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Potentiometric Surface of the McQueen Branch, Charleston, and Gramling Aquifers in South Carolina, November–December 2019

by
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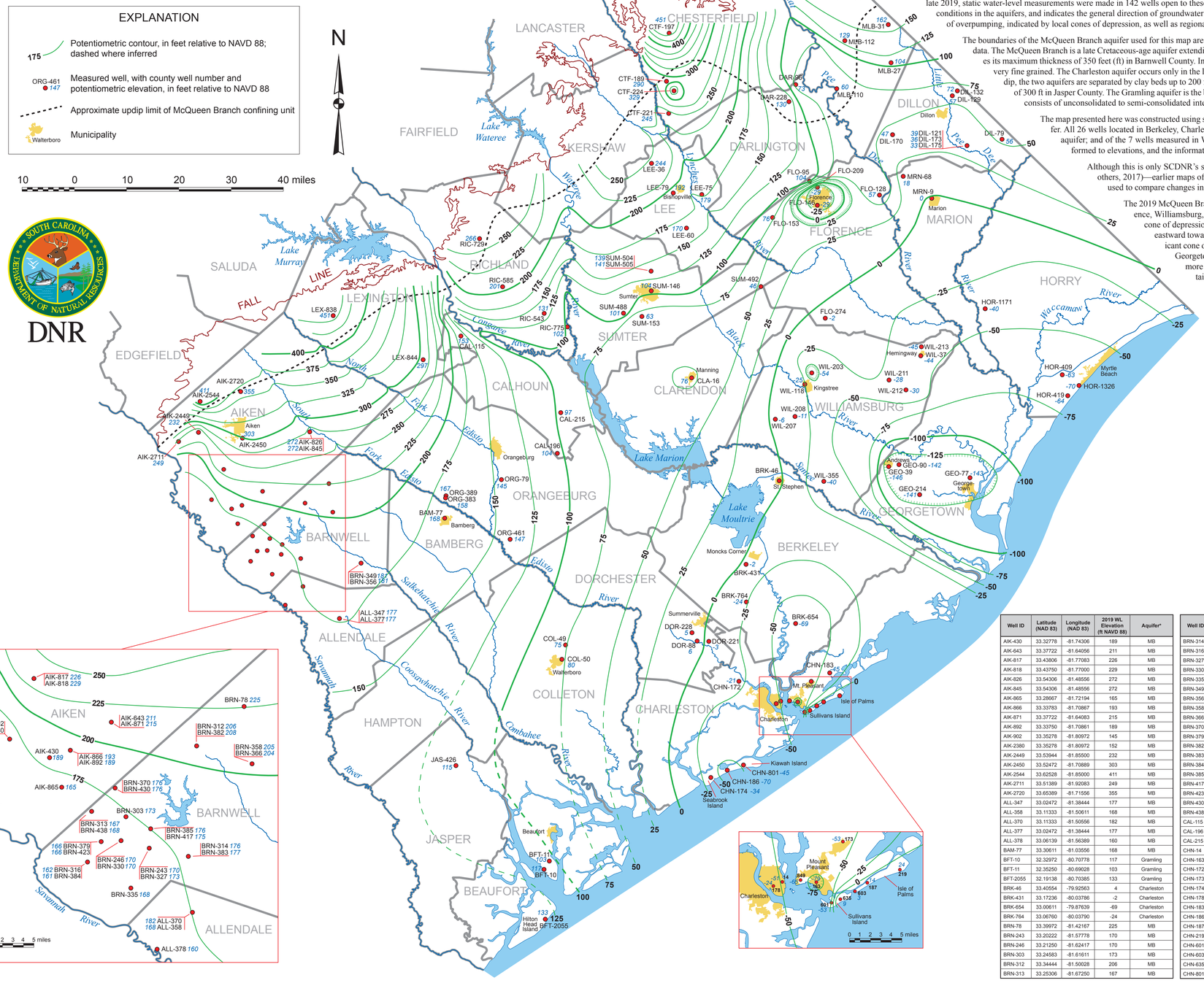

The McQueen Branch, Charleston and Gramling aquifers are the deepest Cretaceous-age aquifers in the Coastal Plain of South Carolina and are an important source of water for many public, industrial, and agricultural users. In late 2019, static water-level measurements were made in 142 wells open to these aquifers in order to produce a potentiometric surface map, which illustrates the elevation of water levels in the aquifers, provides an overview of conditions in the aquifers, and indicates the general direction of groundwater flow. Routine monitoring of water levels in these aquifers allows the South Carolina Department of Natural Resources (SCDNR) to identify areas of overpumping, indicated by local cones of depression, as well as regional changes in aquifer storage related to groundwater development.

The boundaries of the McQueen Branch aquifer used for this map are those defined by Gellici and Lautier (2010), who delineated the aquifer using geologic (corehole, fossil, and borehole geophysics) and water-level data. The McQueen Branch is a late Cretaceous-age aquifer extending over most of the Coastal Plain. The aquifer, which consists primarily of interbedded quartz sand and clay, outcrops along the Fall Line and reaches its maximum thickness of 350 feet (ft) in Barnwell County. In the updip areas, the aquifer is composed of unconsolidated medium to very-coarse grained sand interbedded with clay lenses; downdip, it becomes very fine grained. The Charleston aquifer occurs only in the lower half of the Coastal Plain, and is hydraulically connected to the overlying McQueen Branch aquifer in middle part of the Coastal Plain. Downdip, the two aquifers are separated by clay beds up to 200 ft thick. The Charleston aquifer consists of unconsolidated fine to very-coarse quartz sand, clayey sand, and clay, and reaches a maximum thickness of 300 ft in Jasper County. The Gramling aquifer is the basal aquifer of the Coastal Plain, sitting on basement rock and occurring primarily only in the lower half of the Coastal Plain. The Gramling aquifer consists of unconsolidated to semi-consolidated interbedded quartz sand, clayey sand, silt, and clay, and reaches a thickness of 1,000 ft at Hilton Head Island in Beaufort County.

The map presented here was constructed using static (non-pumping) water levels measured in 142 wells during late 2019. Of those 142 wells, 109 are screened solely in the McQueen Branch aquifer. All 26 wells located in Berkeley, Charleston, Colleton, Dorchester, and Jasper Counties are open to the Charleston aquifer; only the 3 wells in Beaufort County are open to the Gramling aquifer; and of the 7 wells measured in Williamsburg County, 3 are McQueen Branch and 4 are screened in both Charleston and McQueen Branch aquifers. The water levels were transformed to elevations, and the information was contoured to represent the aquifers' potentiometric surface in ft above or below the North American Vertical Datum 1988 (NAVD 88).

Although this is only SCDNR's second potentiometric map using the boundaries of the McQueen Branch aquifer—the first being made from data collected in 2016 (Wachob and others, 2017)—earlier maps of the Middendorf aquifer (Wachob, 2015; Hockensmith and others, 2013; Hockensmith, 2012; 2008; 2003; Hockensmith and Waters, 1998) can be used to compare changes in hydrologic conditions over time.

The 2019 McQueen Branch-Charleston-Gramling potentiometric surface map shows a generally southeastward groundwater flow affected by potentiometric lows in Florence, Williamsburg, Charleston, and Georgetown Counties. Potentiometric levels range from more than 450 ft near the Fall Line to -146 ft in Georgetown County. A cone of depression centered at Mount Pleasant in Charleston County has rebounded at its center by 22 ft since 2016 but continues to expand inland to the north and eastward towards the barrier islands; water levels on Sullivan's Island and Isle of Palms have declined at an average rate exceeding 1 ft per year since 2011. A significant cone of depression around the City of Florence—missing from the 2016 map because of a lack of water-level data but seen on prior maps—is again shown. Georgetown County has a large potentiometric low that affects both the City of Georgetown and the Town of Andrews. Compared to the 2016 map, several more McQueen Branch wells were identified and measured to better characterize the magnitude and extent of this cone of depression. There is some uncertainty about the potentiometric levels in Clarendon and Sumter Counties because of a scarcity of water-level measurements available for this map.

The 2019 McQueen Branch-Charleston-Gramling potentiometric map suggests that, downdip from the recharge areas and outside of the western edge of the aquifer, water levels throughout much of this aquifer have declined 50 to 100 ft below predevelopment levels (Aucott and Speiran, 1985), and in parts of Charleston and Georgetown Counties, more than 200 ft.

Water levels were collected by staff from SCDNR, the Savannah River National Laboratory, the South Carolina Department of Health and Environmental Control, and the U.S. Geological Survey. The authors are grateful for the assistance of these agencies and the cooperation of well owners to obtain the water-level measurements used to produce this map.

References

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Well ID	Latitude (NAD 83)	Longitude (NAD 83)	2019 WL Elevation (ft NAVD 88)	Aquifer*
AIK-430	33.32778	-81.74306	189	MB
AIK-643	33.37722	-81.64056	211	MB
AIK-817	33.43806	-81.77083	226	MB
AIK-818	33.43750	-81.77000	229	MB
AIK-826	33.54306	-81.48556	272	MB
AIK-845	33.54306	-81.48556	272	MB
AIK-865	33.28667	-81.72194	165	MB
AIK-866	33.33783	-81.70867	193	MB
AIK-871	33.37722	-81.64083	215	MB
AIK-892	33.33750	-81.70861	189	MB
AIK-902	33.35278	-81.80972	145	MB
AIK-2380	33.35278	-81.80972	152	MB
AIK-2449	33.53944	-81.85500	232	MB
AIK-2450	33.52472	-81.70889	303	MB
AIK-2544	33.62528	-81.85000	411	MB
AIK-2711	33.51389	-81.92083	249	MB
AIK-2720	33.65389	-81.71556	355	MB
ALL-347	33.02472	-81.38444	177	MB
ALL-358	33.11333	-81.50611	168	MB
ALL-370	33.11333	-81.50556	182	MB
ALL-377	33.02472	-81.38444	177	MB
ALL-378	33.06139	-81.56389	160	MB
BAM-77	33.30611	-81.03556	168	MB
BFT-10	32.32972	-80.70778	117	Gramling
BFT-11	32.35250	-80.69028	103	Gramling
BFT-2055	32.19138	-80.70385	133	Gramling
BRK-46	33.40554	-79.92563	4	Charleston
BRK-431	33.17236	-80.03786	-2	Charleston
BRK-654	33.00611	-79.87639	-69	Charleston
BRK-764	33.06760	-80.03790	-24	Charleston
BRN-78	33.39972	-81.42167	225	MB
BRN-243	33.20222	-81.57778	170	MB
BRN-246	33.21250	-81.62417	170	MB
BRN-303	33.24583	-81.61611	173	MB
BRN-312	33.34444	-81.50028	206	MB
BRN-313	33.25306	-81.67250	167	MB

Well ID	Latitude (NAD 83)	Longitude (NAD 83)	2019 WL Elevation (ft NAVD 88)	Aquifer*
BRN-314	33.19111	-81.51306	176	MB
BRN-316	33.18254	-81.67869	162	MB
BRN-327	33.20238	-81.57804	173	MB
BRN-330	33.21419	-81.62390	170	MB
BRN-335	33.14667	-81.60750	168	MB
BRN-349	33.17889	-81.31417	181	MB
BRN-356	33.17889	-81.31444	181	MB
BRN-358	33.32056	-81.40778	205	MB
BRN-366	33.32056	-81.40778	204	MB
BRN-370	33.28592	-81.63497	176	MB
BRN-379	33.21056	-81.65722	166	MB
BRN-382	33.34462	-81.50032	208	MB
BRN-383	33.19122	-81.51331	177	MB
BRN-384	33.18250	-81.67861	161	MB
BRN-385	33.22969	-81.57532	176	MB
BRN-417	33.22944	-81.57528	175	MB
BRN-423	33.21086	-81.65752	166	MB
BRN-430	33.28583	-81.63472	176	MB
BRN-438	33.25303	-81.67259	168	MB
CAL-115	33.81222	-80.98194	153	MB
CAL-196	33.48583	-80.65972	104	MB
CAL-215	33.59861	-80.64787	97	MB
CHN-14	32.79139	-79.92861	-51	Charleston
CHN-163	32.78806	-79.87167	-79	Charleston
CHN-172	32.84721	-80.06478	-21	Charleston
CHN-173	32.84528	-79.82694	-53	Charleston
CHN-174	32.58056	-80.15972	-34	Charleston
CHN-178	32.78417	-79.94306	-24	Charleston
CHN-183	32.86806	-79.76556	-45	Charleston
CHN-186	32.59972	-80.10583	-70	Charleston
CHN-187	32.78750	-79.78722	14	Charleston
CHN-219	32.80497	-79.73386	24	Charleston
CHN-601	32.75944	-79.84889	-53	Charleston
CHN-603	32.77686	-79.80981	3	Charleston
CHN-635	32.76444	-79.83278	9	Charleston
CHN-801	32.61444	-80.05247	-45	Charleston

Well ID	Latitude (NAD 83)	Longitude (NAD 83)	2019 WL Elevation (ft NAVD 88)	Aquifer*
CHN-849	32.79167	-79.89861	-65	Charleston
CLA-16	33.69389	-80.21278	76	MB
COL-49	32.95083	-80.63444	75	Charleston
COL-50	32.91167	-80.64722	80	Charleston
CTF-189	34.51806	-80.28972	290	MB
CTF-197	34.65194	-80.27917	451	MB
CTF-221	34.42889	-80.28278	245	MB
CTF-224	34.49167	-80.26500	329	MB
DAR-96	34.50583	-79.85611	73	MB
DAR-228	34.45861	-79.98000	130	MB
DIL-79	34.34551	-79.16775	56	MB
DIL-121	34.32833	-79.28306	39	MB
DIL-129	34.46833	-79.33167	57	MB
DIL-132	34.48258	-79.31469	72	MB
DIL-170	34.36333	-79.53417	47	MB
DIL-173	34.33028	-79.28694	36	MB
DIL-175	34.33028	-79.28694	33	MB
DOR-88	32.96979	-80.20158	6	Charleston
DOR-221	32.95889	-80.16278	-3	Charleston
DOR-228	32.98372	-80.21845	5	Charleston
FLO-95	34.23694	-79.81306	104	MB
FLO-128	34.19556	-79.58056	57	MB
FLO-146	34.16972	-79.78833	-29	MB
FLO-153	34.13694	-79.93861	76	MB
FLO-209	34.21972	-79.78833	-29	MB
FLO-274	33.85580	-79.76656	-2	MB
GEO-39	33.44117	-79.56209	-146	MB
GEO-77	33.40666	-79.29368	-143	MB
GEO-90	33.44627	-79.52830	-142	MB
GEO-214	33.36224	-79.46139	-141	MB
HOR-409	33.68806	-78.98194	-63	MB
HOR-419	33.62994	-78.96490	-64	MB
HOR-1171	33.87538	-79.23406	-40	MB
HOR-1326	33.65722	-78.92681	-70	MB
JAS-426	32.61833	-80.99583	115	MB
LEE-36	34.29028	-80.34167	244	MB

Well ID	Latitude (NAD 83)	Longitude (NAD 83)	2019 WL Elevation (ft NAVD 88)	Aquifer*
LEE-60	34.11000	-80.22611	170	MB
LEE-75	34.20250	-80.17444	179	MB
LEE-79	34.20741	-80.26951	192	MB
LEX-838	33.86806	-81.40722	451	MB
LEX-844	33.74611	-81.10750	297	MB
MLB-27	34.56333	-79.53528	104	MB
MLB-31	34.66889	-79.54333	162	MB
MLB-110	34.49306	-79.71944	60	MB
MLB-112	34.62639	-79.68944	129	MB
MRN-9	34.18472	-79.40611	0	MB
MRN-68	34.24667	-79.50028	18	MB
ORG-79	33.41320	-80.84759	145	MB
ORG-383	33.36806	-81.03111	158	MB
ORG-389	33.36250	-81.03306	167	MB
ORG-461	33.24722	-80.81944	147	MB
RIC-543	33.87500	-80.70222	131	MB
RIC-585	33.94889	-80.84083	201	MB
RIC-729	34.08278	-80.91722	266	MB
RIC-775	33.83722	-80.62528	102	MB
SUM-146	33.93611	-80.34556	104	MB
SUM-153	33.86500	-80.37667	63	MB
SUM-488	33.87444	-80.43778	101	MB
SUM-492	33.94556	-79.98000	46	MB
SUM-504	33.99092	-80.34573	139	MB
SUM-505	33.99091	-80.34573	141	MB
WIL-37	33.74772	-79.45115	-44	MB
WIL-118	33.67250	-79.83694	-25	MB
WIL-203	33.70417	-79.81389	-54	MB/Charleston
WIL-207	33.57639	-79.93639	-6	MB/Charleston
WIL-208	33.58355	-79.87087	-11	MB/Charleston
WIL-211	33.68167	-79.55722	-28	MB/Charleston
WIL-212	33.65361	-79.50194	-30	Charleston
WIL-213	33.72778	-79.44806	-45	Charleston
WIL-355	33.40252	-79.77819	-40	MB

* MB: McQueen Branch