservation Order No. 2, DRBC asked the Army Corps of Engineers to store water in two federally-owned, flood control reservoirs: F.E. Walter (located in the upper Lehigh River) and Prompton (located on the Lackawaxen River). During 1965-1966, up to 11 billion gallons were stored in F.E. Walter and released based on a schedule developed by DRBC. Prompton Reservoir was not used to store water during the drought because its release gates had not yet been installed.[6]

Also, on August 6, flow objectives along the Delaware River at Montague and Trenton were lowered to decrease demand on reservoir storage. Per Emergency Resolution No. 2, the flow objective of 2,000 cfs was established at Trenton and the flow objective at Montague was reduced to 1,200 cfs but could be adjusted lower if DRBC determined it was necessary.

In October 1965 the flow objective at Trenton was further reduced from 2,000 cfs to 1,800 cfs per Emergency Resolution No. 6 (adopted October 7, 1965).

Drought continued in the Delaware River Basin into 1966. Due to the uncertain hydrologic conditions, DRBC extended the drought emergency several times during the year. Precipitation amounts, streamflow, and groundwater levels all began to improve by the fall of 1966. Storage in the NYC reservoirs increased to normal after a wet fall and winter of 1966-67. Groundwater was also recharged. Confident that the six-year drought had come to an end, DRBC adopted Resolution No. 67-3 on March 2, 1967 (effective March 15), terminating its 20-month long water supply emergency.

1970s

The 1970s was a decade of greater than normal precipitation and no droughts or water supply emergencies occurred.

[6] Richard A. Hogarty, *The Delaware River Drought Emergency*, p. 25.

1980s

The basin entered drought watch operations five times during the 1980s (refer to Table 1 *Basinwide Drought Actions*). Conditions warranted drought emergency actions for three of these drought events. The three events are summarized below. Figures D and E depict reservoir storage and drought operations during years 1980-1989.

October 1980 – April 1982

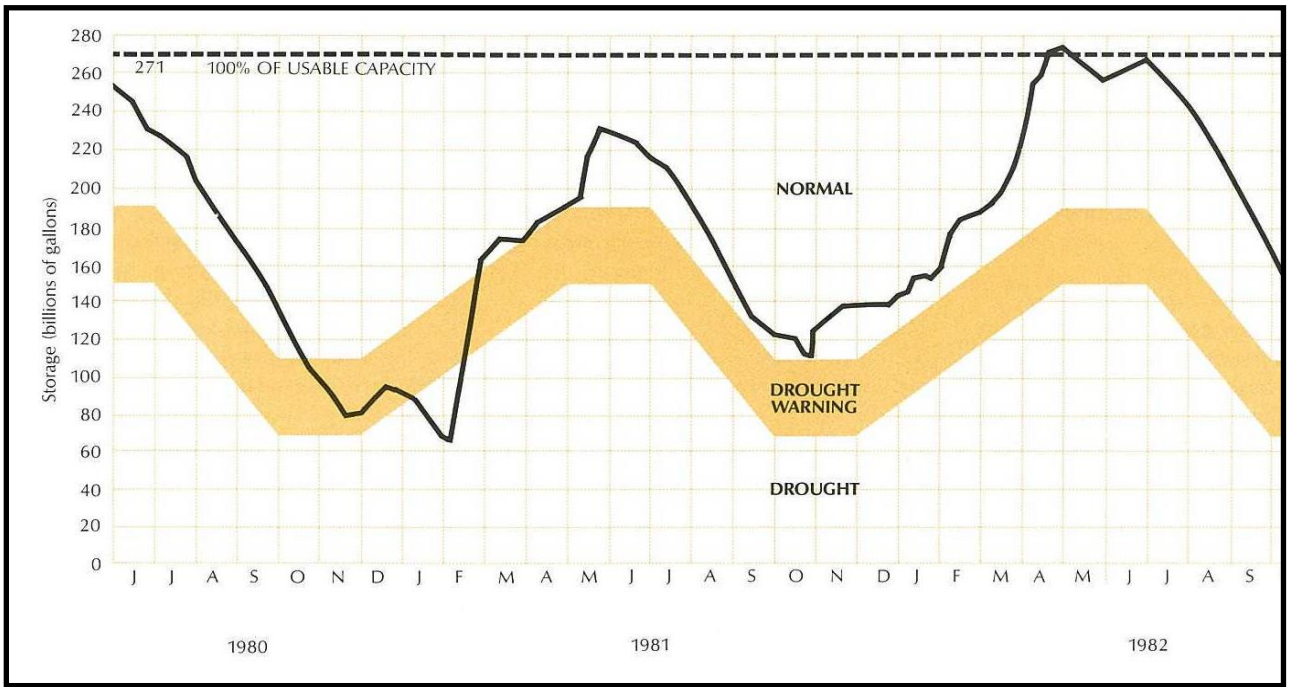
Midway through 1980, growing precipitation deficits resulted in below-normal groundwater levels, reservoir storage, and streamflow. On October 17, combined storage levels in the NYC reservoirs were at 40 percent capacity and in the "drought warning condition" as defined by the NYC reservoir operation curves in Resolution No. 80-20. In response to the developing drought, DRBC worked with the four basin states and New York City to slow the drawdown of the NYC reservoirs by decreasing diversions to New York City and New Jersey and reducing flow objectives at Trenton and Montague.

By January 1981, combined storage in the NYC reservoirs declined to 31 percent of capacity and precipitation totals since May 1, 1980, were more than 30 percent below normal. DRBC met for a special session on January 15 and formally declared a drought emergency (Resolution No. 81-01).

DRBC drought emergency declaration meeting of January 15, 1981, at the auditorium of New Jersey State Museum in Trenton. Governors of New Jersey, Pennsylvania, New York, and Delaware and the mayors of New York City and Philadelphia met for the meeting. (*Photo: Commission Archives. Source Unknown)*

Combined storage in the NYC Delaware reservoirs declined to 25-percent capacity before above-normal precipitation during February 1981 added more than 100 billion gallons to the reservoirs. Storage increased to above drought warning for the first time in several months and remained above the warning level for the rest of 1981. The three NYC reservoirs refilled in April 1982, prompting DRBC to unanimously vote to end the drought emergency on April 27, 1982 (Resolution No. 82-04).

Figure D: NYC Delaware Reservoir Storage and Drought Operations 1980-1982



Source: DRBC Annual Report-1982

January - December 1985

Dry conditions caused storage in the NYC reservoirs to decrease to the drought watch range in January 1985. Normally the reservoirs should have been nearly full on May 1, but in 1985 the combined storage was only 62 percent of usable storage. At Trenton, NJ, Delaware River streamflows were lower than any previous April flows on record. Groundwater levels at many wells were also low with a few at record lows.

A drought emergency was declared on May 13, 1985, by Resolution No. 85-13. Releases were made from Blue Marsh, Beltzville, F.E. Walter, Wallenpaupack, and Mongaup System reservoirs to augment Delaware River flows. Additional releases were made from a designated bank of water in the NYC reservoirs intended to protect the cold-water fisheries in the Upper Delaware Basin. These releases were made until August 12, when the bank was depleted. On August 15-16, trout fish kills occurred on the West Branch of the Delaware River below Hale Eddy and on the main stem Delaware River between Hancock, NY and Lordville, NY.

Hydrologic conditions improved significantly in early autumn. On September 27, Hurricane Gloria produced as much as nine inches of rain in the basin. The streamflow at Trenton went from a drought-level of 2,800 cfs to nearly 89,000 cfs (less than four feet below flood stage)[7]. Freshwater inflows into the Delaware River moved the salt front more than 20 miles downstream from its furthest upstream location at river mile 89 (near the

[7] DRBC Annual Report 1985, p.35.

Philadelphia International Airport). DRBC officially lifted the drought emergency on December 18, 1985, by the adoption of Resolution No. 85-50.

January – May 1989

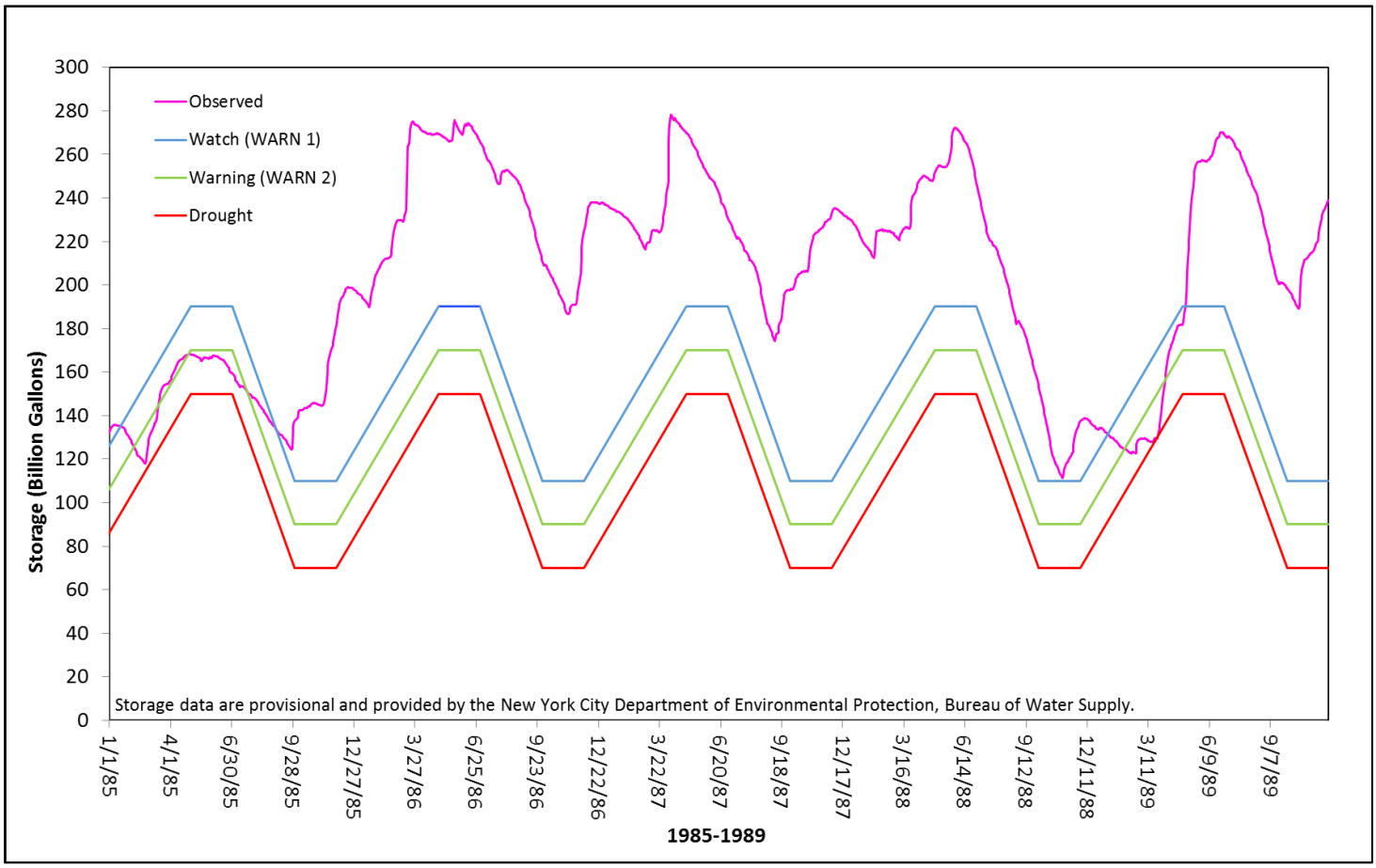
Long-term precipitation deficits and a heatwave during the summer of 1988 placed heavy demands on NYC's water supply system. Storage declined to the drought watch (DW1) range in January 1989.

On October 29, 1988, Cannonsville Reservoir (above) was only 26 percent full. By early November, combined storage in Cannonsville, Pepacton and Neversink reservoirs was only 1.2 billion gallons above DRBC's drought watch rule curve. *Photo by Dave Everett, DRBC Staff.*

On March 21, 1989, DRBC declared a *conditional* drought emergency (Resolution No. 89-07), which would have gone into effect had the NYC reservoirs dropped below the drought curve and remained there for five consecutive days. However, the upper basin received enough rain over the next few months to replenish the reservoirs and raise the NYC combined reservoir storage back into the normal range by early May. The improved conditions meant a drought emergency was not necessary and normal operations were reinstated on May 12, 1989[8].

[8] *Drought Warning Lifted*, DRBC Press Release, May 12, 1989.

Figure E: NYC Delaware Reservoir Storage and Drought Operations 1985-1989



1990s

The Delaware River Basin entered drought operations six times during the 1990s (refer to Table 1 *Basinwide Drought Actions)*. Two of these droughts were severe enough for DRBC to implement the drought emergency actions described below. Figure F presents the combined NYC reservoir storage during the 1998-1999 drought period.

November 1998- February 1999

Annual precipitation deficits approached 12 inches in parts of the basin during the second half of 1998. New Jersey had experienced its driest July through November period since record-keeping began in 1895. The flow in the Delaware River at Trenton, NJ was so low in December 1998 that the annual reenactment of George Washington crossing the Delaware River took place, not on boats as was done in 1776, but on the Washington Crossing Bridge. It was the first time in 45 years that drought conditions forced the crossing to occur over the bridge and not by boats on the river.

On 11/21/98, special action was taken before the combined storage in the three NYC Delaware reservoirs officially entered drought watch operations. This action included reducing flow objectives at Montague, NJ and Trenton, NJ and reducing the NYC and NJ diversions. Drought watch operations were not officially entered until 12/14/98 and drought warning operations were entered on 12/23/98.

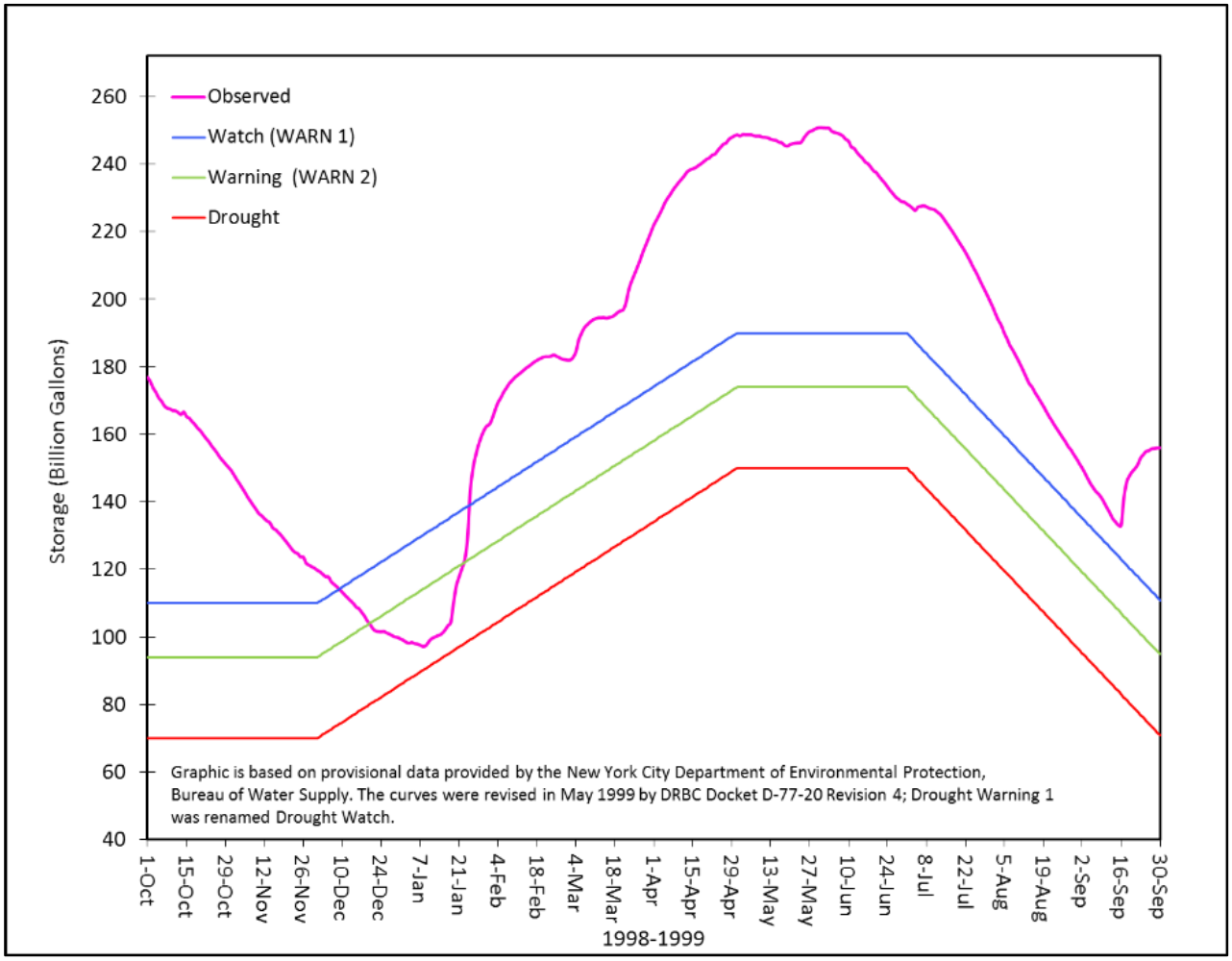
The DRBC declared a *conditional* drought emergency on 1/5/99 (Resolution No. 99-01). The emergency would have gone into effect had the storage in the NYC reservoirs declined to the drought zone and remained there for five consecutive days. Instead, hydrologic conditions improved in January when consecutive storms provided enough water to increase storage in the NYC reservoirs. The drought warning was terminated in February.

July – September 1999

Drought conditions returned to the DRB in June 1999. Precipitation deficits were severe enough to cause some streams to run dry and thousands of acres of farm crops to be destroyed. By mid-August, below-normal flow on the Delaware River caused the salt front to advance upstream to near the Philadelphia International Airport (river mile 89). Although storage in the NYC reservoirs did not trigger basinwide drought operations, DRBC determined that pre-emptive drought management actions were necessary to conserve water.

On July 21, 1999, the flow objective at Trenton was reduced from 3,000 cfs to 2,700 cfs in an effort to conserve storage in Beltzville and Blue Marsh reservoirs. On August 18, 1999, the DRBC adopted additional emergency drought actions such as storing water in FE Walter Reservoir in the upper reaches of the Lehigh River and requesting releases from Nockamixon Reservoir, Lake Wallenpaupack and the Mongaup System (Resolution 99-18, adopted August 18, 1999). The drought actions were only needed until September 16 when the basin received six to ten inches of rain over an 18-hour period from Hurricane Floyd. After Floyd, water supply storage, groundwater, and streamflow improved and the emergency drought actions were terminated on September 30, 1999, by Resolution 99-22.

Figure F: NYC Delaware Reservoir Storage and Drought Operations 1998-1999



2000s

The Delaware River Basin entered basinwide drought operations only once during this decade, but drought conditions were so severe a drought emergency declaration was warranted. Figure G below presents the combined NYC reservoir storage during the 2001-2002 drought period.

December 2001- November 2002

By the end of October 2001, the upper basin's annual precipitation deficit was nearly eight inches. The deficits caused the NYC Delaware reservoir storage to rapidly decline throughout the summer and into autumn. By late November, NYC Delaware reservoir storage descended below the drought operations curve and the salt line had moved upstream to river mile 86-- its maximum upstream location for 2001. On December 15, 2001, the combined storage in the reservoir system declined to a record combined storage low of 63.3 billion gallons for the three reservoirs, which is less than 25% of usable capacity. DRBC declared a drought emergency by Resolution 2001-32 on December 18, 2001.

Below-normal precipitation persisted into 2002. February was a particularly dry month, with records for dryness set in Philadelphia and Allentown. Much needed relief arrived in early spring when normal to above-normal rainfall patterns returned to the basin and drought indicators improved. Stream levels rose, reservoirs

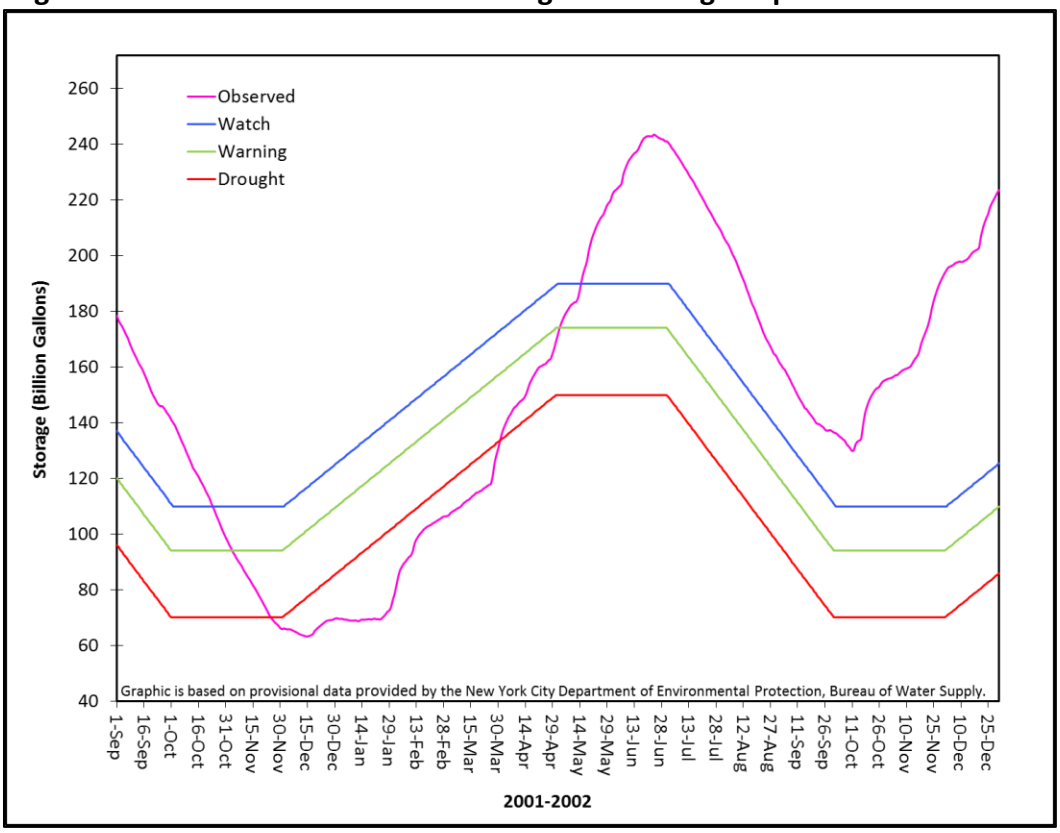
made gains in storage, and groundwater in many wells began a seasonal, upward trend. By April 1, a combination of rainfall and snowmelt caused the NYC Delaware reservoirs to rise above the drought threshold for the first time since November 2001 and by May 26, the storage in the reservoirs had remained at least 15 billion gallons (BG) above the drought watch threshold for five consecutive days. Because of the improved storage, the basin returned to DRBC's normal operating plan, although the DRBC's drought emergency continued to remain in effect. With the return to normal operations, normal flow objectives at Montague, New Jersey, and Trenton, New Jersey resumed, as did normal diversions for New York City and New Jersey.

By July 8, the NYC Delaware reservoir storage had remained more than 40 BG above the drought watch threshold for more than 30 consecutive days. Although the DRBC Water Code would have allowed the Commission to terminate the drought emergency under these circumstances, dry weather had returned and commissioners at the July 17 commission meeting made a unanimous decision to continue in drought emergency status with the option to terminate it if hydrologic conditions improved sufficiently.

Rainfall was significantly below normal during July and August. By September, below normal flows on the mainstem Delaware caused the salt front to advance upstream to river mile 89 near the Philadelphia International Airport. This was the salt front's furthest upstream location during the 2001-2002 drought period. The dry weather pattern finally broke and ample rainfall returned to the basin by the end of September.

Above-normal precipitation also occurred in October and November and drought indicators continued to improve. On November 25, 2002, DRBC adopted Resolution 2002-31 ending the drought emergency. Details about the drought of 2001-2002 are provided in "Chronology of Drought in the Delaware River Basin" (pdf 118 KB).

Figure G: NYC Delaware Reservoir Storage and Drought Operations 2001-2002



Cannonsville Reservoir in November 2001 (7.1% usable capacity). *Photo source unknown*

2010s

November 2016-January 2017

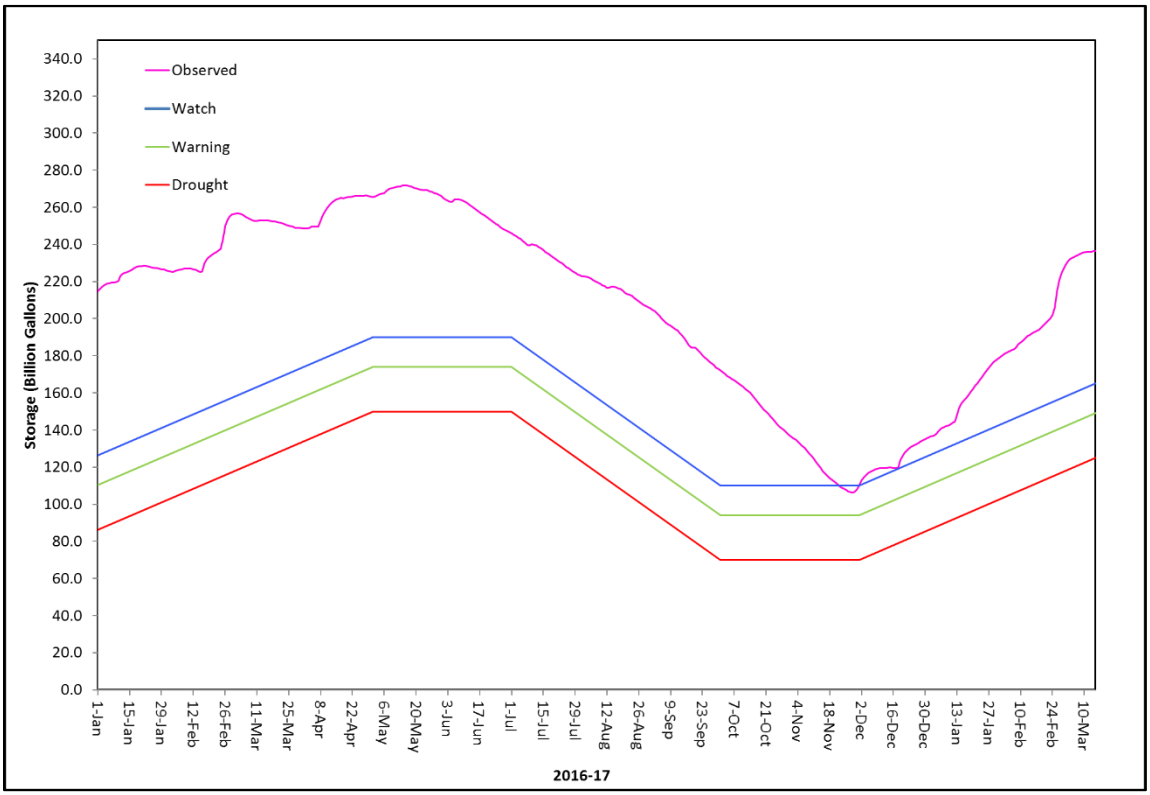
Drought returned to the Basin late in 2016. In response to declining reservoir storage and increasing precipitation deficits, DRBC held a drought hearing on November 9, 2016, to accept public input about the drought issues impacting the basin. On November 23, as combined storage in the NYC Delaware reservoirs declined to the drought watch range, DRBC held a special meeting and unanimously approved Resolution 2016-07 for coordinated operation of regional reservoirs, out-of-basin diversions, and Delaware River flow objectives in response to the persistent dry conditions. The resolution deemed the entire basin under a drought watch. The drought was short-lived but before it ended the salt front had reached as far upstream as Delaware river mile 90 in late November.

Delaware River at Washington Crossing, PA, looking upstream during mid-October 2016. *(Photo by DRBC Staff)*

Delaware River at Trenton, NJ, looking downstream during late November 2016. The mean streamflow for this month was 3,130 cfs compared to the normal November flow of 10,000 cfs (USGS). *Photo by DRBC Staff.*

By December, increased precipitation improved streamflow, groundwater levels and reservoir storage throughout the basin. The Commission lifted the basinwide drought watch on January 18, 2017. Figure H presents the combined NYC reservoir storage during the 2016-17 drought period.

Figure H: NYC Delaware Reservoir Storage and Drought Operations 2016-2017



LOWER BASIN DROUGHT OPERATIONS

Elevations in Blue Marsh and Beltzville reservoirs are used to trigger lower basin drought warning and drought operations in the portion of the basin downstream of Montague, NJ. When both reservoirs fall below their respective drought warning and drought levels, the Trenton flow objective and diversions to the Delaware and Raritan Canal are reduced. Typically, basinwide drought operations prevail over Lower Basin drought operations.

Lower basin drought operations were approved a few years after the basinwide drought criteria were developed. Recommendation 4 of the Good Faith Agreements declared criteria for defining lower basin drought warning and drought be prepared. In June 1983, the commission directed its Flow Management Technical Advisory Committee to develop alternative operating plans using criteria from Recommendation 4. The operating plans were approved by Resolution No. 88-22 (Revised) on September 28, 1988.

DRBC's Lower Basin Drought Actions

The only lower basin drought declared by DRBC occurred in 2010. Table 2 below summarizes the lower basin drought actions since the establishment of the commission.

Table 2: Lower Basin Drought Actions

Enter Lower Basin Drought Warning	End Lower Basin Drought Warning	Enter Drought	End Drought
9/24/10	10/31/10		

September - October 2010

On September 24, 2010, DRBC issued a lower basin drought warning. Persistently dry weather conditions over the summer necessitated directed releases from the Beltzville and Blue Marsh reservoirs to meet the flow objective at Trenton, NJ. Nearly daily releases during August and September reduced storage in both reservoirs to levels that automatically triggered the lower basin drought warning declaration. Heavy rainfall during the last week of September increased storage in both reservoirs to above the drought warning elevations. The drought warning was lifted on October 31, 2010, after elevations in both reservoirs had been above the trigger per the lower basin drought operating plan. Figure I and Figure J show the elevations in Beltzville and Blue Marsh reservoirs in 2010.

Figure I: 2010 Beltzville Reservoir Elevation

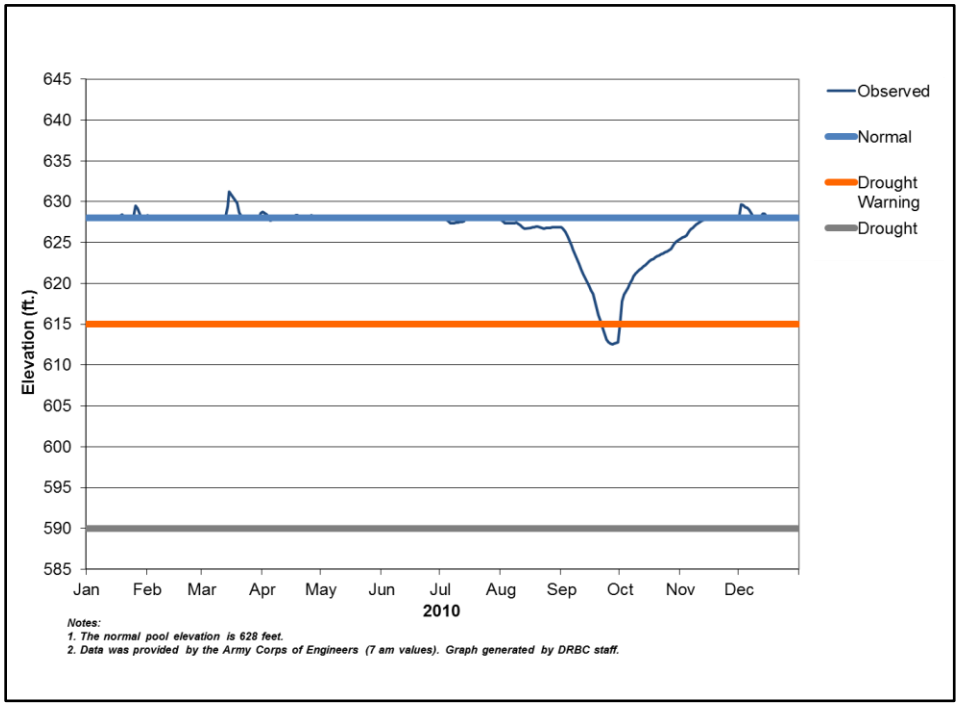


Figure J: 2010 Blue Marsh Reservoir Elevation