

The Drought of 1999

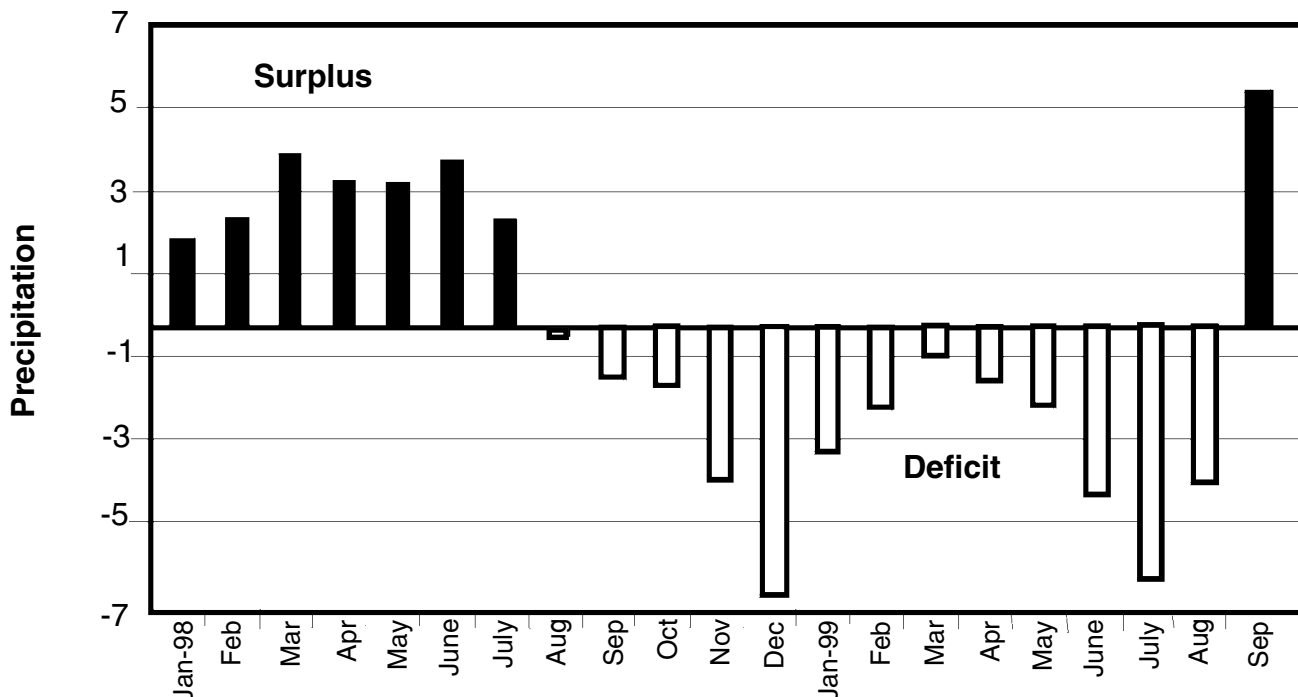
On July 23 the Governor requested residents across the state to voluntarily curb “non-essential” water uses. Only 12 days later a state of emergency was declared in northern New Castle County, and Delaware encountered another drought for the second time in four years.

How did this happen again?

Technically, Delaware was in a drought beginning as early as December 1998. Figure 5 shows the extended period of below normal rainfall from September 1998 through August 1999, and the rainfall deficit peaked at nearly seven inches. Since water demand is at its lowest in winter, this did not represent an immediate threat, and the deficit eased over the winter. Rainfall was sparse in the springtime, and the hydrologic system failed to recharge before the peak demand season. Each successive month increased the deficit, and Delaware risked a supply shortfall sometime during the summer. The dry weather pattern locked in week after week; and around late May and early June it became apparent that 1999 would be a drought year.

A big sign of trouble was declining stream flows in the Christina River Basin. Chester County, Pennsylvania was experiencing even worse conditions, and ground water in Chester was starting to reach emergency levels. This caused base flow in the streams to fall off as well. Northern New Castle County relies on these streams for seventy-five percent of its fresh water supply. Next came the July heat. Pennsylvania declared a statewide drought emergency shortly afterward, and the five million gallons Delaware purchases from Chester each day was cut back. All these factors came together very quickly, but all were anticipated. Unfortunately, no amount of rain short of a hurricane would stave off the coming emergency.

Figure 5
Cumulative Precipitation January 1998 through September 27, 1999
Porter Reservoir- Wilmington , Delaware



How bad was it?

Downstate – Kent and Sussex Counties suffered mostly due to heavy agricultural losses, and even those with irrigation capacity were hurt because of the wilting heat. The Delaware Department of Agriculture estimated fifty percent losses to corn and thirty percent losses to soybeans. However, the downstate supply systems never reached the point of being at risk of running out of water. This has been the case in every previous drought due to a substantial surplus of ground water, which supplies all drinking water and most irrigation water.

Upstate – The City of Wilmington fared best, so to speak, among the major water utilities in 1999. One reason is that Wilmington is not bound by a stream flow requirement to which the City of Newark and United Water Delaware must adhere. Therefore, the City accesses all the water that can be pumped from the Brandywine Creek. This is good for Wilmington’s customers, but it also represents a major issue concerning stream ecology and water quality.

The Brandywine set fourteen record-low daily flows in 1999. The creek was very sluggish and a large percentage of that flow was made up of treated wastewater discharged into the Brandywine in Pennsylvania. The treated wastewater combined with the high water temperatures resulted in the formation of vast mats of algae in the creek. When the algae died, the dissolved oxygen in the water was depleted due to the decaying algae. Fortunately, no fish kills were reported on the Brandywine, and it is presumed the native species migrated elsewhere.

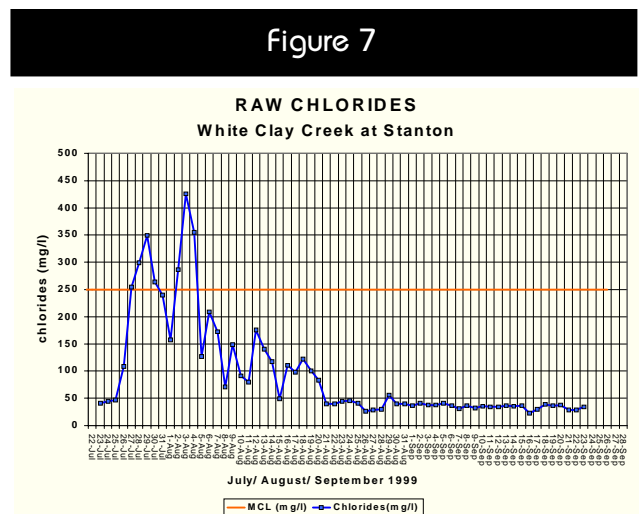


Brandywine Creek experienced record low flows during recent droughts. Treated wastewater discharged into the Brandywine in Pennsylvania made up a large percentage of the flow since natural water runoff was depleted by the drought.

The other reason Wilmington fared better is because of stored water in Hoopes Reservoir. Hoopes makes up for the Brandywine when it becomes too low or too difficult to treat. As long as a drought is not too severe or does not last too long, the City has enough surplus that it can help supply United Water Delaware and Artesian Water Company. This arrangement will not continue as the Division of Water Resources is moving closer to setting new standards for stream quality and stream flow for the Brandywine. Accordingly, Wilmington has stated that it cannot serve as the backup water supplier when these new stream standards are adopted.

Salt in the water supply became the focus of the crisis, reaching upwards of a 1,000 parts per million in some sections of the water systems, and prompting health advisories for certain individuals. The salt also disrupted certain industrial processes and some businesses had to move off of public water and re-activate abandoned wells and other emergency supplies to keep operating.

Figure 7 shows the chloride concentration of the water in White Clay Creek that was measured at Stanton where United Water Delaware’s main treatment plant is located. When the chloride concentration exceeded the drinking water standard (250 parts per million) the drought had struck full force. When the voluntary restrictions failed to curb usage as much as expected and salt began to enter the water supply, an emergency was declared by the Governor on August 5.



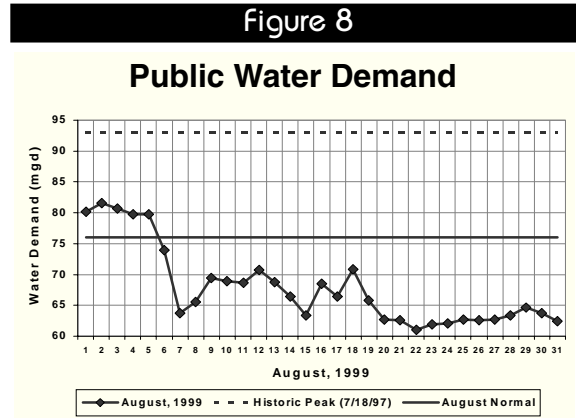
By that time the City of Newark declared its own water emergency due to insufficient stream flow that had shut down its surface water treatment plant two weeks before. (Seventeen new daily low-flow records were set on White Clay Creek near Newark).

Newark’s back-up wells were insufficient to make up the difference and some traditionally have high dissolved iron, so the City had no alternative except to purchase from United Water Delaware. Salty water then spread throughout Newark’s system.

This salt crisis was overcome in a matter of days by a combination of aggressive actions. The

demand restrictions the Governor imposed were much tougher than any previous ones. This brought consumption down fifteen million gallons per day to just within the available supply (Figure 8). Releases were ordered from Hoopes Reservoir to dilute the raw water in the stream to within the standard. A few brief thunderstorms helped that effort, too.

The other action taken was to suspend the stream flow requirement on White Clay Creek at Stanton in order to capture all the available flow. As a result, sections of White Clay Creek had no water at low tide. Delaware was criticized for again having to take such



drastic action for the second time in four years. It is still unclear if there are any lasting or temporary impacts to the stream and stream-supported ecology. What is certain is that drinking water quality was impacted.

Ground-water supplies were also impacted in northern New Castle County. The Division of Water Resources obtained data showing that salt water was starting to encroach into the main supply aquifer—the Potomac. Elevated salinity levels in the Delaware River, combined with depressed ground-water levels and high pumping rates resulted in saltwater intrusion. In some areas the safe draw-down limits were exceeded in order to meet high demands.

Economic Impacts

Industry representatives expressed concern over the request to curb usage by twenty-five percent. Many reported it would cut directly into production and force workers to be laid off. Hardest hit economically were the “Green Industry” businesses - not in total dollars but in impact to operations. Since outdoor water usage was essentially forbidden, water dependent operations such as nurseries and washing companies simply laid off workers for the summer. Some operated illegally as numerous individuals reported violations of the restrictions to the Division and other enforcement agencies. An alternative was offered to business to help ease the impact. For the first time contractors transported treated wastewater from the Wilmington Wastewater Plant to stay in operation.

Economically, the water utilities were not especially hard hit by the mandatory restrictions. In fact, record water sales were being recorded prior to the drought even though the county did not set a record demand. Demand was high enough that, combined with the rate increases over the past few years and the cutbacks on purchases, one utility actually set a record third quarter with a 150 percent increase over 1998. Some utilities profited slightly from extra sales while other utilities suffered slightly due to having purchased extra water to meet demand.

An unprecedented enforcement effort was also undertaken with over seven hundred actions logged. Several thousand phone calls were received on the Drought Hotline and Division of Water Resources staff operated on a twelve-hour, seven-day per week schedule for most of August.

Hurricane Floyd – A Welcome Relief?

Hurricane Floyd ended the drought episode fifty-six days after it started by setting the all-time, one-day rainfall record and the all-time September rainfall record. Floyd just missed topping the all-time monthly rainfall total. It was a difficult if not bizarre situation for Delaware going from drought emergency to flood emergency in a single day. Tropical storms have ended every serious drought we have ever had, but that quick of a turn-around and the scale of flooding had never been seen before.

In terms of how 1999 compared to others, Table 6 ranks all droughts since the record drought of 1963. The chart makes adjustments so that an equal comparison can be made among the various historical droughts. This is done by subtracting a “drought day” for each day that rainfall allowed Hoopes Reservoir to be refilled as well as for days that Marsh Creek Reservoir (Downington, Pennsylvania, constructed 1973) would have made mandatory releases.

As seen in the chart – the 1999 drought slightly out-ranks 1995 but also note that both droughts were medium-term events. The drought of the 1960s lasted for four successive summers with 1963 being the worst at 115 days. The question often raised is why those droughts did not cause nearly as many problems as the recent ones. This illustrates an important point; a drought is not only a weather event, but a combination of other factors that determine how serious the impacts are.

**Table 6
Analysis & Comparison of Droughts New Castle County, DE**

1	2	1-2=3	4	5	3-4=6	7	
	Start of Drought	End of Drought	Duration (Days)	Hoopes Refills (Days)	Marsh Creek Releases (Days)	Drought Duration (Days)	Rank Severity
1963*	Jun 18	Nov 6	141	19	7	115	1
1965*	Jul 25	Nov 8	105	12	16	77	2
1966*	Jul 3	Sep 14	73	3	2	68	3
1999	Jul 5	Sep 15	72	11	--	61	4
1995	Jul 25	Sep 16	52	7	--	44	6
1980	Sep 3	Oct 24	52	10	10	41	7
1964*	Aug 15	Oct 16	61	10	10	41	7
1981	Aug 19	Sep 15	27	4	--	23	8

*Pre-Marsh Creek Reservoir

1. Brandwine Creek @ Wilmington flow less than 7Q10 + withdrawal
2. Brandwine Creek @ Wilmington flow greater than 7Q10 + withdrawal
3. Number of days flow less than 7Q10 + withdrawal
4. Number of rain days allowing pumping to Hoopes Reservoir
5. Adjustment for droughts occurring prior to Marsh Creek Reservoir = number of days of releases of 6 MGD required during droughts
6. Duration of drought for planning purposes
7. Based on days of drought duration

Even the 1963 drought caused no apparent hardship. In contrast, a “middling” 1999 drought set off an emergency. Simply, the population has almost doubled in thirty years. In that time per capita water consumption has increased roughly one percent each year due to more and more water-using appliances in larger homes with larger yards. This has occurred despite effective conservation programs such as the high-efficiency plumbing codes. Otherwise, consumption would have grown at a much faster rate.

Lastly, and most important, little additional water supply has been added to New Castle County in thirty years. The last major improvement was the upgrade of the former Wilmington Suburban Water Corporation (now United Water Delaware) Stanton plant by fourteen million gallons per day in 1970. The largest of the new water supplies recently built are the City of Newark’s water treatment plant and United Water Delaware’s tidal control dam at Stanton. The problem with both facilities is that they depend on an unreliable supply stream.

Next Steps

There is still a question regarding how much excess ground water can be developed that could help meet future demand at a minimal cost. While all existing scientific reports conclude that the ground water in northern New Castle County is fully exploited, these reports are dated. There may be ways to extract additional water or optimize the existing withdrawals. The ground-water system in northern New Castle County is geologically complex and scattered with wells of a wide range of capacities and depths. To help understand the system better, the Division of Water Resources will be conducting a major study to help ground-water-supplied utilities explore the possibility of developing or re-engineering ground-water withdrawals.

Still, most water resources officials are not banking on ground water development in northern New Castle County to put a significant dent in our supply deficit. Accordingly, there was a consensus on the Governor’s Water Supply Task Force that new major projects are required and those projects focus on surface reservoirs. It is now agreed that a reservoir, if located properly so that the environmental impact is minimized, can preserve water in the streams during droughts. This is water that our streams clearly need for the continued health of the habitat and protection of drinking water quality.

The Governor’s Water Supply Task Force Report published December 2, 1999 provides more details on the drought and New Castle County’s future water plans. A copy of the report is available from the Division of Water Resources at (302) 739-4793 or the Water Resources Agency (WRA) at (302) 831-4925. The Report can also be viewed at WRA’s Web Site — www.wr.udel.edu.

The Water Resources Agency has been appointed by the Governor to lead the effort in the future with the assistance of the Delaware Geological Survey and the Division of Water Resources. The real burden is on the water companies and they have pledged that they will develop new water supplies.

Certificates of Public Convenience and Necessity

Certificates of Public Convenience and Necessity were granted to five water utilities to allow them to provide public water supplies in eleven new service areas. The new service areas will bring public water to 1,827 existing and new homes.