North Carolina
Division of Water Resources
Groundwater Resources Section
Groundwater Management Branch
2022 Annual Report

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Division of Water Resources
September 2022

Four Mile Desert Monitoring Station, E13M
Perquimans County, NC

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Acknowledgements

The author would like to thank the following colleagues employed in the FY 2022 with the North Carolina Division of Water Resources (DWR), Groundwater Management Branch, (GWMB) for their contributions to the GWMB in the FY 2022: Mike Bauer, Tony Butz, Gabrielle Chianese, Mark Durway, Kevin McVerry, Andy Neal, Kalli Unthank, Justin Williams, Barbara Peck, Mike Ranck, and Nat Wilson. The author would also like to recognize Connor Bassett, who was the GWMB intern from May 2022 through July 2022.

A special thanks to Mark Durway, author of Section 5.2, Chloride Sampling, and associated figures, Andy Neal, author of Section 7.0, Water Quality, and Gabrielle Chianese, author of Section 9.0, Central Coastal Plain Capacity Use Area, and associated figures.

A very special thanks to Nat Wilson for creating a website/database where all needed information and statistical information were easily accessed.

1.0 Introduction

The State of North Carolina (the State) relies on groundwater for approximately 50 percent of its drinking (potable) water use. In addition, the State has thousands of agricultural and industrial groundwater users. The North Carolina Department of Environmental Quality (DEQ), Division of Water Resources (DWR), and preceding agencies have operated, installed, and monitored a statewide monitoring well network from the 1960s to the present. The operation of this monitoring well network is an essential part of DWR's mission to ensure that the State has an adequate water supply for its citizens. Information collected quarterly from this well network include the following:

- Evaluating climatic influences on the State's groundwater supply, including effects of drought and recharge-discharge relationships;
- Monitoring human-induced impacts on the State's groundwater supply, particularly in the regional aquifer systems of the Coastal Plain physiographic province. These effects include local and regional water level declines as well as migration of the fresh water-salt water interface within various aquifers;
- Providing supporting data for enforcement and creation of current and future groundwater usage regulations, such as the Central Coastal Plain Capacity Use Area rules;
- Periodic sampling of the monitoring well network to establish background levels for constituents (e.g., nitrates, etc.); and
- Providing high quality groundwater data to local governments, groundwater professionals, and the public to use in making informed decisions in groundwater related issues.

Cremo Monitoring Station, F19V
Bertie County, NC

Data collected from the network are available to the public through DWR's internet website https://www.ncwater.org/GWMB. These data include groundwater levels, water quality measurements, well construction information, borehole log construction (lithological and geophysical), groundwater monitoring station locations, and geophysical/lithological data collection from non-DWR well sites.

Chicod Monitoring Station, O23L
Pitt County, NC

2.0 Purpose and Scope

The 2022 Annual Report summarizes field activities and conclusions derived from activities performed or associated with the Groundwater Management Branch (GWMB) during the July 1, 2021 through June 30, 2022 fiscal year (FY 2022). These activities include the groundwater monitoring well network water quantity and water quality data statistics, monitoring well installations, including both new installations and acquired wells, monitoring well abandonments, monitoring well repairs, monitoring equipment usage and evaluations, site surveys, local monitoring well network information, and a summary of the Central Coastal Plain Capacity Use Area FY 2022 activities.

Viena Vista Monitoring Station, S49D
Moore County, NC

3.0 Background

DWR and its predecessor agencies have operated the statewide Groundwater Resource Monitoring Program from the 1960s to the present. The active monitoring well network has expanded by approximately forty-five percent (332 monitoring wells) by either installation or acquisition of new monitoring wells since 1998.

The U.S. Geological Survey (USGS) has also contributed to the monitoring of the State's groundwater resources under a cooperative agreement between the State of North Carolina and the Federal government. The USGS cooperative well network consists of 14 monitoring wells, six of which are also part of the DWR statewide network.

Three local cooperative networks whose water level data are currently being uploaded to the DWR database and contribute to both the statewide monitoring well network and the drought network are the Orange Well Network (OWN) in Orange County, the Guilford County network, and the Western Carolina Hydrological Research Station (WCHRS) in Jackson County. The statewide monitoring well network includes two wells, CC Old Well (Q94I1) and Stillwell Building (Q94J1) from the WCHRS cooperative network. The water level data can be viewed by the public on the DWR website https://www.ncwater.org/GWMB.

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Cove City Monitoring Station, R23X
Craven County, NC

4.0 DWR Statewide Monitoring Well Network Overview

4.1 Description

The monitoring well network currently consists of 704 wells at 235 monitoring stations (sites), divided into six regions, comprising 68 counties (Figure 1). There are 56 wells located in the Piedmont and Mountain physiographic provinces (Piedmont and Mountain) and 648 wells located in the Coastal Plain physiographic province (Coastal Plain). The Coastal Plain relies more heavily on groundwater supplies than either the Piedmont or Mountains. Consequently, groundwater monitoring and research have been more concentrated in the Coastal Plain.

Video Logging
Stillwell Building Monitoring Station, Q94J
Western Carolina University, Jackson County, NC

In the past few years, more resources have been invested in monitoring the Piedmont and Mountain groundwater conditions to better understand the impact of drought cycles on groundwater supplies and their contribution to surface water flow. There were 49 wells monitored by DWR within the monitoring well network used to assess drought conditions in FY 2022 (Figure 2).

Of the 235 monitoring stations, 87 are on State or Federal property, 65 are located on property owned by local governments, 79 are located on private property through agreements with landowners, and 4 stations are located on properties where the landowner indicates that the land property ownership may change. In the past, some wells have been abandoned at the landowner's request due to changes in land use or ownership. Due to the high cost of well construction, combined with the fact that the wells are most valuable when they are monitored continuously over a period of decades, every attempt is made to put new stations in secure, stable locations. A scale has been developed to rank new and existing well sites for potential well abandonment due to land-use issues in the future. This scale is referred to as the Site Susceptibility Rating (Table 1). It is preferred that new wells be installed at sites with a susceptibility rating of 1 or 2.

Depth to Water Measurement
Godley Monitoring Station, Q16G
Beaufort County, NC

4.2 Monitoring

The statewide monitoring network is divided into six regions (Figure 1). One staff member is responsible for each region. Staff member responsibilities include visiting the wells quarterly to collect water level data, collecting data from drought wells monthly if needed, performing routine site maintenance, keeping automatic data recorders in working order, and keeping sites accessible and aesthetically pleasing. Additional site activities (i.e., data logger removal/replacement, site maintenance, video-logging, etc.) are conducted on an as needed basis.

HOBO Datalogger
Chicod Monitoring Station, O23L
Pitt County, NC

Depth to groundwater level measurements are collected from the network in two different ways. Manual water levels are measured using electronic water level indicators. Hourly water level measurements are collected using unvented pressure transducers (data loggers). Hourly water level data are extremely valuable in assessing aquifer recharge, impacts of large storms on groundwater conditions, and delineation of aquifer boundaries. Manual water level readings and daily automatic data logger water level data are typically published on the DWR website. However, hourly data is available upon request for specific wells. Table 2 summarizes site and recorder distribution by region.

Downloading HOBO Datalogger
Chicod Monitoring Station, O23L
Pitt County, NC

In addition to the data loggers mentioned above, Solinst Telemetry System (STS) data logger units have been installed in sixteen wells that are included in the Drought Indicator Well network. They consist of one pressure transducer, one barometer (corrects for air pressure), and are powered by a twelve-volt battery. Data is collected by a controller unit that stores hourly readings. The readings are sent to the home station (DWR web page server) every reporting interval (currently 3 hours) via a cell phone modem. DWR uses the STS system on the Drought Indicator Well network to take the place of monthly visits. They are serviced every quarter or semi-annually depending on battery life. The STS data is especially helpful in keeping the Drought Indicator well water levels up to date https://www.ncwater.org/droughtwells. Table 3 summarizes STS system information. Eight of the STS data logger units did not collect data due to equipment failure at some point in FY 2022 . DWR is in the process of updating and replacing the STS equipment.

4.3 Chloride Sampling

Chloride samples were collected from select wells in the Coastal Plain during the FY 2022. The samples were analyzed using the Quantab® field method. Field results were used to monitor the migration of the fresh water-salt water interfaces in the Coastal Plain aquifers.

Additional chloride samples are collected for field analyses when new monitoring wells are installed and as needed for special projects. The next chloride sampling event will occur in September-October 2024 to track salt water encroachment conditions. Section 5.2 summarizes the FY 2022 chloride sampling event.

5.0 Well Network Statistics

5.1 Groundwater Data Collection

Depth to groundwater was measured in 709 wells in the FY 2022. It is not uncommon for this number to differ from the total number of wells currently in the network (e.g., well

Solinst Telemetry System
Clarendon Monitoring Station, DD42N
Columbus County, NC

abandonment, well removal, etc.). Table 4 contains DWR monitoring well network statistics from January 1, 2005 through June 30, 2022. Statistics may vary in comparison to previous years due to additional data entry in the DWR database as older field books are scanned and unrecorded data entered. Figure 3 compares the number of wells monitored to the water level data collected from the network from 1967 to present. Hourly water level data is not included in this graph. Calendar year 2021 represents the most water level data collected in any single year since starting the monitoring well network operation. The FY 2022 data was collected from July 1 through June 30, 2022.

Data obtained from DWR and its predecessor agencies, including records dating from the 1960s through 1980s, continue to be digitized and data recorded into the DWR online database. These data include, but are not limited to, water level data, well construction records, well development information, chloride sampling events, memorandums of agreement, and field notes.

Chloride Sampling
Arapahoe Monitoring Station, S18U
Pamlico County, NC

5.2 Chloride Sampling

In 2022, a chloride sampling event was conducted at 413 DWR monitoring wells. Samples were collected from March 15, 2022 through May 15, 2022. During the event, groundwater was analyzed using Quantab® chloride test strips, and conductivity, salinity, and pH were measured using YSI® portable probes.

The purpose of chloride sampling is to monitor salinity levels and trends at the fresh water-salt water interface within each of the major coastal plain aquifers. Salinity levels and the location of the interface can change as a result of sea level rise, storm surges during hurricanes, groundwater pumping, and mine dewatering. Chloride levels are used to determine if groundwater is fresh (< 250 ppm chloride) or salty (≥ 250 ppm chloride). Chloride sampling is also used to identify the transition zone between the fresh and salty zones.

Chloride Sampling
Deppe Monitoring Station, V23X
Onslow County, NC

Grifton Monitoring Station, P24O, Pitt County, NC

This transition zone is characterized by a vertical salinity gradient within the aquifer in which salinity increases with depth, from fresh to salty. Salinity zones and chloride results for three of the state's major Cretaceous aquifers, the Black Creek Aquifer (Kbc), the Upper Cape Fear Aquifer (Kucf) and the Lower Cape Fear Aquifer (Klcf), are summarized in Figures 4, 5, and 6, respectively. Included in the figures are analytical results from chloride sampling events in 2012, 2015, 2017, 2019, and 2022. The number of samples collected from the Black Creek, Upper Cape Fear, and Lower Cape Fear aquifers were 47, 44, and 22, respectively.

Figure 4 shows chloride sample results for selected Black Creek wells located along the aquifer's fresh water-salt water interface. For 2022, chloride levels range from below detection limits to as high as 12,296 mg/l (ppm equivalent). Between 2019 and 2022, salinity increases were observed at Wilmar (P21K5), Palmetto Swamp, Aurora II, Clarks, Parkertown Road, and Folkstone stations. During this same period, decreases in salinity were observed at Chicod, Lee Creek, Bear Grass School, Wilmar (P21K9), Deppe, Long Creek, and Kelly stations. Notable fluctuations in chloride levels have occurred over the years at the Lee Creek and Aurora II wells, both of which are located near open-pit mines where large-scale pumping and dewatering contribute to frequent fluctuation in chloride levels. Ten wells exceeded 250 mg/L.

Figure 5 shows chloride sample results for selected Upper Cape Fear aquifer wells located along the aquifer's fresh water-salt water interface. For 2022, chloride levels range from below detection limits to as high as 2,631 mg/l (ppm equivalent). Between 2019 and 2022, salinity increases were observed at Moyock, Morgans Corner, Bear Grass School, Chicod, Cove City, Clarks, Jones Middle School, and Kelly stations. During the same period, decreases in salinity were observed at Windsor, Gold Point, West Research Campus, LaGrange, Comfort, and Ivanhoe stations. Nine wells exceeded 250 mg/L.

Figure 6 shows chloride sample results for selected Lower Cape Fear aquifer wells located along the aquifer's fresh water-salt water interface. For 2022, chloride levels range from below detection limits to as high as 3,883 mg/l (ppm equivalent). Between 2019 and 2022, salinity increases were observed at Windsor, North Pitt High School, Falkland, West Research Campus, Grifton Ball Field, Cove City, Beaver Creek, Jones Middle School, Pink Hill, Six Runs, Kelly, and Lake Waccamaw stations. During the same period, decreases in salinity were observed at Merchants Millpond State Park, Gold Point, and Chicod stations. Twelve wells exceeded 250 mg/L.

Additional information on chlorides is available from the Groundwater Management Branch map interface and water quality data page at https://www.ncwater.org/GWMB.

5.3 Well Installation and Development

From June 2021 through July 2021 the following monitoring wells were installed using the mud rotary drilling method:

- Shingle Landing Monitoring Station in Currituck County, two wells were installed (B10K1 and B10K2).

From February 2022 through March 2022 the following monitoring wells were installed using the mud rotary drilling method.

- Maple Monitoring Station in Currituck County, two wells were installed (D7F1 and D7F3), one existing well was acquired from Currituck County and included in the Maple Monitoring Station (D7F2).

From June through July 2021, and February through March 2022, Toano Well and Pump Service, Inc. (Toano) from Toano, Virginia, installed wells at the new Shingle Landing and Maple Stations in Currituck County. A pilot hole was previously advanced at each station. Both pilot holes were installed using the mud rotary drilling method. The boreholes were used to construct monitoring wells B10K1 and B10K2 at Shingle Landing and wells D7F1 and D7F3 at Maple. DWR staff collected samples of the drill cuttings at ten-foot intervals to assess the borehole lithology.

In addition, a borehole geophysical log was obtained by lowering a probe into the pilot hole borehole once the borehole was completed for each of the referenced stations. The geophysical log makes a detailed record of the geologic formations in the borehole. Geophysical and lithologic log interpretation enabled the DWR staff to identify aquifers and confining units and optimize screen intervals. The wells were installed using 4-inch PVC riser and 10 to 20 feet of 4 to 4.5-inch stainless steel continuous wire wrap V-slot screen. The wells were constructed of a gravel pack extending from the bottom of the screen to a minimum of five feet, but no more than ten feet, above the screen. A minimum of ten feet of bentonite was installed by tremie pipe above the top of the gravel pack to provide a sufficient bentonite seal in the well.

Drilling
Shingle Landing Station, B10R
Currituck County, NC

Development of the well removes fine-grained sediments from the vicinity of the well screen and ensures proper hydraulic connection with the aquifer. DWR staff developed the Shingle Landing stations on August 30, 2021. Field data was collected for pH, conductivity, salinity, and temperature in thirty minute or hourly intervals during development.

Toano developed the new wells at the Maple Station once the wells were completed in March 2022.

On May 12, 2022, Geologic Exploration from Statesville, NC installed a surficial well (X47K4) at the Red Banks Monitoring Station, Robeson County. On June 24, 2022, Geologic Exploration installed a surficial well (V32T10) at the Six Runs Monitoring Station, Sampson County. Both wells were installed using hollow stem augers. The 2-inch wells were installed using PVC riser and 10 ft of .010 SCH 40 PVC slotted screen. The wells were constructed of a gravel pack extending from the bottom of the well to a minimum of two feet above the screen, but no more than five feet. A bentonite seal was installed by tremie pipe above the gravel pack in the remainder of the well to provide a sufficient bentonite seal. Both wells were developed by Geologic Exploration upon completion.

Table 5 summarizes the monitoring well construction information. The FY 2022 completed monitoring station well locations are included in Figure 1.

Well Development
DF Walker Elementary School., G15E
Chowan County, NC

5.4 Acquired Network Wells

During FY 2022, DWR acquired two existing wells, Maple (D 7F2), Currituck County and Tater Hill (E 76Q3), Watauga County. Details of the monitoring stations are included in Table 5.

5.5 Well Repair

Nine wells were repaired in FY 2022. Geologic Exploration removed a blockage from the Upper Cape Fear Marietta station well, BB45M2, Robeson County. The well was moved from inactive to active status on June 9, 2022. Well BB 45M2 had been inactive since April 19, 2012.

Casings were extended on two artesian wells, McCain (T48I2), Hoke County, and Ivanhoe (Y34P4), Sampson County, by Geologic Exploration and AC Schultes of Carolina, Inc., respectively. This allowed DWR to install data loggers on each well to collect hourly water level data.

AC Schultes of Carolina, Inc. performed a variety of well repairs and associated activities FY 2022. Artesian fittings were replaced on four wells in the statewide well network: Lake Waccamaw (CC38B7); Bear Pen (EE36K2); and Calabash (HH39J2 and HH39J6). AC Schultes of Carolina, Inc. also repaired a leak in Bear Pen well EE36K4. Attempts were made to remove a blockage in Calabash well HH39J8. After video-logging the well, it was deducted that the blockage could not be removed.

5.6 Well Abandonment

Seven wells were abandoned in FY 2022: North Pitt (L24B4), Pitt County; Falkland (L25P5), Pitt County; Cox Crossroads (P19M2), Beaufort County; Six Runs (V35T3 and V35T8), Sampson County; and Red Banks (X47K2), Robeson County. Table 5 summarizes the monitoring well abandonment information.

5.7 USGS Cooperative Network

The Tater Hill well E76Q2, Watauga County, was acquired by the USGS in September 2021 for extensive monitoring.

5.8 NC Drought Indicator Well Network

The NC Drought Indicator Well Network includes 54 active monitoring wells in the statewide network. Of these, 5 wells are monitored by the USGS for drought conditions, and 49 wells are monitored by DWR. Of the 49 wells that are monitored by DWR, 16 are equipped with telemetry systems. Table 6 summarizes the NC Drought Indicator Network Wells.

5.9 Well Maintenance

The well network requires continual maintenance to keep active monitoring stations usable. Many of the wells exceed 35 years in age and are constructed of materials that are susceptible to corrosion, especially in acidic or saline groundwater conditions. Some older wells were constructed with outdated, less than desirable construction practices which included backfilling boreholes with cuttings instead of neat cement or bentonite grout. Boreholes backfilled with cuttings form an inadequate seal and allow other aquifers to influence the water level and water quality in that well. Another outdated practice included well construction using telescoped casing. Telescoped casing uses a reducer to trim the well to a smaller diameter casing at depth apparently to save money during well construction. Telescoped wells are very susceptible to blockage at the depth of the reducer. Approximately 143 wells remain in the network that were constructed with reducers. DWR has implemented a long-term program for replacing damaged or unsuitably constructed wells with new, properly constructed wells.

5.10 Automatic Water Level Recorders

Automatic water level recorders play an integral role in the DWR monitoring program. Hourly water level measurements are collected using unvented submersible pressure transducers (data loggers). They allow for economical collection of near-continuous data at remote well stations.

Two primary recorders (Onset Computer's Hobo U20 series and Solinst Telemetry System or STS) were utilized in the FY 2022 referenced in Table 3. Table 7 lists the recorders outfitted on network wells as of June 30, 2022. Eight of the STS systems were in total failure by the end of FY 2022. All sixteen STS systems will be upgraded and replaced in FY 2023.

5.11 Site Surveys

Concrete survey monuments have been installed at each of the 235 active monitoring well stations within the network. Five of those stations have more than one monument.

Each of the installed monuments have been surveyed using Survey Grade Global Positioning System (GPS) to calculate the most accurate horizontal and vertical location data possible, with the exception of the Maple Station. DWR was unable to get elevations at two monitoring stations, Beach Grove School Field Well (M93L) and Woody Creek (M93R), due to the inability to acquire a cell phone signal at the station's location. GPS surveying will be conducted again in the summer/fall of the FY 2023 to provide horizontal and vertical data on any newly installed and acquired monitoring well stations.

6.0 Local Monitoring Well Network Information

6.1 Orange County Monitoring Well Cooperative Network

The creation of the Orange County Groundwater Observation Well Network, referred to as Orange Well Net (OWN), was proposed in May 2005. It was decided to utilize existing bedrock wells in lieu of installing new wells for monetary reasons. In March 2010, the OWN included six inactive bedrock wells for groundwater data collection. In 2011, three regolith wells were added to the OWN as a result of a cooperative arrangement. In 2012, two bedrock wells (Ray Road and Rocky Ridge) were removed from the network. These wells were replaced with two bedrock wells (4D in Duke Forest and a well at the former Orange County 911 Center). The wells that were most recently added to the network are the Brumley East well, as the result of an agreement with the Triangle Land Conservancy, and the Duke Forest 4S and 4I wells, with the agreement (informal) of DWR and Duke Forest. Table 8 summarizes the OWN well information. Figure 7 is a map of the OWN well locations.

Monument Installation
Stone Mountain Station, G68X
Wilkes County, NC

Groundwater data is collected periodically from the OWN. This data is collected to assess groundwater availability and concerns locally in Orange County. The data is formatted and uploaded to the DWR groundwater database and is available to the public. Table 9 is a summary of the OWN statistics from March 2010 through June 30, 2022. The 2011, 2012, and 2013 OWN Annual Reports are available on the DWR website. Wesley Poole (Water Resources Coordinator for the Orange County Department of Environment, Agriculture, Parks and Recreation), the OWN Annual Reports, and information provided by the DWR database, are the sources for the Orange County Monitoring Well Network information provided herein.

6.2 Guilford County Monitoring Well Cooperative Network

The Guilford County groundwater monitoring network was established in 2002 and includes eight monitoring well stations located on public properties owned by Guilford County or the City of Greensboro. Each well site was selected to represent an area of the county and to minimize the influence of any existing water supply wells nearby. Table 10 summarizes the Guilford County monitoring well information. In addition, NC A&T State University uses the Knox Road Station for their hydrology class and the students use the data from this station for their course project.

Water levels are collected manually on the same day of each month. Hourly data is collected using Global Water WL16 submersible transducers and are downloaded at the time of manual collection of depth to groundwater levels. The data is formatted and uploaded to the DWR groundwater database which is available to the public.

Table 11 summarizes the Guilford County monitoring well statistics from 2008 through June 30, 2022. Figure 8 is a site map of the Guilford County monitoring well locations. Gene Mao (Guilford County Department of Health and Human Services, Division of Environmental Health, Health, Environment, & Risk Assessment Unit), and information obtained from the DWR database, are the sources for the Guilford County Monitoring Well Network information provided herein.

6.3 Western Carolina Hydrological Research Station Cooperative Network

Western Carolina Hydrological Research Station Cooperative Network. The Western Carolina Hydrological Research Station, (WCHRS), was established in 2010 in a partnership between Western Carolina University (WCU) and DEQ. The WCHRS is comprised of over 40 monitoring wells and is located within the Cullowhee Creek watershed. The well network was designed to study groundwater interaction with streams in a headwaters region typical of the southern Appalachians. The hydrologic station is unique in that is serves four distinct, but mutually supportive roles:

1. hydrologic monitoring and research
2. research-based education of undergraduates
3. real-world training of future hydrology and geoscience professionals
4. incubator for doing and advancing models for course-based undergraduate research experiences.

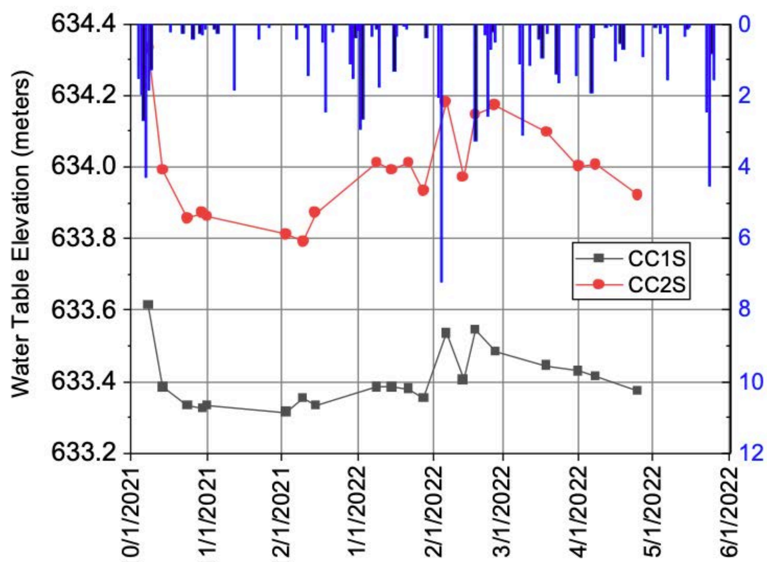
It was decided in 2017 that the WCHRS cooperative well network would be comprised of seventeen of these wells, including two wells acquired by DWR, Stillwell Building Station (Q 94J1) and the CC Old Well Station (Q 94I1), both active wells in the statewide monitoring well network. Table 12 summarizes the WCHRS cooperative network well information. Figure 9 is a map of the WCHRS cooperative network well locations. Groundwater data is collected periodically, mostly by students, from the WCHRS. Data from select wells are formatted and uploaded to the DWR groundwater database and is available to the public. Table 13 is a summary of the WCHRS statistics from 2011 through June 30, 2022.

Research at the WCHRS focuses on four broad questions:

1) How does the interaction of groundwater and stream water vary with their landscape setting?
2) Where and when does recharge of groundwater occurs in the watershed?
3) What is influence of historic land uses & ongoing changes in land cover on water resources and quality?
4) How does the sensitivity of groundwater to climate/weather changes vary in different settings?

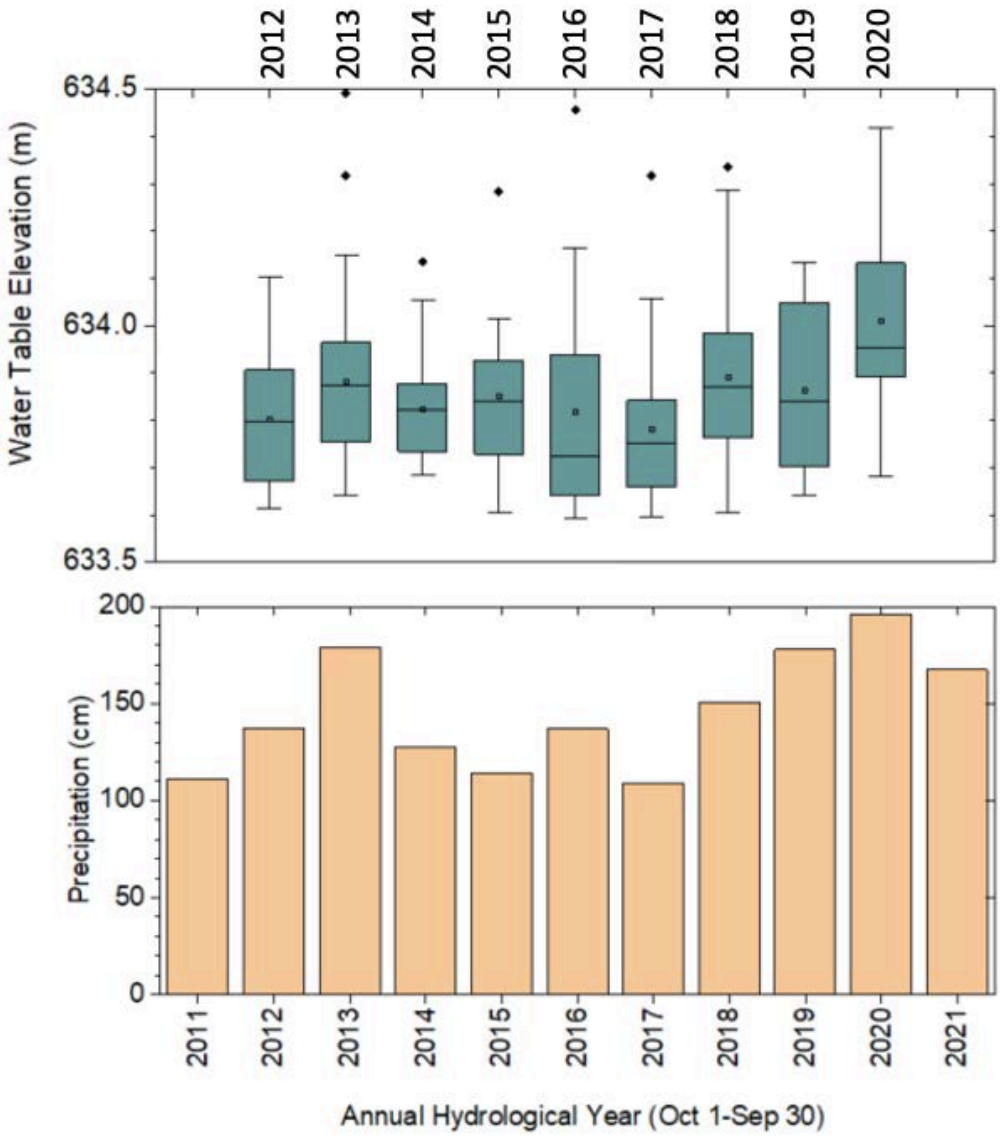
Early in the pandemic, monitoring activity in the WCHRS slowed, but has become more regular. WCU students in classes in Hydrogeology, Wetlands, Soils, and Hydrology used the site and the DWR database extensively. Outside of classes, students (mostly volunteers) help run the station. Past monitoring, students take on special projects. This past spring, the students, led by Nick Guarneri, opted to review station monitoring data and select some key trends to highlight for this report, summarized below.

The WCHRS includes 3 main well clusters, each located near a stream ranging from the largest stream, Cullowhee Creek (area of 62 km^2) to one the headwater streams, Gribble Gap Creek (area of 0.4 km^2). The figure below shows that rain events in the past year did directly impact the groundwater levels, but the dominant trend is seasonal, showing highest levels in early spring and lowest in late fall. The wells data plotted are from Cullowhee Creek. The well adjacent to the

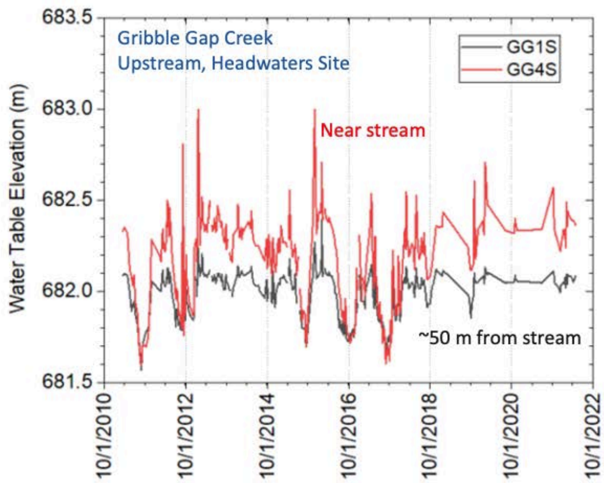


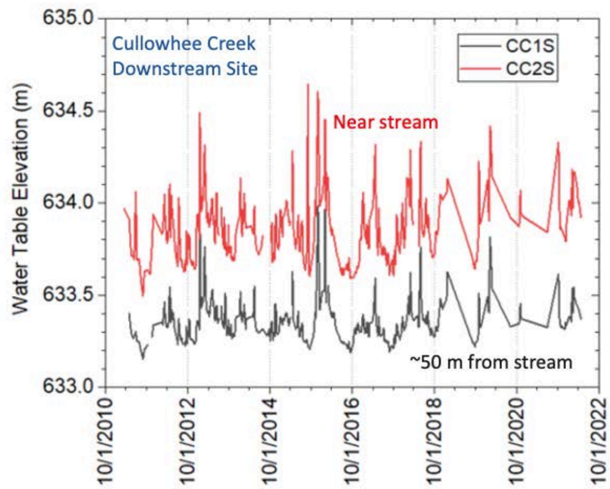
creek (CC1S) shows less seasonal variation that CC2S, which is located in the floodplain about 50 meters from the creek.

In the figure below, annual precipitation (bar graph) and groundwater levels (box plots, CC2S) show an overall positive correlation since 2011. The correlation isn't exact, though. For example, though the precipitation during 2017 was the lowest, groundwater levels hit lower levels during 2016, the year prior to the largest drought in decades. Groundwater levels during 2017 likely benefitted from high amounts of precipitation late in 2016.



A comparison of groundwater levels at the upstream site (Gribble Gap Creek, GG) to the downstream site (Cullowhee Creek, CC) show some important differences in the interaction of streams and groundwater. In the figure below, the near stream groundwater levels (GG1S, CC1S) are generally lower in elevation than the distal wells (GG4S, CC2S), indicating groundwater flow towards the streams (i.e., gaining streams). However, at the upstream site, the near stream groundwater levels (GG1S) were commonly lower than the distal wells during times of seasonal low water tables, indicating a losing stream. This likely indicates a higher sensitivity of headwaters streams to climate change.





Mark Lord and David Kinner, Professors of Geology with the Department of Geosciences and Natural Resources, WCU in Cullowhee, NC, the http://wchrs.wcu.edu/ website, and information provided by the DWR database are the sources for the WCHRS information provided in Section 6.3.

7.0 Water Quality

Since 2015 the Groundwater Management Branch has supported Tasks 6 & 7 of the North Carolina FY 2021 Workplan for the Clean Water Act Section 106 Groundwater Grant (EPA).

Task 6 - Characterize the State's Groundwater Resources, and Task 7 - Groundwater Monitoring Program

The Division of Water Resources conducts an active program of groundwater monitoring that advances the DWR mission by improving DWR's knowledge in the following areas:

1. Impacts of land-applied wastes, artificial infiltration practices, or other human activities, including:
   - Potential impacts of these activities on the surficial aquifer and the secondary impacts to the deeper aquifers or surface waters;
   - The occurrence of "emerging contaminants" related to these activities; and
   - Effectiveness of regulations and permits for these activities.
2. Threats to groundwater quality, including:
   - The existence, nature, and scope of emerging or existing threats;

- Assessment of the causes and factors affecting naturally occurring contamination, agricultural contamination, or contamination resulting from activities permitted by DWR; and
- Tracking the status of groundwater quality across the state.

Groundwater Sampling for Metals Using 0.45 µm Filter
Bent Creek Station, O87D
Buncombe County, NC

Groundwater Management Branch (GWMB) staff collect groundwater quality data throughout the state. Most of the groundwater quality data being collected is from the Division of Water Resources (DWR) Monitoring Well Network (MWN). The DWR MWN consists of 704 groundwater wells at 235 sites across North Carolina. These wells range in age from 50+ years to less than a year old. A typical well site in the Coastal Plain may have several wells, each screened in one of the different aquifers at that particular location, while most well sites in the Piedmont and Mountain regions of the state have only one well in the basement rock/saprolite aquifer system.

These wells are, in most cases, located in areas where influence by industry or other land-use practices on groundwater quality is unlikely. This, along with the MWN's broad geographic and geologic coverage, provides prime conditions and an excellent opportunity to conduct a detailed characterization of ambient, or background, groundwater quality from both deep and shallow aquifer systems throughout the state. Currently, a long-term sampling project is underway to collect water quality data from all wells in the network.

Goals of the GWMB groundwater quality monitoring program are to:

- Collect chemical data that describes the overall condition of groundwater quality across the state based on the geologic environment, identifying areas where groundwater quality does not meet the 15A NCAC 02L .0202 Groundwater Standards.pdf
- Characterize groundwater quality in the different aquifers present in the NC Coastal Plain using the DWR MWN.
- Monitor water quality trends and characterization of ambient groundwater quality within defined geologic environments.

- Collect samples from all MWN wells initially, then re-sample on a regular basis. Surficial and first confined aquifer wells will be sampled every 1 to 3 years, and deeper aquifer wells will be sampled every 5 to 10 years.
- Make all GWMB-collected groundwater quality data publicly available for viewing and downloading in a user-friendly mapping application and various other formats.

The State uses comprehensive water quality monitoring and assessment information on environmental conditions and changes over time to support water quality management decisions. This information helps to set levels of protection in water quality standards and to identify problem areas that are emerging or that need additional regulatory and non-regulatory actions. Results from this project will yield valuable groundwater quality data throughout the state and inform decision making regarding the relationship of groundwater quality to environmental quality and public health. While the focus of this study was originally intended to identify potential agricultural influences on drinking water in the Coastal Plain, data from this project will support multiple programmatic areas such as nutrient management, coal ash management, groundwater as a source of surface water parameters of concern, and saltwater intrusion. Data is available for viewing and downloading from our groundwater quality webpage or through our groundwater quality mapping interface.

Groundwater Sampling
Bent Creek Station, O87D
Buncombe County, NC

In FY 2022, groundwater samples were collected from 120 wells at 54 monitoring stations and were analyzed for one or more of the following parameters:

- Metals (total and dissolved): Silver (Ag), Antimony (Sb), Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Molybdenum (Mo), Nickel (Ni), Lead (Pb), Selenium (Se), Tin (Sn), Strontium (Sr), Thallium (Tl), Zinc (Zn), Aluminum (Al), Boron (B), Barium (Ba), Beryllium (Be), Calcium (Ca), Cobalt (Co), Iron (Fe), Potassium (K), Lithium (Li), Magnesium (Mg), Manganese (Mn), Sodium (Na), Titanium (Ti), Vanadium (V)
- Nutrients: Ammonia/ammonium (NH_3 / NH_4 as N), total Kjeldahl nitrogen as N (TKN), nitrite + nitrate (NO_2 + NO_3 as N), and total phosphorus
- Wet Chemistry: bromide, chloride, fluoride, silica, sulfate, sulfide, total dissolved solids (TDS)
- Microbiological: bicarbonate, carbonate, total organic carbon (TOC), turbidity
- Volatile organic compounds (VOCs),
- Semi-volatile organic compounds (SVOCs)
- Pesticides
- Per- and polyfluoroalkyl substances (PFAS)
- Field parameters: Specific conductivity, pH, dissolved oxygen (DO), temperature (˚C), oxidation-reduction potential (ORP), salinity, turbidity.

8.0 Central Coastal Plain Capacity Use Area

The Central Coastal Plain Capacity Use Area (CCPCUA) has been designated over fifteen counties in the coastal plain due to unsustainable groundwater overuse. On August 1, 2002, the CCPCUA rules came into effect because of significant groundwater depletion. As stated in 15A NCAC 2E .0501, "The intent is to protect the long-term productivity of aquifers within the designated area and to allow the use of groundwater for uses at rates which do not exceed or threaten to exceed the recharge rate of the aquifers…" For many years, water was withdrawn from the deep confined aquifers, which are a primary source of water in the CCPCUA, at a rate that was greater than they were naturally recharged. If this situation had been allowed to continue indefinitely, the aquifers could have been permanently damaged, impairing their ability to function as a water supply.

The goal of the DWR is to regulate water withdrawals in the Central Coastal Plain (CCP) under the authority of the Environmental Management Commission (EMC). The following summarizes how these withdrawals are regulated:

- Water withdrawal permits are required for groundwater users who withdraw greater than 100,000 gallons of water per day.

- Annual registration and reporting of withdrawals is required for surface and groundwater withdrawals greater than 10,000 gallons per day.

- Counties included in the CCPCUA are Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne, and Wilson.

DWR collects water level measurements and water quality data from monitor wells within the state's well network along with data from CCPCUA permitted wells to assess aquifer conditions. 15A NCAC 2E .0506 required DWR to assess aquifer conditions in 2008, 2013, and 2018 to determine if CCPCUA rule changes were necessary. Through the CCPCUA permitting system, large groundwater users (>100,000 gpd) in some parts of the capacity use area were required to progressively reduce withdrawals in 2008, 2013, and 2018 to allow the aquifers to recover. The managed withdrawals from these aquifers have allowed the aquifers to recover as depicted in the following maps: Figure 10, Black Creek Aquifer Recovery; and Figure 11, Upper Cape Fear Aquifer Recovery.

The Black Creek Aquifer Recovery map (Figure 10) shows the areas where groundwater levels have risen between 5 feet (red) to more than 95 feet (pink) from November 2007 through November 2021. The largest recovery is observed in the Onslow County area where water users have made large investments in developing the Castle Hayne aquifer as an alternate water source. The Upper Cape Fear Aquifer map (Figure 11) shows the areas where groundwater levels have risen between 5 feet (red) to more than 65 feet (purple) from November 2007 through November 2021. The largest recovery is observed in the Lenoir County area due to the development of a surface water treatment plant on the Neuse River in 2008, and the Craven County area which developed wells in the Castle Hayne aquifer as an alternate water source. The recovery depicted in previous years has changed in Onslow County due to a reclassification of a monitoring well in 2022, so that data has been deleted.

Based on analysis of water level and water quality concentration data gathered through January 2013 in the CCPCUA, and a thorough review of aquifer conditions, DWR concluded that no action needed to be taken by the EMC to alter either the reduction zone boundaries or rule language in 15A NCAC 2E .0503 but recommended the use of temporary permits under rule .0502. This may give certain permit holders a stable withdrawal rate which is higher than indicated by their reduction schedule and reduction zone, provided that all well construction and reporting criteria are met as specified in the 2013 CCPCUA Assessment Report, which can be viewed at https:/www.ncwater.org/CCPCUA under the miscellaneous link.

DWR uses a series of criteria to evaluate each production well and aquifer conditions by individual permit in the permitting process. This enhanced permit application review allows the division to alter an individual permit holder's reduction requirements, if the permit holder can demonstrate they are using the groundwater at a sustainable rate. As of June 30, 2022, the following twelve permit holders have acquired temporary permits: Greene County Regional Water System, Craven County Water, Jones County Regional Water, City of New Bern, Town of La Grange, Town of Snow Hill, Town of Winterville, Belfast-Patetown Sanitary District, Northwestern Wayne Sanitary District, Southeastern Wayne Sanitary District, Fork Township Sanitary District, and Chinquapin Water Association, Inc.

Although the CCPCUA rules require assessments to be produced in 2008, 2013, and 2018, the DWR staff will continue to constantly track aquifer conditions to best serve the permit holders in the region and to provide awareness of potential groundwater supply issues. The 2018 assessment concluded with the EMC's approval of the report on October 10, 2018. The assessment report reviewed aquifer data in a similar fashion to previous efforts in 2008 and

2013. Water levels in the Black Creek and Upper Cape Fear aquifers were found to be equilibrating to the lower rate of aquifer use as water systems continue to shift demand to other sources which include surface water and shallower aquifers. While water level data are consistent with sustainable use of the aquifer system, chloride concentrations are somewhat inconsistent. Smaller and static cones of depression have developed in the Peedee and Castle Hayne aquifers in response to new well fields and are only visible using the combined DWR and permit holder water level data. Figures 12 through 18 depict the water levels provided by the CCPCUA permit holders and DWR's groundwater monitoring stations in each of the seven major aquifers in the Coastal Plain Physiographic Province. Figure 12 (Yorktown Aquifer Potentiometric Surface Map), Figure 13 (Castle Hayne Aquifer Potentiometric Surface Map), Figure 14 (Beaufort Aquifer Potentiometric Surface Map), Figure 15 (Peedee Aquifer Potentiometric Surface Map), Figure 16 (Black Creek Aquifer Potentiometric Surface Map), Figure 17 (Upper Cape Fear Aquifer Potentiometric Surface Map), and Figure 18 (Lower Cape Fear Aquifer Potentiometric Surface Map).

Reports referencing the CCPCUA rules along with water use and permit holder information may be viewed by visiting the DWR's CCPCUA website, https:/www.ncwater.org/CCPCUA. Figure 19 is a summary of water withdrawals reported by permit holders and registrants within the CCPCUA for the calendar year 2021. Water withdrawal summaries of historical years may be found on the CCPCUA website.

N.C. General Statute 150B-21.3A requires state agencies to review existing rules every 10 years, determine which rules are still necessary, and either re-adopt or repeal each rule as appropriate. In May of 2021, a public hearing was held for the Rules Re-adoption of 15A NCAC O2E (Water Use Registration and Allocation). The public comment period ended July 2, 2021. DWR staff submitted the Hearing Officers report to the Environmental Management Commission on November 18, 2021, which the EMC approved. The re-adopted rules became effective on January 1, 2022.

The following is a summary of the rule revisions made:

Rule	Proposed Change
15A NCAC 02E .0501 Declaration and Delineation of Central Coastal Plain Capacity Use Area	Format changes and removed language deemed unnecessary.
15A NCAC 02E .0502 Withdrawal Permits	Format changes and removed language deemed unnecessary. Updated language for clarification.
15A NCAC 02E .0503 Prescribed Water Use Reductions in Cretaceous Aquifer Zones	Repeal rule. Removed language deemed unnecessary.
15A NCAC 02E .0504 Requirements for Entry and Inspection	Updated language for clarification.
15A NCAC 02E .0505 Acceptable Withdrawal Methods that Do Not Require a Permit	Format changes and removed language deemed unnecessary.
15A NCAC 02E .0506 Central Coastal Plain Capacity Use Area Status Report	Repeal rule. Removed language deemed unnecessary.
15A NCAC 02E .0507 Definitions	Updated language for clarification. Added 3 definitions (aquifer recharge, cretaceous aquifer system zones, and recharge rate).

9.0 Summary and Conclusions

DWR and its predecessor agencies have maintained and monitored a statewide network of groundwater monitoring wells used to assess North Carolina's groundwater supply since the 1960s.

Data collected from the monitoring well network are available to the public through DWR's Internet website, https://www.ncwater.org/GWMB. These data include, but are not limited to, groundwater levels, chloride measurements, well construction information, lithological and geophysical logs, groundwater monitoring station locations, well coordinates and elevations, and data from many non-DWR wells.

The monitoring well network consists of 704 monitoring wells at 235 individual stations. From July 2021 through June 2022, groundwater level data were collected from 709 wells within the network. These data include manual measurements taken quarterly from wells plus hourly water levels collected using automatic data recorders from 599 wells.

Sixteen STS units have been installed as of FY 2022 on drought monitoring network wells. The addition of the STS units replace monthly site visits, allow access to current water level data, and provide positive economic impacts. Eight of those system were in total failure by the end of FY2022. All sixteen STS systems will be upgraded and replaced in FY 2023.

Chloride sampling was performed on 413 wells from March through May 2022. Sampling results indicated that there continues to be concern for salt water encroachment especially near larger pumping centers located near the fresh water-salt water interface. Chloride levels were collected in 47 Black Creek wells. Of these, six wells showed chloride increases since 2019, seven wells showed chloride decreases since 2019, and ten wells exceeded 250 mg/L. Chloride levels were collected in 44 Upper Cape Fear wells. Of these, eight wells showed chloride increases since 2019, six wells showed chloride decreases since 2019, and nine wells exceeded 250 mg/L. Chloride levels were collected in 22 Lower Cape Fear wells. Of these, twelve wells showed chloride increases since 2019, three wells showed chloride decreases since 2019, and twelve wells exceeded 250 mg/L.

In FY 2022, two monitoring wells were installed at the Shingle Landing Station and two wells were installed at the Maple Station in Currituck County. One well was installed at the Red Banks Station in Robeson County, and one well was installed at the Six Runs Station in Sampson County.

Two existing wells, Maple (D7F2) in Currituck County and Tater Hill (E76Q3) in Watauga County, were acquired and added to the monitoring well network in FY 2022.

Multiple well repairs were completed in the FY 2022. Artesian fittings were replaced on four wells: Lake Waccamaw (CC38B7); Bear Pen Station (EE36K2); and Calabash (HH39J2 and HH39J6), One casing leak was repaired at Bear Pen well EE36K4.

Seven wells, North Pitt (L24B4), Pitt County; Falkland (L25P5), Pitt County; Cox Crossroads (P19M2), Beaufort County; Six Runs (V35T3 and V35T8), Sampson County; and Red Banks (X47K2), Robeson County, were abandoned during FY 2022.

The Tater Hill well E76Q2, Watauga County, was acquired by the USGS in September 2021 for extensive monitoring.

There are three local networks whose water level data are currently being uploaded to the DWR database. The OWN in Orange County, the Guilford County network, and the WCHRS in Jackson County water level data can be viewed by the public on the DWR website.

Survey monuments have been installed at each of the well stations. Survey Grade GPS will be performed on the newly installed and acquired well stations during FY 2022 and FY 2023.

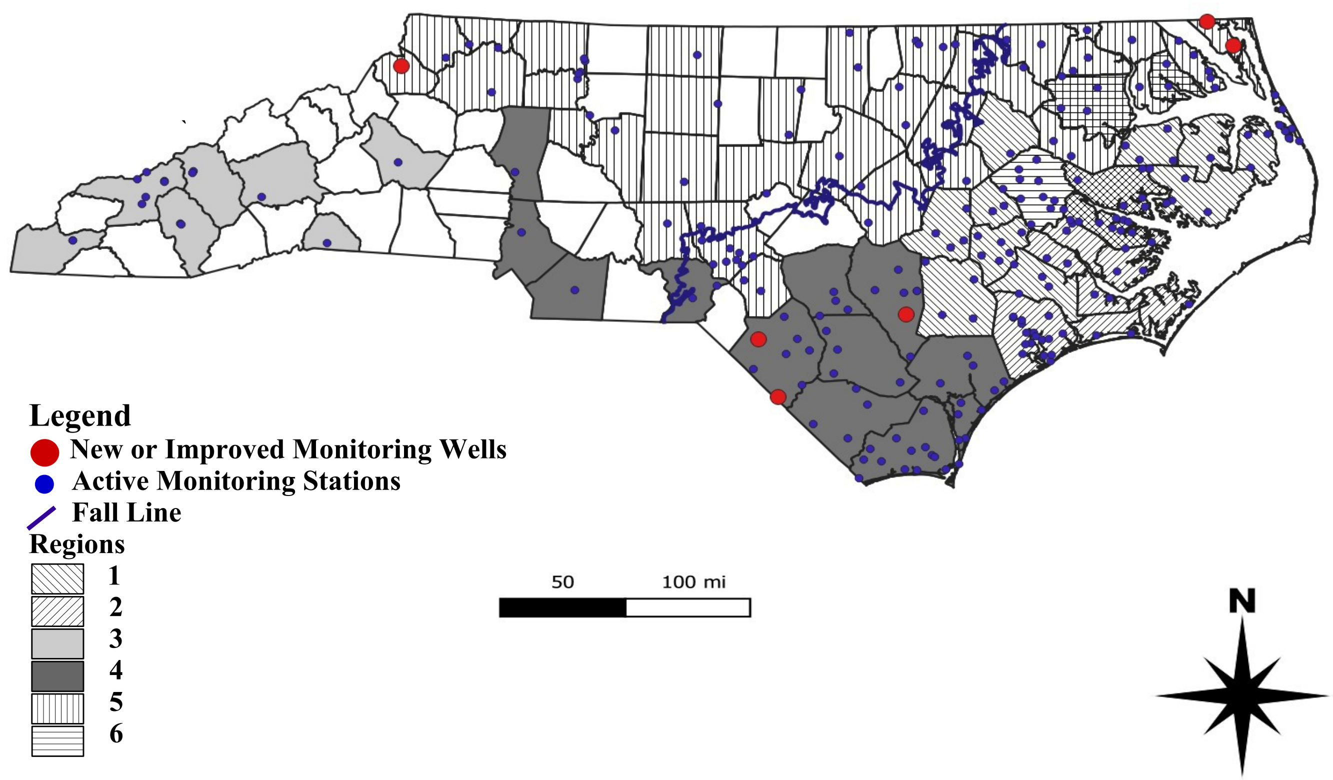
Groundwater quality staff collected groundwater samples from 120 wells at 54 monitoring stations in FY 2022. Samples were analyzed and results were added to the water quality database.

Fifteen counties in the Central Coastal Plain are governed by the Central Coastal Plain Capacity Use Area rules which replaced the Capacity Use Area #1 on August 1, 2002. Data collected from the monitoring well network is being used to assess aquifer conditions and determine whether or not changes to the rules are warranted. Based on the results of the 2018 assessment, concluding with the EMC's approval of the report on October 10, 2018, DWR did not pursue rule changes. Instead, DWR will continue issuing temporary permits under rule 15A NCAC 2E .0502 which can ease withdrawal reduction requirements for certain permit holders but adds other permit conditions.

N.C. General Statute 150B-21.3A requires state agencies to review existing rules every 10 years, determine which rules are still necessary, and either re-adopt or repeal each rule as appropriate. In May of 2021, a public hearing was held for the Rules Re-adoption of 15A NCAC O2E (Water Use Registration and Allocation). The public comment period ended July 2, 2021. DWR staff submitted the Hearing Officers report to the Environmental Management Commission on November 18, 2021, which the EMC approved. The re-adopted rules became effective on January 1, 2022, which can be viewed at https:/www.ncwater.org/CCPCUA under the Laws and Rules link.

FIGURES

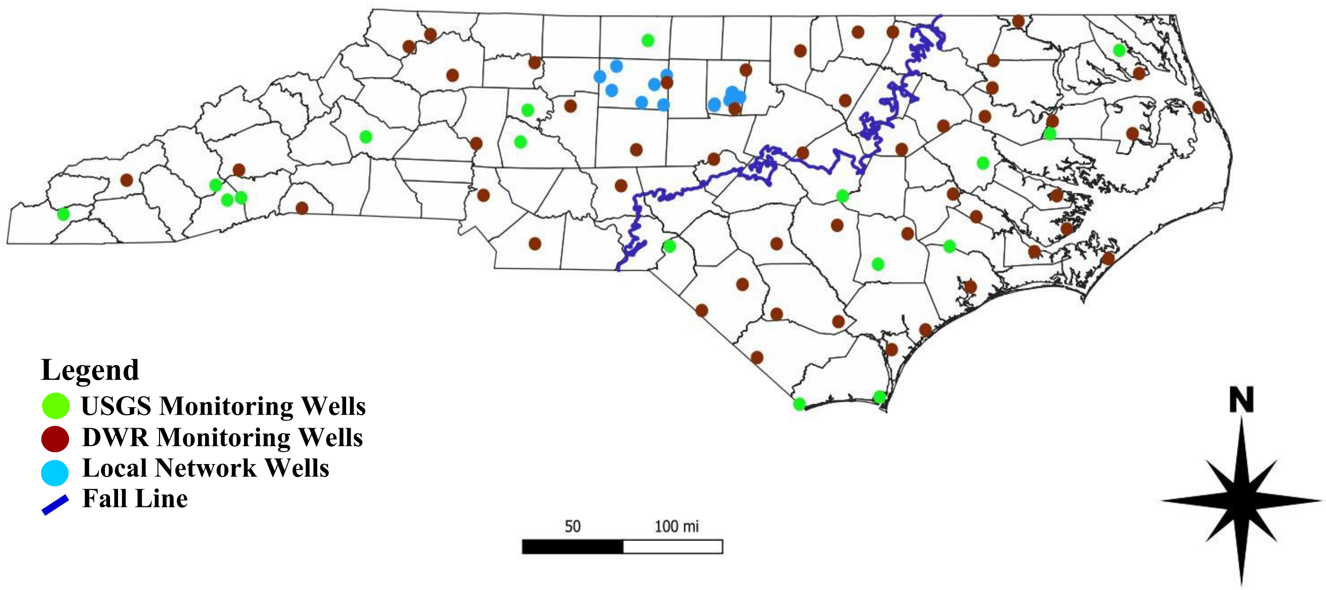
Figure 1
NC Division of Water Resources – Ground Water Management Branch
Monitoring Well Station Locations
2022 Annual Report



08-24-2022

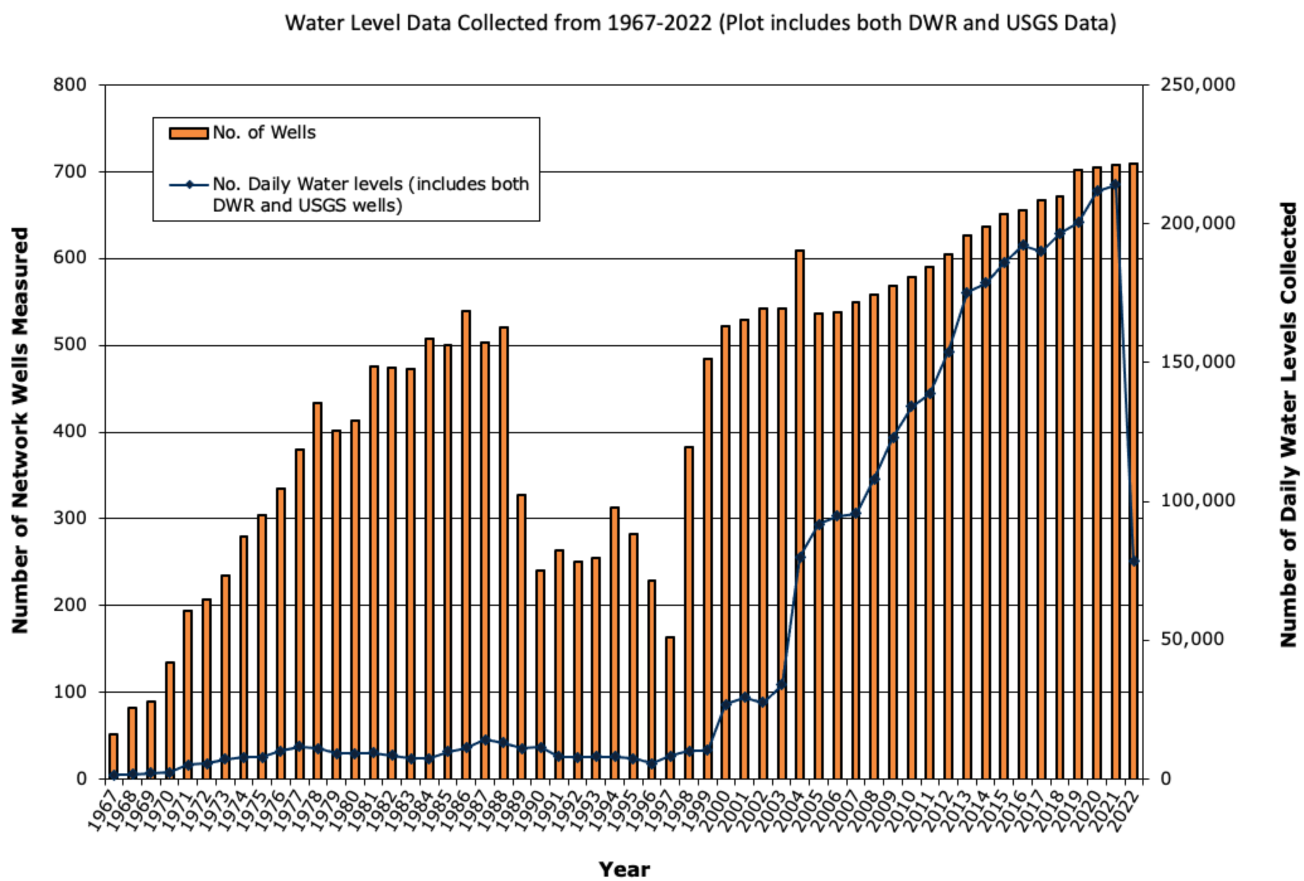
Figure 2

NC Division of Water Resources – Ground Water Management Branch
Drought Indicator Well Network
2022 Annual Report



08-16-2022

Figure 3
NC Division of Water Resources – Groundwater Management Branch
Water Level Data Plot
2022 Annual Report



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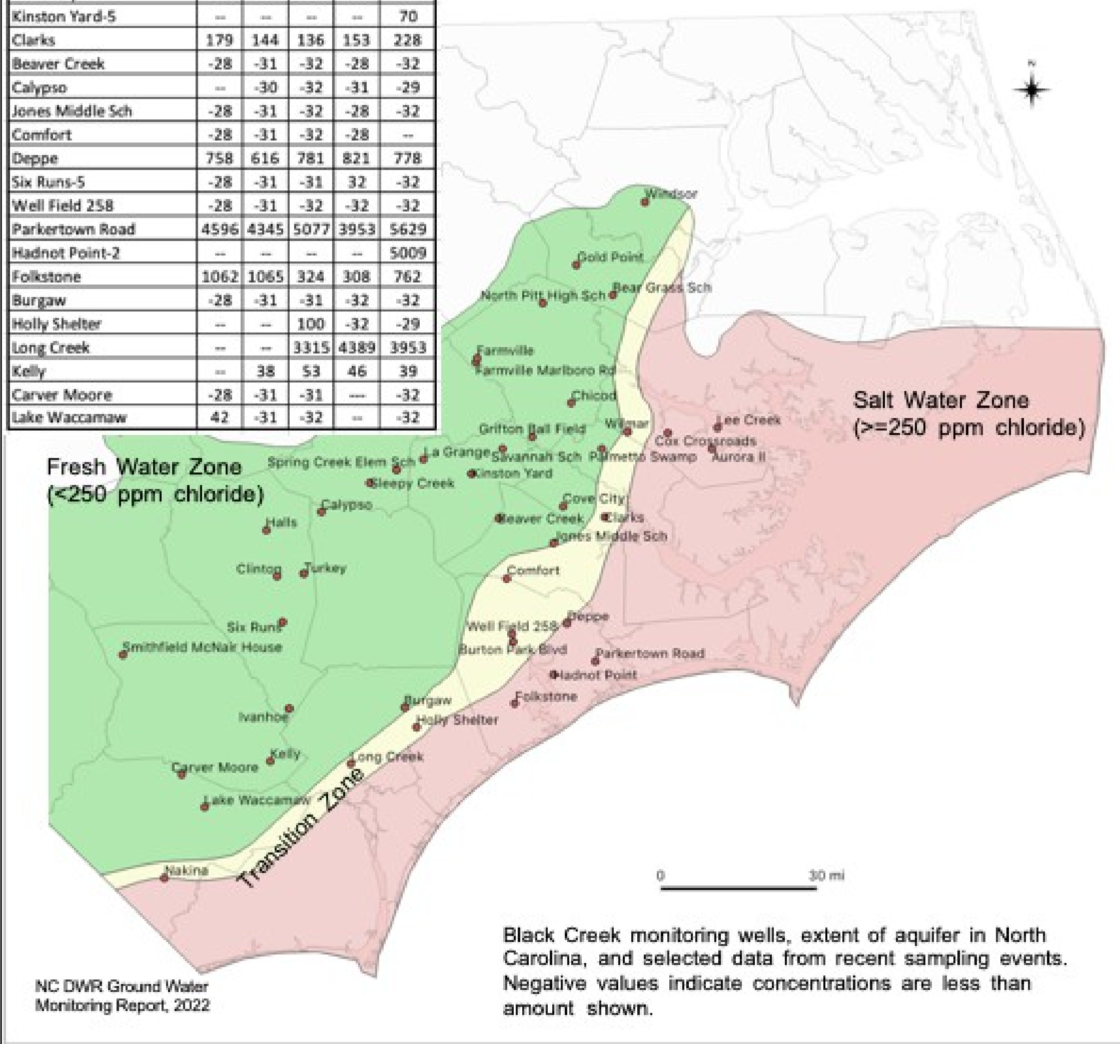
MONITORING STATION	2012	2015	2017	2019	2022
	CHLORIDES (mg/l)				
Windsor	-28	-31	-26	-32	--
Gold Point	-28	-31	-31	-32	-32
Chicod	35	38	45	46	40
Lee Creek	6888	7904	9056	7906	7766
Bonnerton	--	--	--	--	6148
Cox Crossroads	--	--	--	--	4501
Bear Grass Sch	-28	-31	-26	61	-29
Wilmar-5	434	--	496	468	474
Wilmar-9	194	--	188	211	194
Palmetto Swamp	35	38	45	39	50
Grifton Ball Field	-28	-31	-32	-32	-29
Aurora II	7562	9634	8124	9794	12296
La Grange	-28	-31	-32	-32	-32
Spring Creek Elem Sch-3	--	-31	-32	-32	-32
Cove City	-28	-31	-32	-28	-32
Kinston Yard-5	--	--	--	--	70
Clarks	179	144	136	153	228
Beaver Creek	-28	-31	-32	-28	-32
Calypso	--	-30	-32	-31	-29
Jones Middle Sch	-28	-31	-32	-28	-32
Comfort	-28	-31	-32	-28	--
Deppe	758	616	781	821	778
Six Runs-5	-28	-31	-31	32	-32
Well Field 258	-28	-31	-32	-32	-32
Parkertown Road	4596	4345	5077	3953	5629
Hadnot Point-2	--	--	--	--	5009
Folkstone	1062	1065	324	308	762
Burgaw	-28	-31	-31	-32	-32
Holly Shelter	--	--	100	-32	-29
Long Creek	--	--	3315	4389	3953
Kelly	--	38	53	46	39
Carver Moore	-28	-31	-31	---	-32
Lake Waccamaw	42	-31	-32	--	-32

Figure 4
NC Division of Water Resources
Groundwater Management Branch
Chloride Levels in the Cretaceous
Black Creek Aquifer
2022 Annual Report

Figure 4 is based on the 2022 spring chloride sampling event performed by DWR staff



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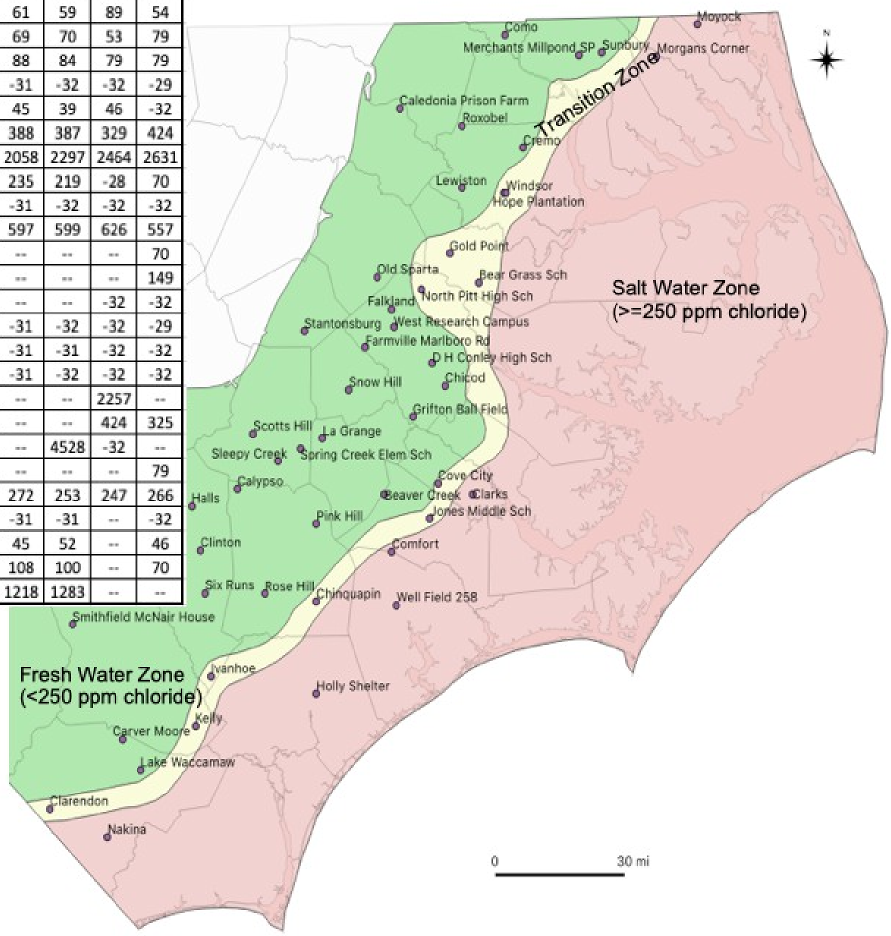
	2012	2015	2017	2019	2022
MONITORING STATION	CHLORIDES (mg/l)				
Moyock	826	744	717	686	698
Morgans Corner	580	535	599	537	557
Merchants Millpond SP	--	--	--	53	--
Cremo-6	28	-31	-26	-32	--
Roxobel	-28	-31	-26	-32	--
Windsor	236	144	194	164	123
Lewiston	-28	-31	-26	-32	-29
Gold Point-5	172	186	164	136	100
Gold Point-7	343	362	416	331	308
Bear Grass Sch	111	45	50	32	54
Old Sparta	56	31	41	-31	-32
North Pitt High Sch-4	284	293	314	267	--
North Pitt High Sch-5	327	--	337	331	396
Falkland	-28	-31	-32	-32	-29
West Research Campus	57	61	59	89	54
D H Conley High School	65	69	70	53	79
Chicod	93	88	84	79	79
Grifton Ball Field	-28	-31	-32	-32	-29
La Grange	42	45	39	46	-32
Cove City	405	388	387	329	424
Clarks	1735	2058	2297	2464	2631
Jones Middle Sch	245	235	219	-28	70
Pink Hill	-28	-31	-32	-32	-32
Comfort	537	597	599	626	557
Pondberry Bay	--	--	--	--	70
Smithfield McNair House	--	--	--	--	149
Clinton	--	--	--	-32	-32
Rose Hill	-28	-31	-32	-32	-29
Six Runs-6	-28	-31	-31	-32	-32
Chinquapin	-28	-31	-32	-32	-32
Well Field 258	--	--	--	2257	--
Ivanhoe	--	--	--	424	325
Holly Shelter	--	--	4528	-32	--
Dublin	--	--	--	--	79
Kelly	--	272	253	247	266
Carver Moore	-28	-31	-31	--	-32
Lake Waccamaw	100	45	52	--	46
Clarendon	202	108	100	--	70
Nakina	1153	1218	1283	--	--

Figure 5
NC Division of Water Resources
Groundwater Management Branch
Chloride Levels in the Cretaceous
Upper Cape Fear Aquifer
2022 Annual Report

Figure 5 is based on the 2022 spring chloride sampling event performed by DWR staff



Upper Cape Fear monitoring wells, extent of aquifer in North Carolina, and selected data from recent sampling events. Negative values indicate concentrations are less than amount shown.

NC DWR Ground Water Monitoring Report, 2022

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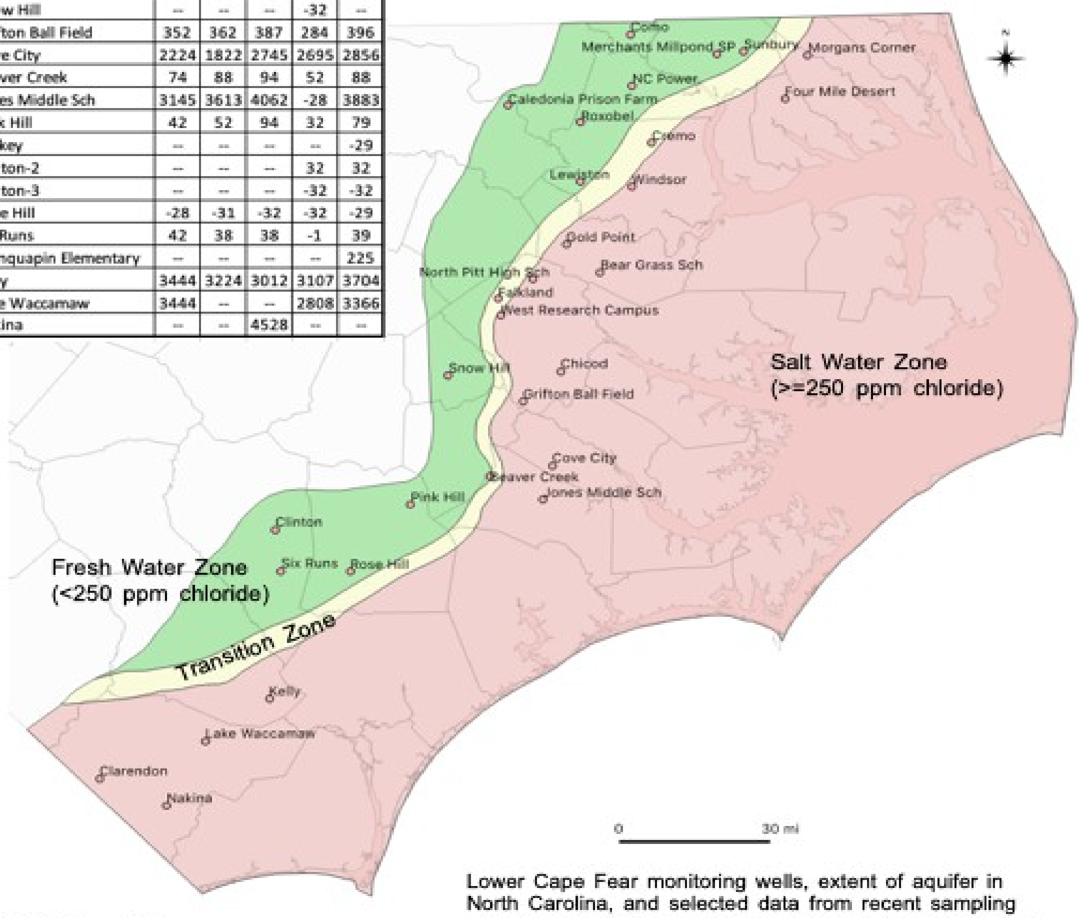
MONITORING STATION	2012	2015	2017	2019	2022
	CHLORIDES (mg/l)				
Como-6	93	88	90	46	--
Como-7	28	-31	-31	-32	--
Morgans Corner	5095	3853	3662	3953	--
Merchants Millpond SP	--	--	--	308	301
NC Power	--	--	--	-32	--
Four Mile Desert	--	--	--	1748	--
Cremo	126	132	137	39	--
Roxobel	28	-31	26	-32	--
Windsor	1220	430	449	381	1061
Lewiston	35	-31	-26	-32	-29
Gold Point	892	791	781	751	618
Bear Grass Sch	2420	655	1283	--	3231
North Pitt High Sch	758	655	645	751	904
Falkland	227	201	-32	89	99
West Research Campus	327	144	415	468	519
Chicod	758	430	781	751	698
Snow Hill	--	--	--	-32	--
Grifton Ball Field	352	362	387	284	396
Cove City	2224	1822	2745	2695	2856
Beaver Creek	74	88	94	52	88
Jones Middle Sch	3145	3613	4062	-28	3883
Pink Hill	42	52	94	32	79
Turkey	--	--	--	--	-29
Clinton-2	--	--	--	32	32
Clinton-3	--	--	--	-32	-32
Rose Hill	-28	-31	-32	-32	-29
Six Runs	42	38	38	-1	39
Chinquapin Elementary	--	--	--	--	225
Kelly	3444	3224	3012	3107	3704
Lake Waccamaw	3444	--	--	2808	3366
Nakina	--	--	4528	--	--

Figure 6
NC Division of Water Resources
Groundwater Management Branch
Chloride Levels in the Cretaceous
Lower Cape Fear Aquifer
2022 Annual Report

Figure 6 is based on the 2022 spring chloride sampling event performed by DWR staff



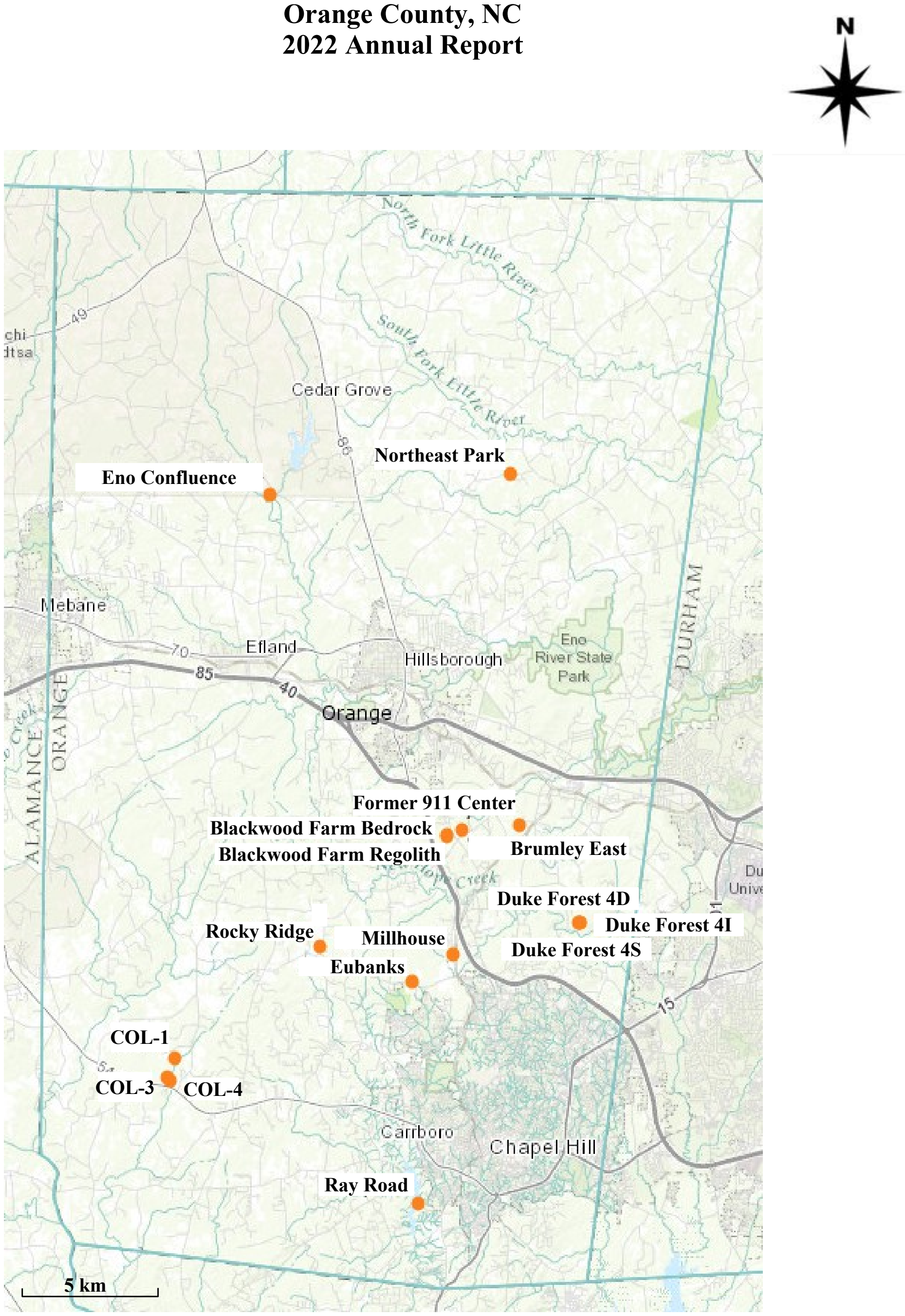
NC DWR Ground Water Monitoring Report, 2022

Lower Cape Fear monitoring wells, extent of aquifer in North Carolina, and selected data from recent sampling events. Negative values indicate concentrations are less than amount shown.

08-15-2022

Figure 7

NC Division Water Resources - Groundwater Management Branch
Orange Well Net Cooperative Monitoring Well Network
Orange County, NC
2022 Annual Report



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<u>Figure 8</u>
NC Division of Water Resources Ground Water Management Branch
Guilford County Cooperative Monitoring Well Network
Guilford County, NC
2022 Annual Report

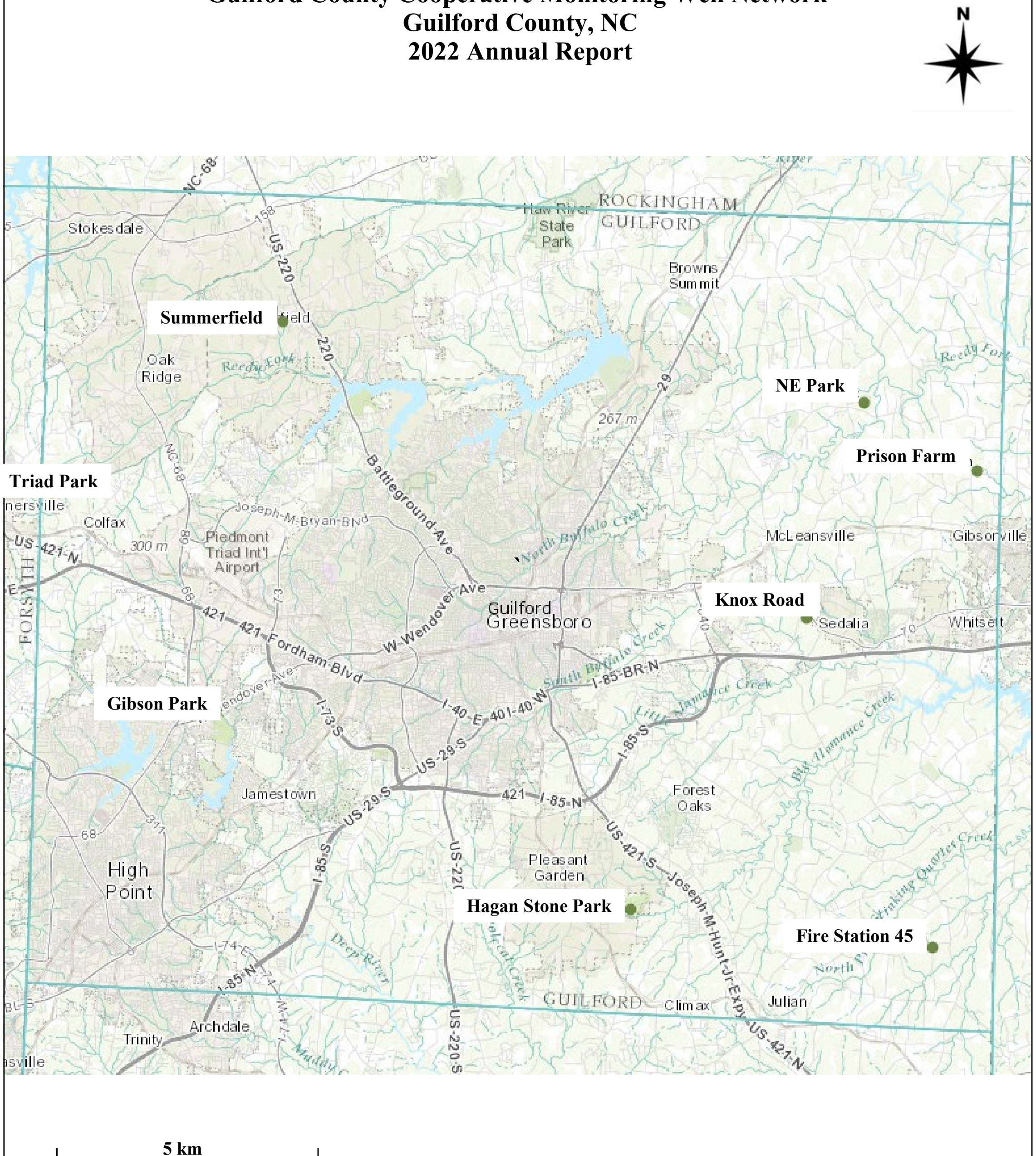

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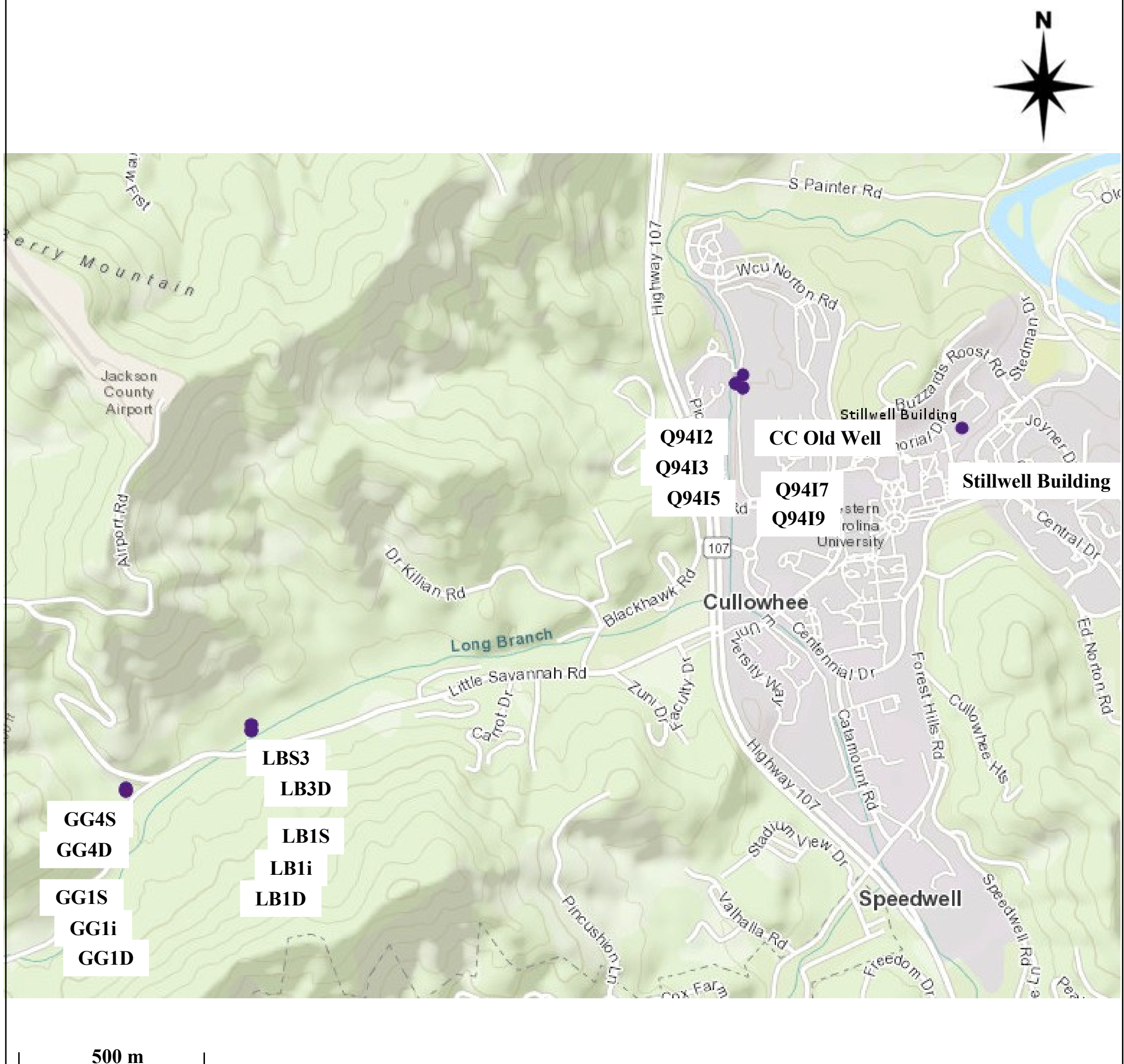
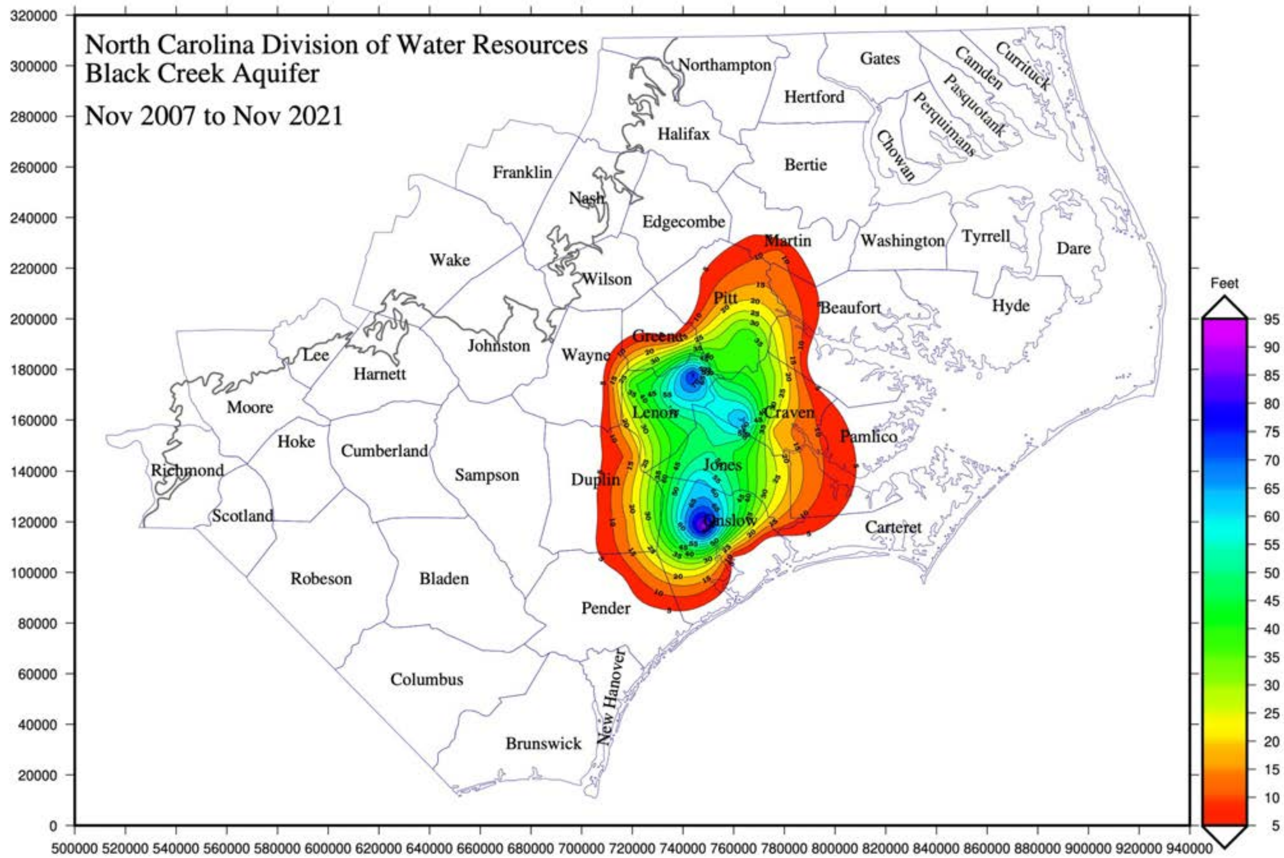
Figure 9
NC Division of Water Resources - Ground Water Management Branch
Western Carolina Hydrological Research Station
Cooperative Monitoring Well Network
Jackson County, NC
2022 Annual Report



08-16-2022

Figure 10

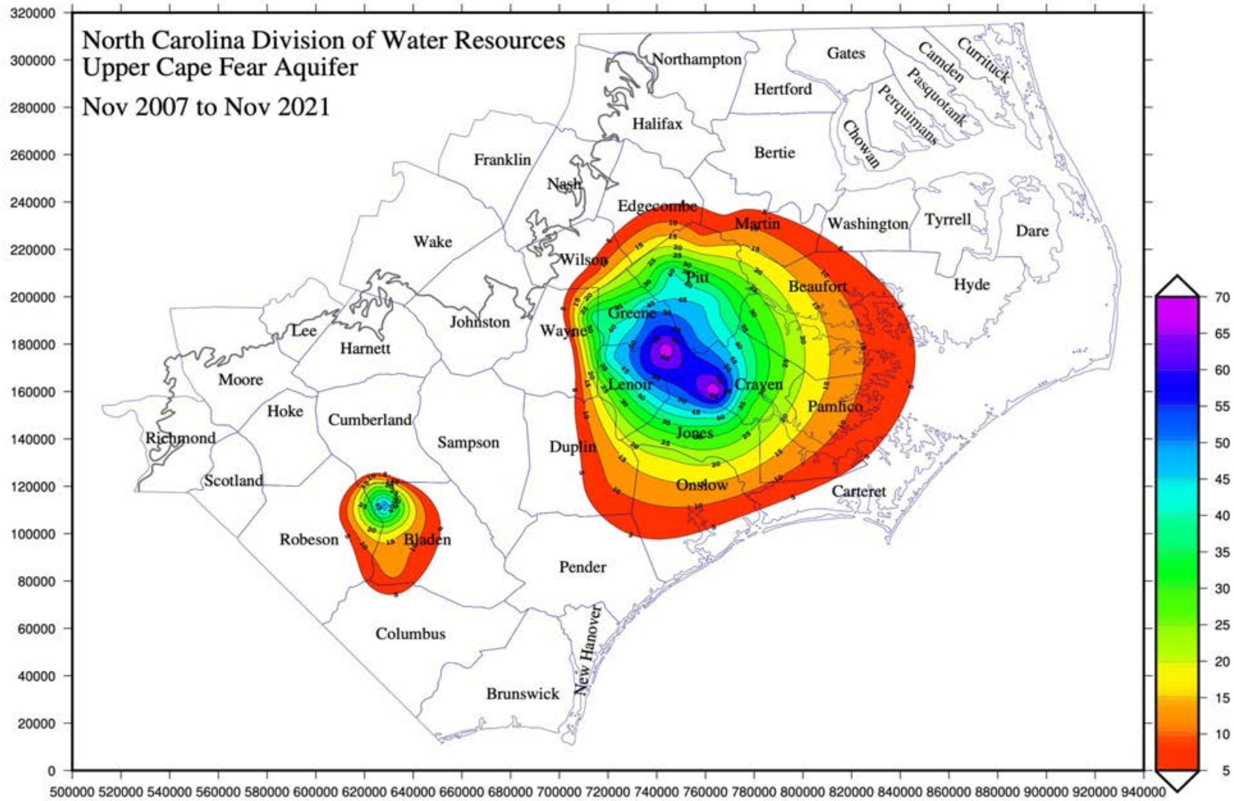
NC Division of Water Resources – Ground Water Management Branch
Black Creek Aquifer Recovery
2022 Annual Report



08-15-2022

Figure 11

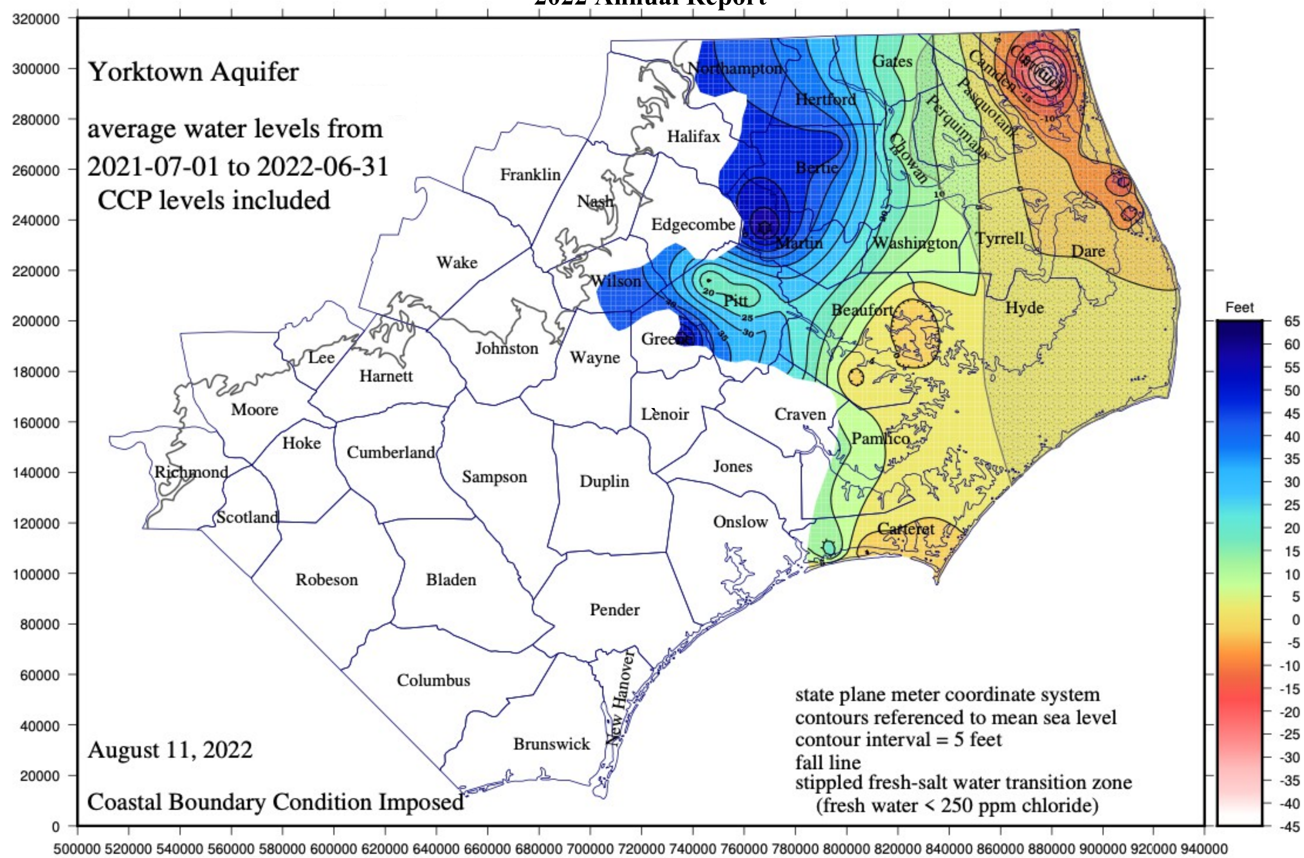
NC Division of Water Resources – Ground Water Management Branch
Upper Cape Fear Aquifer Recovery
2022 Annual Report



08-15-2022

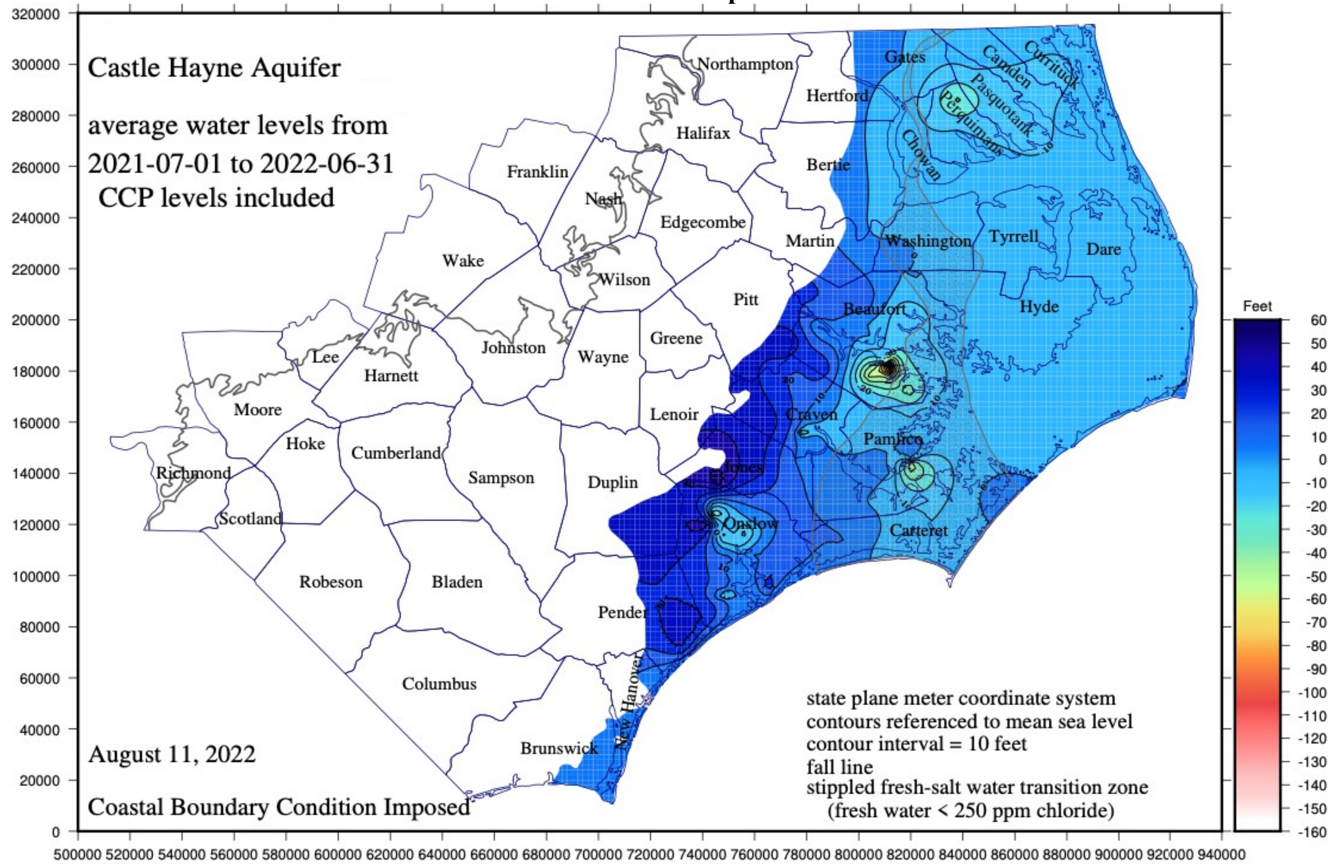
Figure 12

NC Division of Water Resources – Ground Water Management Branch
Yorktown Aquifer Potentiometric Surface Map
2022 Annual Report



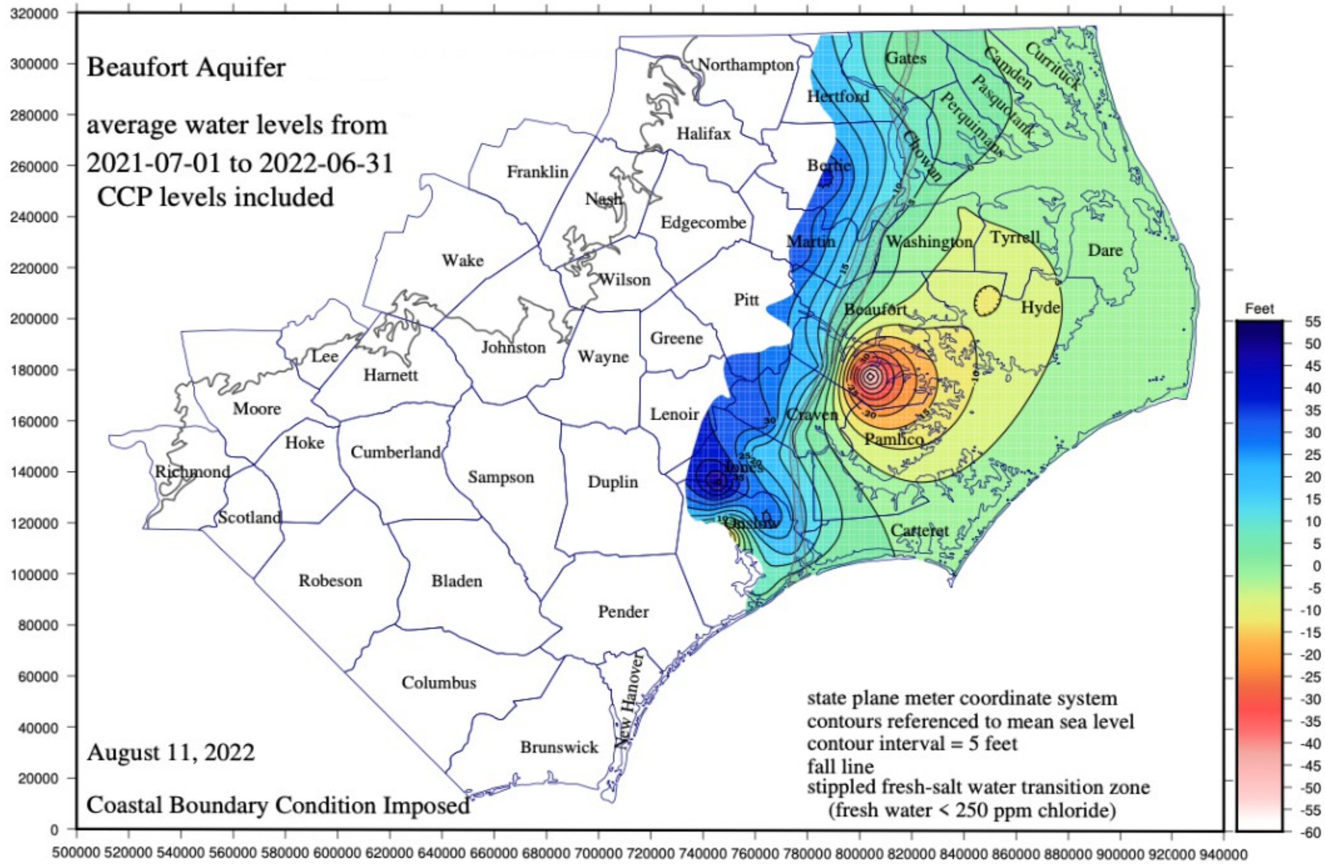
08-16-2022

Figure 13
NC Division of Water Resources – Ground Water Management Branch
Castle Hayne Aquifer Potentiometric Surface Map
2022 Annual Report



08-16-2022

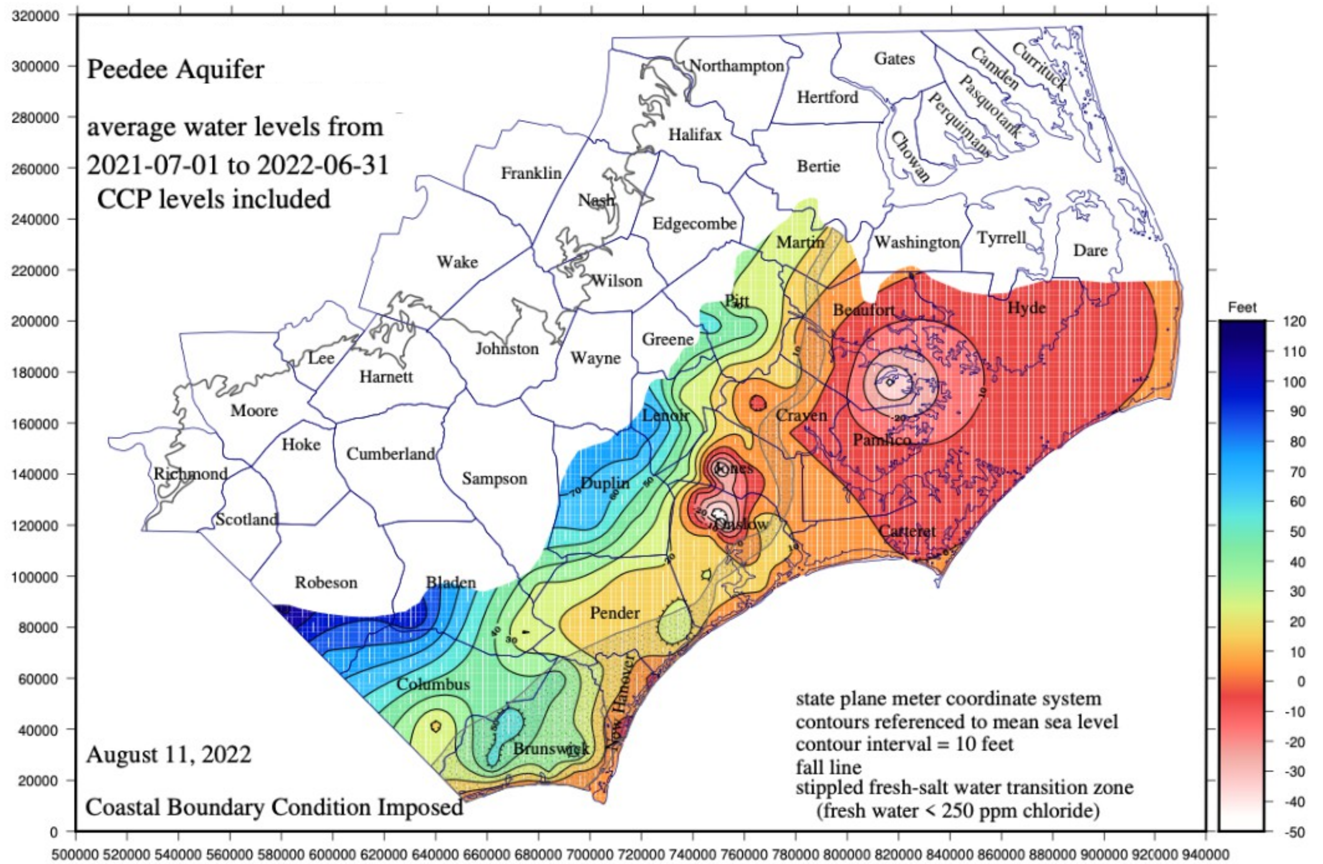
Figure 14
NC Division of Water Resources – Ground Water Management Branch
Beaufort Aquifer Potentiometric Surface Map
2022 Annual Report



08-16-2022

Figure 15

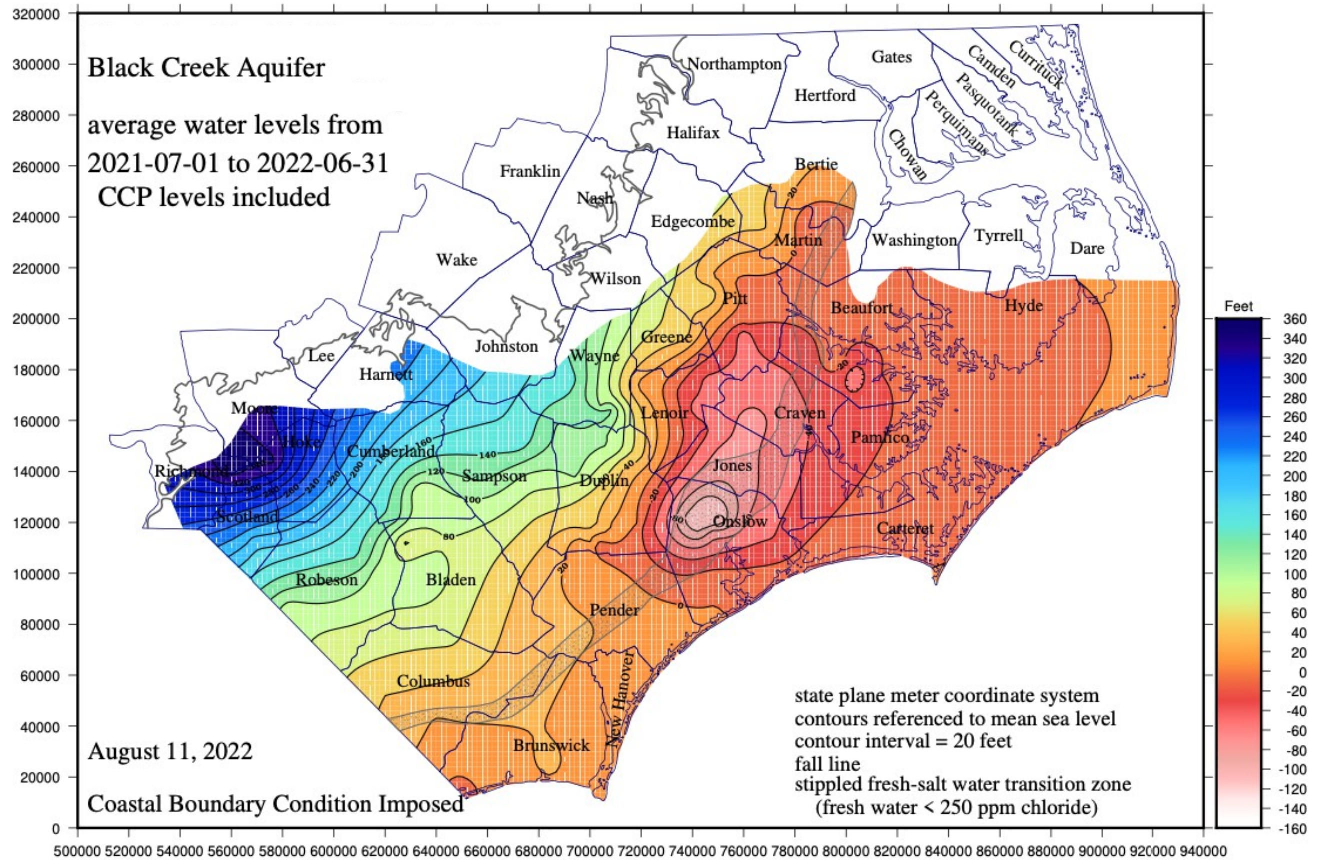
NC Division of Water Resources – Ground Water Management Branch
Peedee Aquifer Potentiometric Surface Map
2022 Annual Report



08-16-2022

Figure 16

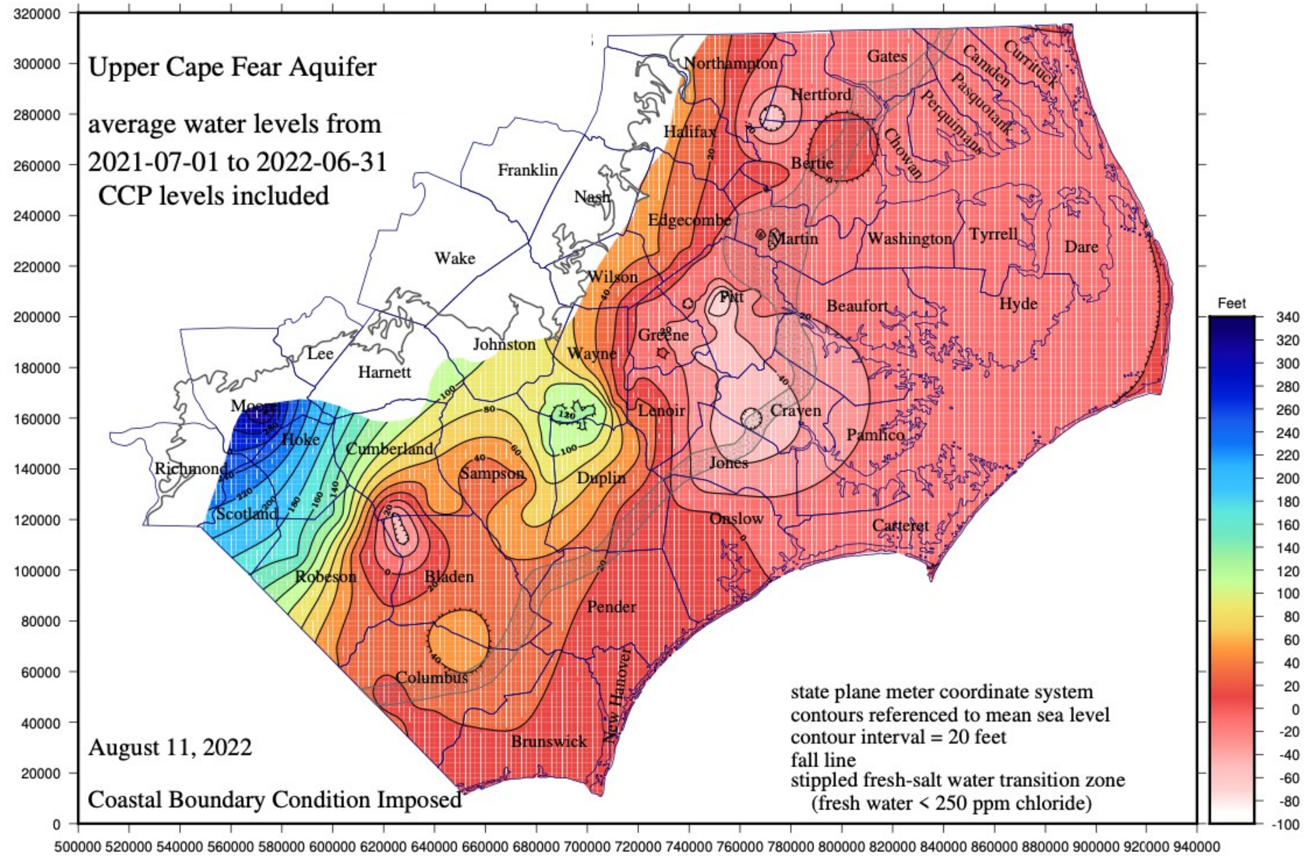
NC Division of Water Resources – Ground Water Management Branch
Black Creek Aquifer Potentiometric Surface Map
2022 Annual Report



08-16-2022

Figure 17

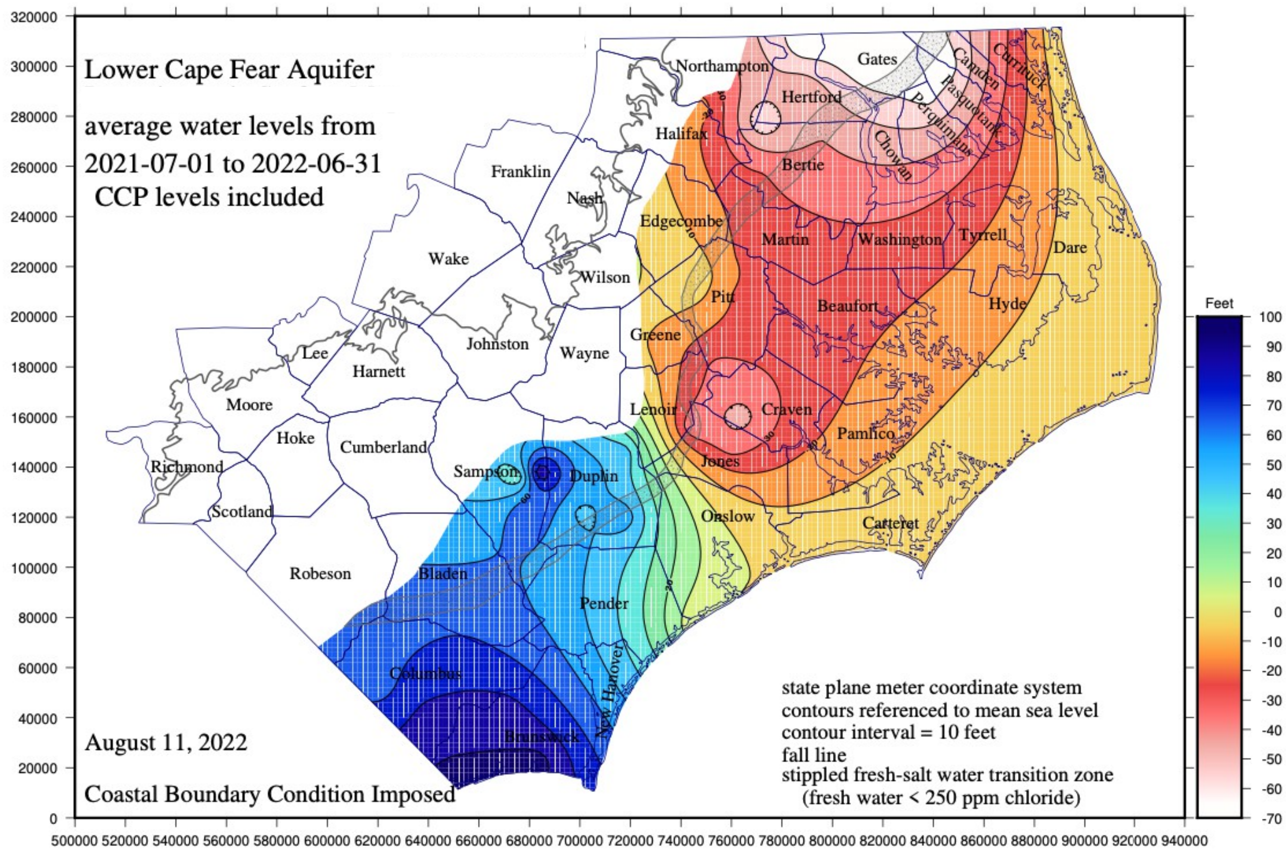
NC Division of Water Resources – Ground Water Management Branch
Upper Cape Fear Aquifer Potentiometric Surface Map
2022 Annual Report



08-16-2022

Figure 18

NC Division of Water Resources – Ground Water Management Branch
Lower Cape Fear Aquifer Potentiometric Surface Map
2022 Annual Report



08-16-2022

Figure 19

NC Division of Water Resources - Groundwater Management Branch

CCPCUA 2021 Water Withdrawal Summary

2022 Annual Report

Choose a year...

2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

Central Coastal Plain Capacity Use Area 2021 Water Withdrawal Summary Tables

Tables compiled 08-11-2022, units are gallons per day

Permitted				Reported for 2021					
Current Permit Limits				Ground Water					Surface Water
County	max daily	yearly (ABRs)	yearly (2018)	by all permits	# of permits	% reported	by yearly permits	by registrations	by registrations
Beaufort	180,060,400			43,313,239	40	75			
Carteret	32,756,080			9,520,614	22	82		105,109	6,762
Craven	75,306,400	6,956,526	1,814,132	22,506,528	32	78	2,463,506	70,679	15,038,850
Duplin	69,317,925	2,805,747	2,297,255	8,310,545	68	65	1,935,636	99,405	9,356
Edgecombe	13,068,000	527,697	429,388	2,586,039	12	92	291,433		
Greene	623,000	3,058,197	914,551	1,059,482	5	80	1,027,948	43,192	452,910
Jones	48,641,600	679,282	169,821	17,257,928	9	67	337,039		
Lenoir	6,925,320	13,522,312	3,522,953	3,565,956	15	87	3,191,435		8,062,952
Martin	4,440,000	4,895,506	2,226,326	1,334,303	14	93	700,190	58,320	23,470,077
Onslow	61,920,600	9,845,143	2,461,286	23,957,226	18	67	3,888,433	243,776	
Pamlico	35,252,000			1,657,436	12	83		2,466	
Pitt	8,078,080	8,651,572	2,521,003	2,012,051	20	90	1,394,097	52,739	14,965,422
Washington	52,608,000			1,488,506	34	68			
Wayne	19,489,200	4,340,026	2,010,532	5,477,058	23	87	1,175,611		3,411,679
Wilson	6,464,160	658,883	491,218	1,109,318	7	86	401,535	160,572	8,701,805
Totals:	614,950,765	55,940,891	18,858,465	145,156,229	331**	76	16,806,864	836,259	74,119,811

Yearly permit limits are linked to withdrawals from the Cretaceous aquifers where reductions are mandated. As phased reductions occur, annual limits allow permit holders more flexibility to plan when withdrawals are made. ABR refers to "Approved Base Rate" and is the annual rate calculated based on 1997 or August 1, 1999 through July 31, 2000 withdrawals. The ABR is the annual rate from which reductions take place (see CCPCUA FAQs). "Yearly (2018)" is the final rate of withdrawal if all three phases of reduction are administered. Figures in the "by all permits" columns are total withdrawals reported by all permit holders (max day and yearly).

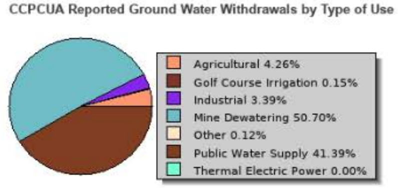
** A few permits have sources in two counties, so those permits are counted twice.

Permitted				Reported for 2021					
Current Permit Limits				Ground Water					Surface Water
Type of Use	max daily	yearly (ABRs)	yearly (2018)	by all permits	# of permits	% reported	by yearly permits	by registrations	by registrations
Agricultural	190,677,325	620,612	400,004	6,104,567	139	62	82,011	114,245	720,737
Golf Course Irrigation	3,954,000	85,589	85,589	128,556	11	64	3,211	85,530	6,762
Industrial	15,355,200	4,473,115	2,471,853	4,733,876	14	100	1,195,165	207,939	41,920,599
Mine Dewatering	256,690,080			73,896,095	61	80		127,000	9,356
Other	10,514,480	368,561	300,003	171,390	12	67	127,385		
Public Water Supply	137,759,680	50,393,015	15,601,016	60,121,745	86	97	15,399,092	299,079	31,462,358
Thermal Electric Power					86	97			
Totals:	614,950,765	55,940,891	18,858,465	145,156,229	323	76	16,806,864	833,793	74,119,811

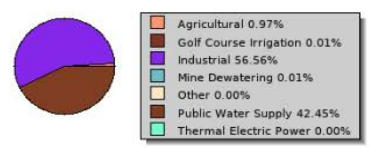
Permitted				Reported for 2021				
Current Permit Limits				Ground Water				
Aquifer	max daily	yearly (ABRs)	yearly (2018)	by all permits	# of permits	% reported	by yearly permits	by registrations
Basement rock	13,606,060			2,051,865	11	91		221,395
Black Creek	33,157,363	21,884,121	7,173,409	12,537,262	76	76	8,983,690	136,590
Peedee	18,940,050	6,877,228	1,785,236	1,684,254	20	73	104,885	60,590
Upper Cape Fear	48,280,962	27,129,542	9,849,819	13,370,310	90	83	7,694,266	85,615
Lower Cape Fear		50,001	50,001	69,989	1	100	24,023	
Surficial	135,543,630			32,740,448	72	72		263,935
Castle Hayne	329,152,450			81,788,650	127	70		406,704
Beaufort	3,495,250				1	100		52,739
Upper Tertiary								
Yorktown	32,775,000			913,450	17	55		16,614
Totals:	614,950,765	55,940,891	18,858,465	145,156,229	414**	75	16,806,864	836,259

** Many permits use multiple aquifers, so those permits are counted more than once.

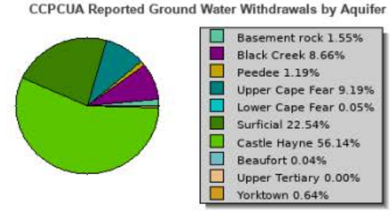
CCPCUA Reported Ground Water Withdrawals by Type of Use



CCPCUA Reported Surface Water Withdrawals by Type of Use



CCPCUA Reported Ground Water Withdrawals by Aquifer



08-16-2022

TABLES

TABLE 1 Site Susceptibility Rating North Carolina Division of Water Resources Groundwater Management Branch 2022 Annual Report	
Susceptibility Rating	**Description**
1	**Secure**—station is located on State or Federal government property
2	**Secure**—station is located on local government or school property
3	**Moderately secure**—station is located on private property, but landowner does not give any indication that land use or property ownership may change
4	**Tenuous**—station is located on public or private property and landowner is giving indications that land use or property ownership may change
5	**Imminent threat**—station is on public or private property and landowner desires abandonment of well station.

TABLE 2
Site and Recorder Distribution by Region as of 06/30/2022
North Carolina Division of Water Resources
Groundwater Management Branch
2022 Annual Report

Region	Parameter	Number	% of Region	% of Network
	Wells	151		21.4
1	Sites	45		19.1
	Hobo	129	85.4	18.3
	Solinst	1		
	Wells	175		24.9
2	Sites	39		16.6
	Hobo	158	90.3	22.4
	Solinst	0		
	Wells	15		2.1
3	Sites	15		6.4
	Hobo	12	80.0	1.7
	Solinst	2		
	Wells	185		26.3
4	Sites	55		23.4
	Hobo	142	76.8	20.2
	Solinst	6		
	Wells	129		18.3
5	Sites	68		28.9
	Hobo	115	89.1	16.3
	Solinst	7		
	Wells	49		7.0
6	Sites	13		5.5
	Hobo	48	98.0	6.8
	Solinst	0		

These are counts of the number of wells which have at least one recorder of the stated variety. These numbers do not indicate the total number of recorders deployed. For example, there are always two Solinst recorders on a well and only one is counted per well. In addition, Solinst recorders are always installed on wells with Hobos, so the number of Solinst recorders does not increase the total number of wells with recorders.

TABLE 3
Solinst Telemetry System (STS) Distribution by Region as of 06/30/2022
North Carolina Division of Water Resources
Groundwater Management Branch
2022 Annual Report

Region	Station Name	Well Number	Date Installed
1	Como	B 20U8	10/14/2014
1	Lewiston	H 22I3	06/20/2013
1	Manteo Airport	I 4W5	06/04/2014
1	Bunn	I 35K2	10/20/2016
2	Topsail Beach	BB 28J5	06/12/2014
3	Bryson City	O 97W2	02/18/2014
5	Clarendon	DD 42N1	04/24/2014
5	Rowland	Z 47R5	04/24/2014
5	Laurel Springs	C 71U1	10/11/2016
5	Gibsonville	G 50W2	09/26/2016
5	Wilkesboro	G 69J1	11/22/2016
5	Troutman	L 67U2	8/27/2014
5	NC Zoo	M 53L1	06/19/2014
5	Hornets Nest	Q 66C1	10/07/2014
5	Columbus	R 82I1	02/19/2014
5	Monroe	U 62A1	07/02/2014

TABLE 4
Monitoring Well Network Statistics (01/01/2005 through 6/30/2022)
North Carolina Division of Water Resources
Groundwater Management Branch
2022 Annual Report

Parameter	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Number of monitored wells	537	538	550	559	568	579	591	605	626	637
Manual water levels (tapedowns)	2,606	2,719	2,599	2,463	2,556	2,906	2,624	2,953	3,265	2,703
Daily water levels (automatic recorders	89,088	92,038	93,145	105,708	120,694	131,317	136,208	150,912	172,111	176,111
Total hourly water levels	2,141,368	2,229,355	2,294,909	2,593,630	2,961,371	3,163,188	3,276,496	3,622,891	4,128,993	4,225,684
Chloride Samples	17	22	175	12	17	251	21	274	13	10
Geophysical & lithologic logs at new stations	2	1	3	1	1	0	2	1	1	1

TABLE 4 (Continued) Monitoring Well Network Statistics (01/01/2005 through 06/30/2022) North Carolina Division of Water Resources Groundwater Management Branch 2022 Annual Report								
Parameter	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Number of monitored wells	651	655	667	671	702	705	708	709
Manual water levels (tapedowns)	3,140	2,996	3,477	3,890	4,085	3,662	4,211	1,912
Daily water levels (automatic recorders	182,907	189,302	186,558	192,646	200,395	211,823	214,121	78,361
Total hourly water levels	4,389,822	4,542,068	4,447,347	4,618,783	4,712,493	4,995,091	5,037,298	1,827,772
Chloride Samples	270	31	358	14	413	6	8	361
Geophysical & lithologic logs at new stations	2	2	3	1	3	5	4	1

TABLE 5
Well Construction Information for New Well Installation and Acquired Wells for the FY 2022
Well Abandonments for the FY 2022
North Carolina Division of Water Resources
Groundwater Management Branch
2022 Annual Report

Well ID	Station Name	Date Installation Complete	Well Diameter (inches)	Well Depth (ft bls)	Screened Interval (x to y ft bls)	Measuring Pt (MP)(ft)	Aquifer	**Water Level Date Measured (from MP) (ft)
B10K1	Shingle Landing	07/20/2021	4	710	660-680	3.3	Beaufort (Tb)	11.12 (07/27/2022)
B10K2		07/21/2021	4	27	17-27	3.35	Surficial (S)	6.60 (07/27/2022)
D7F1	Maple	03/08/2022	4	25	10-25	1.82	Surficial (S)	6.70 (07/27/2022)
D7F3		03/08/2022	4	760	730-750	1.07	Castle Hayne (Tch)	21.60 (07/27/2022)
X47K4	Red Bank	05/12/2022	2	40	25-35	2.73	Surficial (S)	14.07 (07/27/2022)
V35T10	Six Runs	06/24/2022	2	20	10-20	2.58	Surficial (S)	7.49 (08/02/2022)

Well Construction Information for Wells Acquired in FY 2022

Well ID	Station Name	Date Acquired	Well Diameter (inches)	Well Depth (ft bls)	Screened Interval (x to y ft bls)	Measuring Pt (MP)(ft)	Aquifer	**Water Level Date Measured (from MP) (ft)
E76Q3	Tater Hill	09/02/2021	6	345	*23-345	1.03	Basement Rock (Br)	65.19 (05/17/2022)
D7F2	Maple	03/08/2022	4	200	190-195	1.92	Yorktown (Ty)	51.05 (07/27/2022)

TABLE 5 (Continued)
Well Construction Information for New Well Installation and Acquired Wells and Well Abandonment Information for FY 2022
North Carolina Division of Water Resources
Groundwater Management Branch
2022 Annual Report

Well Abandonments in FY 2022

Well ID	Station Name	Date Installation Complete	Well Diameter (inches)	Well Depth (ft bls)	Screened Interval (x to y ft bls)	Measuring Pt (MP)(ft)	Aquifer	Date Abandoned
X47K2	Red Bank	10/28/1971	2.5	38	28-38	1.6	Surficial (S)	05/12/2022
L24B4	North Pitt	04/03/1980	4	370	360-370	3.08	Upper Cape Fear (Kucf)	05/18/2022
L25P5	Falkland	04/21/2005	4.5	11	5-10	5.13	Surficial (S)	05/18/2022
P19M2	Cox Crossroads	03/14/1967	4	40	23-34	1.74	Yorktown (Ty)	05/18/2022
V35T3	Six Runs	04/25/1978	1.25	9	5-9	0.45	Surficial (S)	06/24/2022
V35T8	Six Runs	07/26/1978	2.5	268	258-268	2.82	Lower Cape Fear (Klcf)	06/24/2022

*Indicates Open Hole

TABLE 6
NC Drought Indicator Network Wells
North Carolina Division of Water Resources
Groundwater Management Branch
2022 Annual Report

Station Name	Well Number	Aquifer	STS or USGS
Atlantic	V 12I5	S	-
Beaver Creek	D 72Y1	Br	-
Bent Creek	O 87D1	Bs	-
Big Flatty Creek	G 9C6	S	-
Bladenboro	Z 41U1	S	-
Bryson City	O 97W2	Br	STS
Bunn	I 35K2	Br	STS
Calabash	HH 39J8	S	USGS
Caldwell	F 43X1	Br	-
Camp Lejeune (Hadnot)	X 24S7	S	-
Cherry Point	U 18Q6	S	-
Clarendon	DD 42N1	S	STS
Cleveland	M 38Q1	Br	-
Columbus	R 82I1	Br	STS
Comfort (NC-173)	U 26J8	S	USGS
Como	B 20U8	S	STS
Cove City	R 23X5	S	-
Densons Creek Park	P 54H1	Br	-
East Bend VFD	F 62J1	Br	-
General Timber	N 46H1	Br	-
Gibsonville	G 50W2	Br	STS
Glen Alpine (BK-126)	L 76G2	Br	USGS
Godley	Q 16G6	S	-
Gold Point	J 22P3	S	-
Graingers	Q 25D11	S	-
Gum Neck	L 10A2	Ty	-
Halls	S 35Q5	S	-
Hornets Nest	Q 66C1	Bs	STS
Kelly	AA 35N1	S	-
Laurel Springs	C 71U1	Br	STS
Lewiston	H 22I3	S	STS
Littleton	C 30P1	Br	-
Magnolia School	X 44K4	S	-
Manteo Airport	I 4W5	S	STS
Monroe	U 62A1	Br	STS
NC Zoo	M 53L1	Br	STS
NH Correctional Institutes	C 31U1	S	-

TABLE 6 (Continued) NC Drought Indicator Network Wells North Carolina Division of Water Resources Groundwater Management Branch 2022 Annual Report			
Station Name	**Well Number**	**Aquifer**	**STS or USGS**
Old Sparta	K 26M2	S	-
Oxford	E 38F1	S	-
Pink Hill	T 29G11	Br	-
Plymouth	K 17A9	S	-
Rowland	Z 47R5	S	STS
Roxobel (NC-154)	F 22B7	S	-
Seabrook School	U 41A1	S	-
Southport (BR-083)	GG 32T6	S	USGS
Stantonsburg	M 30L1	S	-
Topsail Beach	BB 28J5	S	STS
Troutman	L 67U2	S	STS
UNC Campus OR-069 (Chi Psi Fraternity-UNC)	J 44D1	Br	-
Upper Piedmont RS (RK-239)	D 52L1	Bs	USGS
Warren County High School	C 33Y1	Bs	-
Welcome	I 58Y2	Bs	-
Whortonsville	S 15Y7	Br	-
Wilkesboro	G 69J1	S	STS

TABLE 7 Automatic Water Level Recorders as of 06/30/2022 North Carolina Division of Water Resources Ground Water Management Branch 2022 Annual Report	
Recorder Type	**Number in Service***
HOBO U20 Water Level Logger (including separate barometer per station installed	822 (includes 221 barometers)
Solinst Telemetry System (STS)	32 (includes 16 barologgers and 16 leveloggers)

***As of June 30, 2022**
Note: Due to the large number of recorders deployed by DWR, there are, at any given time, a number of units that are being serviced or replaced. These units are not reflected in the above totals.

TABLE 8
Orange Well Network Monitoring Well Information
Orange County, NC
North Carolina Division of Water Resources
Ground Water Management Branch
2022 Annual Report

Quad	Well Name	Total Depth (ft bgs)	Casing Depth (ft bgs)	Land Surface (ft)	Aquifer	Geology
G 44G1	Northeast Park NES	45	15	622	Bs	Epiclastics
G 45F1	Eno Confluence Property	192	37	611	Br	Felsic Tuff
H 44P1	Blackwood Farm Bedrock	302	100	556	Br	Felsic Lavas and Tuffs (Dacite)
H 44P2	Former 911 Center	400	85	581	Br	Altered Tuff
H 44P3	Blackwood Farm Regolith	45	15	556	Bs	Felsic Lavas and Tuffs (Dacite)
H 44R1	Brumley East	605	108	562.39	Br	Mafic Lavas and Tuffs
I 44B1	Duke Forest DF-4D	397.09	82.1	424.91	Br	Felsic Plutonics
I 44B2	Duke Forest DF-4S	25	15	428.81	Bs	Felsic Plutonics
I 44B3	Duke Forest DF-4I	41	26	426.77	Br	Felsic Plutonics
I 44F1	Millhouse Road	166	67	517	Br	Epiclastics
I 45G1	Rocky Ridge	Removed from network in 2012				
I 45J1	Eubanks Road	141	33	525		
I 46R1	Andrews Rd. (COL-1)	30	10	514	Bs	Felsic Tuff
I 46R2	Hwy 54 (COL-3)	40.5	25	516	Bs	Epiclastics
I 46W1	Orange Grove Rd (COL-4)	32	17	502	Bs	Epiclastics
J 45J1	Ray Road	Removed from network in 2012				

bgs – below ground surface
** Estimated Elevation

TABLE 9
Orange Well Network Statistics (2008 through 06/30/2022)
North Carolina Division of Water Resources
Ground Water Management Branch
2022 Annual Report

Parameter	2008	2009	2010	2011	2012	2013	2014	2015	2016
Manual water levels (tapedowns)	3	18	49	68	59	54	52	75	71
Daily water levels (automatic recorders	-	-	1,612	2,783	3,095	3,281	3,468	4,286	5,096
Total hourly water levels	-	-	38,802	66,689	74,065	78,636	83,090	102,643	121,985

TABLE 9 (continued)
Orange Well Net Network Statistics (2008 through 06/30/2022)
North Carolina Division of Water Resources
Ground Water Management Branch
2022 Annual Report

Parameter	2017	2018	2019	2020	2021
Manual water levels (tapedowns)	80	65	54	72	52
Daily water levels (automatic recorders	4,865	4,744	4,721	4,616	2,182
Total hourly water levels	116,515	113,565	114,948	109,219	52,219

TABLE 10 Guilford County Monitoring Well Information North Carolina Division of Water Resources Ground Water Management Branch 2022 Annual Report								
Quad	**Station Name**	**Date Installed**	**Well Diameter (inches)**	**Well Depth (ft)**	**Casing Depth (ft)**	**Land Surface (ft)**	**Aquifer**	**City**
F 54O1	Summerfield (Jack Dent Park)	10/2/02	6.25	103	81	858.5	Br	Summerfield
G 50H1	Prison Farm	5/14/04	6.25	120	45	685	Br	Gibsonville
G 51B1	Northeast Park	6/24/15	6.125	100	77	683	Br	Gibsonville
G 56L1	Triad Park	10/9/02	6.25	140	0	925	Br	Colfax
H 51D1	Knox Road	10/9/02	-	-	39	715	Br	McLeansville
H 55L1	Gibson Park	4/15/03	6.25	205	79	813	Br	Jamestown
I 50P1	Station 45 (Humble Road)	12/15/04	6.25	180	124	679.5	Br	Liberty
I 52N1	Hagan Stone Park	05/17/03	6.125	100	52	755	Br	Pleasant Garden

TABLE 11 Guilford County Monitoring Well Network Statistics (2005 through 06/30/2022) North Carolina Division of Water Resources Ground Water Management Branch 2022 Annual Report												
Parameter	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Manual water levels (tapedowns)	-	28	14	28	35	77	77	56	63	49	69	71
Daily water levels (automatic recorders	2,106	1,884	1,922	1,892	2,000	2,592	2,561	2,474	2,585	2,562	2,592	941
Total hourly water levels	-	-	-	-	-	3	-	-	-	-	36,415	22,636

TABLE 11 (continued) Guilford County Monitoring Well Network Statistics (2005 through 06/30/2022) North Carolina Division of Water Resources Ground Water Management Branch 2022 Annual Report					
Parameter	**2017**	**2018**	**2019**	**2020**	**2021**
Manual water levels (tapedowns)	72	55	79	62	23
Daily water levels (automatic recorders)	432	134	1,258	2,572	1,010
Total hourly water levels	10,379	3,216	37,281	62,634	24,280

TABLE 12
WCHRS Network
Monitoring Well Information
North Carolina Division of Water Resources
Ground Water Management Branch
2022 Annual Report

Quad	Station Name	Date Installed	Well Depth (meters)	Casing Depth (meters)	Screen (meters)	MP (meters above land surface)	Land Surface (NED Elevation) (meters)	Geology	Aquifer
Q 94H1	GG1S	11/30/2009	2.41	0.88	0.88-2.4	1.02	683.26	colluvium/saprolite	Bs
Q 94H2	GG1i	11/30/2009	4.42	3.81	3.81-4.42	0.99	683.26	saprolite	Bs
Q 94H3	GG1D	11/30/2009	7.56	6.95	6.95-7.56	0.97	683.26	saprolite	Bs
Q 94H11	GG4S	11/30/2009	2.83	1.31	1.31-2.83	0.89	682.93	colluvium/saprolite	Bs
Q 94H13	GG4D	11/30/1999	7.80	7.19	7.19-7.8	1.01	682.93	saprolite	Bs
Q 94H14	LB3S	11/30/1999	2.65	1.13	1.13-2.65	1.02	667.35	colluvium/saprolite	Bs
Q 94H16	LB3D	11/30/2009	5.43	4.82	4.82-5.43	1.05	667.35	saprolite	Bs
Q 94H22	LB1S	11/30/2009	2.47	0.94	0.94-2.46	1.00	667.15	colluvium/saprolite	Bs
Q 94H23	LB1i	11/30/1999	3.87	3.26	3.26-3.87	1.00	667.15	saprolite	Bs
Q 94H24	LB1D	11/30/1999	5.67	5.06	5.06-5.67	0.96	667.15	saprolite	Bs
Q 94I1	CC Old Well	11/22/2004	6.28	0.30	0.30-6.40	0.82	634.00	saprolite	Bs
Q 94I2	CC1S	11/30/2009	2.53	1.01	1.01-2.53	1.01	633.07	alluvium/saprolite	Bs
Q 94I3	CC1i	11/30/1999	3.29	2.99	2.99-3.29	1.05	633.07	saprolite	Bs
Q 94I5	CC1D	11/30/1999	5.64	5.33	5.33-5.63	1.02	633.07	saprolite	Bs
Q 94I7	CC2S	11/30/1999	2.68	1.16	1.16-2.68	0.98	634.15	alluvium/saprolite	Bs
Q 94I9	CC2D	11/30/2009	6.31	5.70	5.70-6.31	0.99	634.15	saprolite	Bs
Q 94J1	Stillwell Building	-	61.27	25.91	25.91-61.27	0.65	655.45	-	Br

Note: All monitoring wells are located in Jackson County, NC

TABLE 13 WCHRS Network Statistics (2011 through 06-30-2022) North Carolina Division of Water Resources Ground Water Management Branch 2022 Annual Report							
Parameter	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Manual water levels (tapedowns)	238	628	661	469	422	486	661

TABLE 13 (Continued) WCHRS Network Statistics (2011 through 06-30-2022) North Carolina Division of Water Resources Ground Water Management Branch 2022 Annual Report				
Parameter	**2018**	**2019**	**2020**	**2021**
Manual water levels (tapedowns)	517	165	180	15