Lowcountry Capacity Use Area
2021 Groundwater Evaluation Report

Prepared by: Andrea L. H. Hughes, PhD, Hydrogeologist

Ashley Carothers, Hydrogeologist

Courtney Kemmer, Hydrogeologist

Courtney Milledge, Hydrogeologist, Lowcountry Area Coordinator

Bureau of Water

Jennifer Hughes, Interim Bureau Chief

Water Monitoring, Assessment, and Protection Division

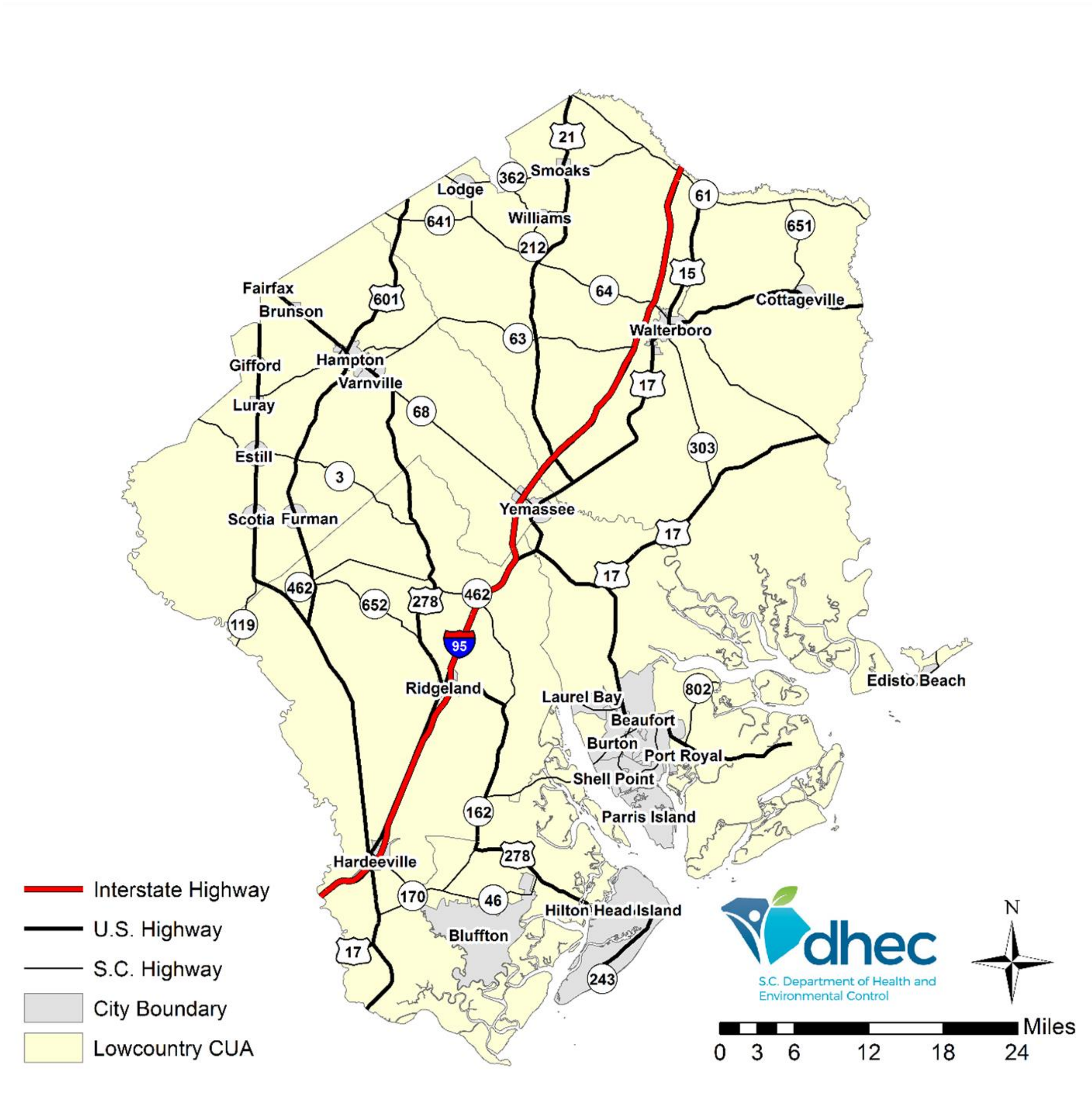
Robert Devlin, *Director*

Water Quantity Permitting Section

Leigh Anne Monroe, *Manager*

Technical Report Number: 011-2021

October 2021



Map of the Lowcountry Capacity Use Area showing major roads, cities, and towns.

S.C. Department of Health and Environmental Control

Lowcountry Capacity Use Area 2021 Groundwater Evaluation Report

Author and Editor ______________________
Andrea L. H. Hughes, PhD

Author ______________________
Ashley Carothers, Hydrogeologist

Author ______________________
Courtney Kemmer, Hydrogeologist

Author ______________________
Courtney Milledge, Hydrogeologist/Lowcountry Area Coordinator

Section Manager ______________________
Leigh Anne Monroe

Division Director ______________________
Robert J. Devlin

Technical Report Number 011-2021
October 2021

PAGE LEFT INTENTIONALLY BLANK

Table of Contents

List of Figures

List of Tables

Introduction

The Lowcountry Capacity Use Area (Lowcountry Area) was the second of six currently designated areas of South Carolina's Coastal Plain to be incorporated into the Capacity Use Program. The Lowcountry Area first included Beaufort, Colleton, and Jasper Counties (July 24, 1981). Hampton County was added to the Lowcountry Area on June 10, 2008 (Fig. 1). In the parts of the state designated as a Capacity Use Area, a groundwater withdrawer is defined as *a person withdrawing groundwater in excess of three million gallons during any one month from a single well or from multiple wells under common ownership within a one-mile radius from any one existing or proposed well* (Groundwater Use and Reporting Act, 2000).

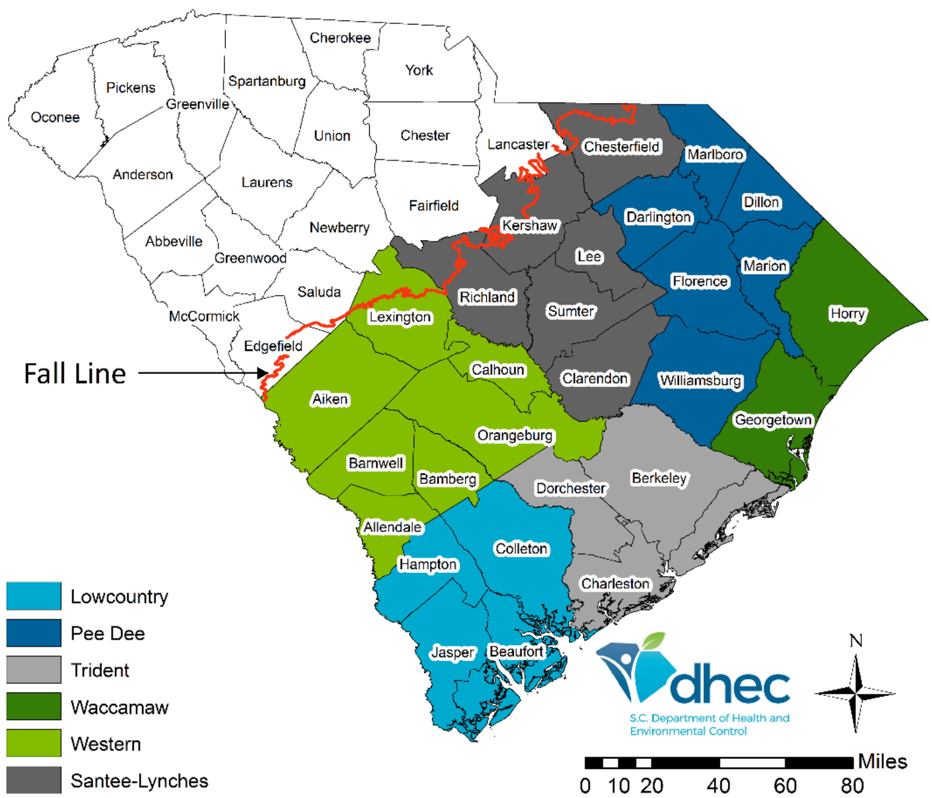


Figure 1. Map of SC DHEC Capacity Use Areas.

Regulatory History

In 1967, the S.C. Water Resources Planning and Coordination Act (Water Resources Act) established the S.C. Water Resources Commission (the Commission), which designated the Waccamaw Area (Horry and Georgetown Counties and the Brittons Neck of Marion County) as the first Capacity Use Area in 1979. In 1993, under the Water Resources Act, the responsibilities of the Commission were distributed so that water permitting tasks went to the S.C. Department of Health and Environmental Control (DHEC) and water planning tasks went to the S.C. Department of Natural Resources (DNR), and the Commission was dissolved. In 2000, the South Carolina Code of Laws (Title 49, Section 5) were revised to include what is now the current Groundwater Use and Reporting Act (Groundwater Use and Reporting Act, 2000). Significant changes enacted by the new law were 1) groundwater assessments to determine the necessity of establishing a Capacity Use Area could be initiated by DHEC as well as requested by local governments or non-governmental organizations within the state; and 2) a Groundwater Management Plan was now required for each Capacity Use Area. The Capacity Use Areas and associated counties were designated in the following order:

- **Waccamaw Area (1979):** Georgetown and Horry Counties, and Brittons Neck of Marion County
- **Lowcountry Area (1981):** Beaufort, Colleton, and Jasper Counties
- **Trident Area (2002):** Berkeley, Charleston, and Dorchester Counties
- **Pee Dee Area (2004):** Darlington, Dillon, Florence, Marion[1], Marlboro, and Williamsburg Counties
- **Lowcountry Area (2008):** Addition of Hampton County
- **Western Area (2018):** Aiken, Allendale, Bamberg, Barnwell, Calhoun, Lexington, and Orangeburg Counties
- **Santee-Lynches Area (2021):** Chesterfield, Clarendon, Kershaw, Lee, Richland, and Sumter Counties

The initial Lowcountry Groundwater Management Plan (LGMP) was approved by the DHEC Board of Directors in August 2017 (Berezowska & Monroe, 2017). The stated goals of the LGMP are to:

1. Ensure sustainable development of the groundwater resource by management of groundwater withdrawals.
2. Protect groundwater quality from saltwater intrusion.
3. Monitor groundwater water quality and quantity to evaluate conditions.

The LGMP addressed achieving these goals by evaluating the following aspects of groundwater use in the Lowcountry Area:

- Groundwater sources currently utilized.
- Current water demand by type and amount used.
- Current aquifer storage and recovery, and water reuse.
- Population growth and projections.
- Water demand projections.
- Projected opportunities for aquifer storage and recovery, as well as water reuse.
- Projected groundwater and surface water options.
- Water conservation measures.

Following the guidelines set forth in the LGMP, this document provides an evaluation of current groundwater use and recommendations for its management.

[1] All of Marion County, including Brittons Neck, became part of the Pee Dee Capacity Use Area. Therefore, the Waccamaw Area now includes only Georgetown and Horry Counties.

Hydrogeologic Framework

Physiographic Provinces

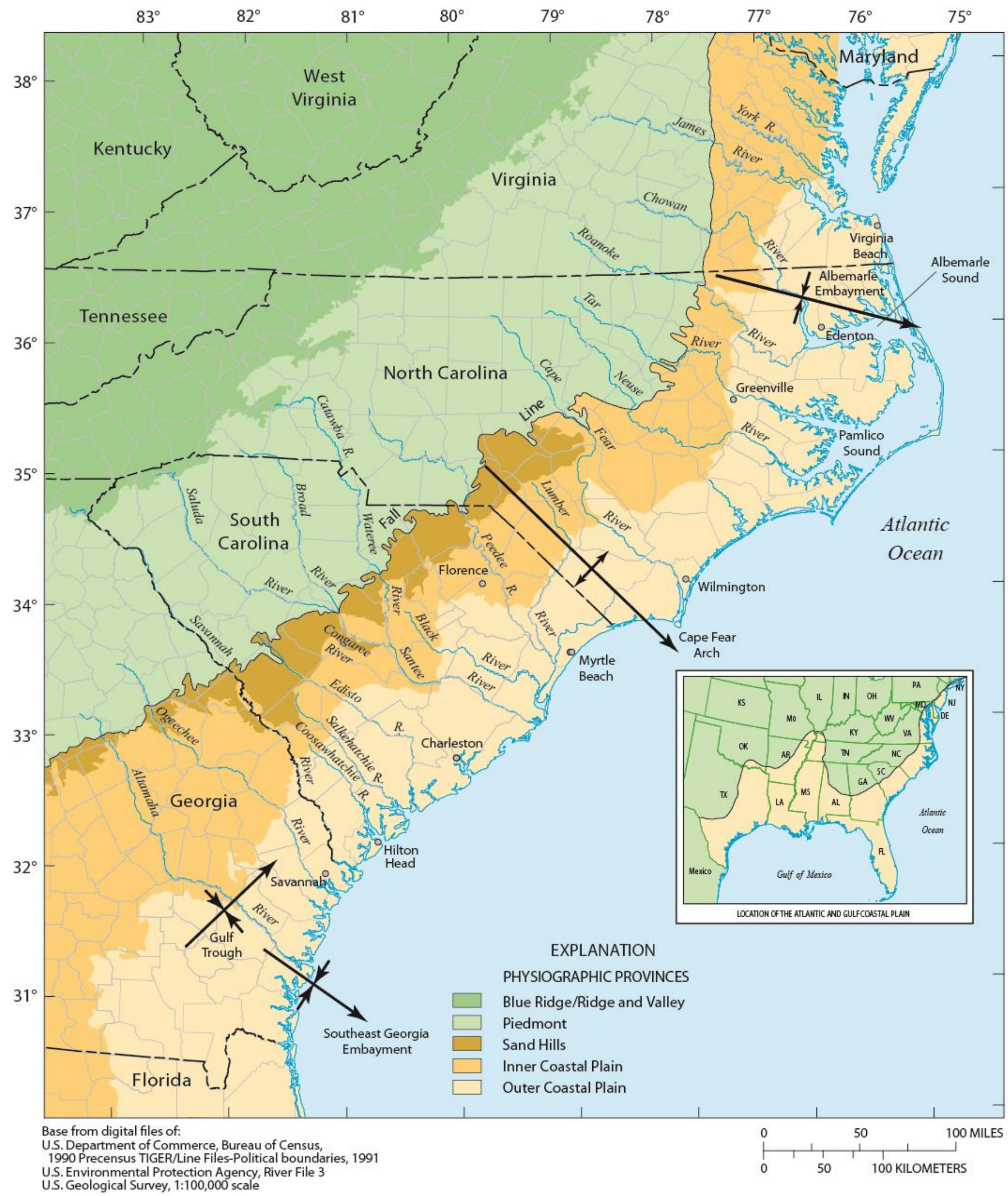


Figure 2. Map of the Atlantic Coastal Plain from North Carolina through Georgia. Inset map indicates the extent of the entire Atlantic and Gulf Coast Plain. US Geological Survey (usgs.gov/media/images/atlantic-coastal-plain-maryland-florida); accessed 7/7/2021.

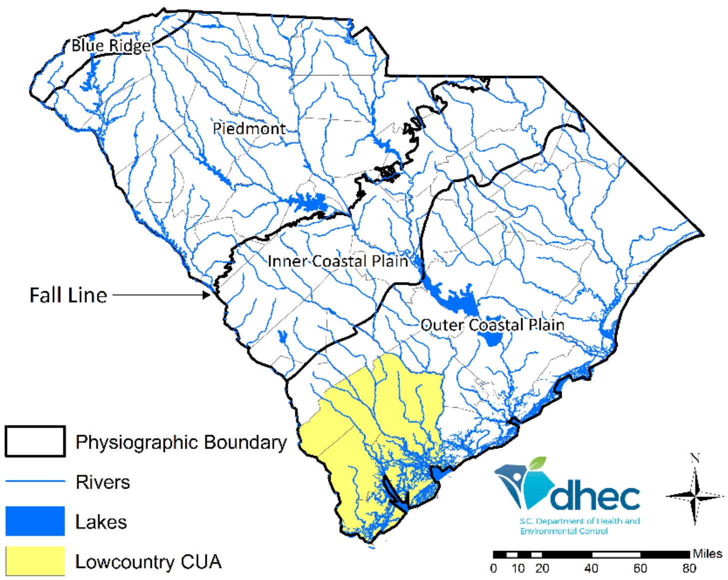


Figure 3. Map of the South Carolina Physiographic Provinces with the Lowcountry Area highlighted in yellow.

The Coastal Plain of South Carolina (CPSC) is part of the larger Atlantic Coastal Plain (ACP). The ACP's northern boundary is in New Jersey and southern boundary is in Florida. From east to west, the ACP extends from the Fall Line to the coastline with three regions that run roughly parallel to the Atlantic Coastline (Fig. 2).

The CPSC is typically divided into two regions. The Inner Coastal Plain includes the Sandhills Region, and the Outer Coastal Plain is identical to that of the ACP. The Lowcountry Area is located entirely within the Outer Coastal Plain (Fig. 3). This physiographic region is characterized by a series of terraces dissected by numerous streams. The topography of the Lowcountry Area is low relief with elevations ranging from sea level to about 270 feet. Due to the low relief, Jasper and Beaufort Counties experience frequent inundation from tidal storm surges and river flooding (Hayes, 1979). Both groundwater and surface water sources are available and utilized by water withdrawers in this area, but the majority of the rivers in Beaufort and Jasper Counties are too salty for potable water with the exception of the Savannah River.

Aquifers

The hydrogeologic framework of the CPSC consists of a wedge- shaped stratigraphy divided into alternating layers of water-bearing, permeable sand, or carbonate deposits (aquifers) with layers of fine-grained clays, silts, or low-permeability carbonate deposits (confining units) (Figure 4) (Gellici & Lautier, 2010). The hydrogeologic units underlying the CPSC were deposited during the late Cretaceous to Tertiary Periods. From oldest to youngest, the Cretaceous units are Gramling, Charleston, McQueen Branch, and Crouch Branch (Gellici & Lautier, 2010). The Tertiary units, in the same chronological order, are the Gordon, Floridan, and Surficial (Figure 4).

The Cretaceous units are present below all four Lowcountry Area counties, with the exception of the McQueen Branch Aquifer, which is only present below Hampton County, the north half of Colleton County, and a small portion of northern Jasper County. The Tertiary units are also present beneath all of the Lowcountry Area except for the Upper Floridan Aquifer, which is found below Hampton, Jasper, and Beaufort Counties as well as a small portion of southwest Colleton County (Wachob, Gellici, & Czwartacki, 2017).

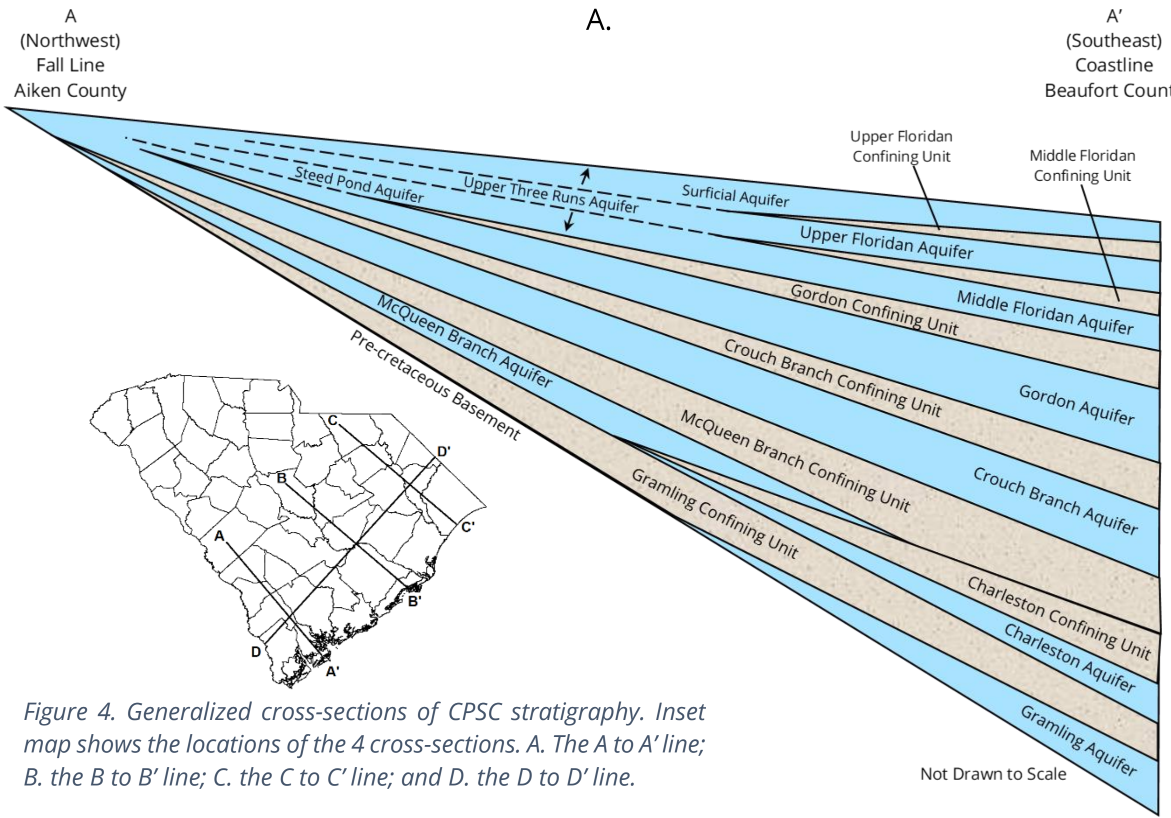
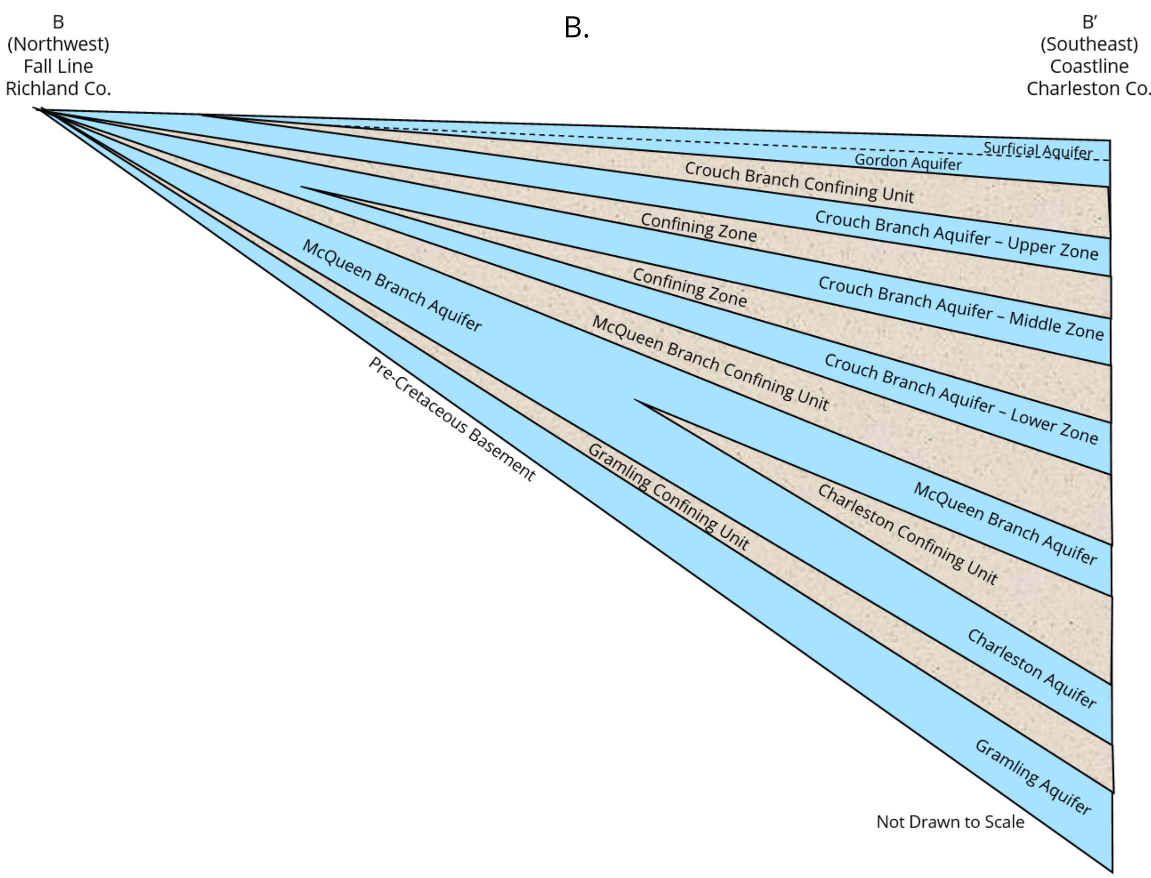
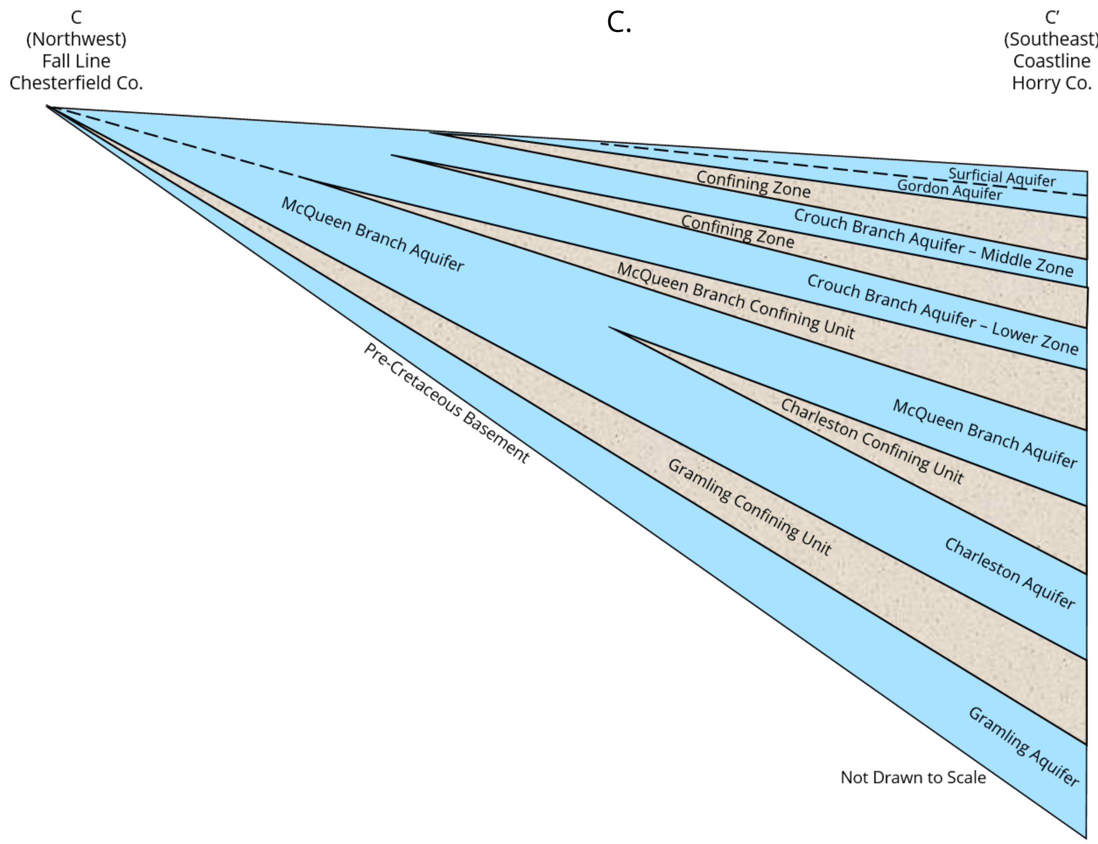
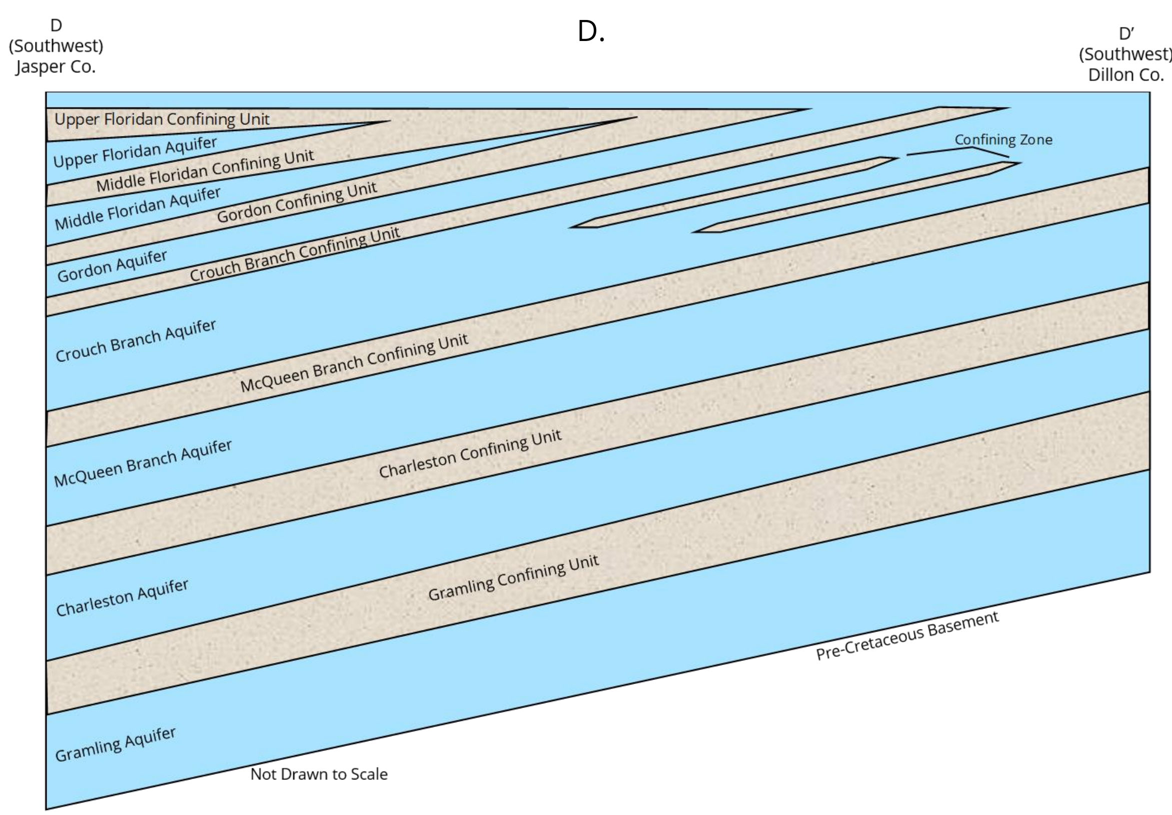


Figure 4. Generalized cross-sections of CPSC stratigraphy. Inset map shows the locations of the 4 cross-sections. A. The A to A' line; B. the B to B' line; C. the C to C' line; and D. the D to D' line.




C
(Northwest)
Fall Line
Chesterfield Co.
C.
C'
(Southeast)
Coastline
Horry Co.
Surficial Aquifer
Gordon Aquifer
Confining Zone
Crouch Branch Aquifer – Middle Zone
Confining Zone
Crouch Branch Aquifer – Lower Zone
McQueen Branch Aquifer
McQueen Branch Confining Unit
McQueen Branch Aquifer
Charleston Confining Unit
Charleston Aquifer
Gramling Confining Unit
Gramling Aquifer
Pre-Cretaceous Basement
Not Drawn to Scale


D
(Southwest)
Jasper Co.
D.
D'
(Southwest)
Dillon Co.
Upper Floridan Confining Unit
Upper Floridan Aquifer
Middle Floridan Confining Unit
Middle Floridan Aquifer
Gordon Confining Unit
Gordon Aquifer
Crouch Branch Confining Unit
Confining Zone
Crouch Branch Aquifer
McQueen Branch Confining Unit
McQueen Branch Aquifer
Charleston Confining Unit
Charleston Aquifer
Gramling Confining Unit
Gramling Aquifer
Pre-Cretaceous Basement
Not Drawn to Scale

Recharge Areas

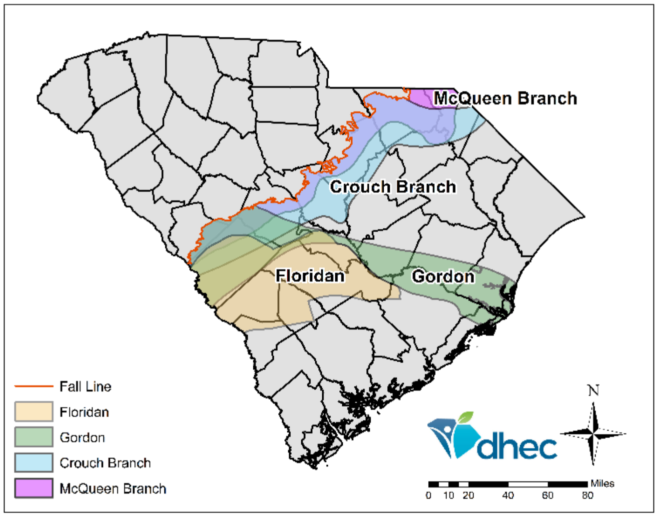


Figure 5. Map indicating the location and extent of the CPSC aquifer recharge areas.

The recharge areas for South Carolina aquifers are primarily located within the Inner Coastal Plain (Figure 5). The surficial aquifer receives direct recharge through infiltration of local precipitation and surface water bodies. Groundwater in the deeper aquifers is primarily replenished by precipitation and surface water infiltration in the recharge areas. Water that enters here then moves slowly 'down-dip' through the hydrogeologic framework towards the Atlantic Ocean. Consequently, the rate at which groundwater is replenished in the deeper aquifers of the Lowcountry Area is largely controlled by the rate at which groundwater travels from the recharge zones near the Fall Line and the transmissivity of the aquifer. Typical groundwater flow rates for silts to well-sorted sands range from 0.003 to 300 feet per day (Fetter, 2001). This means that once the precipitation becomes part of the groundwater system, it may take from a few years to tens of thousands of years to reach some locations below the Lowcountry Area.

Surface Water

The Lowcountry Area spans portions of the Savannah, Salkehatchie, and Edisto River Basins in South Carolina (Fig. 6). Surface water sources are primarily rivers and streams, but locally impounded waters are used for irrigation as well. The Savannah and Edisto are two of the largest rivers that flow through this area, defining the boundaries to the northeast (Edisto) and the southwest (Savannah—also partly defining the state boundary) (Fig. 7).

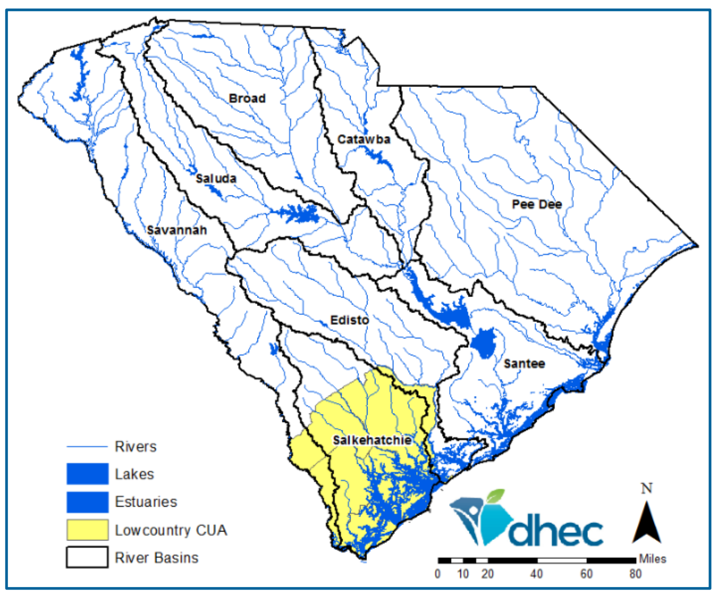


Figure 6. Surface water map of South Carolina. The Lowcountry Area is highlighted in yellow.

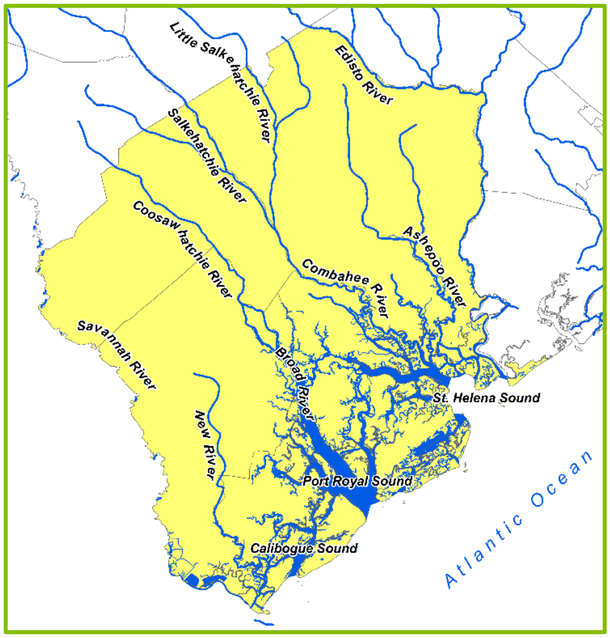


Figure 7. Detailed map of the surface water available within the Lowcountry Area.

Other major rivers that originate or flow through the Lowcountry Area are the Ashepoo, Salkehatchie and Little Salkehatchie, Combahee, Coosawhatchie, Broad, and New Rivers. Although rivers and streams are abundant in the Lowcountry Area, the Savannah River is currently the only surface water source used for public water supply. The Little Salkehatchie and Coosawhatchie Rivers, as well as private ponds and lakes, are used as water sources for irrigation.

Current Groundwater Demand

For 2020, there were 133 facilities that reported water use from 497 wells in Lowcountry Area counties (Table 1, Figure 8) (Craig & Monroe, 2020). Over half of the wells are permitted for irrigation (63%), followed by water supply (22%), golf course (13%), aquaculture, industry, and other (1% or less). No wells were permitted for mining, hydro power, nuclear power, and thermo power. More than half of the permitted wells are located in Beaufort and Hampton counties (76% combined). The fewest number of permitted wells are located in Jasper county.

Table 1. Lowcountry Area Capacity Use Wells by County and Use Category

Use Category	Beaufort	Colleton	Hampton	Jasper	Total (%)
Aquaculture (AQ)	3	0	2	0	5 (1%)
Golf Course (GC)	56	3	0	5	64 (12%)
Industry (IN)	1	0	3	0	4 (<1%)
Irrigation (IR)	91	42	151	29	313 (63%)
Mining (MI)	0	0	0	0	0 (0%)
Other (OT)	2	0	0	0	2 (<1%)
Hydro Power (PH)	0	0	0	0	0 (0%)
Nuclear Power (PN)	0	0	0	0	0 (0%)
Thermo Power (PT)	0	0	0	0	0 (0%)
Water Supply (WS)	54	23	19	12	109 (22%)
Total (%)	207 (42%)	69 (14%)	175 (35%)	46 (9%)	497 (100%)

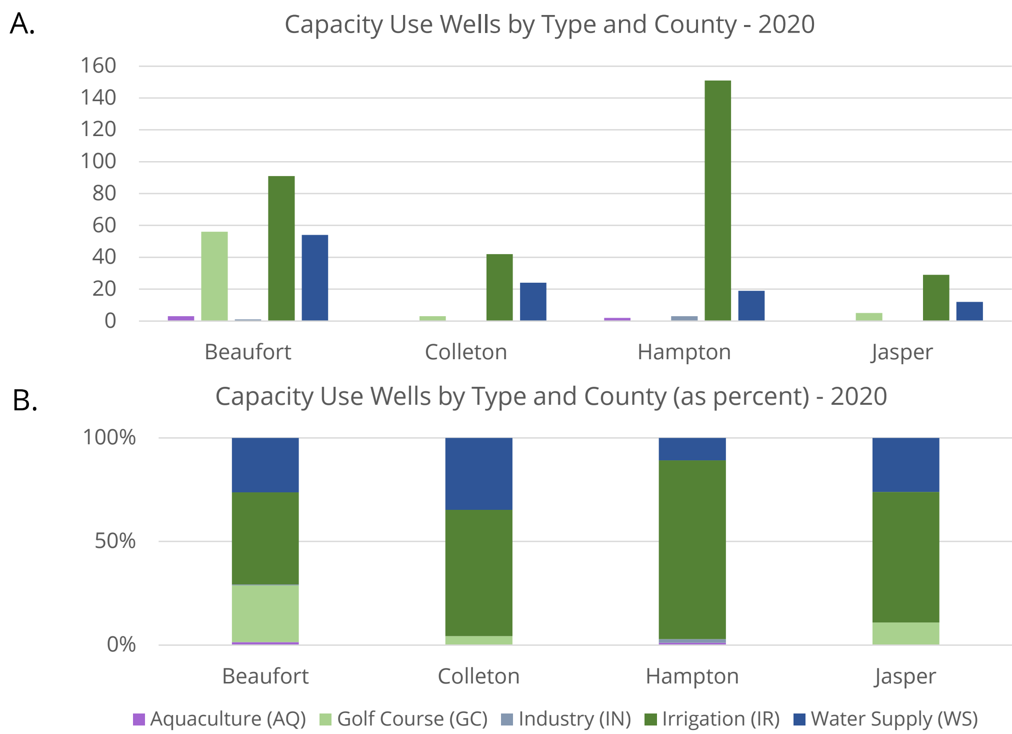


Figure 8. Graphs of Lowcountry Area Permitted Wells by Type and County - 2020. A. Number of each well type by county, and B. Each well type presented as a percent of the total by county.

A total of 13,264 million gallons (MG) (or 13.264 billion gallons) was reported for groundwater use during 2020 for the Lowcountry Area (Table 2, Figure 9). Even though there are more permitted irrigation wells than any other type, the largest volume of groundwater use reported was for public water supply at 54% of the total. Irrigation was the next largest reported water use category at 37%. The remaining categories comprised 8% or less of the total.

Table 2. Reported Water Use (MG) by County and Use Category

Use Category	Beaufort	Colleton	Hampton	Jasper	Total (%)
Aquaculture (AQ)	1	0	157	0	158 (1%)
Golf Course (GC)	893	66	0	86	1,045 (8%)
Industry (IN)	16	0	0	0	16 (<1%)
Irrigation (IR)	476	1,212	2,665	496	4,849 (37%)
Mining (MI)	0	0	0	0	0 (0%)
Other (OT)	20	0	0	0	20 (<1%)
Hydro Power (PH)	0	0	0	0	0 (0%)
Nuclear Power (PN)	0	0	0	0	0 (0%)
Thermo Power (PT)	0	0	0	0	0 (0%)
Water Supply (WS)	5,570	856	457	293	7,177 (54%)
Total (%)	6,975 (53%)	2,134 (16%)	3,279 (25%)	876 (7%)	13,264

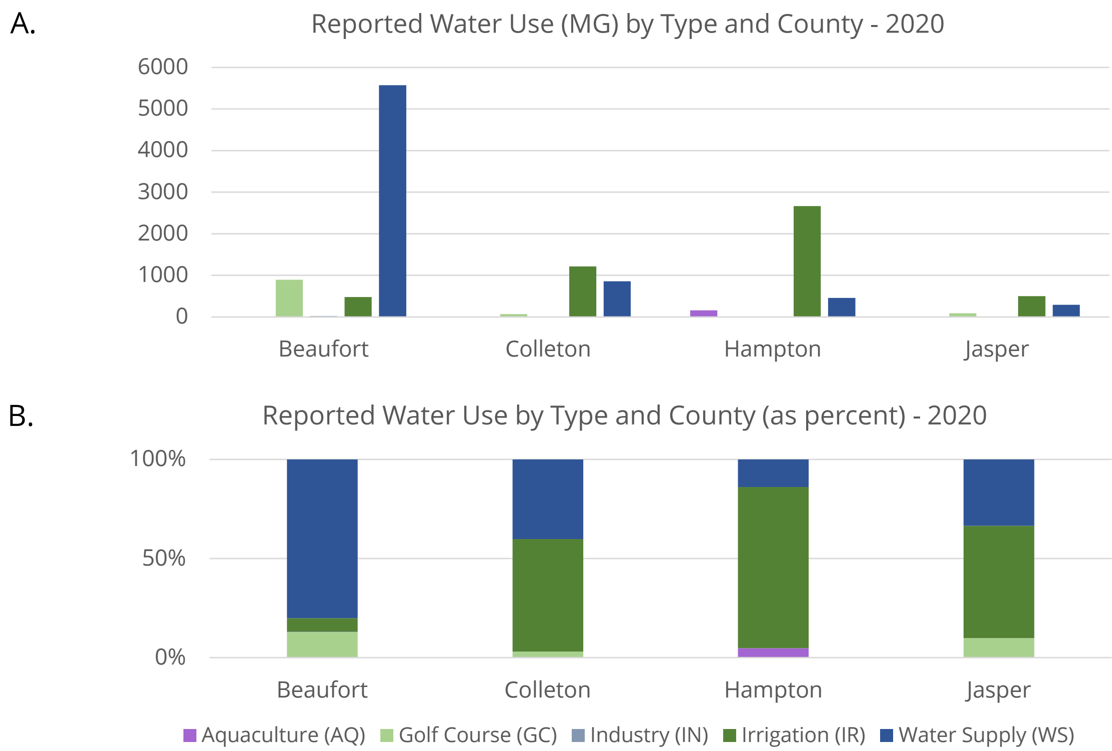


Figure 9. Graphs of 2020 Reported Water Use by County and Use Type. A. Reported water use for each county in millions of gallons (MG). B. Reported water use as a percent of the total for each county.

Water supply and irrigation are the categories with the largest demand on groundwater in all but Beaufort County (for which it is water supply and golf course) (Table 2, Figure 9). Water supply accounts for 54% and irrigation accounts for 37% of current demand for the entire region. Out of all four counties, Beaufort has the largest demand on groundwater at 53%, and Jasper has the least demand at 7% (Table 2).

Beaufort County Details

Beaufort County has 57 permitted facilities that own a total of 207 wells (Table 3). Note that permitted facility is defined as having a unique Permit Number. There are groundwater withdrawers who have more than one permitted facility. The total reported withdrawals for 2020 were 60% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for the county is the Upper Floridan Aquifer supplying 51% (3,553 MG) of the total reported water use for 2020, followed by the Middle Floridan Aquifer at 40% (2,778 MG) (Table 3).

Table 3. Permit Limits and 2020 Reported Water Use - Beaufort County

Facility	Permit No.	Aquifer(s)	Permit Limit (MGY)	2020 Water Use (MG)
Waddell Mariculture	07AQ002	Upper Floridan	36	0.87
Ocean Point Golf Course	07GC005	Gramling	36	1.41
Water Oak Utility	07GC009	Middle Floridan	75	39.62
Dataw Island Club	07GC012	Upper Floridan	60	52.51
Spanish Wells Club	07GC013	Upper Floridan	27.35	9.91
Olde Beaufort Golf Club	07GC017	Upper Floridan	88.5	79.5
Callawassie Island Club	07GC019	Upper Floridan	48	15.6
Colleton River Club - Nicklaus Course	07GC022	Surficial Middle Floridan	175	36.81 110.518
Island West Golf Club; IW Homeowners Association	07GC024	Upper Floridan Middle Floridan	43.49	0.09 0
Spring Island Club	07GC026	Middle Floridan	96	84.2
Bloody Point Golf Club	07GC028	Middle Floridan	149.5	0
Okatie Creek/Hidden Cypress Golf Club	07GC030	Middle Floridan	110	29.49
Belfair Property Owners Association	07GC031	Middle Floridan	97.5	94.3
Ocean Creek Golf Course	07GC032	Gramling	62.9	26.14
Oldfield Club	07GC034	Middle Floridan	75	56.23
Eagle's Pointe Golf Club	07GC036	Middle Floridan	75	24.6
Crescent Pointe Golf club	07GC037	Middle Floridan	75	46.8
Colleton River Club - Dye Course	07GC038	Middle Floridan	170	19.78
Chechessee Creek Club	07GC039	Middle Floridan	50	34.795
Haig Point Club & Community Association	07GC040	Surficial Middle Floridan	18 110	8.25 27.7
Berkeley Hall Club	07GC041	Upper Floridan Middle Floridan	18	1.78 12.648
Hampton Hall Golf Club	07GC045	Middle Floridan	60	7.978
Pinecrest Golf Club	07GC046	Middle Floridan	100	16.185
May River Golf Club	07GC047	Middle Floridan	85	32.431
Bray's Island Plantation Colony	07GC048	Upper Floridan Middle Floridan	60	2.42440 0

Facility	Permit No.	Aquifer(s)	Permit Limit (MGY)	2020 Water Use (MG)
Argent 2 Golf Course	07GC049	Middle Floridan	55	21.009
Resort Services Inc.	07IN005	Upper Floridan	48	16.137
Kuzzens Inc. - Capers Farm	07IR003	Surficial	60.3	11.67
Seaside Farm, Inc.	07IR007	Upper Floridan	300	162.36
Dempsey Farms	07IR008	Upper Floridan	25	3.16
Kuzzens Inc. - Bayview Farm	07IR018	Upper Floridan	99.063	36.42
Kuzzens Inc. - Lobeco Farm	07IR054	Upper Floridan Gordon	159.8	0 0
Kuzzens Inc. - Johnny & Norman Jones Farm	07IR056	Upper Floridan	84	45.05
Kuzzens Inc. - Orange Grove Farm	07IR057	Upper Floridan	116.6	34.78
Henry Farms	07IR058	Upper Floridan	98	0
Station Creek Inc. - Seaside Farms	07IR059	Upper Floridan	45	0
Kuzzens Inc. - Station Creek Farm	07IR060	Upper Floridan	80	0
Kuzzens Inc. - Pine Grove Farm	07IR064	Upper Floridan	45.783	11.28
Kuzzens Inc. - Tommy Sanders Fields	07IR066	Upper Floridan	26.93	16.3
Kuzzens Inc. - Penn Center Fields	07IR067	Upper Floridan	89.76	41.931
Coosaw Ag, LLC	07IR068	Upper Floridan	105	88
Beaufort National Cemetery	07IR069	Upper Floridan	15.552	7.551
Coosaw Ag, LLC - Station Creek	07IR070	Upper Floridan	105	17
Henry Farms North	07IR071	Upper Floridan	38	0
Country Club Bluff Lake Association	07OT021	Surficial	54	19.75
Beaufort Jasper W&SA - Main Plant	07WS005	Upper Floridan	300	220.593
Broad Creek PSD - Main Water System	07WS014	Upper Floridan	623.8	597.7
South Island PSD - Main Complex[a] South Island PSD – Long Cove South Island PSD - Cordillo South Island PSD – Wexford Club	07WS016 07WS052 07WS053 07WS054	Upper Floridan Middle Floridan Gramling	1,695.256 526 1,825	1,613.73 288.657 540.295
Hilton Head No. 1 PSD	07WS017	Upper Floridan	895.942	381.17888
Hilton Head No. 1 PSD	07WS018	Middle Floridan	1,961.27	1,831.45
Daufuskie Island Utility Co. - Melrose Pappy	07WS028	Upper Floridan	49.116	14.051
Daufuskie Island Utility Co. - Haig Point	07WS032	Upper Floridan	75	71.706
Daufuskie Island Utility Co. – Melrose Stable	07WS051	Upper Floridan	49.116	8.435
Bray's Island Plantation Colony	07WS055	Upper Floridan	20	2.50733
		TOTALS	11,673	6,975

[a]The four South Island PSD facilities have separate ID's but are on the same permit.

Colleton County Details

Colleton County has 13 permitted facilities that own a total of 69 wells (Table 4). The total reported withdrawals for 2020 were 51% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for the county is the Gordon Aquifer supplying 55% (1,177 MG) of the total reported water use for 2020, followed by the Charleston Aquifer at 17% (353 MG) (Table 4).

Table 4. Permit Limits and 2020 Reported Water Use - Colleton County

Facility	Permit No.	Aquifer(s)	Permit Limit (MGY)	2020 Water Use (MG)
Plantation Course at Edisto, LLC	15GC001	Middle Floridan Gordon	80	9.5 0
Cherokee Plantation Owners, LLC	15GC003	Middle Floridan	72	56.3
Williams Farms Partnership	15IR012	Upper Floridan Middle Floridan Gordon	2,294.4	162 0 904
Carter Farms	15IR016	Gordon	42	3
Indigo Branch Farm	15IR017	Gordon	15	1
Rizer Farms	15IR018	Gordon	105	15.8
Federate Farm, LLC	15IR019	Gordon	67.5	11.648
Kinard Farms	15IR020	Gordon	15	2.958
Benton Farms	15IR021	Gordon	302	57.422
Big O Farm, LLC	15IR022	Crouch Branch	50	22
Carolina Turfgrass and Landscape Supply	15IR025	Middle Floridan-Gordon	45	31.867
City of Walterboro	15WS001	Gordon Crouch Branch Charleston	778.3	180.7 89.15 353.2
Town of Edisto Beach	15WS002	Aquifer Zone Used By Edisto Beach	327	233.318
		TOTALS	4,193	2,134

Hampton County Details

Hampton County has 42 permitted facilities that own a total of 175 wells (Table 5). The total reported withdrawals for 2020 were 56% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for the county is the Upper Floridan Aquifer supplying 62% (2038.6 MG) of the total reported water use for 2020, followed by the Floridan Aquifer at 17% (571.2 MG) (Table 5).

Table 5. Permit Limits and 2020 Reported Water Use - Hampton County

Facility	Permit No.	Aquifer(s)	Permit Limit (MGY)	2020 Water Use (MG)
Fish Network, Inc.	25AQ033	Upper Floridan	190	157
Recycled Group of South Carolina, LLC	25IN001	Gordon	393.4	0
Youmans Farms - Peeples Pivot	25IR004	Gordon	96	44.1
Corrin F. Bowers & Son	25IR005	Upper Floridan	429	123.03
Rouse Farms	25IR015	Upper Floridan Floridan[a]	395.93	71.2 328.53
Mole Farms	25IR018	Floridan[a] Gordon	36	8.1 18.6
Corrin F. Bowers & Son - Laffitte	25IR025	Upper Floridan	125	65.14
Crapse Farms	25IR027	Upper Floridan	350	187.6
Mickey Ginn Farm	25IR028	Upper Floridan	60	43.1
Kuzzens Inc. - Weekly Farm	25IR029	Middle Floridan Gordan	78	0 0
Kuzzens Inc. - Varnville Farm	25IR030	Gordon-Crouch Crouch Branch	108	5.51 14.23
Nimmer Turf & Tree Farm	25IR031	Upper Floridan	48	35.04
Nimmer Turf & Tree Farm	25IR032	Upper Floridan	36	9.513
Mixon 100 Acre Plot	25IR033	Middle Floridan	72	33.6
TBR Way	25IR034	Middle Floridan	36	19.1
Jarrell Jerry Farms	25IR051	Upper Floridan	45	45
David Jarrell Farm	25IR052	Upper Floridan	36	19
Nimmer Turf & Tree Farm	25IR053	Upper Floridan	120	68.44
Nimmer Turf & Tree Farm	25IR055	Upper Floridan	55	10.82
Nimmer Turf & Tree Farm - Estill Farm	25IR056	Upper Floridan	98	38.37
Nimmer Turf & Tree Farm - Ti Aun Crossroads	25IR058	Upper Floridan	36	6.5
Coosaw Ag., LLC	25IR059	Upper Floridan Middle Floridan	178.2	27 64.9
Jarrell Jerry Farms - Hamilton Road	25IR060	Upper Floridan	36	13.5
T&J Farms	25IR061	Upper Floridan	41	40
Corrin F. Bowers & Son	25IR062	Upper Floridan	36	17.5872
C&C Farms of Brunson	25IR064	Upper Floridan Gordon	140	30 100

Facility	Permit No.	Aquifer(s)	Permit Limit (MGY)	2020 Water Use (MG)
Youmans Farms	25IR065	Upper Floridan Upper Floridan-Middle Floridan	1,252.8	519.25 164.21
McMillan Farms	25IR066	Upper Floridan	86	27.36
Sarah Tuten Field	25IR068	Upper Floridan	45	77.26
Griner Farms - Doc Harper & Lawton	25IR069	Upper Floridan Floridan[a]	82	38.27 34.61
Griner Farms – Tuten	25IR070	Upper Floridan	112	82
C&C Farms of Brunson	25IR071	Floridan[a]	200	200
Tony Jarrell Farm	25IR072	Upper Floridan	40	21.85897
Tony Jarrell Farm	25IR074	Upper Floridan	44	4.75195
J&J Farms of Estill SC	25IR075	Upper Floridan	32.5	8.1
Lowcountry Regional Water System – Hampton	25WS001	Crouch Branch Gordon	150	73.632 27.034
Lowcountry Regional Water System – Varnville	25WS002	Crouch Branch	111	145.02
Town of Estill	25WS003	Upper Floridan	225	173.73
Lowcountry Regional Water System – Yemassee	25WS004	Upper Floridan Gordan	73	33.6 17.3
Town of Furman	25WS006	Upper Floridan Middle Floridan Gordan	24	3.18 7.66 6.84
Lowcountry Regional Water System - Brunson & Gifford	25WS007	Upper Floridan Gordon	72	33.4 0.89
Lowcountry Regional Water System – Hampton County Industrial Park	25WS009	Upper Floridan	36	8.006
		TOTALS	5,860	3,279

[a]Some wells are known to be in one of the Floridan Aquifers, but which is not known.

Jasper County Details

Jasper County has 21 permitted facilities that own a total of 46 wells (Table 6). The total reported withdrawals for 2020 were 39% of the total permitted annual withdrawal limits for the county. The largest source of groundwater for the county is the Upper Floridan Aquifer supplying 54% (473 MG) of the total reported water use for 2020, followed by the Middle Floridan Aquifer at 38% (337 MG) (Table 6).

Table 6. Permit Limits and 2020 Reported Water Use - Jasper County

Facility	Permit No.	Aquifer(s)	Permit Limit (MGY)	2020 Water Use (MG)
Hampton Pointe Golf Course	27GC002	Middle Floridan	60	21.4
Golf Club at Hilton Head Lakes	27GC003	Middle Floridan	36	19.1
Congaree Golf Club	27GC051	Upper Floridan Floridan	223	44.32 1.196
Wise Batten Farm	27IR001	Upper Floridan	85	43.1
Nimmer Turf & Tree Farm - Main Farm	27IR004	Upper Floridan	200	143.37
Nimmer Turf & Tree Farm - Former Creekside	27IR007	Upper Floridan	30	4.131
Nimmer Turf & Tree Farm - Hwy 652	27IR008	Upper Floridan	45	21.615
Nimmer Turf & Tree Farm - Nursery	27IR009	Middle Floridan	44.1	25.179
Nimmer Turf & Tree Farm - Hwy 278	27IR010	Upper Floridan	63.5	60.654
Nimmer Turf & Tree Farm - Coosawahatchie	27IR011	Upper Floridan	22	3.521
Low Country Chemical Lawn Care Inc. - Coosawhatchie	27IR013	Upper Floridan	42	9.159
Nimmer Turf & Tree Farm - Road 654	27IR014	Upper Floridan	70	34.749
Youmans Farms - Barnes Robertville	27IR046	Upper Floridan- Middle Floridan	190	48.5
Youmans Farms - Church Newground	27IR047	Upper Floridan- Middle Floridan	44	8.64
CW Degler Septic Tank	27IR049	Floridan	0	0.2
Minto Communities - Margaritaville	27IR050	Upper Floridan Middle Floridan	1 64	4.54 81.53
Beaufort Jasper W&SA - Hardeeville	27WS001	Upper Floridan Middle Floridan	10	0.154 0
Town of Ridgeland	27WS002	Upper Floridan Middle Floridan	675	84.35 189.26
Beaufort Jasper W&SA - Point South	27WS004	Upper Floridan	250.7	17.53
Beaufort Jasper W&SA - Levy	27WS005	Upper Floridan	83.87	0.121
Beaufort Jasper W&SA - Palm Key	27WS006	Upper Floridan	4	1.94
		TOTALS	2,243	876

Aquifer Demand Details

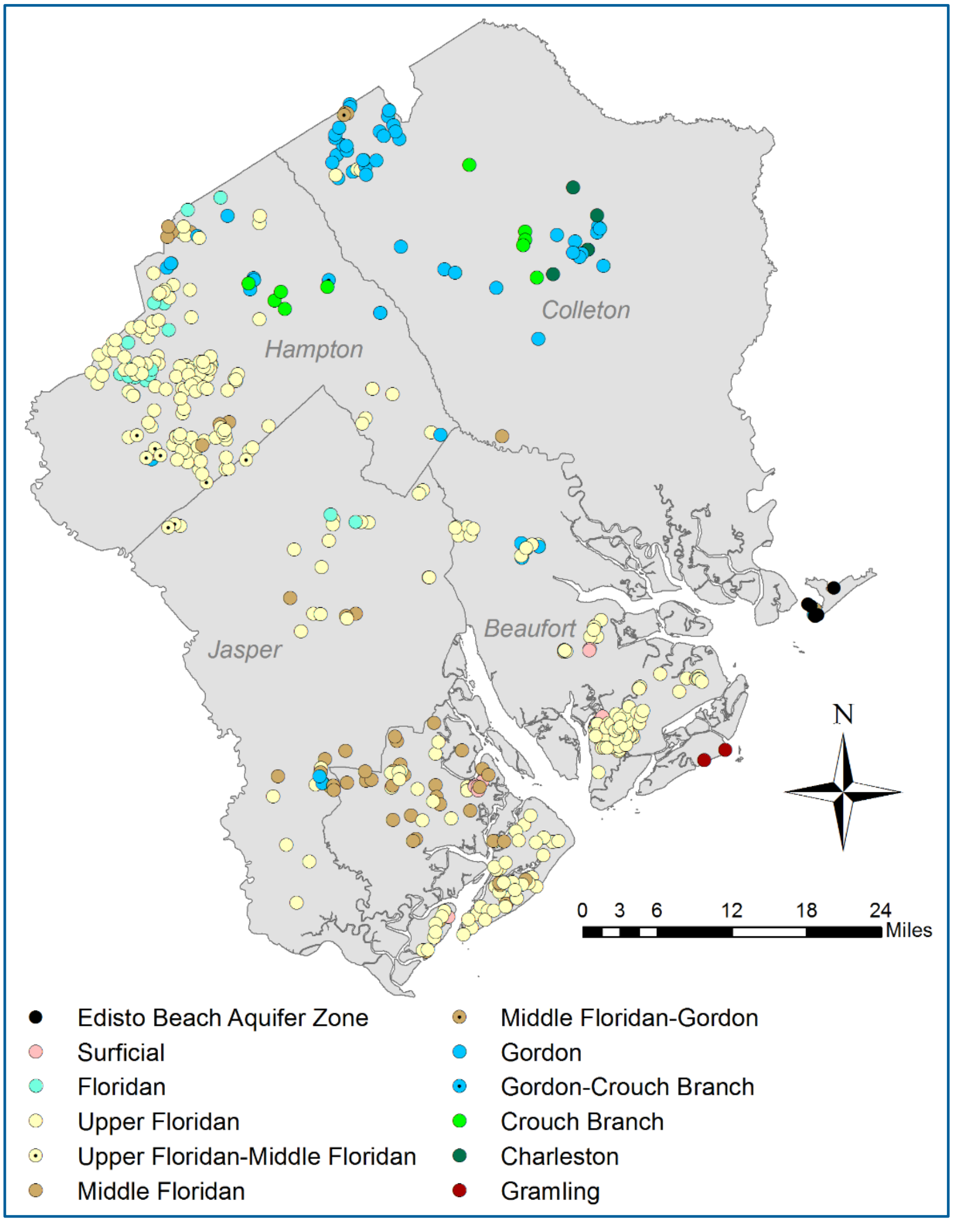


Figure 10. Lowcountry Area map showing the locations of capacity use wells that reported water use for 2020. Different symbol colors represent the aquifer into which each well is screened. Symbols with black dots in the center indicate wells that are screened across two different aquifers.

The combined aquifers of the Floridan Aquifer System (Upper Floridan, Middle Floridan, cross-screened Upper-Middle Floridan, and those in an unknown portion of the Floridan System) are the most heavily used in the Lowcountry Area both in terms of number of wells (395, 79%) and groundwater demand (10,326 MG, 78%). This is followed distantly by wells screened in the Gordon Aquifer (60, 12%) with reported water use of 1,399 MG (11%). Fewer than 20 capacity use wells are screened in each of the remaining available aquifers (Fig. 10, Table 7). The Floridan Aquifer System wells are located almost entirely in Hampton, Jasper, and Beaufort Counties, and the Gordon and Crouch Branch Aquifer wells are primarily in Colleton and northeastern Hampton Counties. Edisto Island taps a portion of the local, surficial aquifer.

Table 7. Number of Wells and 2020 Reported Water Use by Aquifer - Lowcountry Area

Aquifer	Number of Wells (%)	2020 Reported Water Use MG (%)
Edisto Beach Aquifer Zone	9 (2%)	237 (2%)
Surficial	14 (3%)	76 (1%)
Floridan	16 (3%)	573 (4%)
Upper Floridan	307 (62%)	6,226 (47%)
Upper Floridan-Middle Floridan	10 (2%)	221 (2%)
Middle Floridan	62 (12%)	3,306 (25%)
Middle Floridan-Gordon	2 (<1%)	32 (<%)
Gordon	60 (12%)	1,399 (11%)
Gordon-Crouch Branch	1 (<1%)	6 (<1%)
Crouch Branch	9 (2%)	266 (2%)
Charleston	4 (1%)	353 (3%)
Gramling	3 (1%)	568 (4%)
Total	497 (100%)	13,264

Cross-Screened Aquifer Wells

There are 13 capacity use wells that are screened across a confining unit to connect two aquifers. These 13 wells reported water use of 259 MG for 2020, and the aquifers connected by these wells are the Upper and Middle Floridan, the Middle Floridan and Gordon, and the Gordon and Crouch Branch.

Historic Reported Water Use: 2001 – 2020

From 2001 through 2020, water use within the Lowcountry Area has remained relatively constant. Reduced water use from water supply and irrigation capacity use wells was reported for 2003 to 2005, 2013, and 2015 (Fig 11). These reductions correspond to years in which the Lowcountry Area received sufficient rainfall during the growing season and summer months—reducing the need for irrigation for crops and lawns (See Appendix A). Similar to the pattern of reported water use in 2020, water supply and irrigation make up the largest reported water volume over the past 20 years (Fig. 11). There has been a steady reduction in reported use from industrial wells, and comparatively unchanged water use from golf course and aquaculture wells.

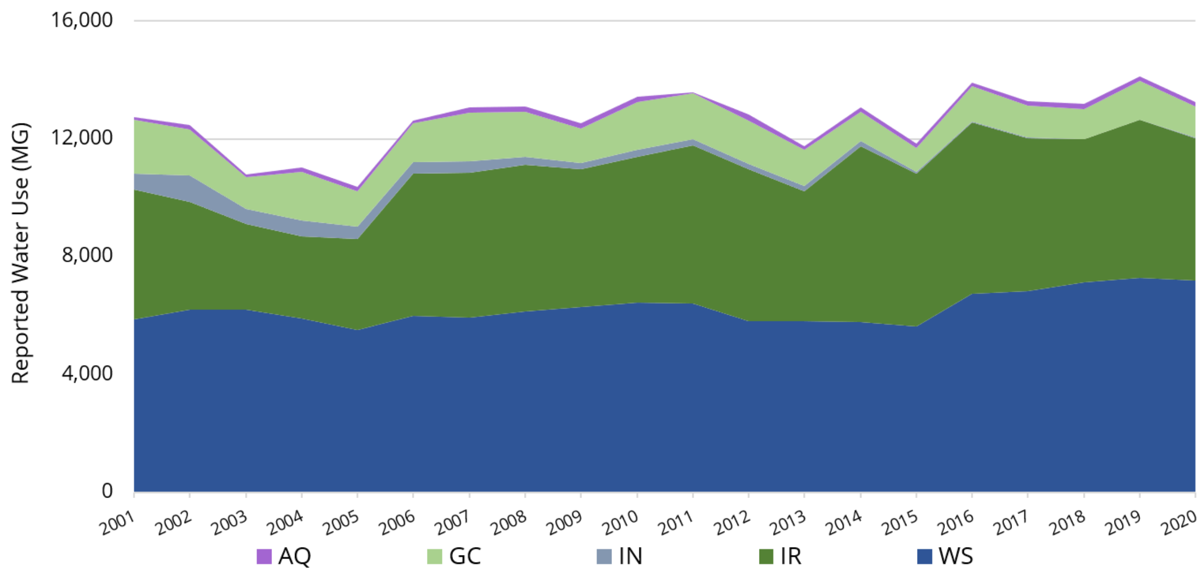


Figure 11. Lowcountry Area reported water use by category from 2001 to 2020.

Comparing historic (2001 to 2020) reported groundwater use across the Lowcountry Area counties shows Beaufort County consistently reported larger groundwater use volumes than the others (Fig. 12). Hampton and Colleton Counties reported the next largest volumes that were also similar to each other. Finally, Jasper County has reported much smaller volumes of groundwater use. These trends among use types (Fig. 11) and distribution among the Lowcountry counties (Fig. 12) were also seen in the most recent reported water use (2020).

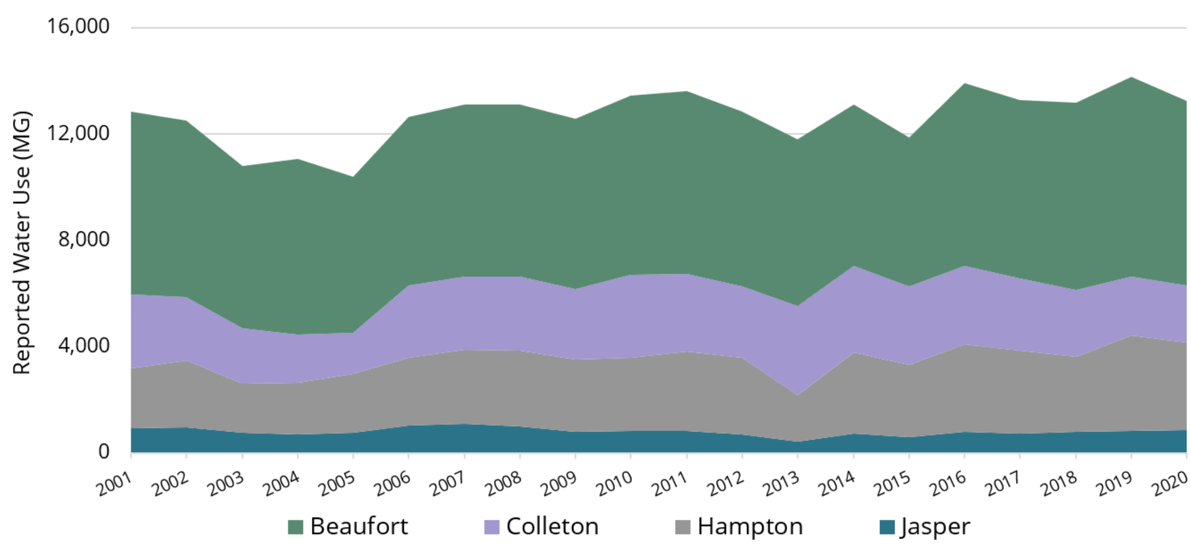


Figure 12. Lowcountry Area reported water use by county from 2001 to 2020.

The total population in the Lowcountry Area has increased by 76,000 over the past 20 years—primarily the result of population increases in Beaufort County and, to a lesser degree, Jasper County. Colleton County's population has remained relatively unchanged, and population decreased in Hampton County (Fig. 13). Reported groundwater use in the Lowcountry Area did not reflect a similar increase (Fig. 12) as seen in the population growth.

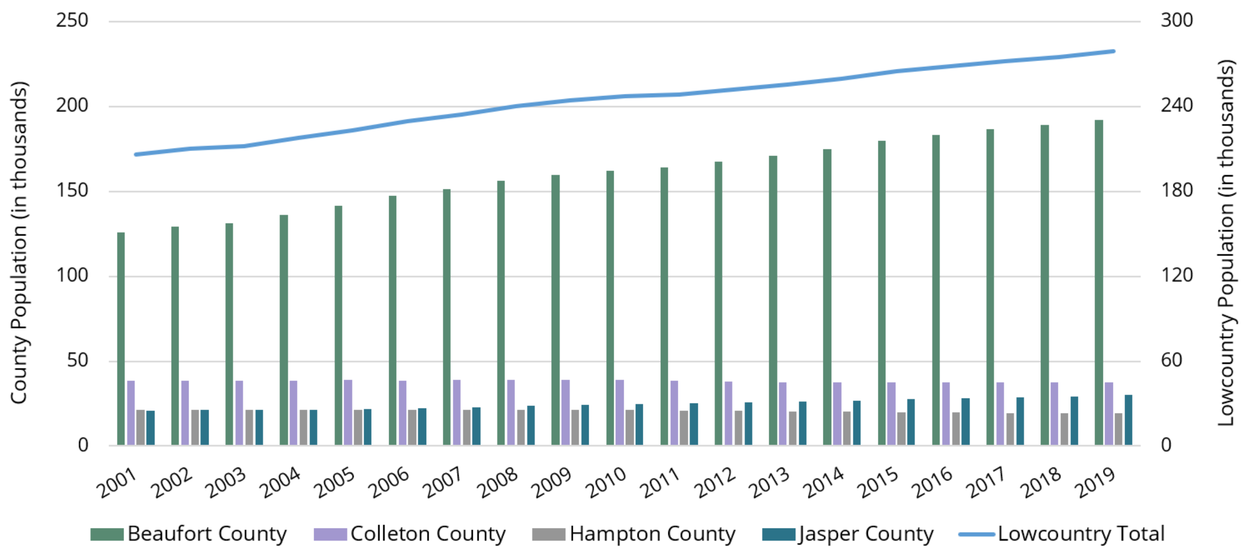


Figure 13. Population estimates and census data for the Lowcountry Area (blue line) and each county (vertical bars). www.census.gov; accessed August 4, 2021.

Groundwater Impacts

In order to assess the ongoing conditions of the aquifers in South Carolina, water levels are measured manually or by using automatic data recorders (pressure transducers) in wells screened in all of the CPSC aquifers. The groundwater monitoring network used for these measurements is maintained by DNR and the U.S. Geological Survey (USGS). These water level measurements are used to understand the impact of groundwater withdrawal over time, as well as provide an areal[2] snapshot of groundwater conditions at a specific time. The extent of the DNR well network may be seen in the map in Appendix B.

Groundwater Trends

There are currently 30 public monitoring wells located in Lowcountry Area counties (Table 8). The majority of these wells are screened in the Upper and Middle Floridan Aquifers and are located in Beaufort County. The length of time for which there are groundwater level measurements ranges from one to 66 years. All of the wells are maintained by DNR as part of their groundwater monitoring network with the exception of BFT-1810, which is maintained by the USGS.

[2] Pertaining to a two-dimensional extent, or over a specific area. In this case, the area of an aquifer.

Table 8. List of monitoring wells in Lowcountry Area counties with Aquifer and length of well record.

DNR Well ID	County	Aquifer	Record Length (years)
BFT-0101	Beaufort	Upper Floridan	66.0
BFT-0429	Beaufort	Upper Floridan	50.5
BFT-0563	Beaufort	Upper Floridan	4.7
BFT-1809	Beaufort	Middle Floridan	35.4
BFT-1810	Beaufort	Upper Floridan	13.6
BFT-1813	Beaufort	Middle Floridan	19.3
BFT-1814	Beaufort	Upper Floridan	34.3
BFT-1820	Beaufort	Middle Floridan	11.6
BFT-1822	Beaufort	Upper Floridan	11.6
BFT-1845	Beaufort	Middle Floridan	26.8
BFT-1846	Beaufort	Upper Floridan	27.3
BFT-2055	Beaufort	Gramling	19.8
BFT-2245	Beaufort	Upper Floridan	4.8
BFT-2247	Beaufort	Upper Floridan	4.8
BFT-2404	Beaufort	Upper Floridan	5.8
BFT-2408	Beaufort	Upper Floridan	5.8
COL-0030	Colleton	Crouch Branch	25.3
COL-0097	Colleton	Middle Floridan	43.9
COL-0301	Colleton	Gordon	21.5
COL-0803	Colleton	Surficial	0.7
HAM-0050	Hampton	Gordon	20.0
HAM-0083	Hampton	Upper Floridan	44.1
HAM-0314	Hampton	Upper Floridan	5.7
HAM-0315	Hampton	Middle Floridan	5.7
JAS-0425	Jasper	Upper Floridan	21.2
JAS-0426	Jasper	Charleston	18.4
JAS-0468	Jasper	Surficial	10.0
JAS-0490	Jasper	Middle Floridan	5.7
JAS-0491	Jasper	Upper Floridan	5.7
JAS-0492	Jasper	Middle Floridan	12.5

Upper Floridan

As stated previously, the Upper Floridan Aquifer is relied upon to the greatest extent as a groundwater resource in the Lowcountry Area. The Upper Floridan Aquifer below coastal Beaufort and Jasper Counties is also most heavily impacted by the large pumping cone beneath Savannah, Georgia. Monitoring wells BFT-0101 (Fig. 15 A), BFT-0429 (Fig. 15 B), and HAM-0083 (Fig. 15 L) have the longest water level records for the Upper Floridan—dating as far back as 1955 (well IDs underlined in Fig. 14). All three of these wells show an overall decline in water levels from 4 feet (HAM-0083) to 10 feet (BFT-0101). Over the past 20 to 30 years, water levels have not continued to drop, but have remained lowered from their previous mid-century levels. The additional pattern that is apparent in all of these well records is a decline in water level in the spring and summer months that rebounds in the fall and winter. This seasonal drawdown is due to increased spring and summer water use for irrigation and water supply. The longer well records also show that the amplitude of seasonal drawdown has increased to as much as 8 feet.

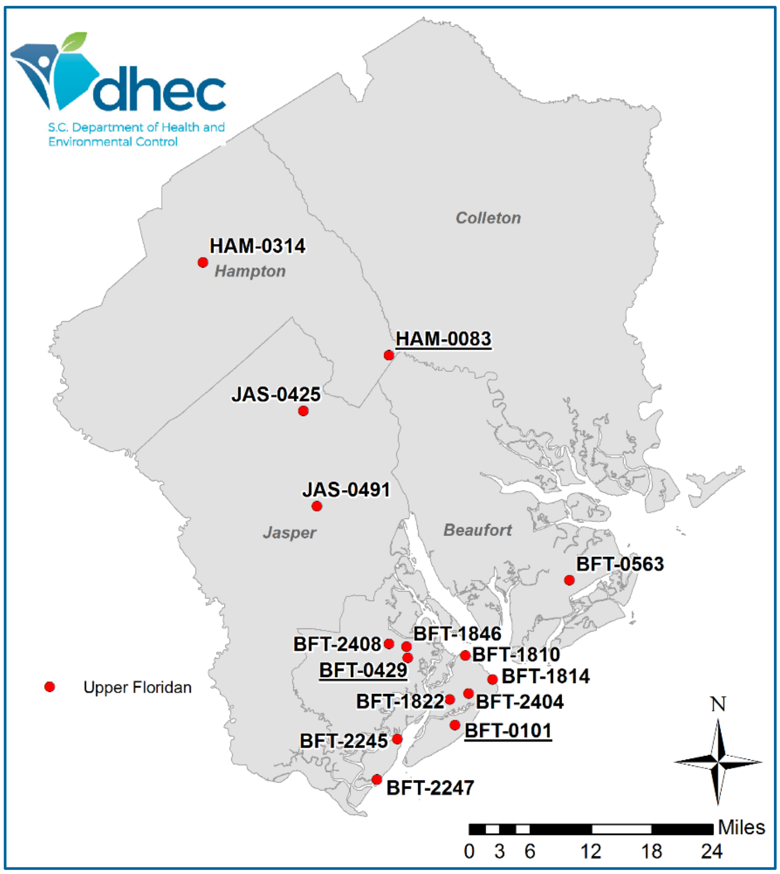


Figure 14. Lowcountry Area map showing the locations of monitoring wells screened in the Upper Floridan Aquifer. The water level records for each are presented below. Underlined Well IDs are discussed in the text.

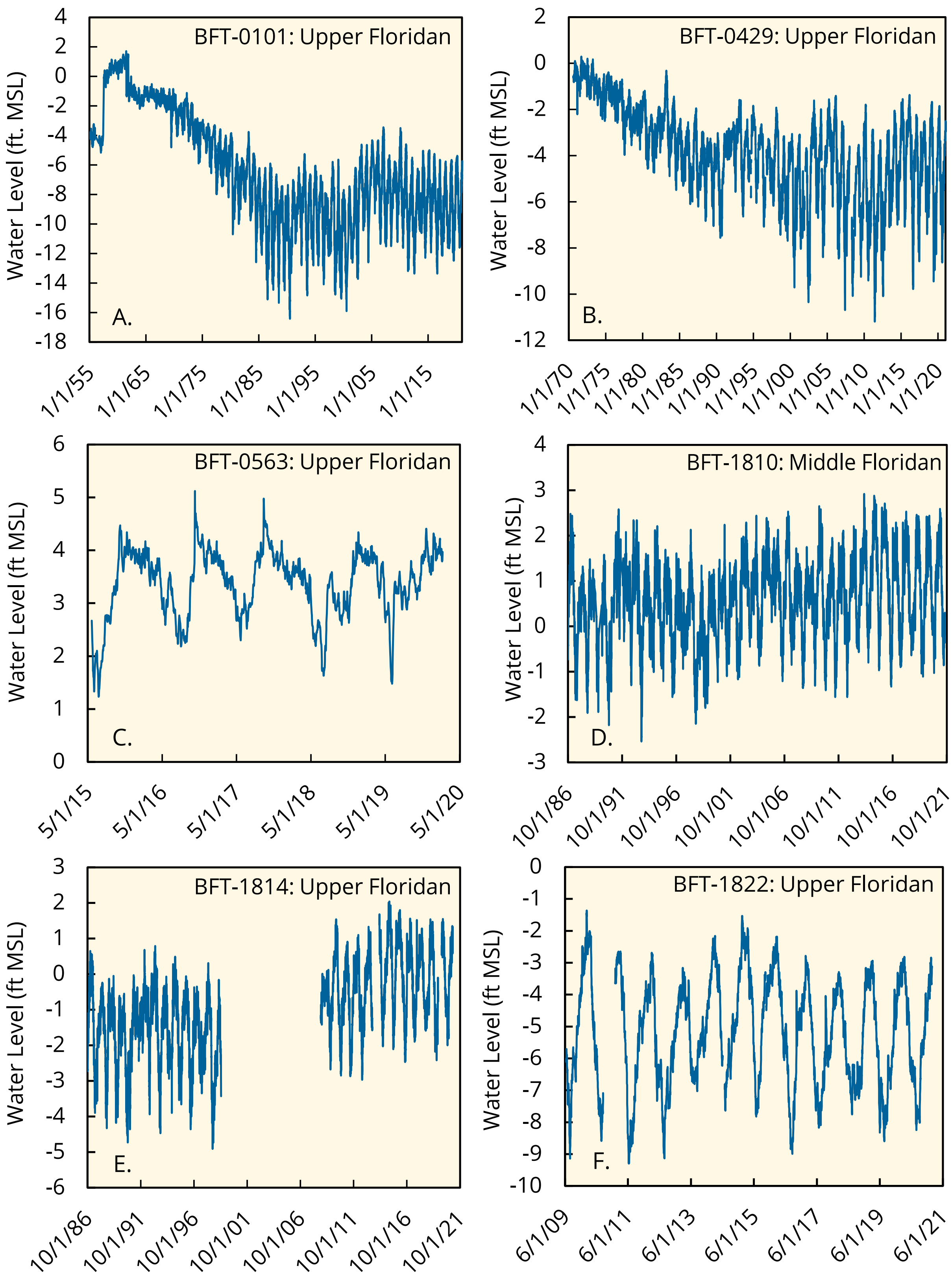


Figure 15. Water level plots from Upper Floridan Aquifer wells in the Lowcountry Area. Water levels are in feet relative to mean sea level (MSL). Figs. 15 A. through F. are plots from wells located in Beaufort County (see Fig. 14). http://hydrology.dnr.sc.gov/groundwater-data/; accessed over several days, July 2021.

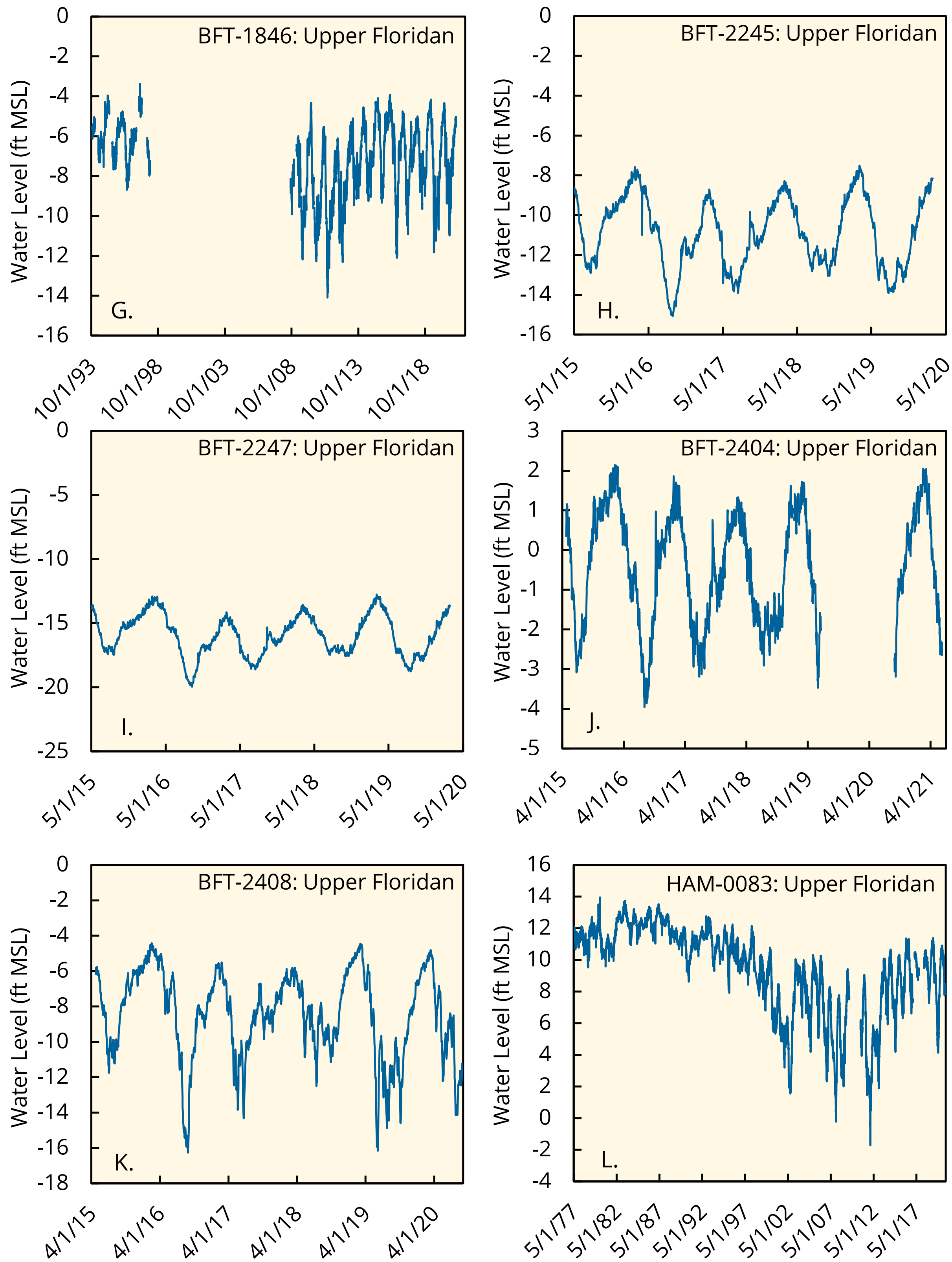


Figure 15, continued. Figs. 15 G. through L. are plots from wells located in Beaufort and Hampton Counties.

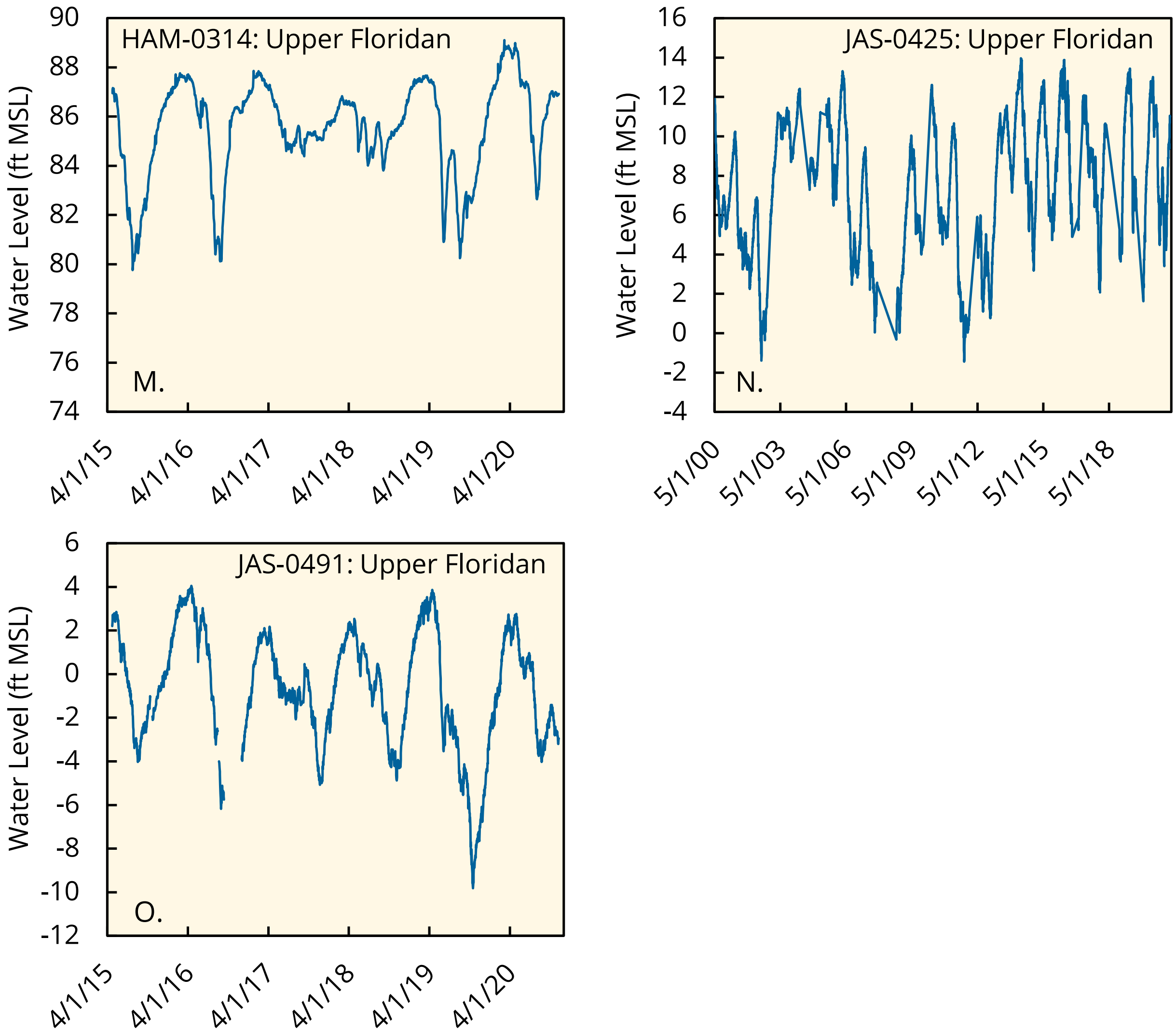


Figure 15, continued. Figs. 15 M. through O. are plots from wells located in Hampton and Jasper Counties.

Middle Floridan

The Middle Floridan Aquifer is the next most utilized groundwater source in the Lowcountry Area, and the majority of the monitoring wells are in Beaufort County. The well with the longest record is located in Colleton County (COL-0097), and it shows water levels declined by nearly 25 feet from 1977 through 2012. This was followed by a smaller recovery of about 8 feet through the fall of 2020. As with the Upper Floridan monitoring wells, seasonal drawdown of up to 10 feet is seen in the Middle Floridan water levels. Three of the Beaufort County wells (BFT-1809, BFT-1813, and BFT-1845) show an increase in the amplitude of the seasonal drawdown in recent years.

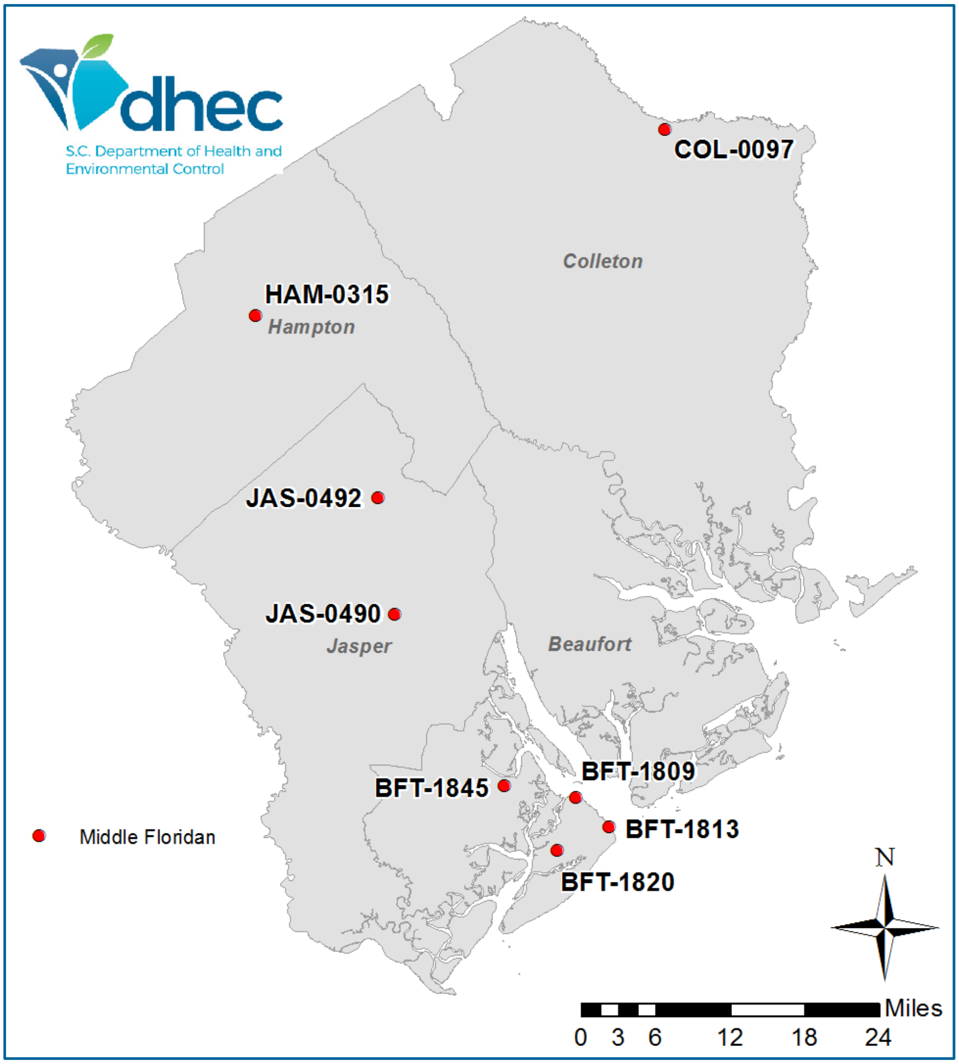


Figure 16. Lowcountry Area map showing the locations of monitoring wells screened in the Middle Floridan Aquifer. The water level records for each are presented below.

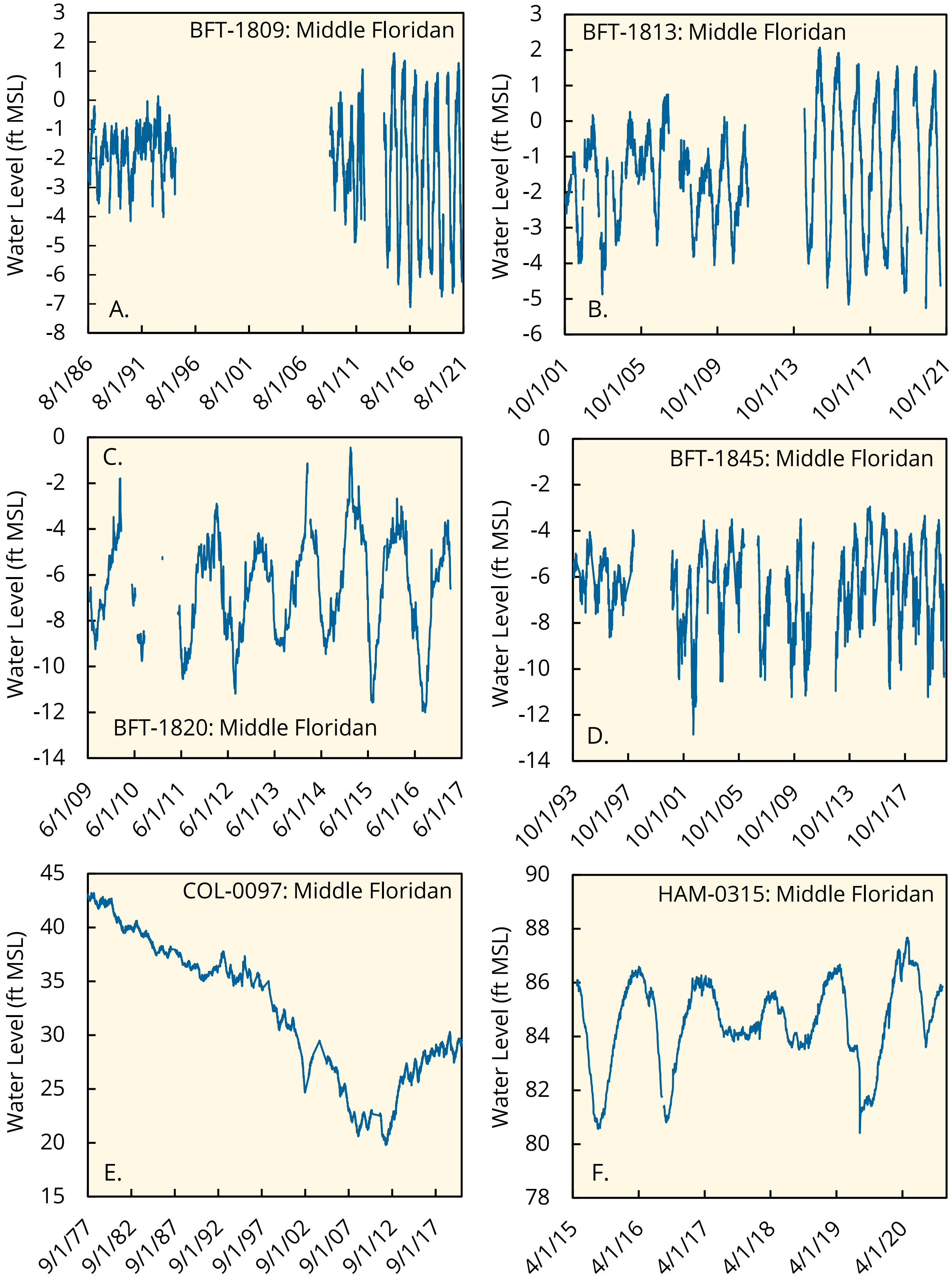


Figure 17. Water level plots from Middle Floridan Aquifer wells in the Lowcountry Area. Water levels are in feet relative to mean sea level (MSL). Figs. 17 A. through F. are plots from wells located in Beaufort, Colleton, and Hampton Counties (see Fig. 16). http://hydrology.dnr.sc.gov/groundwater-data/; accessed over several days, July 2021.

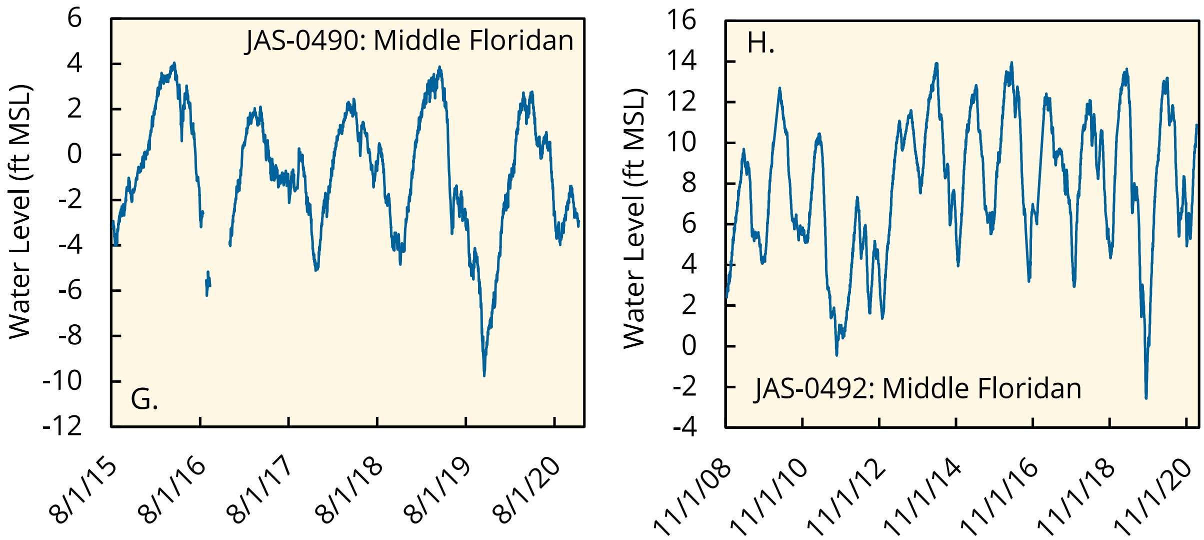


Figure 17, continued. Figs. 17 G. and H. are plots from wells located in Jasper County.

Surficial, Gordon, Crouch Branch, Charleston, and Gramling Aquifers

The remaining aquifers available as groundwater sources in the Lowcountry Area have only one or two monitoring wells each. Please note that these wells are also newer installations than those of the Floridan Aquifers, with water level record lengths of 20 years or less (except COL-0030 with a record length of 25 years). The water level records are presented here in order from shallowest to deepest aquifer. Because the Surficial Aquifer receives local recharge through precipitation, its water level profile reflects the local climate. The monitoring well in Jasper County (JAS-0468) reflects the drought/rain cycle for that area with lower water levels during the 2011-2012 drought and higher water levels during the years in which rainfall was abundant during the growing seasons (2013, 2016, and 2020).

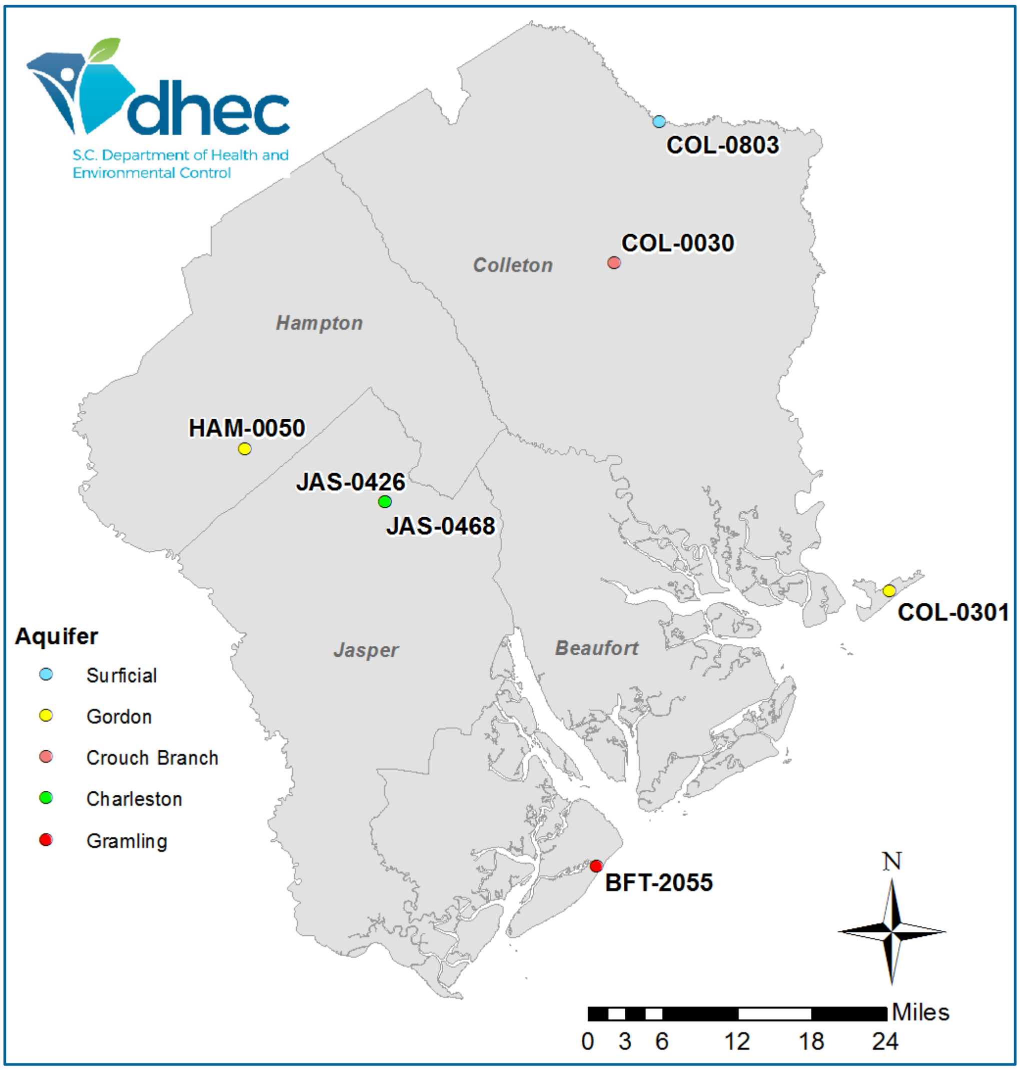


Figure 18. Lowcountry Area map showing the locations of monitoring wells screened in the Surficial, Gordon, Crouch Branch, Charleston, and Gramling aquifers. The water level records for each are presented below. Note that JAS-0468 (Surficial) and JAS-0426 (Charleston) wells are in a cluster of monitoring wells. Therefore, they cannot be differentiated at this map scale.

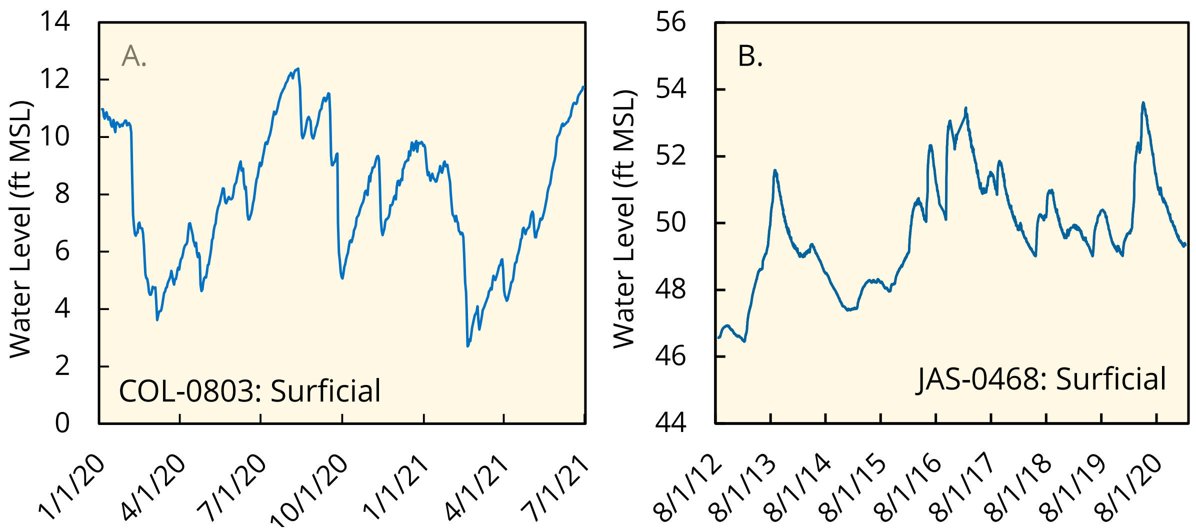


Figure 19. Water level plots from Surficial Aquifer wells in the Lowcountry Area. Water levels are in feet relative to mean sea level (MSL). Figs. 19 A. and B. are plots from wells located in Colleton and Jasper Counties (see Fig. 16). http://hydrology.dnr.sc.gov/groundwater-data/; accessed over several days, July 2021.

There are two monitoring wells in the Gordon Aquifer showing different water level records due to their locations. There are a greater number of capacity use wells in Colleton County than Hampton County. The Colleton County well (Fig. 20 A) shows both a steady decline in water level of 15 feet as well as a seasonal drawdown signal of about 8 feet over the past 21 years. In Hampton County the water level has increased by roughly 6 feet (Fig. 20 B). There is a seasonal drawdown pattern in this well record, but with a smaller amplitude when compared with the Colleton County well.

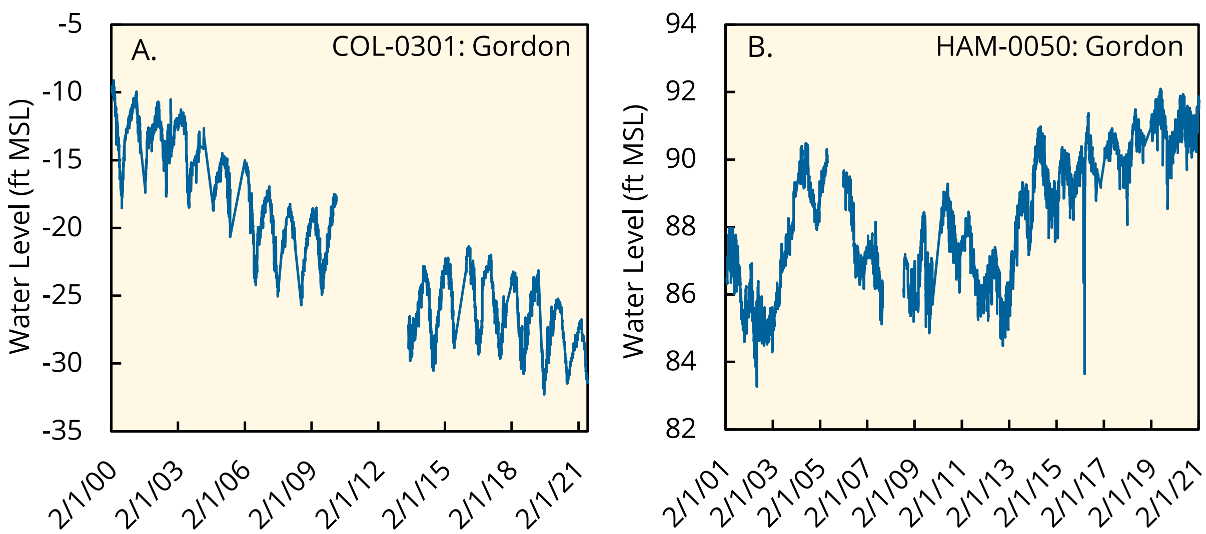


Figure 20. Water level plots from Gordon Aquifer wells in the Lowcountry Area. Water levels are in feet relative to mean sea level (MSL). Figs. 20 A. and B. are plots from wells located in Colleton and Hampton Counties (see Fig. 16). http://hydrology.dnr.sc.gov/groundwater-data/; accessed over several days, July 2021.

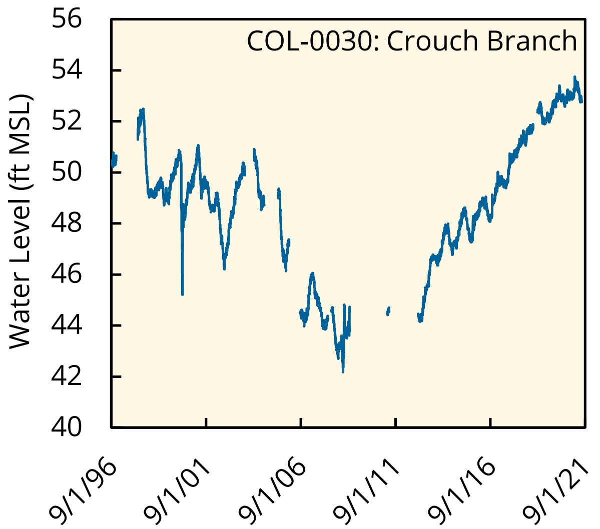


Figure 21. Water level plot from the Crouch Branch Aquifer well in the Lowcountry Area. Water levels are in feet relative to mean sea level MSL). http://hydrology.dnr.sc.gov/groundwater-data/; accessed over several days, July 2021.

The only monitoring well for the Crouch Branch Aquifer shows an overall decline in water level of 10 feet from 1996 through 2010. From 2010 through 2021, water levels recovered to elevations higher than those first recorded in 1996 (Fig. 21). There is also a small, seasonal drawdown with an average amplitude of 1 to 2 feet.

The Charleston and Gramling Aquifers are the two deepest within the layered sediment of the CPSC. The monitoring wells in each of these aquifers show that water levels have risen at each location by 20 and 25 feet, respectively. These monitoring wells do not record the presence of seasonal drawdown which may be due to the single, manual measurements through time compared to automatic data recording.

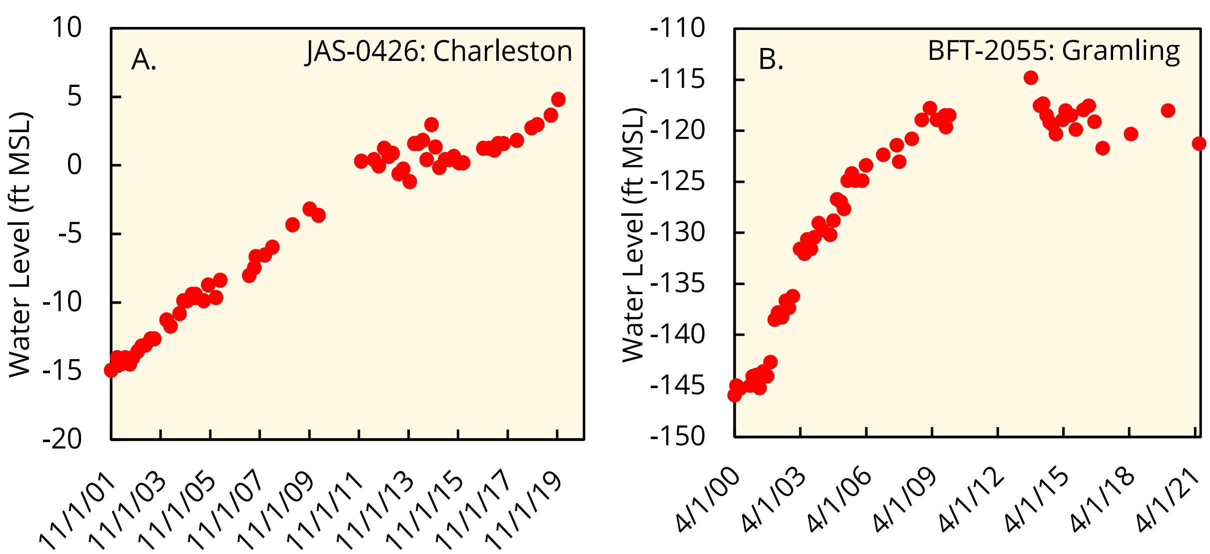


Figure 22. Manual water level measurements in the A) Charleston Aquifer and B) Gramling Aquifer in the Lowcountry Area. Water levels are in feet relative to mean sea level (MSL). http://hydrology.dnr.sc.gov/groundwater-data/; accessed over several days, July 2021.

Potentiometric Maps

Water level measurements also indicate the surface of the water table or the potentiometric surface at the well location (Fig. 23). The water table is the free surface of the groundwater in the surficial aquifer that receives recharge directly from precipitation. The potentiometric surface is the water level measured in a confined aquifer and represents the pressure of the overlying water and sediment at that location (the pressure surface). Concurrent water level measurements at several locations within a single aquifer can be combined to create a water table (surficial aquifer) or potentiometric (confined aquifer) map. Just as contour maps are made of the land surface by connecting points of equal elevation, water table and potentiometric maps are created by connecting points of equal water elevation or pressure.

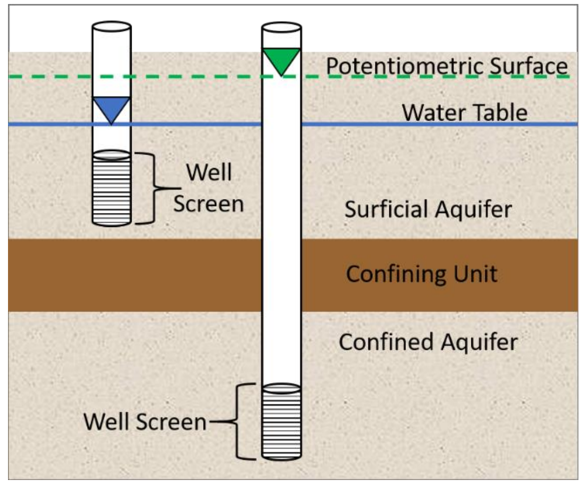


Figure 23. Illustration of a water table and potentiometric surface. Water levels in the wells are indicated by the blue (water table) and green (potentiometric surface) triangles.

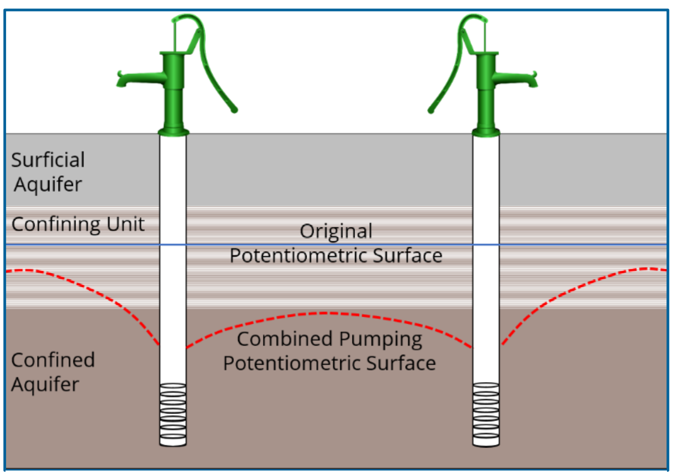


Figure 24. Illustration of the effect of combined pumping on a potentiometric surface.

These maps are used to evaluate groundwater conditions within an aquifer because groundwater withdrawal results in changes to these contour lines. Changes to the contour lines are especially important to note in confined aquifers in areas that take much longer to recharge. Groundwater withdrawal creates a greater impact in confined aquifers when large capacity wells are pumping in close proximity. The combined effect can create pumping cones (or cones of depression) that alter the potentiometric surface for miles from the pumping center (Figs. 24 and 25).

The contours of a potentiometric or water table map also point to changes in the direction of groundwater flow because groundwater flows perpendicular to (at right angles to) the contour lines from high to low water elevation (or pressure). Pumping cones change inland flow paths which can introduce contaminants to wells from any nearby source(s), cause other wells to experience reduced flow, and reduce the discharge to local streams and rivers. Coastal pumping cones reverse the normal offshore direction of net groundwater flow (Fig. 25). This reversal of groundwater flow at the coast can cause saltwater to infiltrate coastal wells.

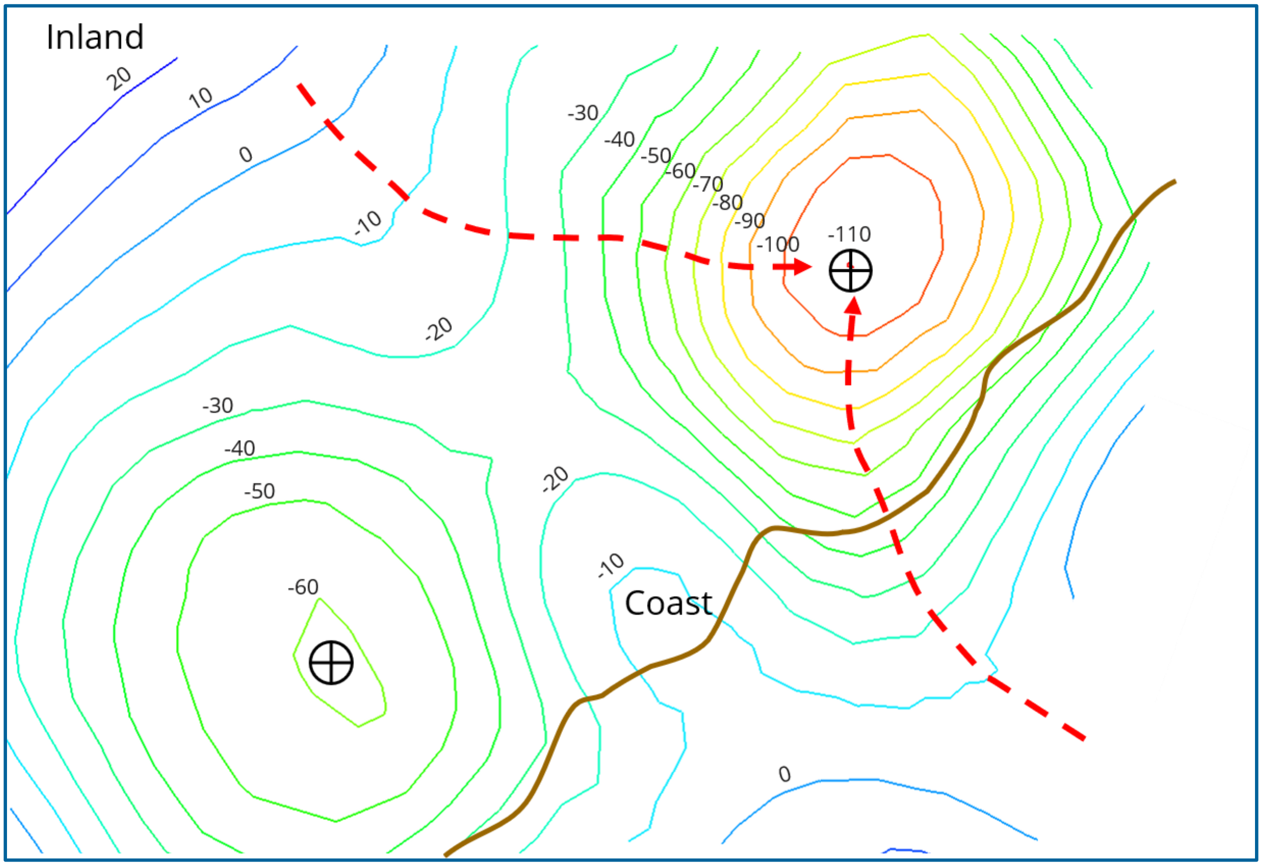


Figure 25. Illustration of a potentiometric map where contour lines show water level elevations from measurements in a confined, coastal aquifer. The numbers in this illustration are elevations in feet relative to mean sea level (the zero contour line). Negative values are feet below mean sea level, and the dashed red arrows indicate the direction of groundwater flow.

Beginning in 1987, SC DNR began publishing potentiometric maps from water level measurements in the aquifers of the CPSC. In addition to the wells presented above, others are used belonging to a variety of water suppliers, irrigators, and industry as well as the USGS. The following figures are a combination of these contour lines with water use data reported to DHEC. Groundwater withdrawal density maps were created using the annual reported groundwater withdrawal amounts from wells in the Lowcountry region. Areas with more intense shading represent higher concentrations of groundwater withdrawal and areas with lighter or no shading represent lower groundwater withdrawal amounts. Each density map was overlain with the corresponding potentiometric map for each year of withdrawal to show how the potentiometric surface has changed over time.

Floridan Aquifer System

The Floridan Aquifer System, formerly the Tertiary (Limestone/Sand) Aquifer System and Black Mingo Aquifer System, contains what are now known as the Upper and Middle Floridan Aquifers and the Gordon Aquifer (Gellici & Lautier, 2010). The aquifers of the Floridan Aquifer System are the most utilized source of groundwater in the Lowcountry Area and the most heavily impacted by the vast pumping cone that has developed below Savannah, Georgia (Appendix C). The pre-development map was made using historic water level data from wells screened in the Upper and Middle Floridan and Gordon Aquifers. The most recent measurements were published in 2018 as separate maps of the Upper and Middle Floridan Aquifers and Gordon Aquifers.

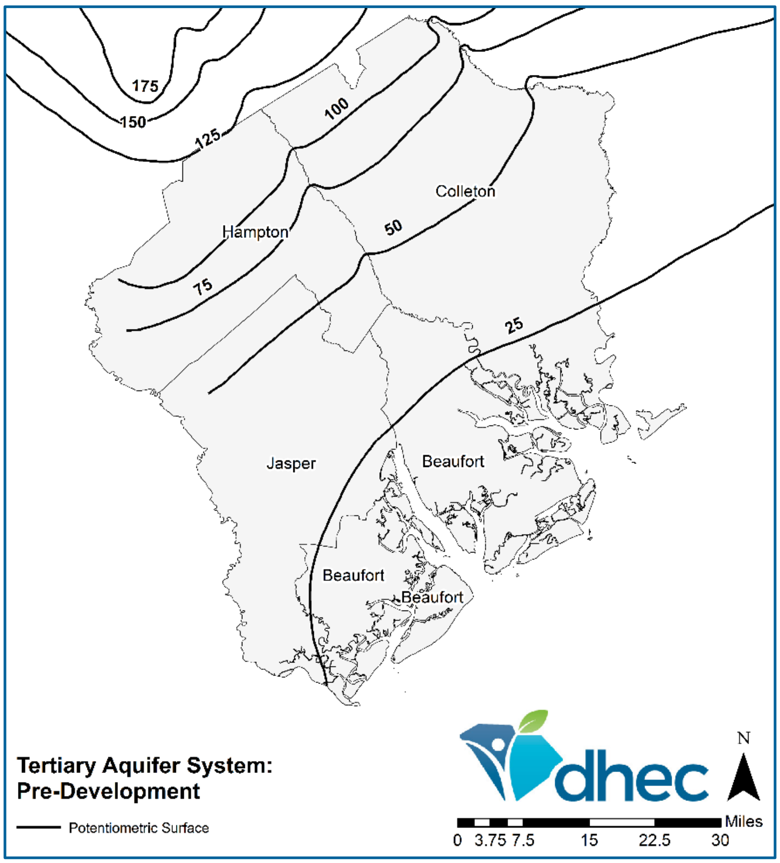


Figure 26. Pre-development potentiometric map of the Floridan Aquifer System in the Lowcountry Area (Aucott & Speiran, 1985). Contour lines are in feet relative to mean sea level (ft. MSL).

As you can see by the pre-development Map (Fig. 26), the potentiometric surface indicates that the water level nears zero (mean sea level) at the coast, and that the net movement of groundwater is in the southeasterly direction. The pre-development potentiometric maps were digitized by DNR from the maps in a 1985 USGS report (Aucott & Speiran, 1985), and are considered to be the potentiometric surfaces of the aquifers in the year 1900.

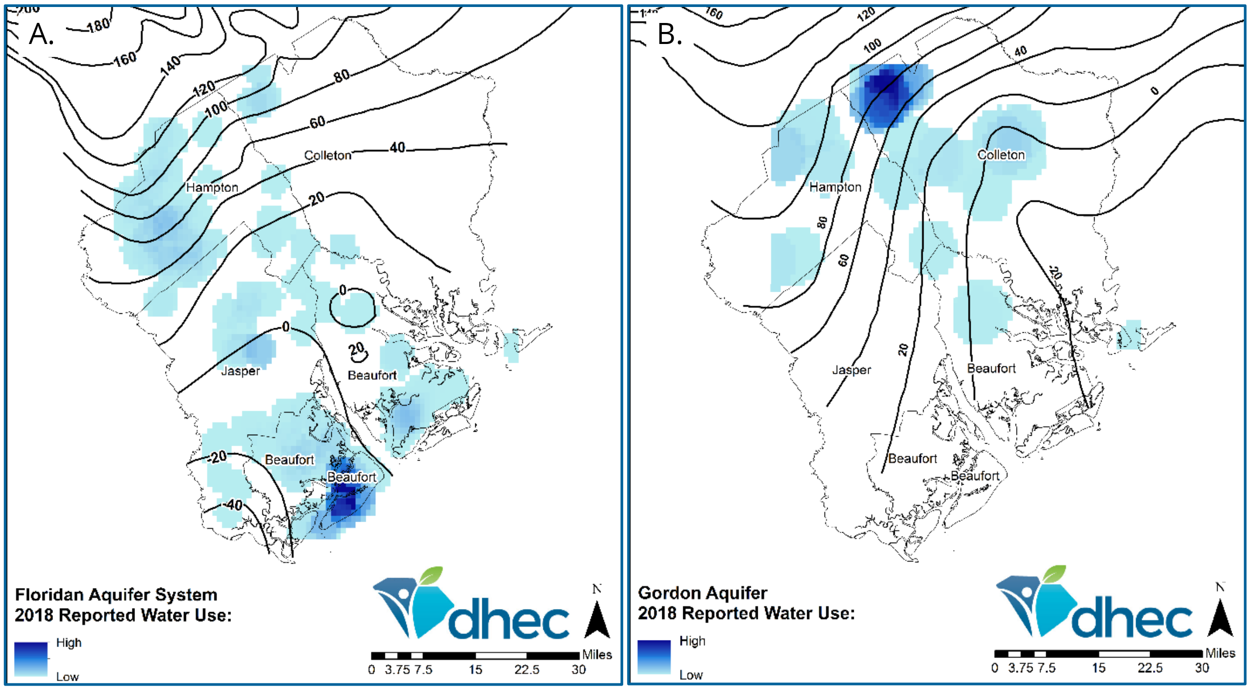


Figure 27. 2018 Potentiometric Maps of A. the Upper and Middle Floridan Aquifers and B. the Gordon Aquifer. (Czwartacki, Wachob, & Gellii, 2019)

The 2018 potentiometric map of the Upper and Middle Floridan Aquifers shows that there has been an overall decline in the potentiometric surface that ranges from 20 feet in northern Hampton and Colleton Counties to nearly 50 feet at the South Carolina-Georgia border in southern Jasper County (Fig. 27 A). Groundwater now flows in the direction of the pumping cone below Savannah, Georgia, instead of discharging to the coast in southern Jasper and Beaufort Counties. An area of high-density groundwater withdrawal in Beaufort County has intensified the lowering of the pressure surface below Hilton Head Island to be below sea level (Fig. 27 A). This resulted in the reversal of groundwater flow causing saltwater intrusion to the public supply wells and contributed to the loss of wells starting in 2000 for Hilton Head Public Service District (Hilton Head Public Service District, 2021).

High-density groundwater withdrawal from the Gordon Aquifer in northern Colleton County has resulted in the zero-contour line of the potentiometric surface to move nearly 45 miles inland from the coast, resulting in a water level drop of more than 20 feet in coastal Colleton County. The direction of groundwater flow in Jasper County has changed from a southeasterly direction to an easterly direction, but the zero-contour line remains near the coast.

Crouch Branch Aquifer

The pre-development potentiometric surface of the Crouch Branch Aquifer indicates that groundwater flowed in an easterly direction (Fig. 28 A). By 2016, the pressure surface had lowered by 75 feet in northern Colleton County to nearly 100 feet in coastal Colleton County, and the groundwater flow direction has shifted to the southeast (Fig. 28 B). There are no pumping cones in the Crouch Branch Aquifer below the Lowcountry Area counties, and only 9 capacity use wells reported 2020 reported water use from this aquifer. The Crouch Branch is not frequently tapped as a groundwater source in the Lowcountry Area because it would require drilling a well to depths of more than 1,000 feet below land surface, which is cost prohibitive.

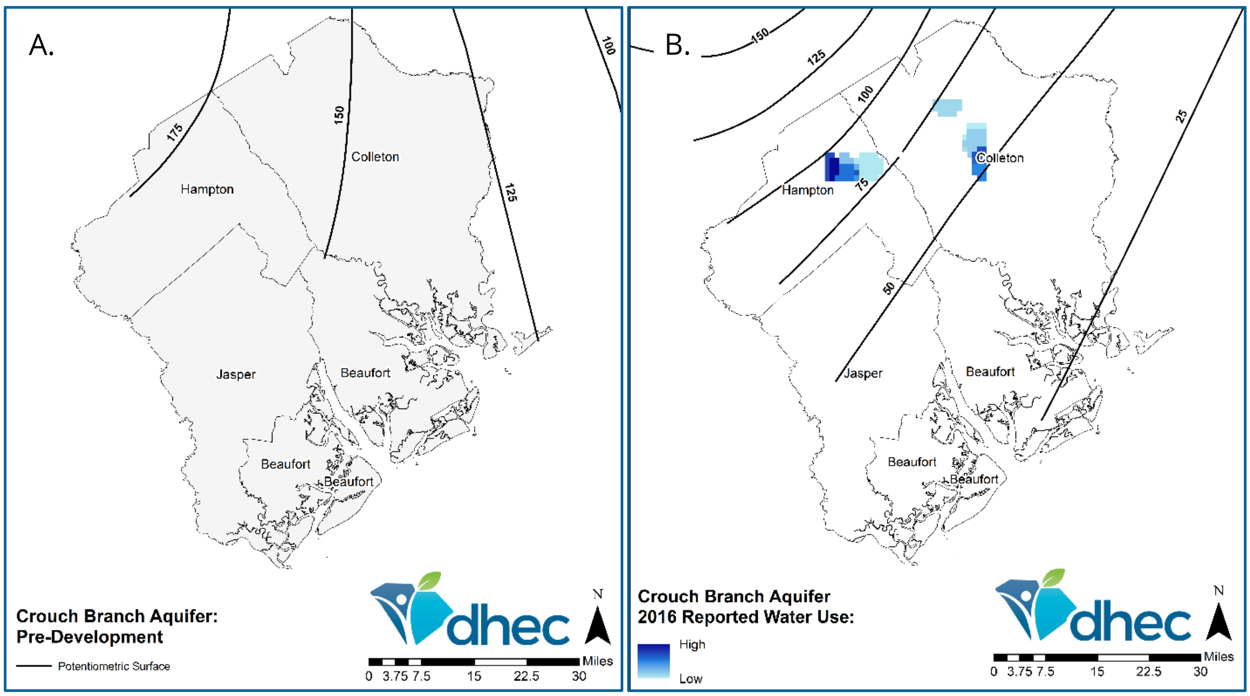


Figure 28. Potentiometric Maps of the Crouch Branch Aquifer in the Lowcountry Area A. pre-development (Aucott & Speiran, 1985), and B. from 2016 water level measurements (Wachob, Gellici, & Czwartacki, 2017). Contour lines are in units of feet relative to mean sea level (MSL).

McQueen Branch, Charleston, and Gramling Aquifers

These three aquifers are known collectively as the Middendorf Aquifer System, or simply the Middendorf, in South Carolina. They are now referenced individually as the McQueen Branch, Charleston, and Gramling Aquifers. The pre-development potentiometric map was created for the Middendorf, and SC DNR continues to publish potentiometric maps by combining data from all three of the Middendorf aquifers. Therefore, it is not possible to determine pressure surface changes unique to each aquifer. The only observation that can be made at this time is that there has been an overall lowering of the Middendorf when comparing the pre-development (Fig. 29 A) and 2019 (Fig. 29 B) potentiometric surfaces. A roughly 100-foot decline of the pressure surface has occurred below eastern Colleton County. The groundwater flow paths below the Lowcountry Area remain relatively unchanged.

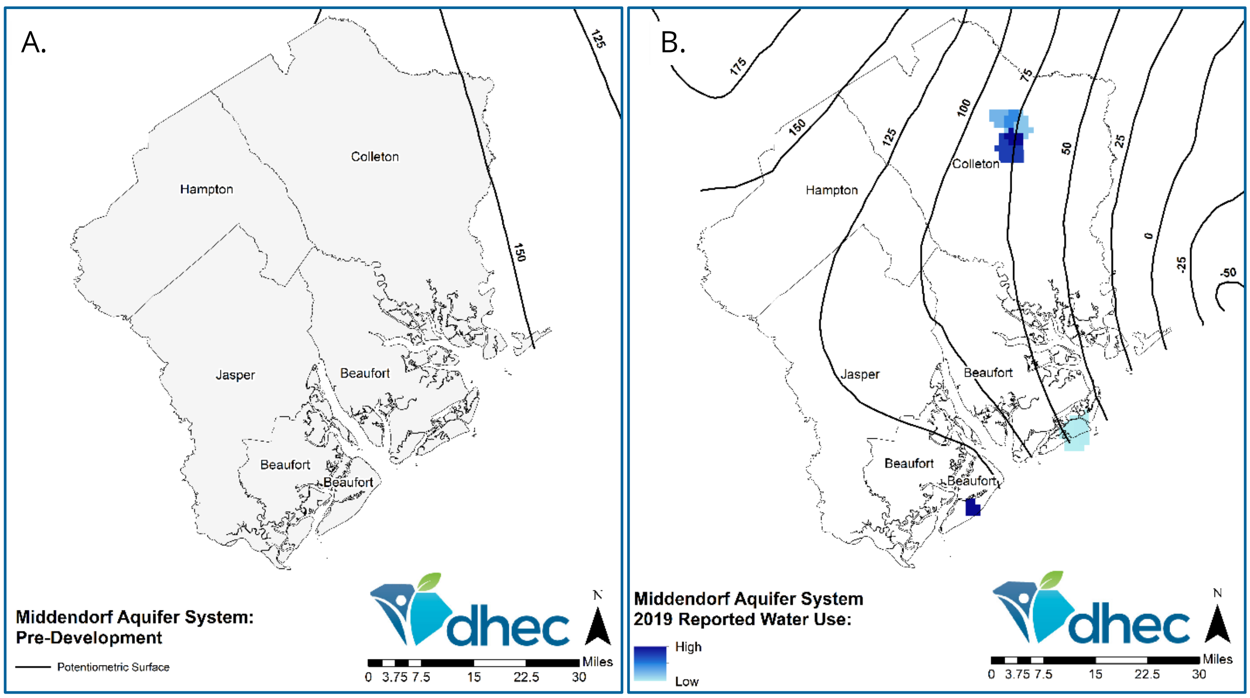


Figure 29. Potentiometric Map of the Middendorf Aquifer System in the Lowcountry Area A. pre-development (Aucott & Speiran, 1985), and B. from 2019 water level measurements (Czwartacki & Wachob, 2020).

Groundwater Evaluation

Water levels have declined since 1900 in all of the aquifers below the Lowcountry Area counties. The Upper Floridan Aquifer is of particular concern as it remains impacted by not only local groundwater withdrawal, but by the pumping cone below Savannah, Georgia. Improvements that have been measured in the Savannah pumping cone in recent years will take some time to migrate to the coastal Lowcountry Area. It should be noted, however, that the water levels in the Floridan Aquifer System have stabilized over the past 10 to 20 years after the declines measured earlier.

The Gordon Aquifer has been most greatly impacted below Colleton and Beaufort Counties as a result of the locally intense pumping in the northern part of Colleton County. This pumping has altered the potentiometric surface, pulling the zero-contour line inland, and lowering the pressure surface at the coast. This has set up a reversal of the hydraulic gradient in the aquifer below coastal Colleton and Beaufort Counties. Because this reversal now exists, the movement of the saltwater/freshwater boundary in that aquifer is moving inland. The rate of that movement is not known as we do not have enough information to make that determination at this time.

The Crouch Branch, McQueen Branch, Charleston and Gramling aquifers show some signs of a lowering of the equipotential surfaces, but the net groundwater flow direction has not been impacted by pumping cones below the Lowcountry Area counties. These four aquifers are also not developed to a great extent in the area because the drill depths required for wells is cost prohibitive.

Recommendations

Although the water levels in the Upper and Middle Floridan and Gordon Aquifers have been relatively stable over the past 10 to 20 years, the ongoing pressure on these groundwater sources should be carefully monitored.

Upper and Middle Floridan Aquifers

- Staff evaluations of applications for withdrawal increases to existing permits and new groundwater withdrawal permits should include a groundwater model assessment to determine the potential for the development of pumping cones, increased saltwater intrusion in southern Beaufort and Jasper Counties, and potential interference on any neighboring wells.

- Permittees should be strongly encouraged to tap the deeper aquifers (Gordon, Crouch Branch or McQueen Branch) to the greatest extent possible in order to relieve the demand on the Floridan Aquifer System in central Hampton County and southern Jasper and Beaufort Counties.

Gordon Aquifer

- Staff evaluations of Colleton and Beaufort County applications for withdrawal increases to existing permits and new groundwater withdrawal permit applications should include a groundwater model assessment to determine the potential for the development of pumping cones, saltwater intrusion (coastal Beaufort County), and potential interference on any neighboring wells.

Low Country Capacity Use Area

- Cooperative work with SC DNR should continue in preparing the potentiometric surface maps, and future maps should be based on data from individual aquifers to the greatest extent possible. This will help evaluate how groundwater withdrawal from capacity use wells (which must be screened into single aquifers) are impacting the local groundwater conditions.

- Work toward educating all South Carolinians on best practices for water conservation must continue in cooperation with all stakeholders.

References

Aucott, W. R., & Speiran, G. K. (1985). *Potentiometric Surfaces of the Coastal Plain Aquifers of South Carolina Prior to Development (WRIR 84-4208).* U.S. Geological Survey.

Berezowska, A., & Monroe, L. A. (2017). *Initial Groundwater Management Plan for the Lowcountry Capacity Use Area (Technical Document Number: 0802-2017).* Columbia: S.C. Department of Health and Environmental Control.

Coes, A. L., Campbell, B. G., Petkewich, M. D., & Fine, J. M. (2010). Chapter C: Simulation of Groundwater Flow in the Atlantic Coastal Plain, North and South Carolina, and Parts of Eastern Georgia and Southern Virginia, Predevelopment to 2004. In B. G. Campbell, & A. L. and Coes, *Groundwater Availability in the Atlantic Coastal Plain of North and South Carolina (Professional Paper 1773)* (p. 241). U.S. Dept. of the Interior, U.S. Geological Survey.

Counts, H. B., & Donsky, E. (1963). *Salt-Water Encroachment Geology and Ground-Water Resources of Savannah Area Georgia and South Carolina (Water Supply Paper 1611).* Washington, DC: U.S. Dept. of the Interior, U.S. Geological Survey.

Craig, B., & Monroe, L. A. (2020). *SC DHEC Water Use Report 2020 (Technical Document Number: 018-2020).* Columbia: S.C. Department of Health and Environmental Control.

Czwartacki, B., & Wachob, A. (2020). *Potentiometric Surface of the McQueen Branch, Charleston, and Gramling Aquifers in South Carolina, November - December 2019 (Water Resources Report 62).* Columbia: S.C. Department of Natural Resources.

Czwartacki, B., Wachob, A., & Gellii, J. A. (2019). *Potentiometric Surface Maps of the Upper and Middle Floridan and Gordon Aquifers in South Carolina, November - December 2018 (Water Resources Report 61).* Columbia: S.C. Department of Natural Resources.

Fetter, C. W. (2001). *Applied Hydrogeology* (4th ed.). (P. Lynch, Ed.) Upper Saddle River, NJ: Prentice-Hall, Inc.

Gellici, J. A., & Lautier, J. C. (2010). Chapter B: Hydrogeologic Framework of the Atlantic Coastal Plain, North and South Carolina. In B. G. Campbell, & A. L. Coes (Eds.), *Groundwater Availability in the Atlantic Coastal Plain of North and South Carolina, Professional Paper 1773* (p. 241). Reston, VA: U.S. Geological Survey.

Groundwater Use and Reporting Act. (2000). *South Carolina Code of Laws, Title 49, Chapter 5*.

Hayes, L. R. (1979). *The Ground-Water Resources of Beaufort, Colleton, Hampton, and Jasper Counties South Carolina.* Columbia: S.C. Water Resources Commission.

Hilton Head Public Service District. (2021, September 23). *About Our Water/Saltwater Intrusion.* Retrieved from http://hhpsd.com/about-our-water/saltwater-intrusion/

Kinnaman, S. L., & Dixon, J. F. (2011). *Potentiometric Surface of the Upper Floridan Aquifer in Florida and Parts of Georgia, South Carolina,and Alabama, May - June 2010 (SIM-3182).* U.S. Dept. of the Interior, U.S. Geological Survey.

Miller, J. A. (1990). Alabama, Florida, Georgia, and South Carolina. In *USGS Groundwater Atlas of the United States.* Reston, VA: U.S. Geological Survey.

Peck, M. F., & McFadden, K. W. (2004). *Potentiometric Surface of the Upper Floridan Aquifer in the Coastal Area of Georgia, September 2000 (OFR 2004-1030).* Atlanta: U.S. Dept. of the Interior, U.S. Geological Survey.

Peck, M. F., Clarke, J. S., Ransom III, C., & Richards, C. J. (1999). *Potentiometric Surface of the Upper Floridan Aquifer in Georgia and Adjacnt Parts of Alabama, Florida, and South Carolina, May 1998, and Water-Level Trends in Georgia, 1990-98.* Atlanta: U.S. Dept. of the Interior, U.S. Geological Survey.

The Georgia Water Stewardship Act. (2010). *Georgia SB370*.

Wachob, A., Gellici, J. A., & Czwartacki, B. (2017). *Potentiometric Surface Maps of the South Carolina Coastal Plain Aquifers: November-December 2016 (Water Resources Report 60).* Columbia: S.C. Department of Natural Resources.

Appendix A: Historic Drought Conditions

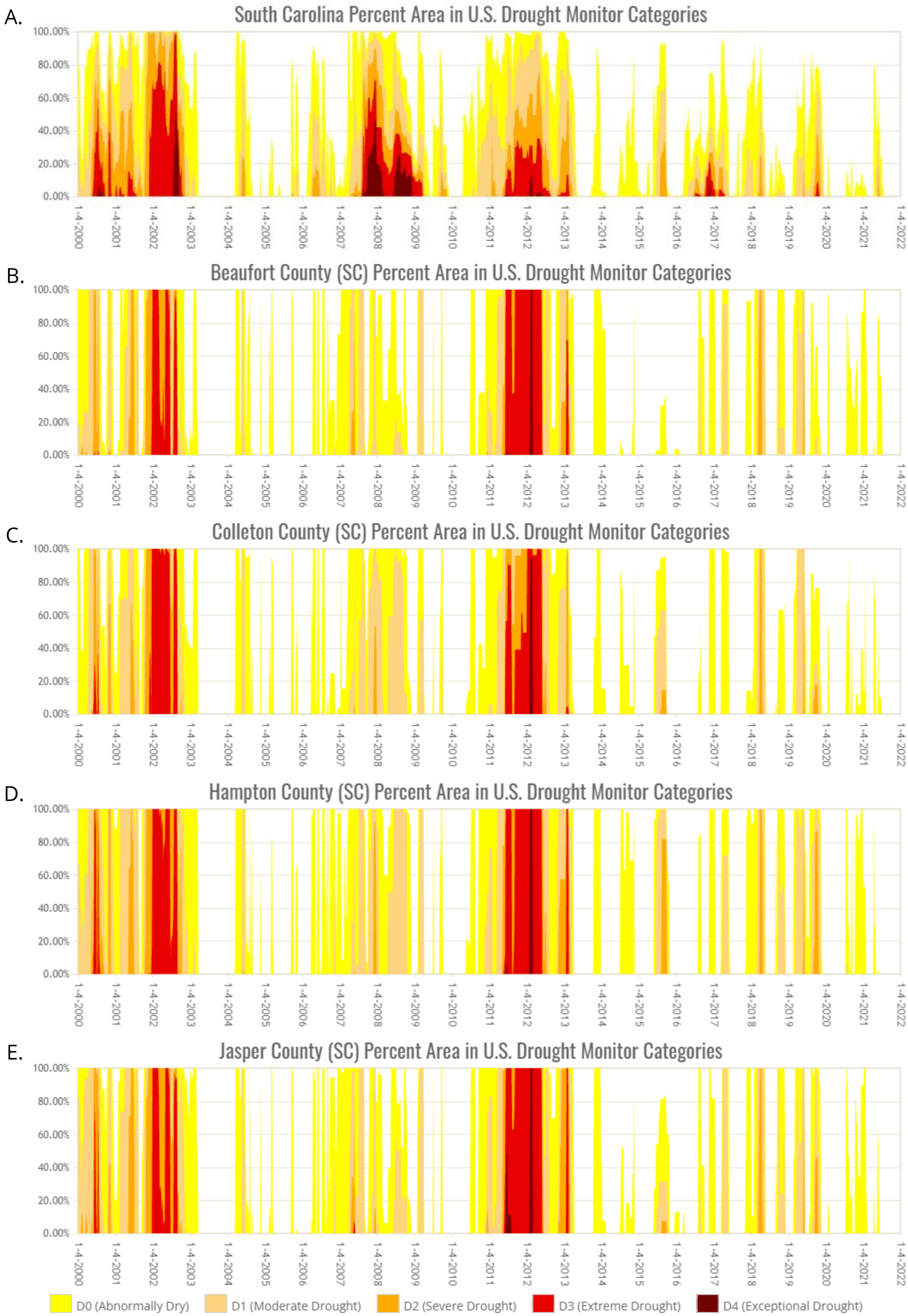
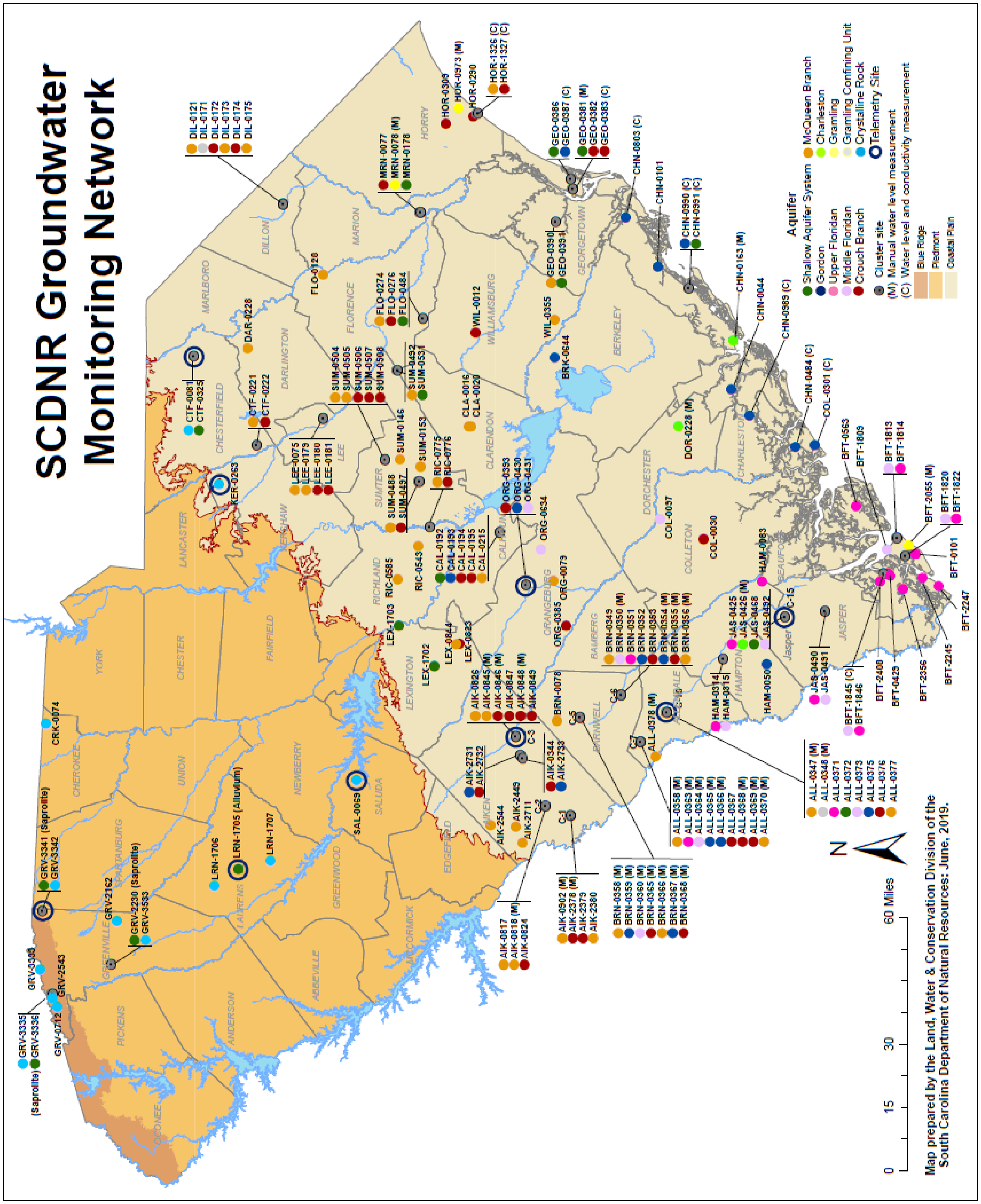


Figure A1. Severity and percent drought coverage for A. South Carolina, B. through E. each Lowcountry Area county.

Appendix B: SC DNR Groundwater Monitoring Network


SCDNR Groundwater Monitoring Network
Aquifer
Shallow Aquifer System
Gordon
Upper Floridan
Middle Floridan
Crouch Branch
McQueen Branch
Charleston
Gramling
Gramling Confining Unit
Crystalline Rock
Cluster site
Telemetry Site
(M) Manual water level measurement
(C) Water level and conductivity measurement
Blue Ridge
Piedmont
Coastal Plain
N
0 15 30 60 Miles
Map prepared by the Land, Water & Conservation Division of the South Carolina Department of Natural Resources; June, 2019.

Appendix C: Brief History of the Savannah, Georgia, Cone of Depression, and its Impact on the Lowcountry Area

1963

The Floridan Aquifers below the Lowcountry Area have been affected by a large pumping cone beneath Savannah, Georgia beginning as early as 1939. In 1963, a US Geological Survey study (Counts & Donsky, Water Supply Paper 1611: Salt-Water Encroachment Geology and Ground-Water Resources of Savannah Area Georgia and South Carolina, 1963) showed that the center of the cone had lowered to 120 feet below sea level, with a drop of 10 feet below the original potentiometric surface at Hilton Head Island (Fig. A1).

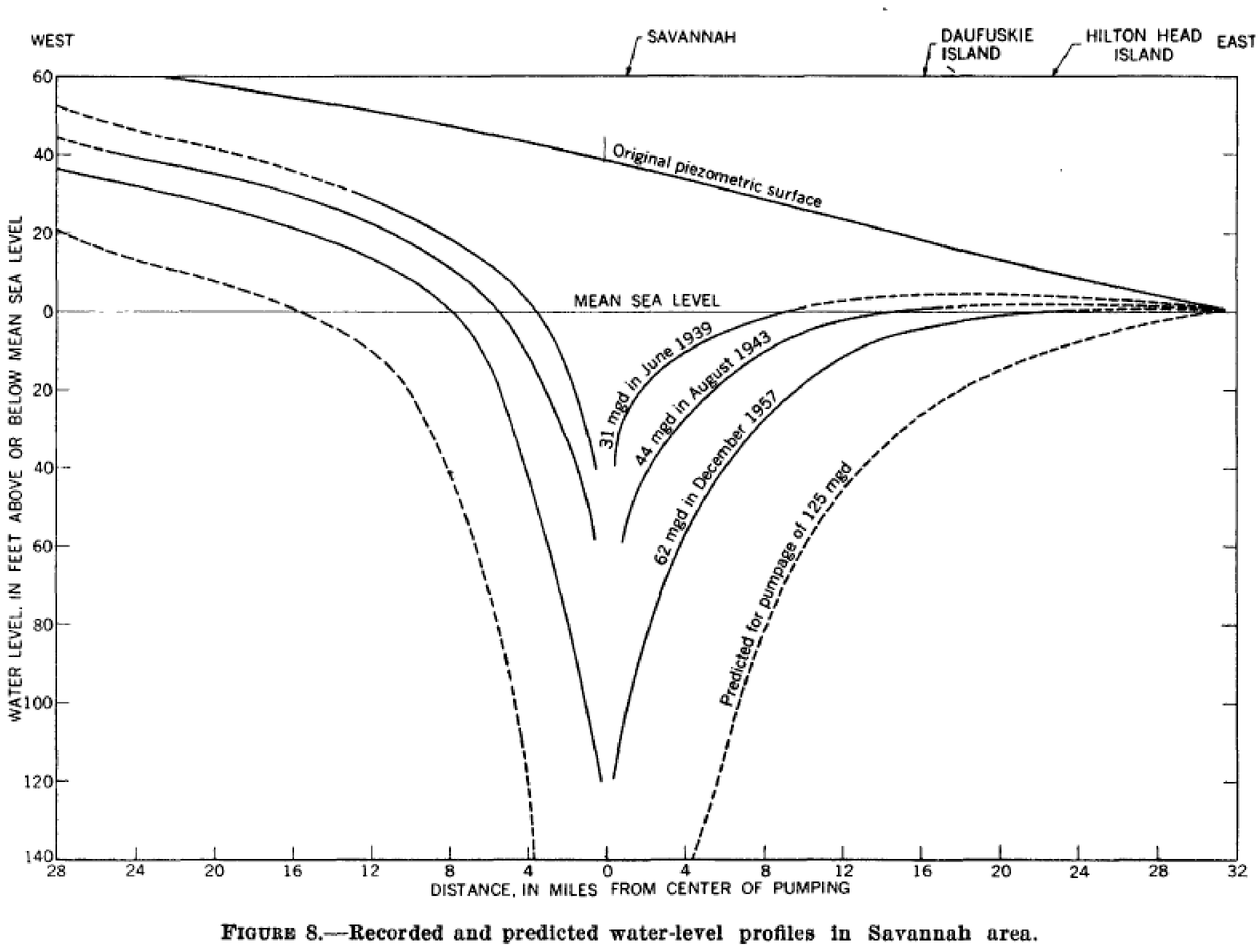


Figure C1. Cross Sectional profile (Fig. 8, Counts & Donsky, 1963) of the water levels in the Upper Floridan aquifer surrounding Savannah, Georgia. The profile shows the areal extent of the impact of this pumping feature through time.

1979

The initial groundwater assessment for the Lowcountry Area was published in 1979 (Hayes, The Ground-Water Resources of Beaufort, Colleton, Hampton, and Jasper Counties South Carolina, 1979). By that time, the potentiometric surface of the Upper Floridan aquifer had dropped from 10 ft to 30 ft across Hilton Head Island, and up to 110 feet at the border between South Carolina and Georgia (Fig. A2). The northward bend in the contour lines suggests that groundwater withdrawal in Hampton, Colleton, and Jasper Counties had caused additional lowering of the potentiometric surface beyond that caused by the pumping cone around Savannah, Georgia.

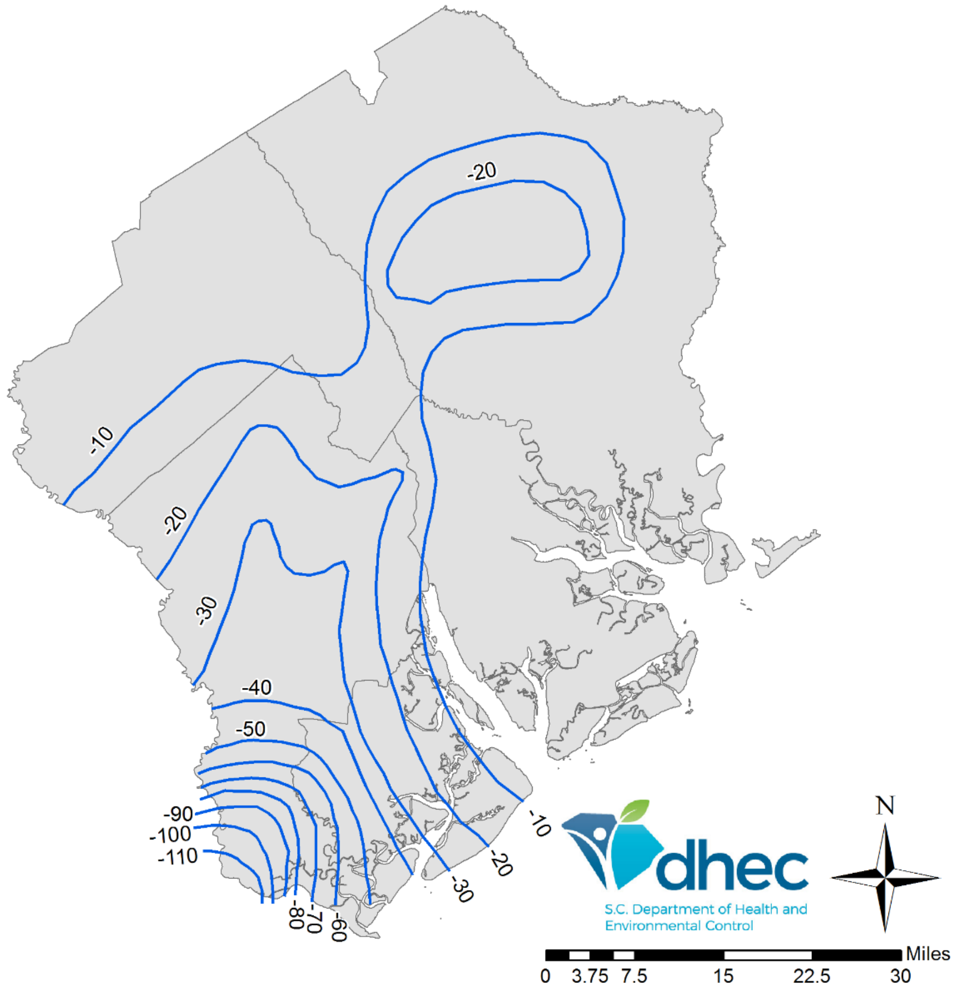


Figure C2. Contour lines of equal change to the Upper Floridan potentiometric surface in 1979 (Hayes, 1979).

1998

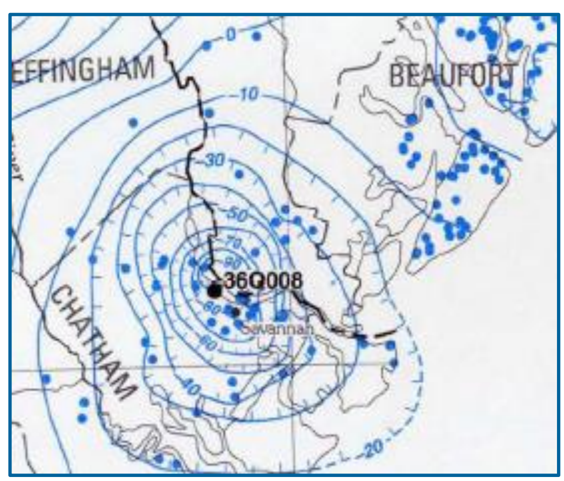


Figure C3. Upper Floridan Aquifer potentiometric surface of 1998 (Peck, Clarke, Ransom III, & Richards, 1999).

Water level observations in the Upper Floridan aquifer in coastal Georgia and parts of Alabama, Florida, and South Carolina were compiled to create a potentiometric map in 1998 (Peck, Clarke, Ransom III, & Richards, Potentiometric Surface of the Upper Floridan Aquifer in Georgia and Adjacnt Parts of Alabama, Florida, and South Carolina, May 1998, and Water-Level Trends in Georgia, 1990-98, 1999). The elevation of the pumping cone's center was over 90 ft below mean sea level (MSL), which was a change in the potentiometric surface of approximately 130 feet (see Figure A1). By that time, the water levels across Hilton Head Island were relatively unchanged from 1979, but the zero-contour line continued to move inland.

2000

The deepest recorded water level at the center of the pumping cone was 150 feet below sea level recorded in 2000 (Peck & McFadden, 2004). Concurrent water levels in the Upper Floridan aquifer were not taken in South Carolina at that time.

2010

The center of Savannah's pumping cone rebounded by nearly 80 feet (from 150 feet to just over 70 feet below MSL) by 2010 ((Kinnaman & Dixon, 2011). The potentiometric surface below Hilton Head Island was still relatively unchanged from 1998. In 2010, the Georgia legislature passed regulations intended to conserve both surface and groundwater through education and outreach, water system audits, irrigation efficiency, and water fixture efficiency in new construction (The Georgia Water Stewardship Act, 2010). With this new law, improvements in groundwater conditions below Savannah, Georgia, are expected to continue. In time, this pumping feature's impact on the Upper Floridan Aquifer below the coastal Lowcountry Area should diminish.

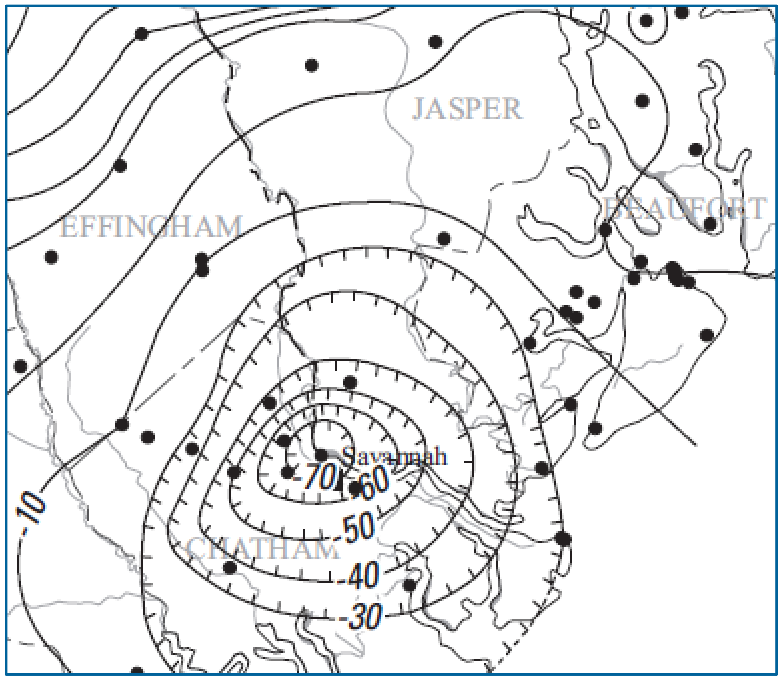


Figure C4. Potentiometric contour lines depicting the state of the Savannah pumping cone in 2010 (Kinnaman & Dixon, 2011). Units are in feet relative to mean sea level.

References

Counts, H. B., & Donsky, E. (1963). Water Supply Paper 1611: Salt-Water Encroachment Geology and Ground-Water Resources of Savannah Area Georgia and South Carolina. Washington, DC: U.S. Dept. of the Interior, U.S. Geological Survey.

Hayes, L. R. (1979). The Ground-Water Resources of Beaufort, Colleton, Hampton, and Jasper Counties South Carolina. Columbia, SC: South Carolina Water Resources Commission.

Kinnaman, S. L., & Dixon, J. F. (2011). SIM-3182, Potentiometric Surface of the Upper Floridan Aquifer in Florida and Parts of Georgia, South Carolina,and Alabama, May - June 2010. U.S. Department of the Interior, U.S. Geological Survey.

Peck, M. F., & McFadden, K. W. (2004). OFR 2004-1030, Potentiometric Surface of the Upper Floridan Aquifer in the Coastal Area of Georgia, September 2000. Atlanta: U.S. Department of the Interior, U.S. Geological Survey.

Peck, M. F., Clarke, J. S., Ransom III, C., & Richards, C. J. (1999). Potentiometric Surface of the Upper Floridan Aquifer in Georgia and Adjacnt Parts of Alabama, Florida, and South Carolina, May 1998, and Water-Level Trends in Georgia, 1990-98. Atlanta: U.S. Department of the Interior, U.S. Geological Survey.

The Georgia Water Stewardship Act. (2010). Georgia SB370.