Google

South Carolina Water Fact Sheet

What is Google's water supply strategy in Berkeley County, SC?

Data centers require water for cooling of their high-performance servers. The water sources used to cool our Berkeley County data center today include both potable supply from Berkeley County Water & Sanitation (BCWS) and a permit for groundwater withdrawal from the McQueen Branch aquifer. As we seek to expand our data center in Berkeley County, we anticipate needing more water for cooling. To meet this need, Google is seeking to expand both our access to potable water from BCWS and our access to groundwater reserves.

We plan for access to water resources far exceeding actual projected needs in order to ensure there is no risk of operational failure. Our groundwater permit provides both backup supply and a diversified source to prepare for any worst-case scenario, such as BCWS supply disruption, pump failures, extreme heat waves, etc. The data center has a policy to prioritize BCWS water ahead of groundwater, and we've developed a Best Management Practices for Groundwater guide with the SC Department of Health & Environmental Control (SC-DHEC).

From the start, Google has been committed to saving water by operating our data centers in a highly efficient manner. Since power generation typically requires using water for cooling purposes, being energy efficient translates to significant upstream water savings (particularly in thermal power supply regions such as South Carolina). We're also investing in new technologies to continually optimize our onsite water usage.

Onsite water storage tanks and cooling towers at our data center in Berkeley County, SC

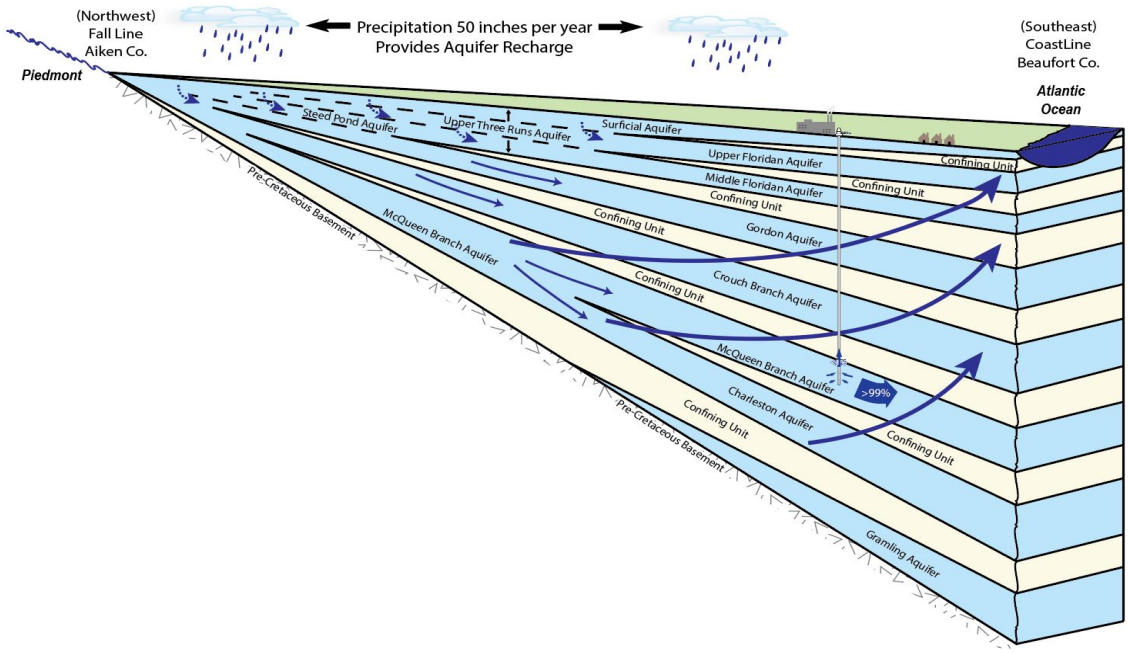
How do underground aquifers work in the Charleston / Tri-County area?

Aquifers are sometimes characterized as "sponges," in the sense that groundwater storage occurs in small pore spaces within the layers of underground terrain. However groundwater is in a dynamic state -- its molecules do not remain in one place, but flow from areas of higher elevation, pressure and/or recharge sources to areas of lower elevation, pressure and/or discharge zones. Sources of recharge for extensive, deep, confined aquifers like the McQueen Branch are typically limited to areas comprising the uncovered edge of the aquifer.

Recharge primarily occurs where the aquifer is exposed at (or very near to) the surface, where rainfall percolates to become part of the groundwater resource. Surface water bodies that occur in this recharge area can also contribute under certain hydraulic conditions. In the case of the McQueen Branch, the recharge area consists of a several mile-wide band which runs parallel to the NE-SW oriented "Fall Line" located about 100 miles from Charleston. This underground aquifer terrain for the Tri-County area is shown in Figure 1.

Once the southeast-sloping McQueen Branch aquifer continues beyond the Fall Line, it transitions to be a "confined aquifer," which becomes increasingly confined towards Charleston (where it occurs at depths in excess of 1,200 feet). The presence of confining clay isolates the overlying shallow aquifers and surface-water bodies (lakes, streams, and wetlands) from the McQueen Branch aquifer, and so surface water does not move downward in response to groundwater pumping within deep parts of this aquifer. Under these conditions, pumping from the McQueen Branch only influences groundwater levels in this aquifer.

Figure 1: Tri-County Area Aquifer Cross-section



What analysis has been completed to ensure Google's groundwater use will be sustainable?

In 2019, we applied for a permit to withdraw groundwater at a rate of 1.5 million gallons per day (MGD) from the McQueen Branch (aka Middendorf) aquifer, one of several major water-bearing components of the layered Coastal Plain groundwater resource system. We expended thorough due diligence efforts to verify that the proposed groundwater usage will be sustainable for the aquifer and will not have adverse impact to other local groundwater users. As part of this effort, we incorporated aquifer-specific groundwater flow modeling tools made available to the public by the U.S. Geological Survey ("USGS"), which were used for a range of scenario models in addition to data from our onsite hydrogeological testing detailed below.

The results indicate that over 200 MGD of naturally recharged groundwater is projected to flow through the McQueen Branch aquifer (including the Charleston aquifer) in the cross-sectional portion of aquifer defined by a NE-SW line passing through the data center area[1]. After passing through this plane, any McQueen Branch groundwater that is not withdrawn by well pumping naturally discharges upwards through shallower aquifers and into the Atlantic Ocean beyond the coast of South Carolina. This is the case even with established users such as Nucor Steel (Nucor) and Mount Pleasant Waterworks (MPW) also pumping groundwater to meet their needs, currently understood to be permitted for 7.1 MGD and 4.7 MGD respectively. Google's proposed permit for up to 1.5 MGD groundwater withdrawal represents less than 1% of that residual groundwater flow.

[1] When modeling the impact of the onsite data center well to the McQueen Branch aquifer, the incremental impact related to groundwater being pumped by other well users from all of the aquifers in the area was based on reported data reflective of conditions in 2004, which represents the reported historical peak. Using that data provides conservative projections -- significantly more groundwater was being pumped from the McQueen Branch aquifer in 2004 than is being pumped today.

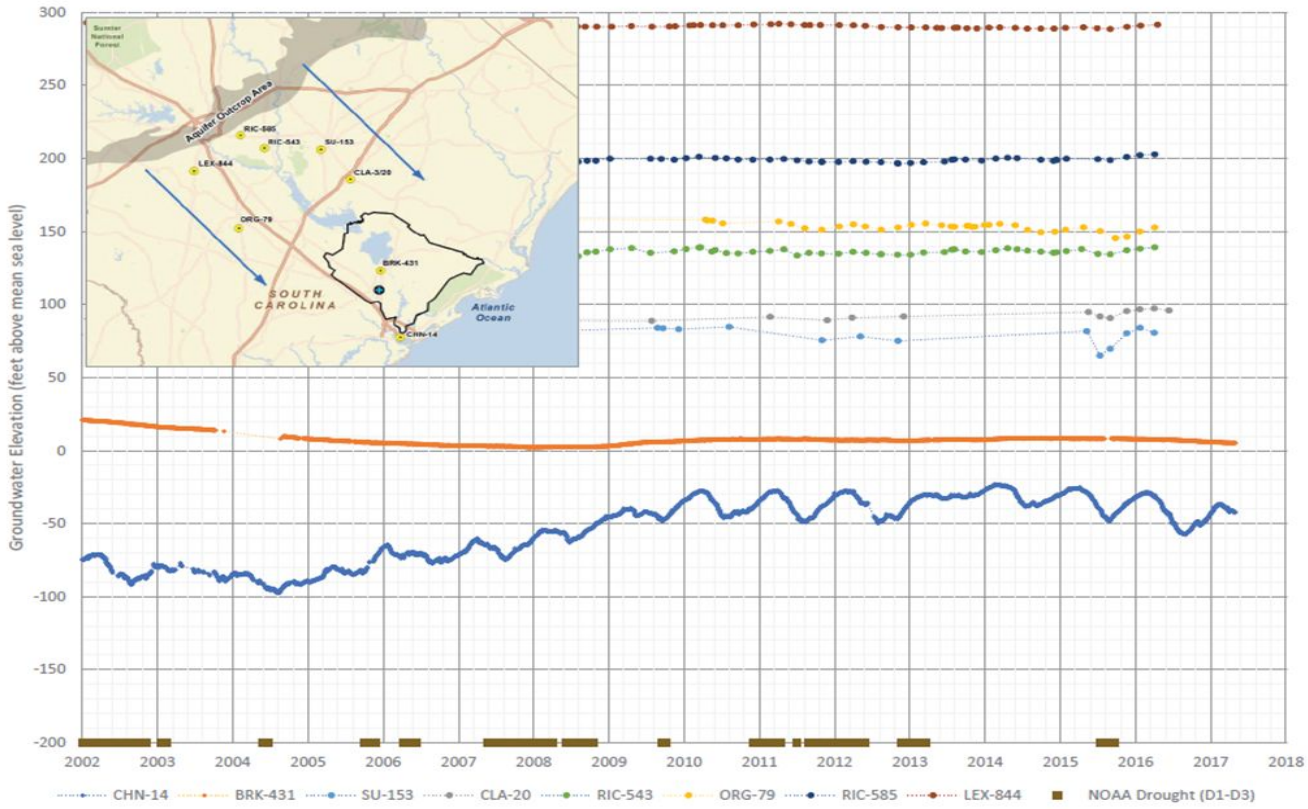
Are surface water levels at risk of falling in the local area?

Google's recent analysis and testing included monitoring surface water levels in nearby water bodies to determine if our test pumping was drawing down any surface water into the McQueen Branch Aquifer. No correlating change was detected, supporting that there is no identifiable relationship between local surface water bodies and the McQueen Branch Aquifer under anticipated onsite pumping conditions. This is consistent with expectations for a confined aquifer, where thick layers of clay isolate surface water from the aquifer below.

Are groundwater levels at risk of falling in the Tri-County area?

Our USGS data modelling supports that localized aquifer recharge is sufficient to sustainably support Google's requested 1.5 MGD permit. As shown in Figure 2, Tri-County area groundwater levels monitored by the USGS have remained fairly stable across the McQueen Branch/Charleston Aquifer since 2002. This monitoring area extends from the Fall Line (recharge area) to Charleston Metro and MPW. Pumpage data available from SC-DHEC indicates that total pumping from the McQueen Branch Aquifer has been relatively constant in Berkeley County since about 2001. Trends in Tri-County pumpage data are shown in Figure 3.

Figure 2: Groundwater Elevation (feet above mean sea level), 2002 - 2017[2]



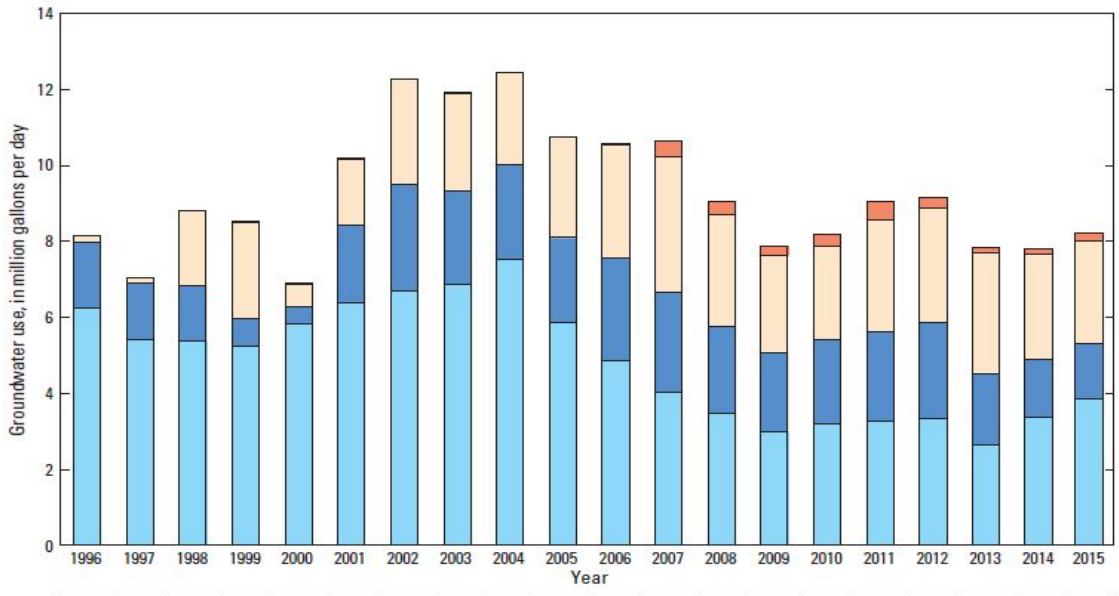
In hydrogeologic terms, the groundwater elevation and corresponding pumpage data reflect an equilibrium between total withdrawals and aquifer recharge throughout the period, supporting the observation that groundwater is being withdrawn from the local area about as fast as it is being replenished by natural aquifer

[2] Figure 2 prepared by Leggette, Brashears & Graham Inc. utilizing historical data published by USGS

recharge. Notably, this timeframe includes several intermittent periods of "drought" as defined by NOAA, supporting that Tri-County aquifer recharge has remained fairly stable even during drought conditions.

To further validate recharge conditions for our proposed permit, we also modelled an "extreme worst case scenario." This assumed continuous pumping at Google's requested permit rate for a period of 25 years -- an unrealistic scenario which is not consistent with our plans or our water use policy. The model also assumed all other major users withdrawal at their historical documented peak rates throughout the full 25-year period, far greater than actual pumping volumes observed today. The results indicated a worst-case potential impact to MPW water levels of 5 feet or less, a relatively minimal impact.

Figure 3: Historical Tri-County Groundwater Use 1996 - 2015 (MGD, by County)[3]



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dorchester (Mgal/d)	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.40	0.35	0.24	0.35	0.46	0.29	0.18	0.16	0.22
Berkeley (Mgal/d)	0.17	0.16	1.98	2.53	0.59	1.75	2.77	2.56	2.45	2.64	2.97	3.60	2.93	2.55	2.44	2.95	3.02	3.16	2.74	2.70
Other Charleston (Mgal/d)	1.68	1.46	1.46	0.71	0.45	2.05	2.84	2.51	2.48	2.23	2.70	2.63	2.28	2.10	2.22	2.36	2.50	1.87	1.54	1.45
Mount Pleasant (Mgal/d)	6.23	5.44	5.38	5.26	5.84	6.39	6.66	6.86	7.51	5.88	4.88	4.02	3.50	2.99	3.21	3.28	3.35	2.66	3.38	3.87

What onsite testing has Google conducted to identify potential impact to the local area?

To substantiate the model-projected aquifer capacity for the data center area, we completed a long-term onsite pumping test in 2015. The test involved pumping the well (and hence the McQueen Branch aquifer) at an average rate of 2,406 gallons per minute, or 3.46 MGD, continuously for 3 days. This test pumping rate and duration are much greater than the 1.5 MGD permit and use case we are seeking, resulting in a conservative picture for potential impact. Water level data was closely monitored across a range of points during the test to identify potential impact to the surrounding area.

The results of this onsite well pumping test indicate that the aquifer can locally support the 3.46 MGD used during the test (and hence the requested 1.5 MGD) without adverse impact to localized recharge rates. The extent of the groundwater levels found to be influenced by onsite pumping (at the conservative 3.46 MGD rate) defined a "radius of influence" to be about 3.8 miles. This is far short of the distance to other major groundwater users such as Nucor (~10 miles) and MPW (~20 miles). MPW in particular has faced challenges to their ambitions for greater groundwater use, seeking +10 MGD in SC-DHEC's 2018 permit renewal round. As detailed in the test results published within our application to SC-DHEC, the onsite well pumping proposed for our data center will not adversely impact water availability for MPW's wells.

[3] Figure 3 extracted from pg 12 of USGS' Report 2017-5128