Report to the Governor of North Carolina and the North Carolina General Assembly's Environmental Review Commission

North Carolina Drought Management Advisory Council Report

October 1, 2022

Division of Water Resources

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY

Pursuant to G.S. 143-355.1

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ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
S. DANIEL SMITH
Director

NORTH CAROLINA
Environmental Quality

October 1, 2022

Governor Roy Cooper
1 E. Edenton Street
Raleigh, NC 27601

Re: Annual Report from the North Carolina Drought Management Advisory Council

Dear Governor Cooper,

The North Carolina Drought Management Advisory Council (NC DMAC) was established by G.S. 143-355.1. The NC DMAC was created to coordinate drought monitoring, assessment, and response activities between state and federal agencies, public water systems, and the public. The objective of the council is to provide consistent and accurate information on drought conditions so that relevant entities can manage and mitigate the harmful effects of water shortages.

In accordance with statutory requirements, the NC DMAC is required to submit a report on drought conditions annually. Enclosed is the report covering FY 2021-2022.

Sincerely,

Klaus Albertin, Chair
NC Drought Management Advisory Council

Enclosures

cc: Elizabeth S. Biser, Secretary
Sushma Masemore, Assistant Secretary of the Environment
Richard Rogers, Division of Water Resources

N.C. Department of Environmental Quality
Division of Water Resources

N.C. Drought Management Advisory Council Annual Report
July 1, 2021 – June 30, 2022

Introduction

The N.C. Drought Management Advisory Council (DMAC), created as required by North Carolina General Statute 143-355.1, coordinates drought monitoring, assessment, and response activities between State and Federal agencies, public water systems, and water users. The objective of the DMAC is to provide consistent and accurate information on drought conditions to these entities: the U.S. Drought Monitor, the Environmental Management Commission, the Secretary of the N.C. Department of Environmental Quality, the N.C. Environmental Review Commission, and the public to manage and mitigate the harmful effects of drought. In accordance with statutory requirements, the council must submit an annual report to the Secretary of the N.C. Department of Environmental Quality, the Governor, and the N.C. Environmental Review Commission by October 1 of each year.

Drought Overview 2021 - 2022

Climate Summary – State Climate Office (Corey Davis)

Overall Summary

In the past year, North Carolina experienced the return of a sustained drought for the first time since 2016-17. The 12-month period from July 2021 through June 2022 ranked as the state's 21st-driest in the past 127 years, with an average statewide precipitation of 43.09 inches, or 6.23 inches below normal. The same period was the State's 8th-warmest on record with an average temperature of 60.8°F, or 2.3°F above normal. This year included several heavy precipitation events, and a number of dry stretches as well, especially across the Coastal Plain.

Summer 2021

Last summer was particularly wet, with concerns of flooding rather than drought in some places. In early July, Tropical Storm Elsa crossed eastern North Carolina and produced rainfall totals of more than 3 inches in the Raleigh area. In mid-August, the remnants of Tropical Storm Fred affected western North Carolina, with rainfall totals of more than 12

inches reported in parts of Transylvania County. The flooding associated with Fred caused six deaths in Haywood County.

Driven by those heavy rain events, the period from June through August 2021 was this state's 21st-wettest summer on record. Locally, Greenville had its wettest summer dating back to 1914, with 33.21 inches total, and Asheville had its 6th-wettest summer due largely to the rain from Fred in August. Exiting the summer, none of the state was classified in drought and only a small portion of the western Piedmont was Abnormally Dry (D0).

Fall 2021

During the typical peak of hurricane season in September and October, no storms or their remnants had any significant impacts on North Carolina, instead remaining mostly out at sea. Without the contribution of tropical rainfall, and compounded by local patterns that limited rain chances, fall was considerably drier than normal, ranking as the 22nd-driest statewide since 1895.

In September, dryness began emerging across the southern Piedmont and Coastal Plain. Following its record wet summer, Greenville measured only 1.31 inches of rain for its 10th-driest September on record. Dryness continued to build in October, with some areas seeing less than an inch of rain all month, including just 0.94 inches in Washington. By the end of the month, parts of the central Coastal Plain including Greenville, Washington, and Williamston were classified in Moderate Drought (D1). The dry weather reached its peak in November, which was tied for its 6th-driest on record with just 0.91 inches of rain, on average across the state. The last November drier than that was in 1931, at the onset of the Dust Bowl era in the Southern Plains. High pressure over the Southeast U.S. diverted any rain-making weather systems, and most areas reported little precipitation. In the northern Piedmont, Yanceyville had only 0.14 inches and Greensboro had 0.30 inches in November. During the month, two notable wildfires sparked in that region, first on Sauratown Mountain and later Pilot Mountain.

By the end of November, 64.8 percent of the state was classified in Moderate (D1) or Severe (D2) drought, including most of the Coastal Plain. The Mountains were shielded from the emerging drought by another heavy rain event on October 5-8, in which more than 10 inches of rain associated with a moisture-rich upper-level low pressure system to the west. That system produced flooding and landslides less than two months after Fred affected the same areas. Even despite those soaking rains, by the end of the fall, parts of the far southwestern Mountains were Abnormally Dry and experiencing below-normal streamflows after the dry November.

Winter 2021-22

For the second consecutive year, La Niña conditions were in place for the winter, which typically means warmer and drier weather in North Carolina. That held true this year, as it was the 11th-warmest and 45th-driest winter on record. However, the cooler overall temperatures and timely precipitation in January limited – and even reversed – the expansion of drought across the state.

The season started with an historically warm December, which was the 2nd-warmest on record and more than 6 degrees above normal. Late in the month, daytime highs reached the 70s and nighttime lows only dipped into the 60s, which set new daily records for warmth in places like Raleigh and Greensboro. December was also dry in most areas, including the driest since 1980 in Boone with just 0.71 inches. That helped the drought to expand, with Severe Drought covering more than half of the state for the first time since July 2008.

January brought precipitation relief in the form of rain and snow events nearly every weekend of the month. The northeastern corner of the state, for instance, had more than 5 inches of snow on January 22, and the slow melt helped replenish surface water and groundwater sources and alleviate drought conditions locally. While February featured warmer, spring-like weather and was generally dry across the Piedmont and Coastal Plain, drought improvements continued during the month, and by the end of winter, only 9.1 percent of the state – all along the southern coastline – was classified in Moderate Drought.

Spring 2022

This spring, the Mountains and Piedmont had generally sufficient precipitation to avoid drought and its impacts, but the cold fronts and other weather systems that brought rain to those regions missed the Coastal Plain. As a result, eastern North Carolina slipped back into Moderate and Severe Drought in March, April, and May.

One of the driest areas was the Interstate-95 corridor including Lumberton, which received only 5.23 inches of rain in its 4th-driest spring on record. The southeastern counties in particular struggled with a warm, dry May that saw the emergence of 90-degree temperatures by mid-month. Wilmington had only 1.12 inches of rain, which was its 11th-driest May on record. Increased evaporation due to the heat with limited rainfall recharge led to declining streamflow levels and a challenging period for early-planted corn.

Early Summer 2022

May's warmth continued into June, which also ranked as the 2nd-driest on record statewide. High pressure in place across the Southeast U.S. mostly suppressed shower and thunderstorm activity, while also elevating temperatures above normal levels. Charlotte had 19 days in June with temperatures reaching at least 90°F, while Raleigh had 17 such days as part of the warmest June there since 2015.

With such widespread warm and dry weather, drought and dryness expanded westward by the end of the month. Abnormally Dry conditions were seen throughout the Mountains, including in Boone (0.93 inches) and Blowing Rock (0.91 inches), which had their driest June in the past 42 and 23 years, respectively. Moderate Drought emerged across the northern and western Piedmont, from Charlotte through the Triad. Severe Drought remained in place across parts of the Coastal Plain, including the same areas that dried out during the spring but continued to miss out on rainfall. Fayetteville, for instance, had only 1.16 inches of rain for its 9th-driest June on record.

By the end of June 2022, drought had been present across some part of North Carolina for 36 consecutive weeks, dating back to late October 2021. At the time, it was the fifth-longest such streak since the U.S. Drought Monitor began officially tracking conditions in January 2000, and the longest since the 53 consecutive weeks with drought from May 2016 through May 2017.

Streamflow and Groundwater – USGS (Curtis Weaver)

Streamflow conditions during the first four months of the annual period (July 1, 2021 through June 30, 2022) were commonly characterized by normal (25th-75th percentiles) and above-normal (>75th percentile) conditions, having come off a previous annual period (2020-21) of above normal and much above-normal (>90th percentile) conditions. However, the last eight months of the annual period were characterized by a wider range of streamflow conditions ranging from much below-normal (less than 10th percentile) to much above-normal that varied both spatially and temporally across North Carolina during these latter months.

Figure 1 shown below indicates the percentage of USGS streamgages in North Carolina with 7-day average streamflows (or 7-day flows) less than the 25th, 10th, and 1st percentiles (or record-low for the calendar date) during the annual period. The percentages of USGS streamgages across North Carolina having 7-day flow percentiles below the 25th and 10th percentiles reached maximum values of 90 percent (December 29 and 31, 2021) and 39 percent (December 29-31, 2021), respectively. By comparison,

the maximum percentages observed during the previous annual period (2020–2021) were 36 and 15 percent, respectively, for these two streamflow indicators.

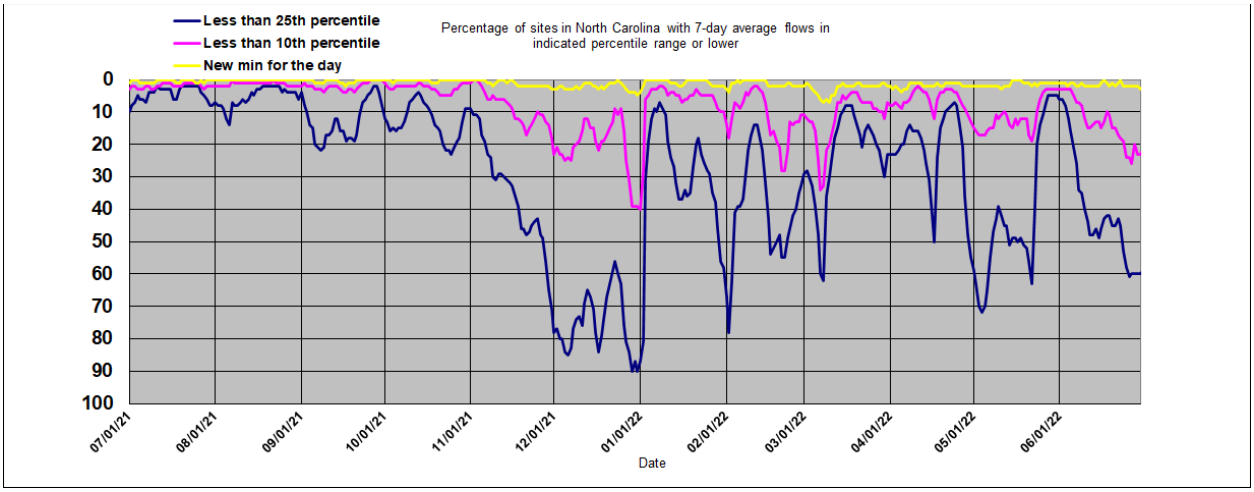

Figure 1. *7-day Flow Percentiles for USGS Streamgages in North Carolina*

From July 2021 through October 2021, USGS WaterWatch streamflow maps indicated mostly normal conditions across the State with the exception of brief durations of much above-normal flows occurring in different regions depending on the passage of storm events. The percentage of streamgages with 7-day flows generally remained less than 20 percent during this 4-month period with occurrences of less than 5 percent following storm events that occurred in late August, mid-September, and again in late October.

Beginning in November 2021, streamflow conditions in the Piedmont and Coastal Plain regions descended into the below-normal ranges with 7-day flows below the 25th percentile across almost all parts of the State by end of December. As previously noted, the percentage of streamgages with 7-day flows less than the 25th and 10th percentiles reached a maximum of 90 and 39 percent, respectively (end of December 2021). The extent of below-normal streamflows across North Carolina was further re-enforced with greater than 80 percent of the streamgages across the State having 28-day average streamflows (or 28-day flows) less than the 25th percentile during the latter half of December (Figure 2, similarly structured as Figure 1 but for 28-day flows).

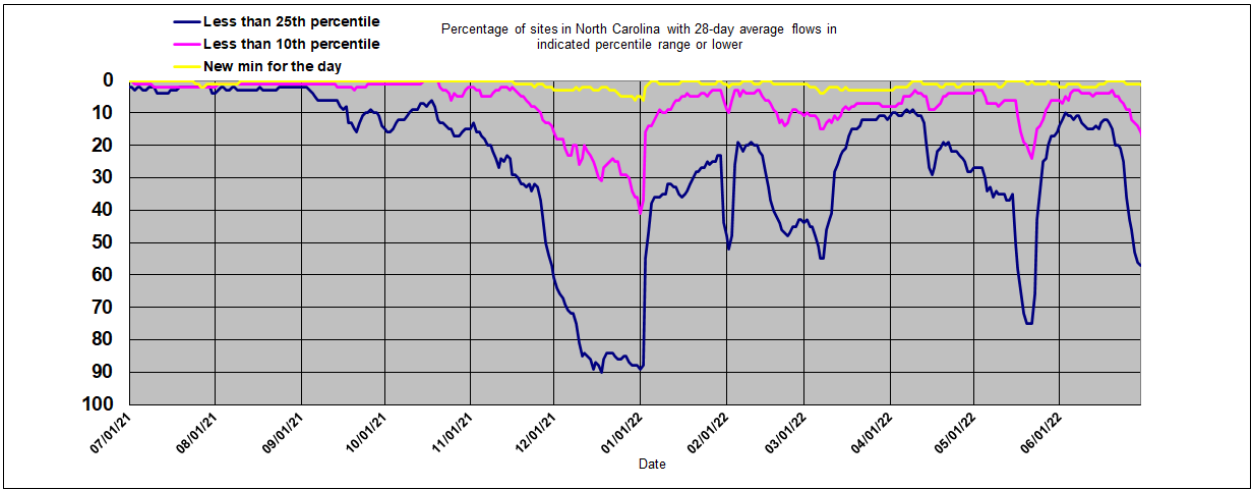

Figure 2. *28-day Flow Percentiles for USGS Streamgages in North Carolina*

At the beginning of the new year (2022), the high percentages for both the 7- and 28-day flows quickly decreased (improved) following passage of heavy precipitation across much of the State. But those declines in percentages were temporary as streamflow conditions across the State shifted into a “roller coaster” pattern of fluctuations during the latter half of the annual period characterized by wide swings from above-normal to below-normal. As indicated on both the 7- and 28-day flow percentile graphs (Figures 1 and 2), periods of below-normal streamflows were noted for late January/early February with Blue Ridge streams initially below normal followed by a return to below normal for streams almost statewide early and mid-February. Percentages for 7-day flows reached the second highest maximum value of 78 percent on February 2, 2022.

From March through June 2022 (end of annual period), the percentages of 7-day flows less than the 25th percentile varied from 72 percent (May 4) to 6 percent (May 25 to June 1). Other notable high 7-day percentages were 62 percent on March 8 when widespread much below-normal streamflows were in effect across most of the Coastal Plain. On March 7-8, the 28-day percentile graph indicates 55 percent of sites across the State had 28-day flows below the 25th percentile. A second notable 7-day percentage of 50 percent (April 18) below the 25th percentile was indicated for mid-April when streams in the Piedmont and Coastal Plain again declined to below-normal levels (See Figure 3).

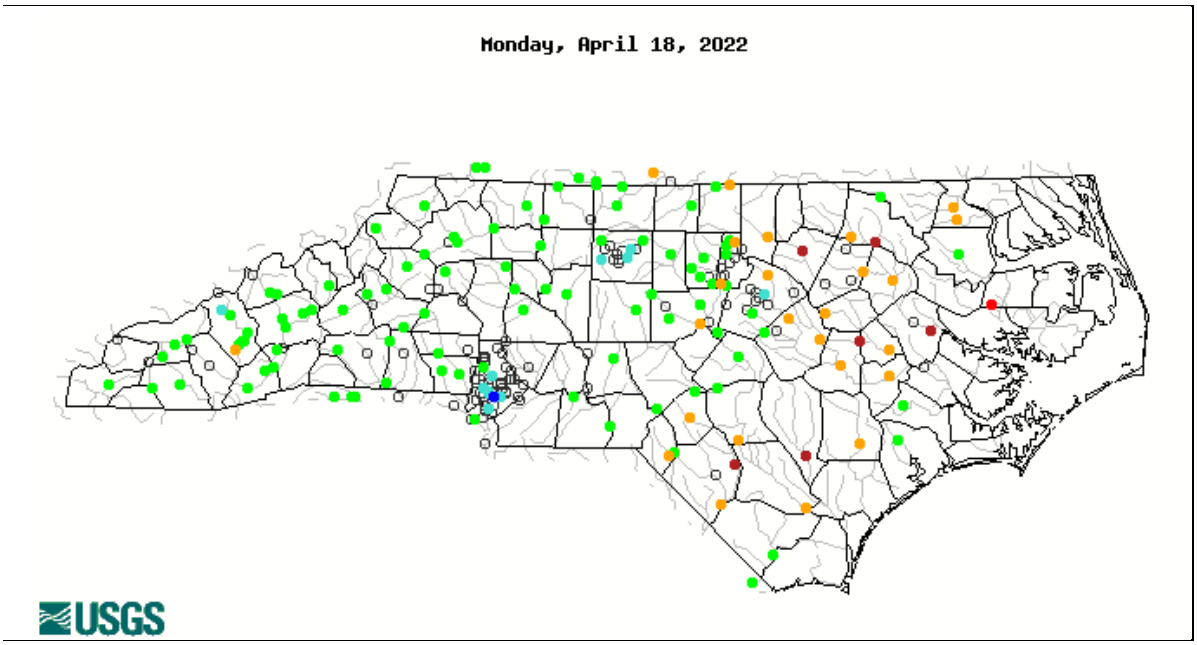

Figure 3. *7-day Flow Percentiles for USGS Streamgages in North Carolina*

The month of May again brought wide swings in streamflow conditions across the State with much below-normal levels being indicated for numerous Blue Ridge and Coastal Plain streams. However, the passage of heavy rainfalls in late May improved streamflow conditions into the record-high (calendar date) and much above-normal ranges for many Blue Ridge and Piedmont streams while Coastal Plain streams briefly transitioned in the normal ranges. Only a handful (less than 5) of streamgages in the extreme southern Coastal Plain depicted persistent much below-normal streamflow conditions.

The month of June, at the end of the annual period, brought a return to below-normal streamflow conditions as air temperatures became much warmer. Streamflows across all parts of the State were in the below-normal ranges with a large area of less than 10th percentile conditions noted from the central Piedmont into the inland Coastal Plain by the end of the month. On June 30, the percentages of 7- and 28-day flows less than the 25th percentile were at 60 and 57 percent, respectively, of the streamgages across North Carolina.

Examination of approved (2021 water year) and provisional (2022 water year) daily discharge data indicates no period of record minimum daily mean discharges or 7-day average streamflows were set at any USGS stream gage in North Carolina during the annual period. However, varying numbers of zero-flow occurrences were observed at 5 streamgages during the period meeting the previous record “zero flow” daily discharges set at these streamgages: USGS 02077200 - Hyco Creek near Leasburg in Caswell County (16 consecutive days September 6-21, 2021), USGS 0208111310 - Cashie

River at SR 1257 near Windsor in Bertie County (3 days during July 3-5, 2022), USGS 02084160 - Chicod Creek at SR 1760 near Simpson in Pitt County(45 days during the period between May 22 and August 11, 2022), USGS 0208524090 - Mountain Creek at SR 1617 near Bahama in Durham County (10 days during September 12-21, 2022), and 1 day of zero-flow occurrence on August 14, 2022, at USGS 02102192 - Buckhorn Creek near Corinth in Chatham County (flows regulated by Shearon Harris Lake).

No period of record minimum 7-day flows was observed at any of the USGS streamgages in North Carolina, with exception of 3 of the 5 streamgages identified above (02077200, 02084160, and 0208524090) where the previous record “zero flow” 7-day average streamflows were again observed within parts of the above-indicated periods. Minimum monthly average streamflows were observed at 12 USGS streamgages in North Carolina during the annual period, but none of the new provisional monthly minimum averages were low enough to surpass the period of record minimum monthly average flow in effect at these streamgages.

Groundwater levels at the 16 USGS observation wells within the USGS North Carolina Climate Response Network varied widely during the annual period from July 1, 2021, through June 30, 2022, reflecting conditions ranging from provisional monthly record maximums to monthly record minimums. The water levels in these 16 wells reflect the climate conditions (occurrence of precipitation), but changes in water levels are also affected by individual well characteristics (e.g., well depth, surrounding material through which the water moves).

As noted for the streamflows, observed water levels at the four Blue Ridge observation wells in this network generally were in the above-normal and normal ranges during the first 5 to 7 months of the annual period, coming off sustained above normal and much above-normal ranges throughout much of the previous annual period (2020-21). However, water levels eventually descended into or close to the below-normal ranges during the period from December 2021 through February 2022. From March through the end of the annual period (June 2022), water levels among these 4 wells generally ranged in the normal ranges although occasional transitions into either above- or below-normal ranges were likewise observed dependent on precipitation characteristics across the region. No period of record minimum or maximum water levels were noted among any of these four Blue Ridge wells during the period. However, monthly maximum water levels were noted during March 2022 at the Pisgah Forest well in Transylvania County and during May 2022 at the Champion well in Haywood County. Likewise, monthly maximum water levels were noted for 4 months (September and October 2021, May and June 2022) during the annual period at the Marble well in Cherokee County. Fluctuations in water levels at the shallow Marble well are quick to respond to

occurrence of precipitation, as characterized by “flashiness” noted in the groundwater hydrographs. In comparison, fluctuations in water levels at the deeper Blantyre well in Transylvania County are much slower to change following precipitation events. With exception of a few weeks in early February 2022, water levels at the Blantyre well remained in the normal ranges throughout the annual period.

No period of record or monthly record minimum or maximum water levels were noted at 4 of the 5 Piedmont observation wells in this network during the annual period. Provisional monthly maximum water levels were observed during each of the first 8 months (July 2021 through February 2022) at the Duke Forest well in Orange County. Analogous to water levels in the Blantyre well in the Blue Ridge region, water level changes in the Duke Forest well have been observed to be from extremely slow to seemingly almost nonresponsive to the occurrence of precipitation events. Water levels at the Piedmont Research Station (RS) well in Rowan County and the Mocksville well in Davie County were sustained in the above-normal and normal ranges during the entire annual period. Similar to the water levels in the Blue Ridge wells at the start of the annual period, the water levels in the Langtree well in Iredell County and the Oak Ridge well in Guilford County were sustained mostly in the normal ranges until the end of the annual period in June 2022 when below-normal conditions were depicted.

Water levels in the Marston observation well in Scotland County (Sand Hills region) were sustained solely within the above-normal and normal ranges throughout the annual period. No period of record or monthly record minimum or maximum water levels were noted for this well. Similar to water levels in the Blantyre well in the Blue Ridge region and the Duke Forest well in the Piedmont region, water levels in the Marston well have been observed to be slow to respond to the occurrence of precipitation events.

Among the six observation wells in the Coastal Plain, water levels varied widely during the annual period. Given the shallow depths of the Coastal Plain wells, water levels are typically quick to respond to the occurrence of precipitation. Hence a wide range of conditions can be in effect at a given point in time, as was noted for this annual period. Similar to the Blue Ridge wells, the water levels among the six wells were in the normal or above-normal ranges during the first 1 to 4 months of the annual period. However, from late 2021 into early 2022, water levels descended into the below-normal ranges at all six wells and generally remained so for the remainder of the annual period at three of the 6 wells: Grantham well in Wayne County, Comfort Research Station (RS) well (Figure 4) in Jones County, and the Simpson well in Pitt County.

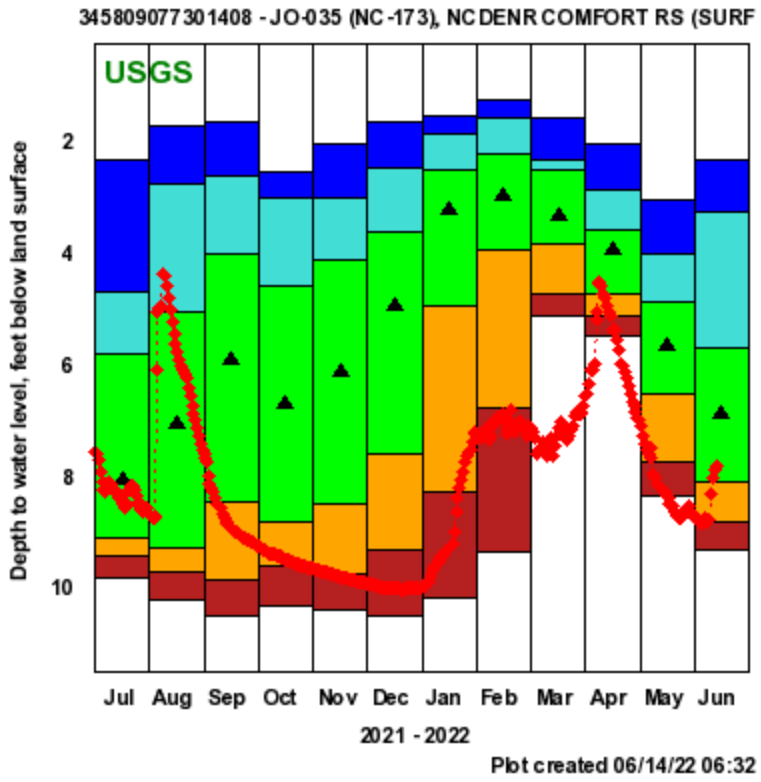

Figure 4. *2021 – 22 Water Levels at the Comfort Well, Jones County*

Among the three remaining Coastal Plain wells, the water levels fluctuated between the normal and below-normal ranges for most of the remaining annual period (Southport well in Brunswick County, Hoke well in Washington County, and Elizabeth City in Pasquotank County). Towards the end of the annual period, water levels were sustained in the above-normal and normal ranges during May and June 2022 at only the Hoke well. No period of record minimum record water levels was noted for any of the six Coastal Plain wells during the annual period. However, a provisional period of record maximum water level was noted for Southport well during September 2021. Provisional record monthly maximum water levels were noted for two of 6 wells during the period: Southport well (October 2021) and Elizabeth City well (April 2022). Provisional record monthly minimum water levels were noted for three of the 6 wells during the period Grantham well (8 months from November 2021 through June 2022), Comfort RS well (3 months from March through May 2022), and Simpson well (2 months of March and April 2022).

Forestry – NC Forest Service (Greg Hicks)

From July 1, 2021, to June 30, 2022, the N.C. Forest Service responded to 6,876 wildfires across the state that burned approximately 23,891 acres on state and private

lands. The number of wildfires increased by approximately 95 percent, while the number of acres increased by 146 percent over the previous year. The number of wildfires was 79 percent more than the 10-year average. The total number of acres burned was 31 percent above than the 10-year average. There were 104,136 acres that were treated with prescribed fire during the past fiscal year, a 52 percent increase from the previous year. This increase in acres can be attributed primarily to more burning windows and efforts by various agencies to increase the acres burned across the state.

Dry periods associated with normal seasonal changes significantly increased wildfire activity across the state. Activity picked up in November due to leaf fall aligning with dry conditions (Figure 5). During this period 1,050 acres burned on Pilot Mountain in the Grindstone Fire that resulted in the deployment of a NCFS Type 2 Incident Management Team. The conditions prompted the implementation of a statewide burning ban on November 29th, 2021. Precipitation in the first part of December reduced fire danger to a point that allowed the lifting of the burn ban.

Activity picked back up in February and carried through until spring greenup lowered fire danger for most areas of the state. Summer dryness associated with lightning activity sparked the Ferebee Road Fire on June 19th, 2022, in Hyde County. This fire burned 1,938 acres in footprint of the Evans Road fire that occurred in the summer of 2008. Below is a chart showing wildfire activity by month for fiscal year 2022.

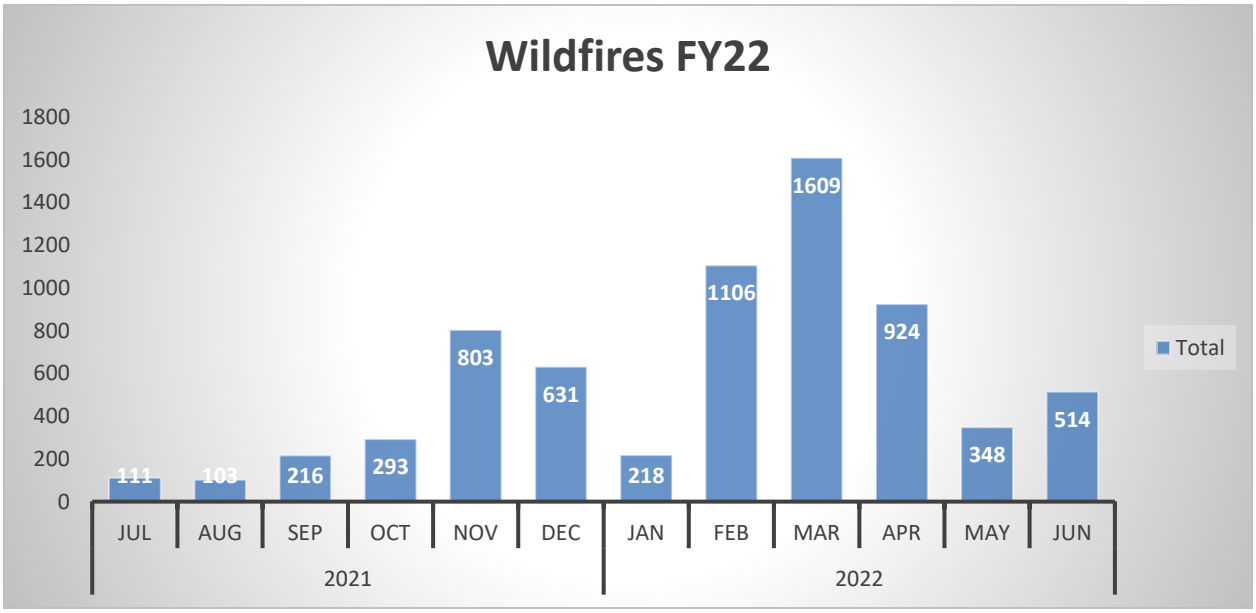

Figure 5. *Wildfire activity by month for fiscal year 2022.*

Agriculture - North Carolina Cooperative Extension (Mike Yoder)

July 1, 2021 found the agriculture industry in reasonably good shape regarding soil moisture and with the exception of corn and cotton, crop progress. The abnormal dryness across much of the central piedmont, into the foothills, limited pasture regrowth and hay production modestly but did not have substantial impact on row crops. While corn and cotton lagged behind 5-year averages, corn quality was actually high, with 78 percent listed as Good to Excellent. By months end, the abnormal dryness had pulled back to the western piedmont and foothills. By mid-August, corn maturity was equal to the 5-year average and the condition of most crops was generally average.

September rains helped pull back the abnormal dryness in most of the piedmont and foothills but the eastern part of the state experienced increasing dryness as a result of declining soil moisture levels. This dryness continued through fall harvest but had minimal impact on production, since rains were present earlier in the summer-fall when needed most. By the end of October, abnormal dryness and pockets of D1 – Moderate Drought developed in Eastern North Carolina. Still, small grain progress was average to above average throughout most of the state.

November brought an expansion of D1 across most of the eastern part of the state, and pockets of D1 across the South Central and Western Piedmont. Most crops had already been harvested and the cereal grains that were planted continued to get enough moisture to show desired progress.

By March, soil moisture had improved across most of the southern piedmont and foothills, while the eastern counties continued to face abnormal to moderate dryness. A three-county area in the southeast suffered from severe drought with its greatest impact being on the berry industry. Irrigation minimized that impact to a large extent. While the abnormal to severe drought continued through most of April and May in the Eastern counties, crop progress was surprisingly strong across most commodities. Progress of the small grains was consistent or ahead of the 5-year averages and spring-planted crops were off to an excellent start.

June of 2022 saw an expansion of the abnormal dryness into much of the piedmont, with D1 expanding in the East. Slightly more than one-third of the agricultural soil moisture reports indicated they were experiencing *Short* moisture conditions. Corn, cotton and Burley Tobacco progress was slightly behind the 5-year average for planting and corn and cotton were developmentally behind the 5-year average. By the end of June, harvest of small grains, with the exception of winter wheat, was 20 to 30 percent behind the 5-year average.

Drought Condition Summary – Division of Water Resources (Klaus Albertin)

The July 1, 2021 to June 30, 2022 period began with 49 counties in Abnormally Dry (D0) or in drought (D1 to D4) conditions following the dry conditions which began in April 2021. The dryness abated in late August due to heavy rains but quickly returned in the fall, increased throughout the winter, and abated somewhat through June 2022 (see Figure 6).

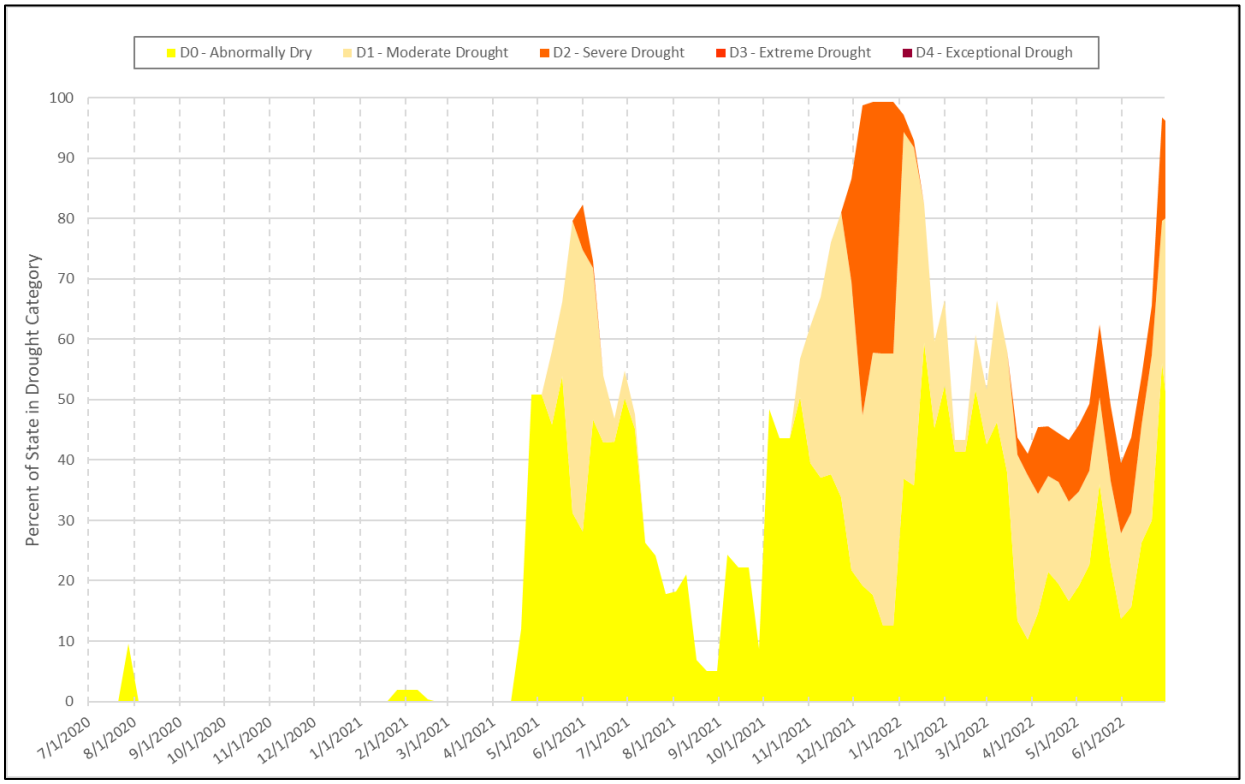

Figure 6. *Drought Levels from July 1, 2020 through June 30, 2022*

Summer 2021

Following a dry spring in 2021, nearly half of the state was still considered to be Abnormally Dry by the end of June 2021 with a small area of Moderate Drought in an area along the Virginia border (see Figure 7). Conditions improved significantly throughout the summer with heavy rains during the week of July 5th and August 9th having a significant impact as shown in Figure 8.

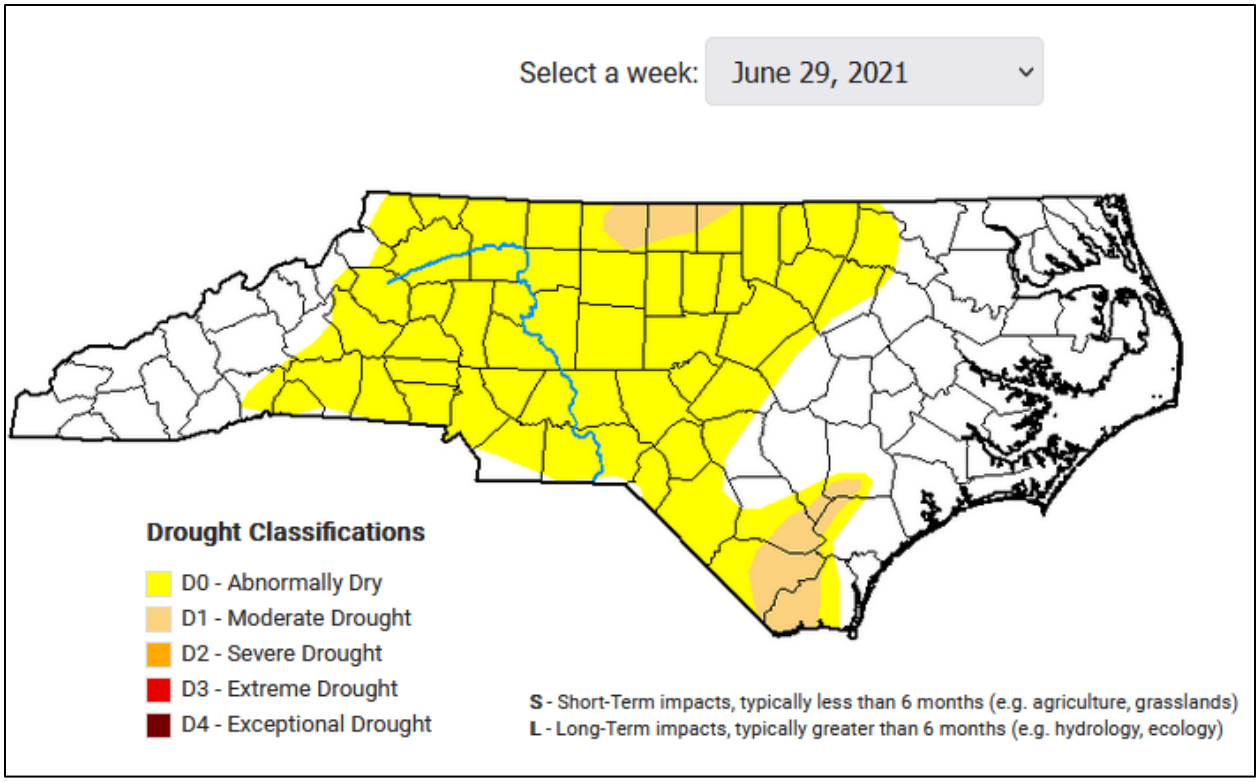

Figure 7. *North Carolina Drought Classification (late June 2021)*

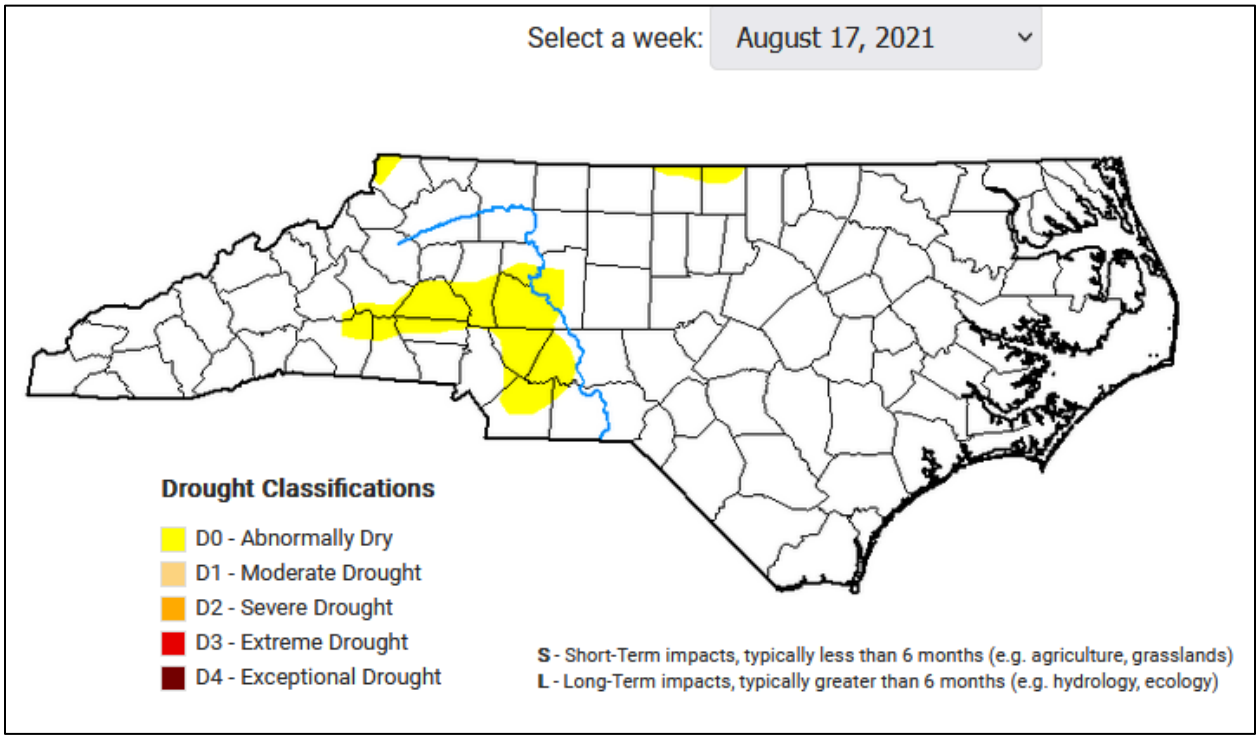

Figure 8. *North Carolina Drought Classification (mid-August 2021)*

By August 24, only five percent of the state was Abnormally Dry with no area in drought. The fall saw limited rainfall however with Abnormally Dry conditions returning to nearly half the state by early October (Figure 9). The dryness centered on the Coastal Plain and this would remain the driest area through the rest of period covered by this report.

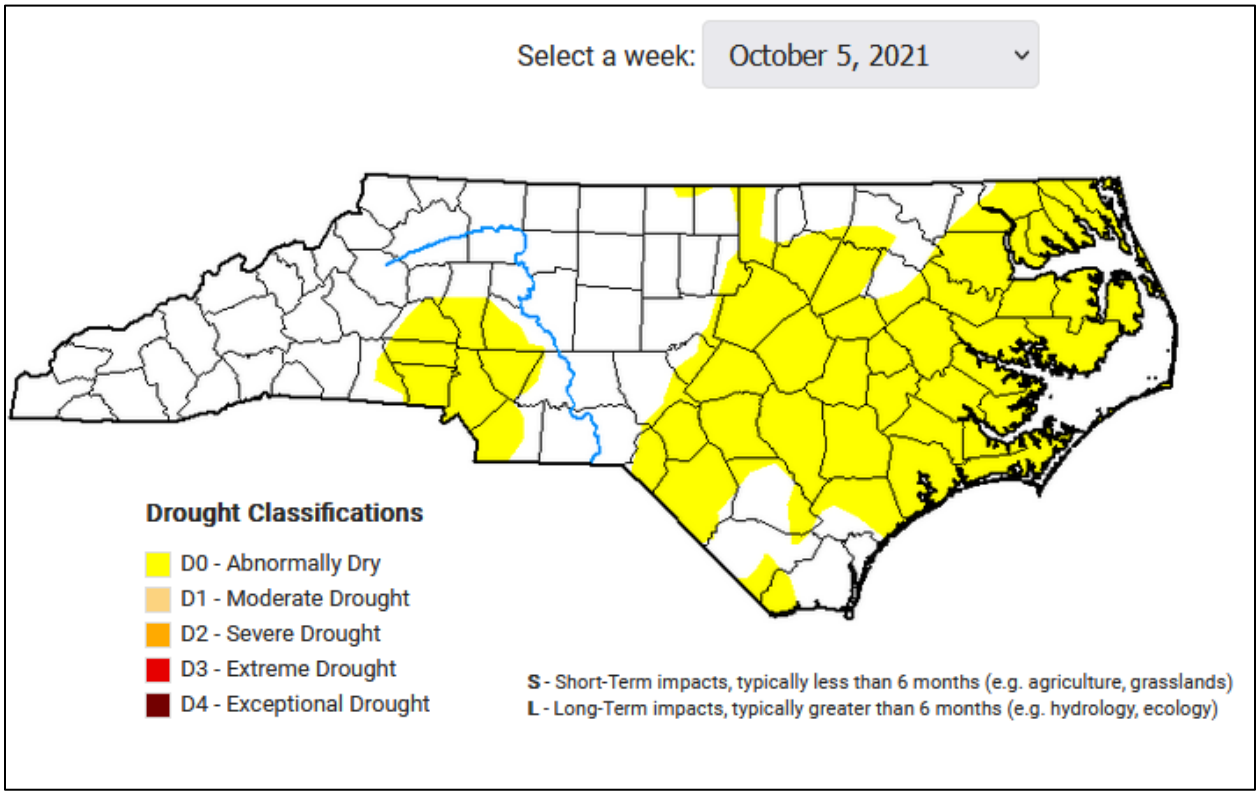

Figure 9. *North Carolina Drought Classification (mid-May 2021)*

As noted in the climate summary section, the state saw limited rainfall beginning in September. By the end of the year, conditions had worsened with approximately 98 percent of the state being considered Abnormally Dry or in some level of drought (see Figure 10). Only a small area in the mountains saw near normal rainfall during this period.

Severe Drought (D2) covered much of the Catawba River Basin, the Sandhills, and northern Coastal Plain. Moderate Drought covered much of the remainder of North Carolina. Fortunately, impacts were limited since the drought conditions occurred during a period when municipal demand is typically low, much of the ecosystem is semi-dormant, and, with the exception of pasture and winter grain, agricultural crops are not growing.

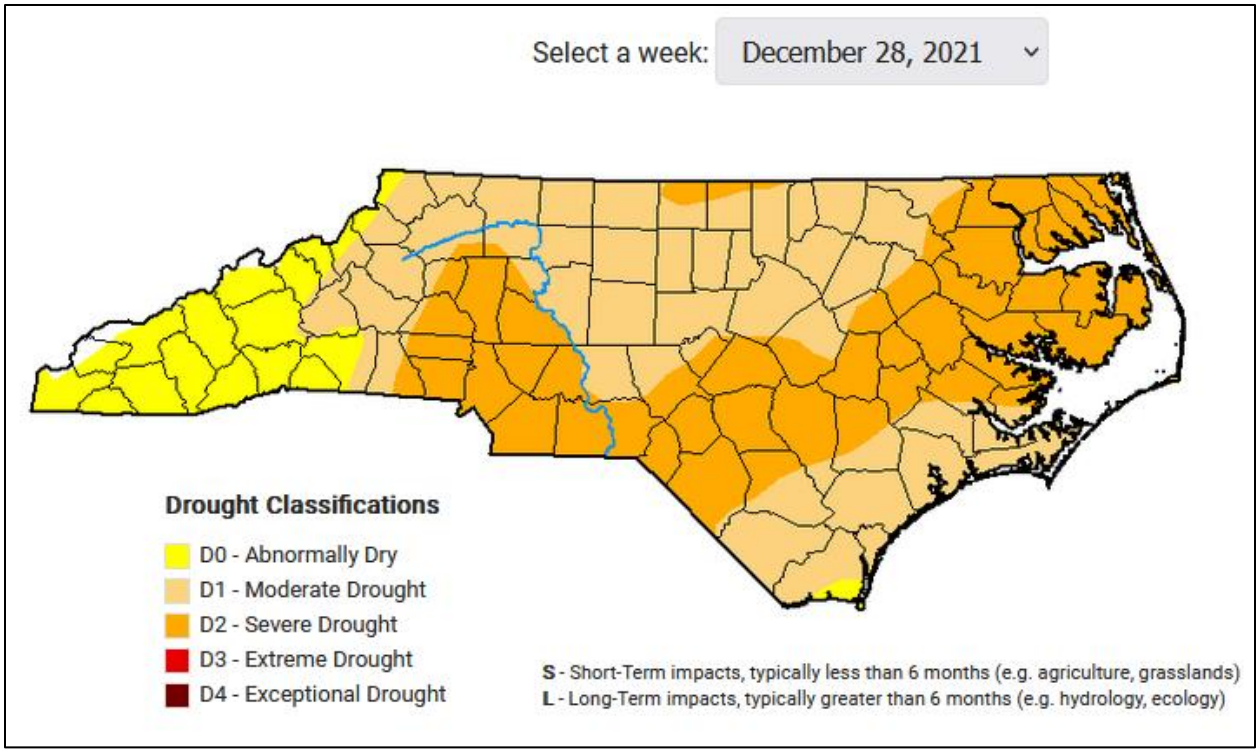

Figure 10. *North Carolina Drought Classification (late 2021)*

Conditions gradually improved throughout the early part of 2022. The Coastal Plain saw little of the rainfall that occurred elsewhere and was still in severe drought by the end of March 2022 (See Figure 11).

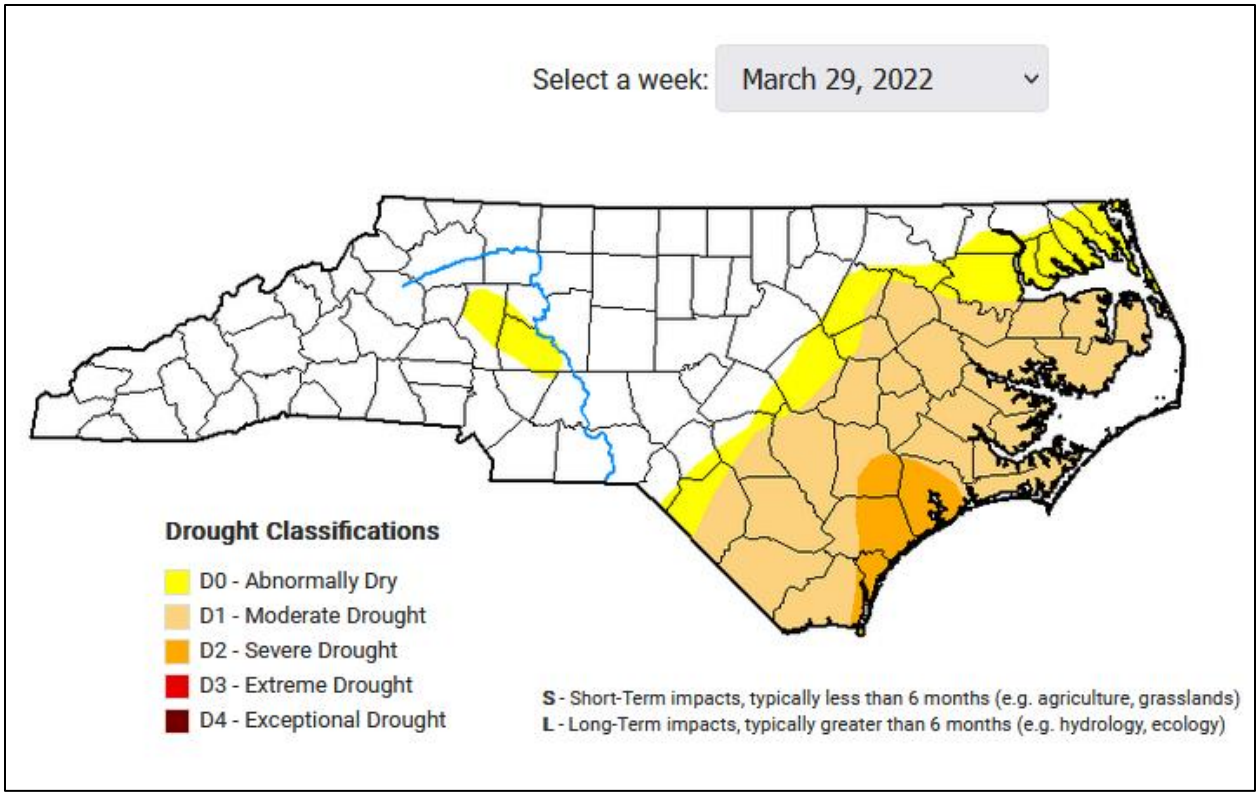

Figure 11. *North Carolina Drought Classification (late March 2022)*

Once again, rainfall was consistently less than average and a return to nearly statewide Abnormally Dry or Drought conditions was seen by the end of June 2022 (See Figure12). The lack of rainfall during the spring had a more significant impact than the dry winter. A number of weeks saw near zero rainfall, especially in the Coastal Plain, during critical plant growth periods. Corn was the most affected, missing rain during the silking stage, showing a significant loss in some areas. Some municipalities initiated voluntary conservation but overall impacts to public water supply was limited. This was in large part due to reservoirs across the state being at their optimal levels when the peak demand season began as a result of conservative discharge management earlier in the year.

The State experienced extended periods of dryness over the 2021 – 2022 but was fortunate for a number of reasons; in many areas periods of moderate or severe drought were brief, municipalities have become more prepared since the 2007-2008 drought and implemented conservation plans when dryness reached key levels, municipalities in the hard hit Coastal Plain either rely on reservoir discharge or groundwater, and there was a break in the dryness during the spring allowing for planting and germination of crops. Undoubtably, agriculture and ecosystems experienced drought stress and saw losses as a result of the extended dry periods but considering the extent and duration of the dryness impacts were limited.

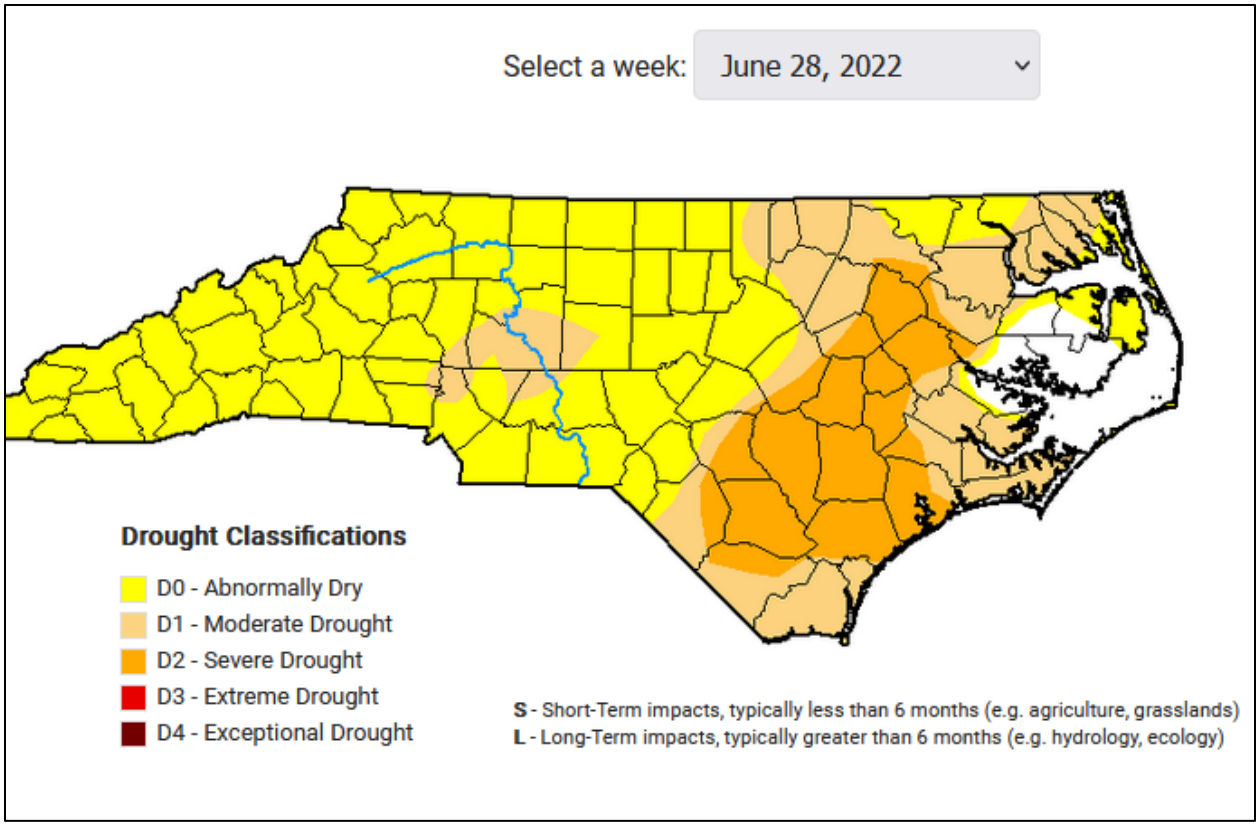

Figure 12. *North Carolina Drought Classification (late June 2022)*

Historical Perspective

Due to the natural variability of climate, drought may occur at any location in the state and at any time of the year. In recent history, 2003 was the only year where no drought occurred in any part of the state. More typically, we see a moderate part of the state with Abnormally Dry conditions and a much smaller area in Moderate Drought. Severe drought or worse conditions do occur in many years, but the extent is often limited. The areas that are affected also shift throughout the year as localized rainfall either hits or misses locations. In this context, the 2021 – 2022 period was a moderate year for drought conditions. Much of the state saw Abnormally Dry or Moderate Drought at some point during the year but the severity and impacts were limited.

Analysis using one of the standard drought assessment metrics, the Palmer Hydrologic Drought Index (PHDI), provides insight into long-term drought conditions for North Carolina (See Figure 13). Similar to the standard deviation of a normal distribution in statistics, PHDI values within +/- 2 reflect typical conditions. Values outside of this range show either very wet (positive) or very dry (negative) conditions. Values above +4 and below -4 reflect very extreme conditions.

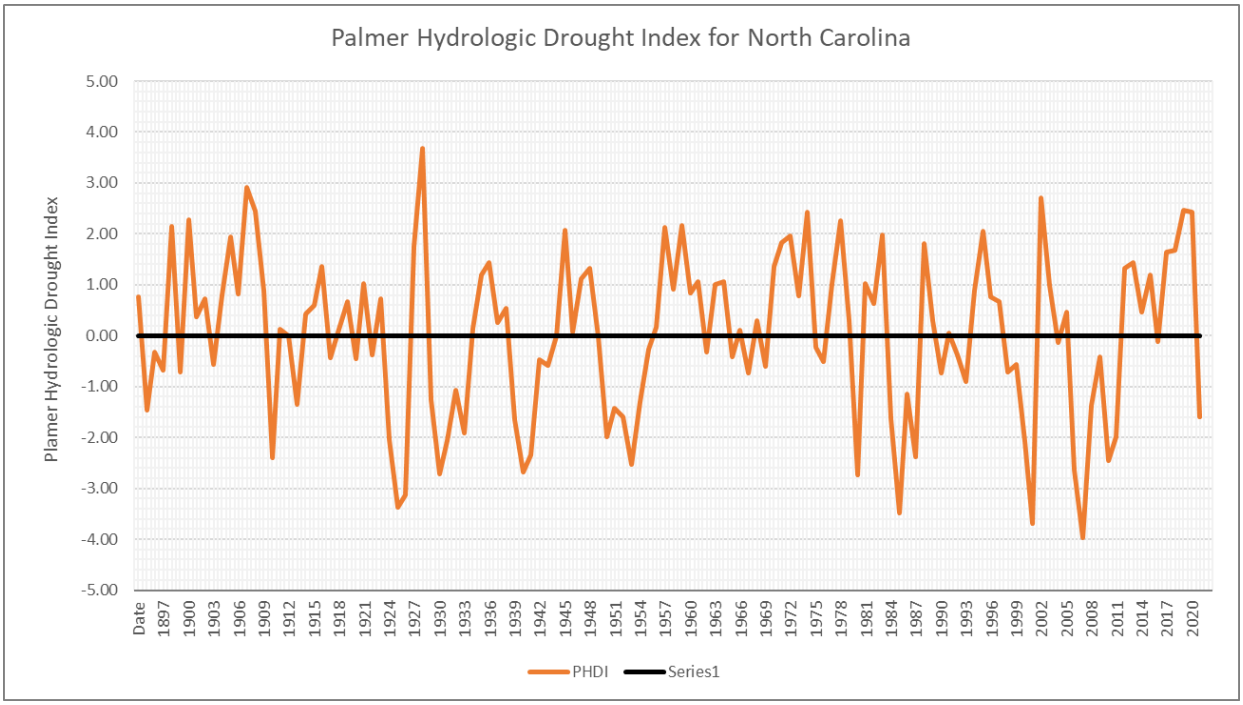

Figure 13. *Palmer Hydrologic Drought Index since 1895* Source: NOAA, 2022

North Carolina experienced extreme drought conditions from 1925 through 1927 with PHDI values reaching -4.1 at one point. A very wet period followed and then an extreme drought occurred in 1932 - 1933. This extreme drought period saw the lowest individual monthly PHDI value of -4.74. Occasional, Moderate Droughts occur in the 1940's and 1950's but it wasn't until the late 1980's that extreme drought returned. The PHDI reached a low of -4.6 in July 1986. Moderate to wet conditions returned in the 1990's but two of the most extreme droughts in North Carolina's recorded meteorological history occurred between 2000 and 2010. One of the wettest years also occurred during this period. Since 2010, conditions have been less extreme but highly variable swinging from moderately wet to moderately dry. No clear trend is seen but it does appear that more extreme swings in conditions are likely. The North Carolina PHDI values for the report period averaged 3.4 and peaked at 4.8 in February 2021 (NOAA, 2021). These values reflect the very wet winter period and a moderately dry spring. Since the 2007 to 2008 drought, conditions have been trending wetter than normal. However, conditions over the last year swung back to moderately dry with an average for 2022 of -1.59.

The 2020 North Carolina Climate Science Report (Kunkel et. Al., 2020) found that based on historical observations and projected changes to temperature and rainfall it is likely that future droughts in North Carolina will be more frequent and intense due to higher temperatures leading to increased evaporation. The total annual precipitation is

not expected to change significantly but variability is expected to increase with more frequent intense rain events and more severe dry periods.

DMAC Meetings

Drought conditions in North Carolina are updated weekly through an audio-video telecom with a Technical Drought Advisory Team, which is a sub-group of the N.C. DMAC. The team consists of experts on climate, weather, hydrology, water supply, forestry, and agriculture that report each week on streams flows, groundwater levels, reservoirs levels, wildfire activity, water supplies, and crop conditions. Based on this information, the team makes a recommendation to the U.S. Drought Monitor author on the state's drought conditions for that week. Those recommendations are used to draw the national drought map (https://droughtmonitor.unl.edu/CurrentMap.aspx) each Thursday. To see or download a copy of the current drought map for North Carolina, visit the State's official drought website at: www.ncdrought.org.

The DMAC is required by law to meet in person at least once each calendar year. The 2022 annual council meeting is scheduled for September 27 at 1 p.m. Items to be discussed at the meeting include a recap of stream flow and ground water levels, lake and reservoir levels, agriculture, forestry, and public water systems conditions over the July 2021 through June 2022 period.

References:

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