S.C. Department of Health and Environmental Control

Trident Capacity Use Area Groundwater Evaluation

For Permitting Year 2018

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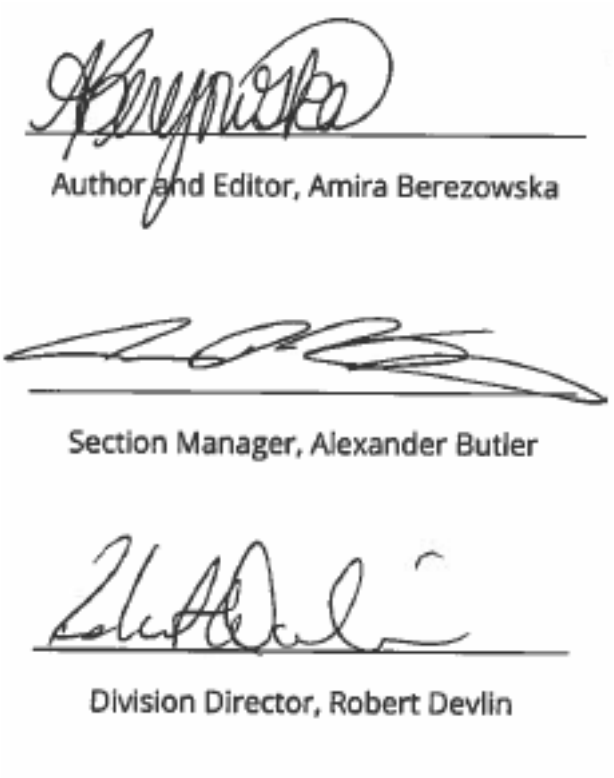

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Introduction

On August 8th, 2002, the South Carolina Department of Health and Environmental Control Board, as established in Section 49-5-60, Capacity Use Designation, declared the whole of Berkeley County, Charleston County, and Dorchester County (BCD region) as the ***Trident Capacity Use Area*** (Trident Area), *(Figure 1)*. The Trident Area was the third of the four currently declared Capacity Use Areas in South Carolina.

Within the Trident Area, no person shall withdraw, obtain, or otherwise utilize groundwater at or in excess of three (3) million gallons per month for any purpose unless said person shall first obtain a Groundwater Withdrawal Permit from DHEC. A groundwater withdrawer is defined as *any person withdrawing groundwater at or in excess of three (3) million gallons during any one month from a single well or multiple wells within a one-mile radius of any existing or proposed well.*

As part of this capacity use designation, the *Trident Area Groundwater Management Plan* was developed and accepted by the Board on May 12th, 2017. The plan's intent is to provide direction for future groundwater management and protection by evaluating the hydrogeologic, environmental, social, and economic impacts of groundwater withdrawals at various rates on the long-term sustainable levels for the aquifers in the region. The three main goals of the plan are to:

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

To accomplish the above goals, the *Trident Area Groundwater Management Plan* addressed the following aspects of water use in the BCD region:

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

Based on these goals, and evaluation of the water use in the region, recommendations for different water sources and reductions in use are made later on in the document.

Land Subsidence and Eustatic Sea-Level Rise

A concern generated from over-pumping of aquifers, and resulting cones of depression is land subsidence. Land subsidence occurs when groundwater is withdrawn in excess from certain types of formations, such as those with fine-grained sediments. These formations compact because the groundwater is partially responsible for maintaining its structure. When too much water is withdrawn, the formation compresses, resulting in subsidence.

The principal causes of land subsidence are aquifer-system compaction, drainage of organic soils, underground mining, hydro-compaction, natural compaction, sinkholes, and thawing permafrost. More than 80 percent of the identified subsidence in the United States is a consequence of our exploitation of underground water, and increasing development of land and water resources, which threatens to exacerbate existing land-subsidence problems, and initiate new ones. *(Groundwater, U. (2018). USGS Groundwater Information: Land Subsidence. [online] water.usgs.gov.)*

In conjunction with land subsidence, eustatic sea-level rise is also a concern for the region. As the oceans warm, seawater expands thus raising sea-level. Melting ice adds more water to the ocean, further contributing to sea-level rise. In South Carolina, the land surface is sinking, so the observed rate of sea level rise relative to the land is greater than the global average rise in sea-level. If the oceans and atmosphere continue to warm, sea-level is likely to rise one to four feet in the next century along the coast of South Carolina. (*What Climate Change Means for South Carolina. (2016). [pdf] United States Environmental Protection Agency, EPA430-F-16-042. https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-sc.pdf)*

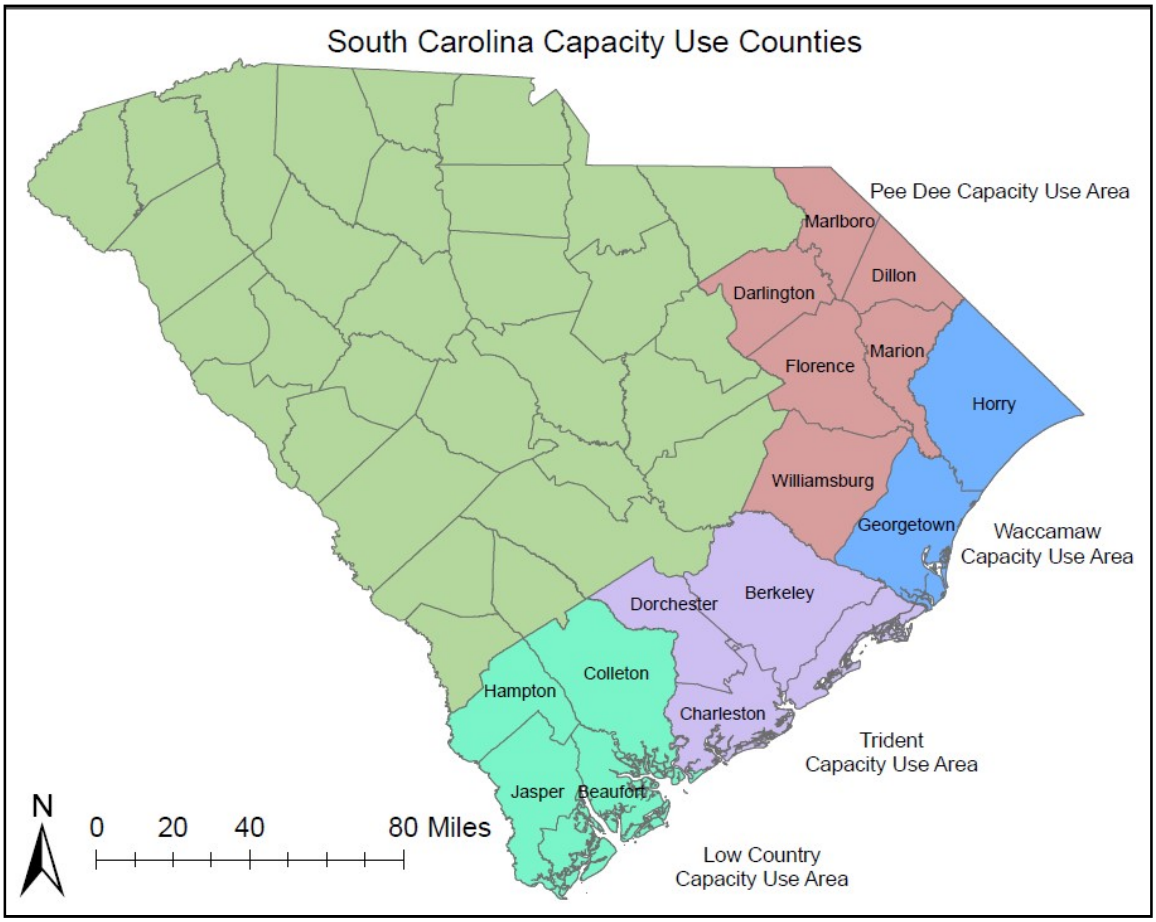

Figure 1: Capacity Use Areas in South Carolina.

Hydrogeologic Framework

Surface Water

Within the tri-county region, there are several major surface water sources. These are the Edisto River, the Santee River, the Ashley River, the Cooper River, the Wando River, and lakes Marion and Moultrie. The Edisto and Santee rivers serve as boundaries for the region and the Ashley, Cooper, and Wando network of rivers discharge into the Atlantic Ocean *(Figure 2)*.

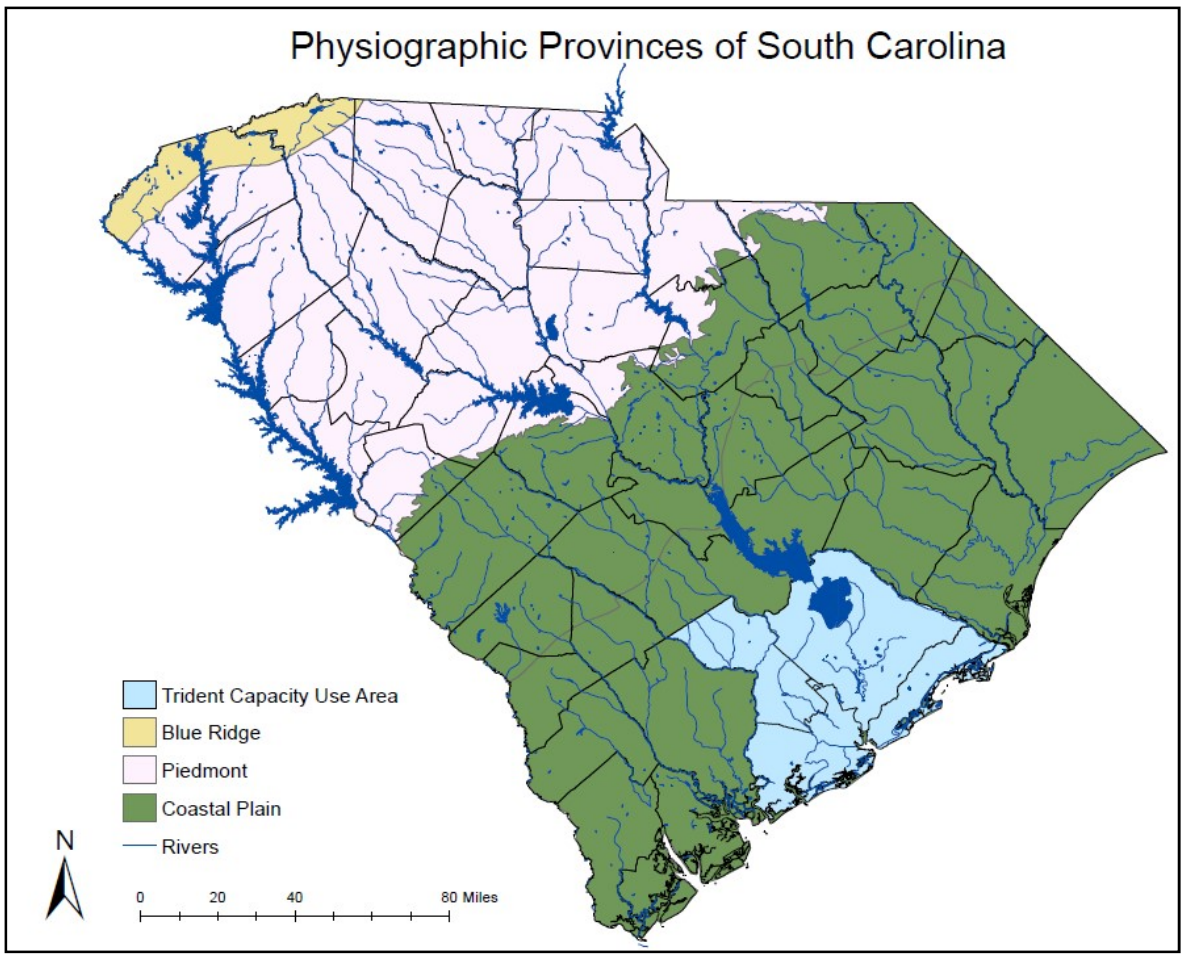

Figure 2: Physiographic provinces of South Carolina with surface water resources.

Aquifer Systems

The oldest and deepest aquifers, or water-bearing units, underlying the Trident Area are of Late Cretaceous age and are comprised of sediments that have been subdivided into three (3) aquifer systems (oldest to youngest): Gramling, McQueen Branch/Charleston, and Crouch Branch, (*Figure 3)*. These units are generally continental shelf to inner marine shelf and deltaic deposits, and range from fine-to-medium grained sand, silts and clays. Water bearing zones are typically beds of sands of varying thickness and extent, separated by silty, clayey beds or lenses.

The Gramling Aquifer is not well defined and no known outcrop has been identified in South Carolina. It is thought to mainly consist of sand and gravel beds separated by thick layers of silt and clay.

The Charleston/McQueen Branch Aquifer occurs throughout the Coastal Plain, from the Fall Line to the coast. The McQueen Branch crops out (catchment area) adjacent to the Fall Line from Chesterfield County to Edgefield County. In the Trident Area the aquifer is generally composed of thin- to thick-bedded sands and clays deposited in marginal marine and/or

lower delta plain environments. In the Trident Area, the McQueen Branch/Charleston Aquifer is approximately 400 feet thick.

The Crouch Branch Aquifer occurs throughout the Lower Coastal Plain and crops out in the eastern portion of the Coastal Plain from Lexington County to Dillon County. The aquifer is generally composed of thin- to thick-bedded sands and clays deposited in marginal marine and/or lower delta plain environments. In the Trident Area, the Crouch Branch Aquifer varies from 400 to 800 feet thick.

Units overlying the Late Cretaceous formations include the Tertiary age Gordon, Floridan, and Surficial Formations, (*Figure 3).* These units range from marginal marine to outer shelf deposits and their lithologies consist predominantly of sand, silt, and clay, with the upper part being mainly pure to impure limestone.

The Gordon Aquifer extends from its catchment area in the middle of the Lower Coastal Plains to the southwest. In the Trident area, the Gordon Aquifer is approximately 200 feet thick.

The Floridan Aquifer occurs throughout the southern portion of the coastal plain. In the Trident area, the Floridan Aquifer is approximately 150 feet thick.

The Tertiary units are overlain by a sequence of sand, silt, clay, and shells of Pleistocene age that are generally not more than 50 feet thick.

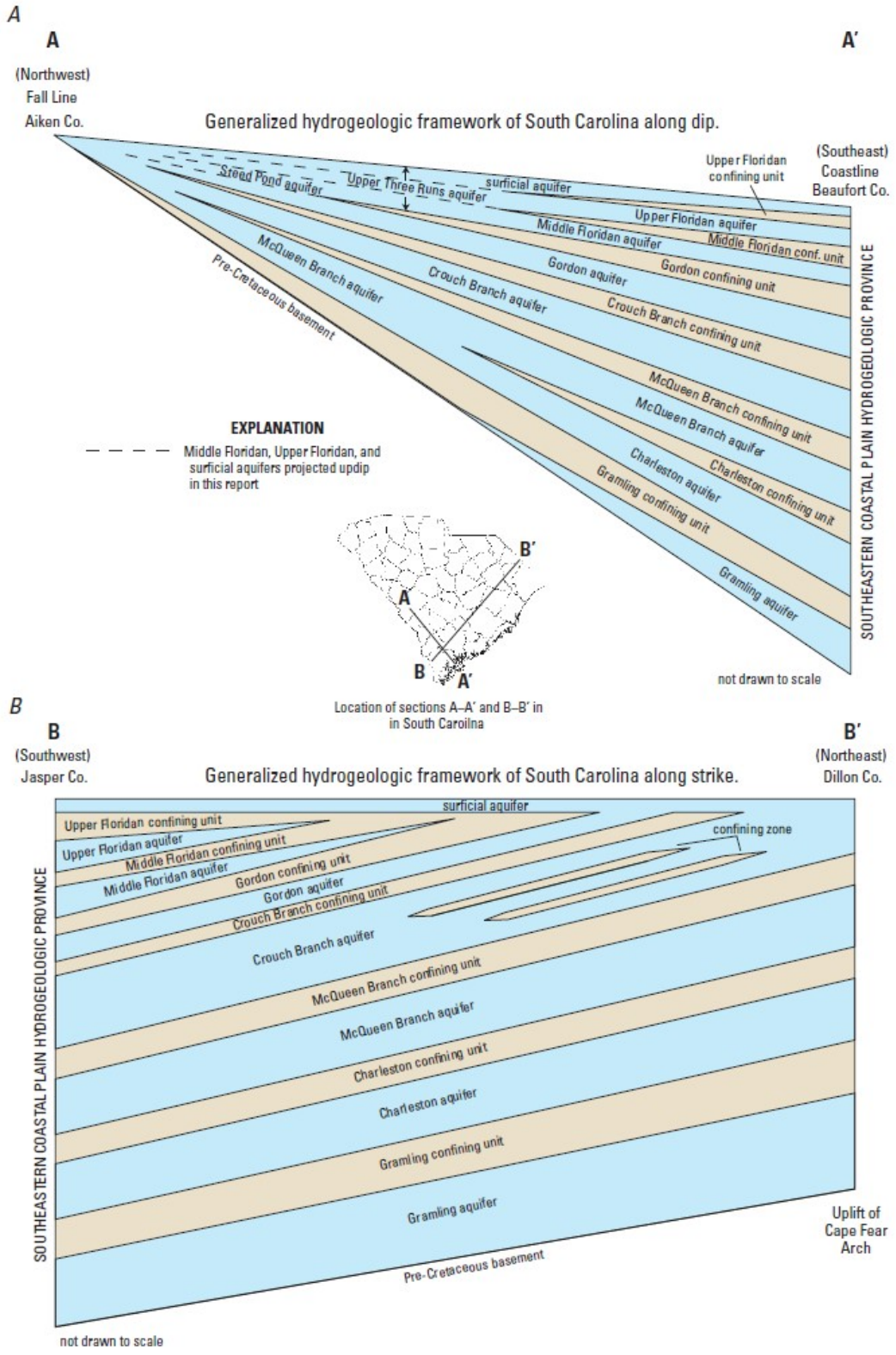

Figure 3: Generalized hydrogeologic framework, J. Gellici and J. Lautier, 2010 Hydrogeologic Framework of the Atlantic Coastal Plain, North and South Carolina: U.S. Geological Survey Professional Paper 1773, 113p.

Groundwater recharge occurs from the infiltration of precipitation in catchment (recharge) areas. Figure 4 depicts the general recharge, or catchment areas, for the aquifers of the Trident Area. Although limited recharge of the Tertiary Sand/Limestone Aquifer occurs in the tri-county area, the majority of recharge of aquifers in the Trident area occurs north of the region proper.

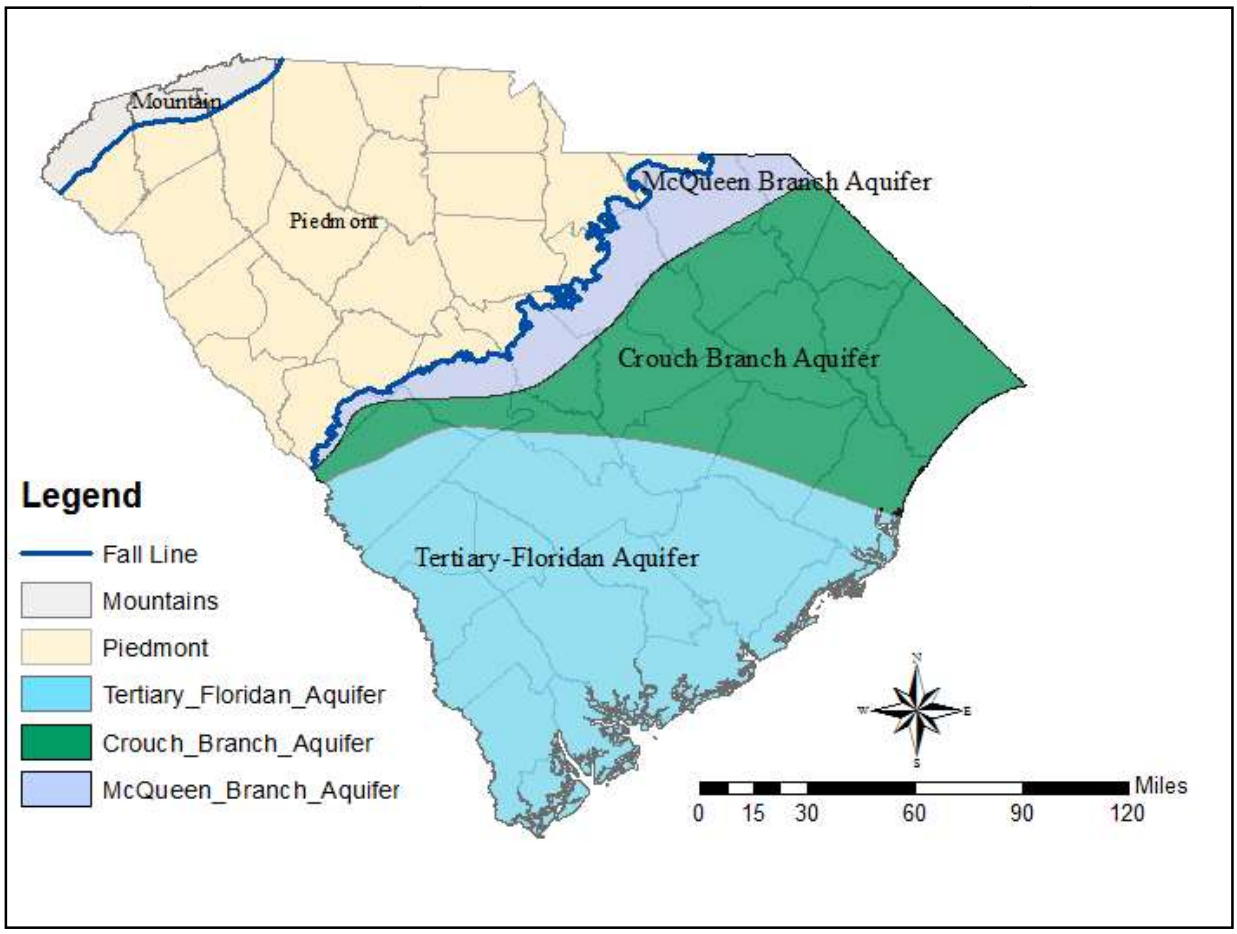

Figure 4: Generalized aquifer recharge areas.

Groundwater Trends

Floridan and Gordon Aquifers

In 2016, the South Carolina Department of Natural Resources (SCDNR) published the most updated potentiometric surface map of the Floridan and Gordon Aquifers. This aquifer is the shallowest aquifer underlying the region. It is estimated that the Floridan Aquifer is about 150 feet thick, and the Gordon Aquifer is no more than 200 feet thick, in the Trident Area. The potentiometric surface map *(Figure 5)* of this aquifer shows that groundwater-levels range from less than 20 feet below mean sea level, to over 100 feet above mean sea level in the more inland areas of the Trident Capacity Use Area. At several monitoring wells within Charleston County, the groundwater-levels are 25-33-feet below mean sea level.

Figure 5: Potentiometric surface of the Upper Floridan, Middle Floridan, and Gordon Aquifers in South Carolina, December 2016. Source: Wachob, Gellici, and Czwartacki 2017, SCDNR Water Resources Report 60.

Crouch Branch Aquifer

In 2016, SCDNR published the most updated potentiometric surface map of the Crouch Branch Aquifer. This aquifer is approximately 400 to 800 feet thick in the Trident Area. The potentiometric surface map *(Figure 6)* of the Crouch Branch Aquifer shows water-level trends that range from less than 25-feet below mean sea level, to over 75-feet above mean sea level in the more inland areas. Most of the Trident Area Crouch Branch Aquifer groundwater-levels are either at or above mean sea level. The areas that fall below mean sea level are eastern Berkeley County, and the northern portion of Charleston County.

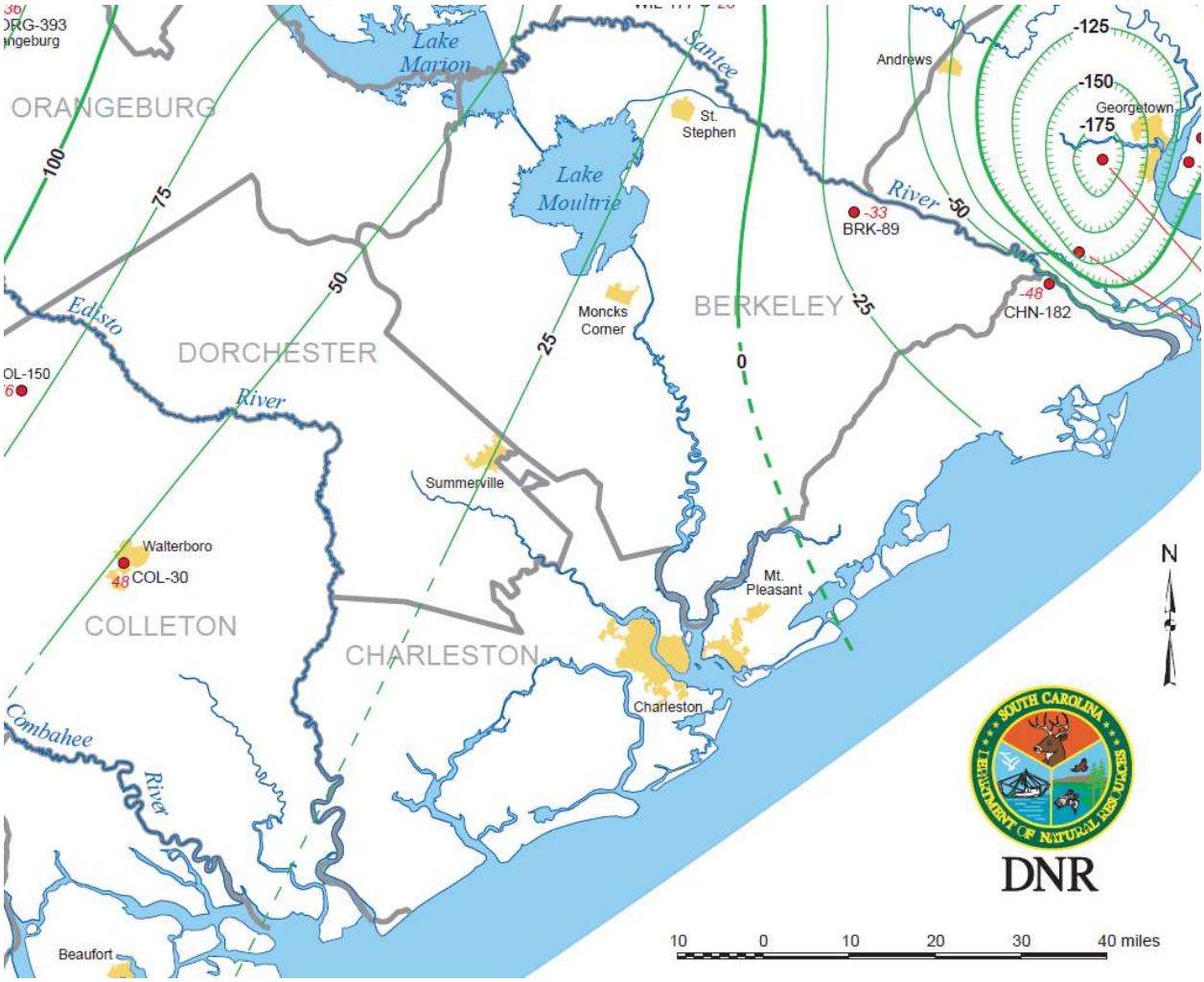

Figure 6: Potentiometric surface map of the Crouch Branch Aquifer in South Carolina, December 2016 Source: Wachob, Gellici, and Czwartacki, 2017, SCDNR Water Resources Report 60.

McQueen Branch Aquifer

In 2016, SCDNR published the most updated potentiometric surface map of the McQueen Branch, Charleston and Gramling Aquifers. The McQueen Branch/Charleston Aquifer is estimated to be 400 feet thick, at its maximum, in the Trident Capacity Use Area. The groundwater-levels *(Figure 7)* in the Trident Area range from 101-feet below mean sea level in Charleston County, to over 100-feet above mean sea level in the more inland areas in Dorchester County. The most significant cone of depression occurs in Charleston County, particularly in Mt. Pleasant where the groundwater-levels range from 71-to-101-feet below mean sea level.

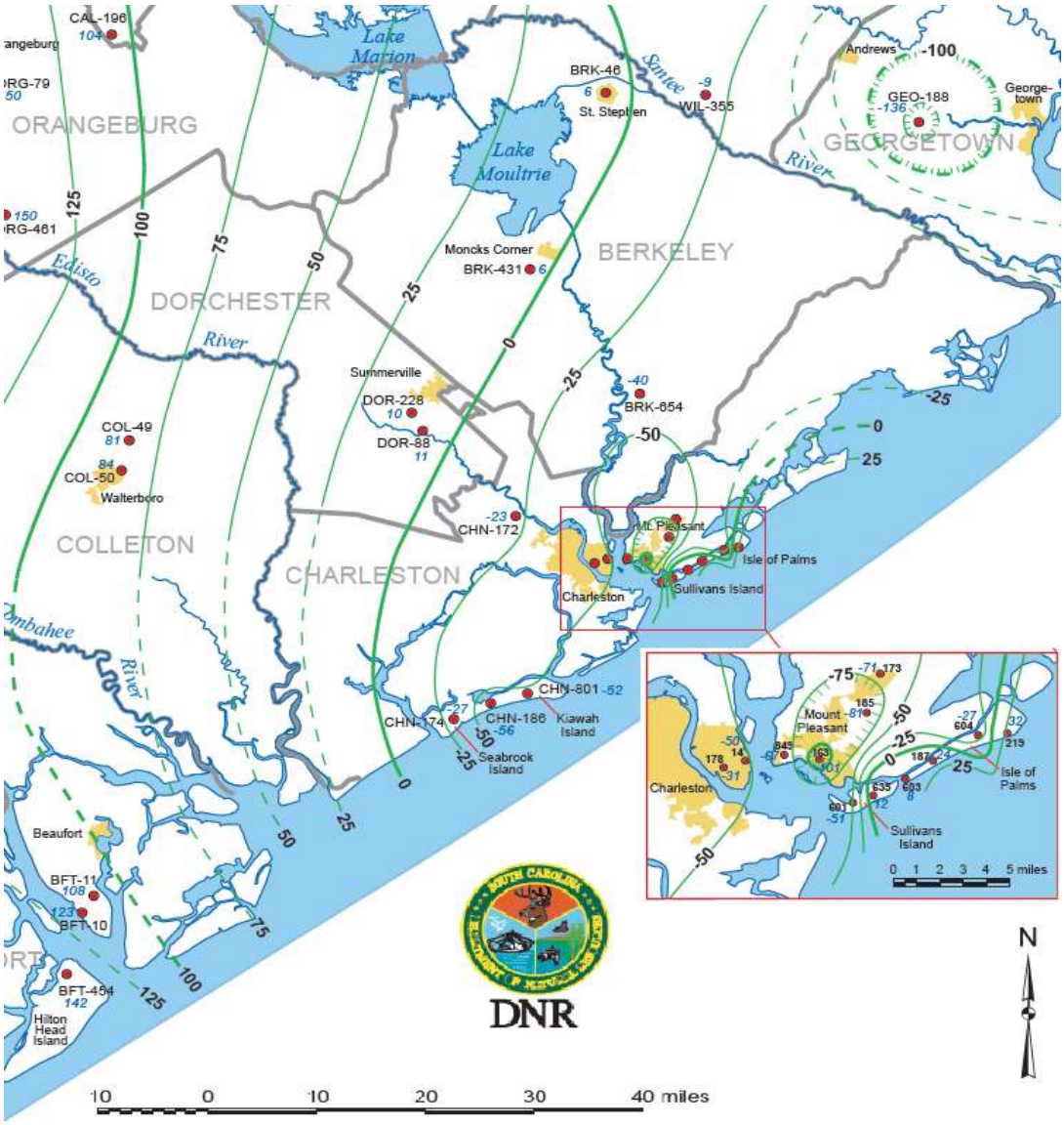

Figure 7: Potentiometric surface map of the McQueen Branch, Charleston, and Gramling Aquifers in South Carolina, December 2016. Source: Wachob, Gellici, and Czwartacki 2017, SCDNR Water Resources Report 60.

Current Groundwater Demand

For purposes of water use reporting, DHEC defines the following groundwater withdrawal categories:

- Aquaculture (AQ)– Water used for raising, farming and/or harvesting of organisms that live in water, such as fish, shrimp and other shellfish, and vegetal matter (seaweed),
- Golf course irrigation (GC)- Water applied to maintain golf course turf, including tee boxes, fairways, putting greens, associated practice areas, and periphery aesthetic landscaping,
- Industrial process (IN)- Water used for commercial and industrial purposes, including fabrication, processing, washing, in-plant conveyance, and cooling,
- Agricultural and aesthetic irrigation (IR)- Water that is used for agricultural and landscaping purposes including turf farming and livestock management.
- Mining process (MI)- Water used in mine operations, including mining, processing, washing and cooling,
- Water supply (WS)- Water withdrawn by public and private water suppliers and conveyed to users or groups of users. Water suppliers provide water for a variety of uses including domestic, commercial, industrial and public water use.

Currently in the Trident Area there are 44 *permitted* groundwater withdrawers distributed as follows: 12 golf course facilities, 10 industries, 3 agricultural irrigation facilities, 1 other facility, 1 thermal power facility, and 17 public water supply facilities (Table 1). These 44 facilities have 112 wells.

Table 1: Permitted facilities in the Trident Capacity Use Area (2016).

Number of Facilities by Type and County				
Category	**Berkeley County**	**Charleston County**	**Dorchester County**	**Totals**
Golf Courses	3	7	2	**12**
Industry	5	2	3	**10**
Agricultural Irrigation	-	-	3	**3**
Other	-	-	1	**1**
Thermal Power	-	-	1	**1**
Public Water Supply	3	4	10	**17**
Totals	**11**	**13**	**20**	**44**

For Berkeley County, average withdrawals were: 23.84 million gallons for golf courses, 1,239.29 million gallons for industrial use, and 44.76 million gallons for public water supply.

For Charleston County, average withdrawals were: 471.98 million gallons for golf courses, 50.85 million gallons for industrial use, and 1,916.05 million gallons for public water supply.

For Dorchester County, average withdrawals were: 24.99 million gallons for golf courses, 380.26 million gallons for industrial use, 244.13 million gallons for agricultural irrigation, 18.89 million gallons for other, 134.53 million gallons for thermal power, and 431.04 million gallons for public water supply.

For reporting year 2016, permitted withdrawers in Berkeley County reported total withdrawals of 1,307,890,000 gallons (approximately 1.31 billion gallons), Charleston County 2,438,890,000 gallons (approximately 2.44 billion gallons), and Dorchester County 1,233,830,000 gallons (approximately 1.23 billion gallons). Permitted usage by category for 2016 is listed in Table 2.

Table 2: Reported 2016 Use (in millions of gallons)

Reported Permitted 2016 Use					
Category	**Berkeley**	**Charleston**	**Dorchester**	**Use Total**	**Use Total %**
Golf Courses	23.84	471.98	24.99	**520.81**	**10.46%**
Industry	1,239.29	50.85	380.26	**1,670.40**	**33.54%**
Agricultural Irrigation	-	-	244.13	**244.13**	**4.90%**
Other	-	-	18.89	**18.89**	**0.38%**
Thermal Power	-	-	134.53	**134.53**	**2.70%**
Public Water Supply	44.76	1,916.05	431.04	**2,409.57**	**48.02%**
Total	**1,307.89**	**2,438.89**	**1,233.83**	**4,980.61**	
Total %	**26.26%**	**48.97%**	**24.77%**	**100%**	

Table 3 lists all of the permitted users in the Trident Area with their permitted amount (in million gallons per year, MGY) and total reported water use (in MGY) from 2016.

Table 3: Permitted Users in Trident Area with Permitted and Reported Use for 2016

Berkeley County				
Facility	**Permit**	**Aquifer**	**Permit Amount (MGY)**	**Reported Use (MGY)**
Berkeley County Club	08GC001	Surficial/Floridan/Gordon, Crouch Branch	24	3.34
Joint Base Charleston/ Red Bank Plantation GC	08GC005	Crouch Branch	48	3.40
City of Goose Creek/ Crowfield Golf and Country Club	08GC006	Crouch Branch	36	17.10
Albany International Corporation, Press Fabrics	08IN002	McQueen Branch/Charleston	60	31.33
Georgia Pacific Wood Products, LLC	08IN004	McQueen Branch/Charleston	132	8.18
CR Bard, Inc.	08IN007	Surficial/Floridan/Gordon, Crouch Branch	103	73.52
Nucor Steel Berkeley Plant	08IN011	Crouch Branch, McQueen Branch/Charleston	1300	1126.26
Maguro Enterprises, LLC	08IN015	McQueen Branch/ Charleston	182.5	0
Moncks Corner Water Works	08WS003	Surficial/Floridan/Gordon, Crouch Branch	288	6.42
Nucor Steel Berkeley Plant	08WS058	Crouch Branch	1300	0
SCDOC Division of Facilities Management	08WS064	Crouch Branch	50	38.34
	Totals		**3,523.5**	**1,307.89**

Charleston County				
Facility	**Permit**	**Aquifer**	**Permit Amount (MGY)**	**Reported Use (MGY)**
Kiawah Island Utility Inc.	10GC002	McQueen Branch/Charleston	175	82.75
LRA Charleston PP Golf, LLC	10GC003	McQueen Branch/Charleston	36	18.65
Kiawah Resort/Osprey Point GC	10GC015	McQueen Branch/Charleston	100	91.42
Kiawah Island Inn Company, LLC/The Ocean Course	10GC020	McQueen Branch/Charleston	113	113.27
Kiawah Resort Associates, LP/Cassique GC	10GC021	McQueen Branch/Charleston	350	129.90
Briar's Creek Holdings, LLC/The Golf Club at Briar's Creek	10GC052	McQueen Branch/Charleston	140	0
Links The @ Stono Ferry	10GC053	Crouch Branch	50	36
CertainTeed Corporation/GS Roofing Products Co., Inc.	10IN004	Surficial/Floridan/Gordon	42	0
Ingevity South Carolina, LLC/Charleston Chemical Plant	10IN010	Surficial/Floridan/Gordon, Crouch Branch	64	50.85
Seabrook Island Utility Commission	10WS003	McQueen Branch/Charleston	258	91.3
Mt Pleasant Waterworks	10WS006	McQueen Branch/Charleston	3953	1700.04
Town of Sullivan Island Water & Sewer Department	10WS007	Gramling	108	3.223
Isle of Palms Water & Sewer Commission	10WS010	McQueen Branch/Charleston	200	121.49
	Totals		**5,589**	**2,438.89**

Dorchester County				
Facility	**Permit**	**Aquifer**	**Permit Amount (MGY)**	**Reported Use (MGY)**
Legend Oaks Golf Operations, LLC	18GC004	Crouch Branch	27	13
City of North Charleston/ The Golf Club at Wescott Plantation	18GC051	Surficial/Floridan/Gordon	50	11.99
Giant Cement Company/ Harleyville Plant	18IN001	Crouch Branch	385	193.14
Showa Denko Inc	18IN002	Crouch Branch	190	68.37
ARGOS Cement LLC/Harleyville Plant	18IN040	Surficial/Floridan/Gordon, Crouch Branch	250	118.74
Ham Bone Farm, LLC	18IR002	Crouch Branch	36	31.26
Infinger Farms Partnership	18IR003	Crouch Branch	235	188.30
J & C Farms	18IR004	Surficial/Floridan/Gordon	98	24.57
Weyerhaeuser Badham Chip Mill	18OT002	Surficial/Floridan/Gordon	84	18.89
Dorchester Biomas, LLC	18PT001	Surficial/Floridan/Gordon, Crouch Branch	198	134.53
Summerville CPW	18WS001	McQueen Branch/Charleston	1210	10.71
St. George Water Department	18WS002	Crouch Branch	164	126.85
Town of Harleyville	18WS003	Crouch Branch	36	30.70
DCWA/KNIGHTSVILLE	18WS005	Crouch Branch	650	141
DCWA/REEVESVILLE	18WS006	Crouch Branch	15	6.30
DCWA/TRANQUIL ACRES	18WS007	Crouch Branch	60	0
DCWA/CONOFLOW	18WS008	Crouch Branch	175	4.10
DCPW/EDISTO TRIBAL COUNCIL	18WS010	Crouch Branch	20	23.43
SCDOC Division of Facilities Management	18WS011	Surficial/Floridan/Gordon	97	87.22
Giant Cement Company/ Harleyville Plant	18WS014	Crouch Branch	15	0.73
	Totals		**3,995**	**1,233.83**

Past Use Comparison

Between 2015 and 2016, groundwater usage in the Trident Area increased. An observed net increase of 492.34 million gallons of water was used. The average withdrawal increase is approximately 1.35 million gallons of water per day. Major increases were from public water supply and golf courses in Charleston County, and industry in Berkeley County. Dorchester County decreased water use in all categories between 2015 and 2016 at a percentage of -5.60%. The percent change in water use for the entire area was +10.97%. The largest percent change in water use occurred in Charleston County at +20.26%, followed by Berkeley County at +13.40%.

Table 4 lists the reported usage in 2015 by the same permitted users in the Trident Area. Table 5 lists the percent difference in reported water use for permitted users between 2015 and 2016 in each county.

Table 4: Reported 2015 Use (in millions of gallons a month)

Reported Permitted 2015 Use					
Category	**Berkeley**	**Charleston**	**Dorchester**	**Use Total**	**Use Total %**
Golf Courses	19.35	384.80	25.29	**429.44**	**9.57%**
Industry	1,092.44	53.01	399.28	**1,544.73**	**34.42%**
Agricultural Irrigation	-	-	279.07	**279.07**	**6.22%**
Other	-	-	20.55	**20.55**	**0.46%**
Thermal Power	-	-	139.71	**139.71**	**3.11%**
Public Water Supply	41.52	1,590.12	443.14	**2,074.77**	**46.23%**
Total	**1,153.30**	**2,027.93**	**1,307.04**	**4,488.28**	
Total %	**25.70%**	**45.18%**	**29.12%**		

Table 5: Percent difference in reported water use between 2015 and 2016

	Berkeley	**Charleston**	**Dorchester**	**Trident**
Percent Changes	+13.40%	+20.26%	-5.60%	**+10.97%**

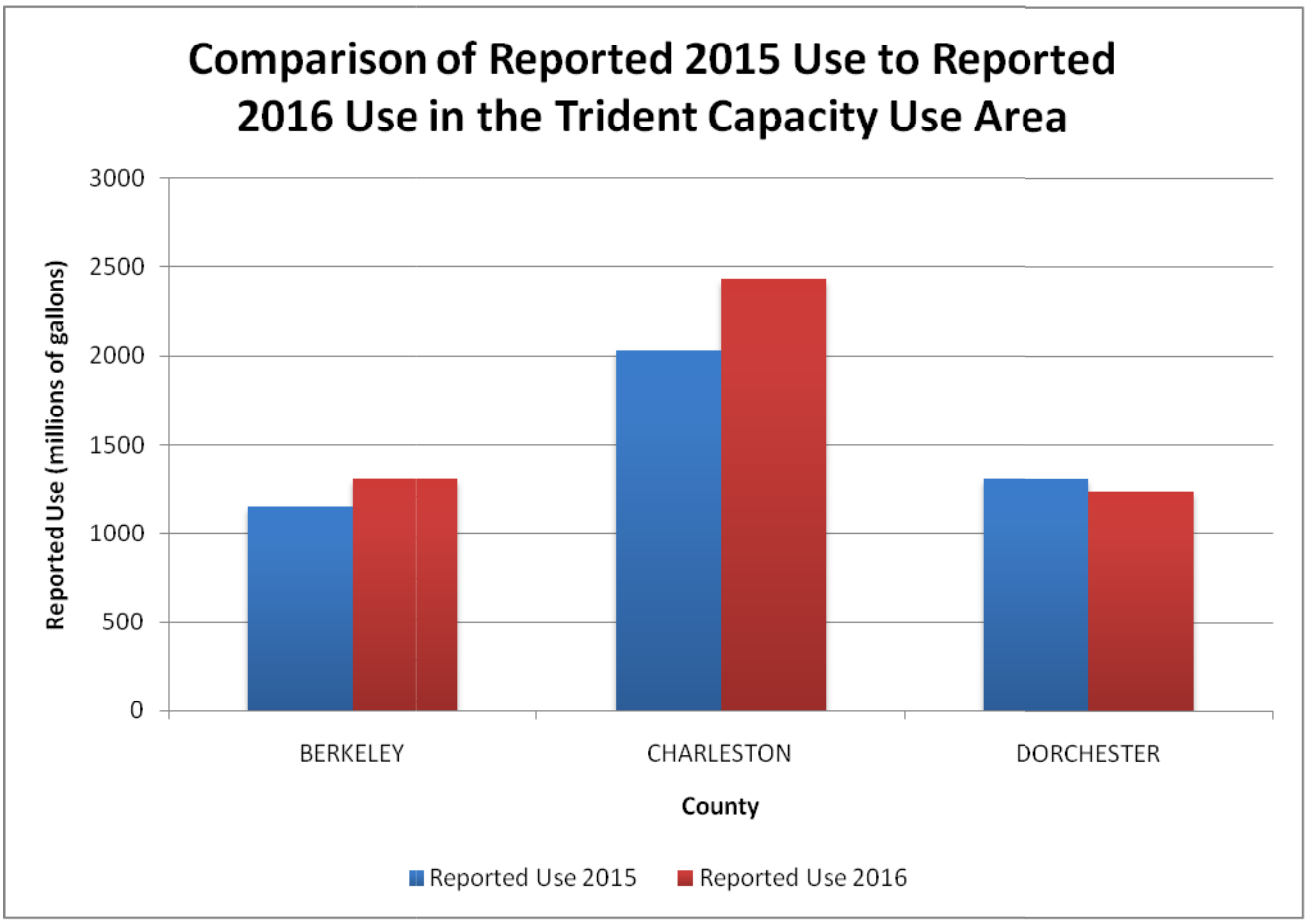

Figure 8: Comparison of Reported 2015 Use to Reported 2016 Use in the Trident Capacity Use Area.

Table 6: Difference in Reported Permitted Water Use between 2015 and 2016 by Category and County (in millions of gallons, negative values indicate decreases in use).

Difference in Use Between 2015 and 2016 (MG)				
Category	**Berkeley**	**Charleston**	**Dorchester**	**Total Change**
Golf Courses	+4.49	+87.18	-0.30	**+91.37**
Industry	+146.85	-2.16	-19.02	**+125.67**
Agricultural Irrigation	-	-	-34.94	**-34.94**
Other	-	-	-1.66	**-1.66**
Thermal Power	-	-	-5.18	**-5.18**
Public Water Supply	+3.25	+325.94	-12.11	**+317.08**
Total Change	**+154.59**	**+410.96**	**-73.21**	**+492.34**

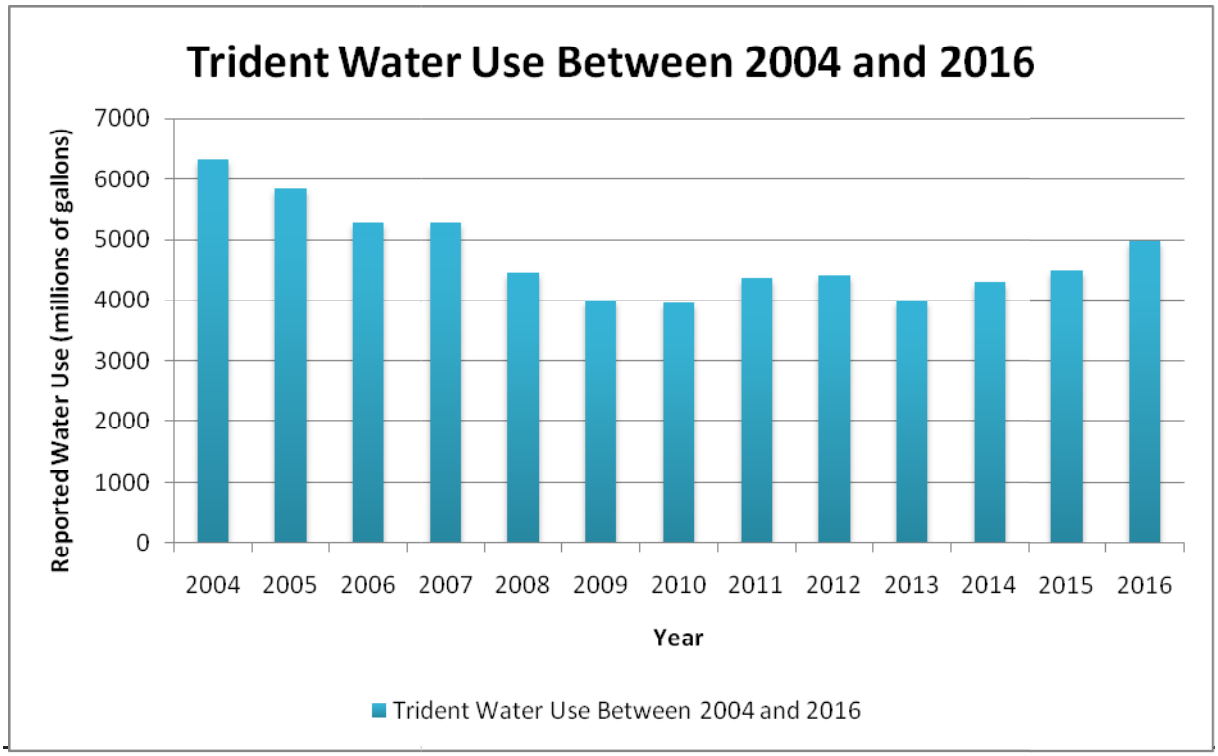

Figure 9: Water Use from 2012 to 2016 in the Trident Capacity Use Area.

Since its designation, the Trident Capacity Use area has seen fluctuations in the reported use in the region. In 2004, when the area was first designated, water use was at its highest at a reported at 6,329,353,000 gallons. Within the first ten years of its designation the area saw great declines in water use, with an overall low in 2010, with a reported use of 3,969,705,000 gallons, almost 2.4 billion gallons less than 2004. Since this time, however, there have been gradual increases in reported use. In 2016, the Trident area reported a total use of 4,980,610,000 gallons. This use reflects use similar to 2006 in which use was only 290.73 million gallons more.

Aquifer Demand

Within the Trident Area, the most utilized aquifer is the McQueen Branch/Charleston Aquifer. Several of the high capacity users in the region use this aquifer because of the high pressure head in the region. This is shown in Table 7.

Table 7: 2016 Permitted Use in Trident Capacity Use Area by Aquifer

2016 Reported Permitted Use in Trident Capacity Use Area by Aquifer (MG)					
Aquifer	**Berkeley**	**Charleston**	**Dorchester**	**Totals**	**Percent**
Surficial/Floridan/Gordon Aquifers	44.52	19.24	177.36	**241.13**	**4.84%**
Crouch Branch Aquifer	112.86	67.61	967.76	**1,148.24**	**22.05%**
McQueen Branch/Charleston Aquifer	1150.51	2348.81	88.71	**3,588.02**	**72.04%**
Gramling Aquifer	-	3.22	-	**3.22**	**0.06%**
Totals	**1,307.89**	**2,438.87**	**1,233.83**	**4,980.61**	**100%**

In 2016, only 0.06% of water pumped was from the Gramling Aquifer. The largest percentage, 72.04%, was pumped from the McQueen Branch/Charleston Aquifer system. This is followed by the Crouch Branch 22.05% and the Surficial, Floridan, and Gordon Aquifers at 4.84%. The water use between aquifer systems is fairly dominated by use from the McQueen Branch/Charleston Aquifer. This is shown in the following figures.

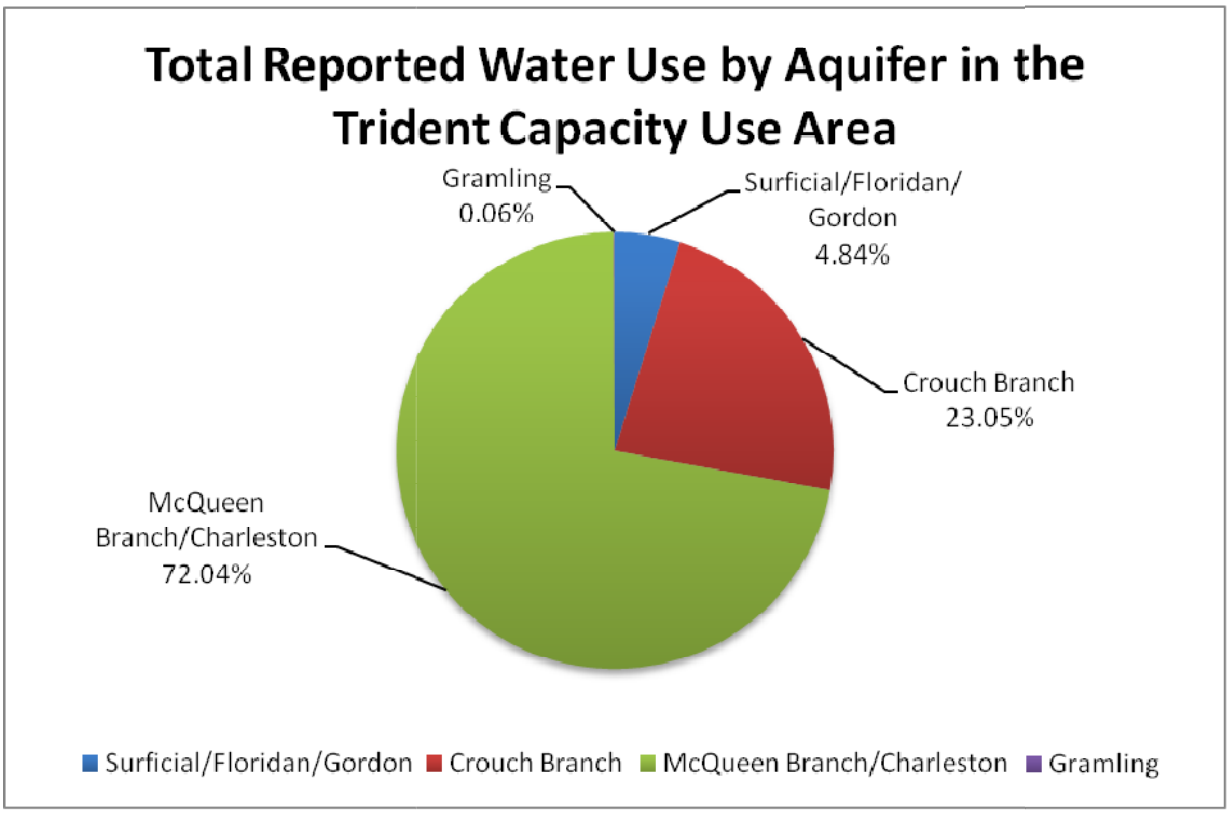

Figure 10: 2016 Permitted Trident Capacity Use Area Use by Aquifer.

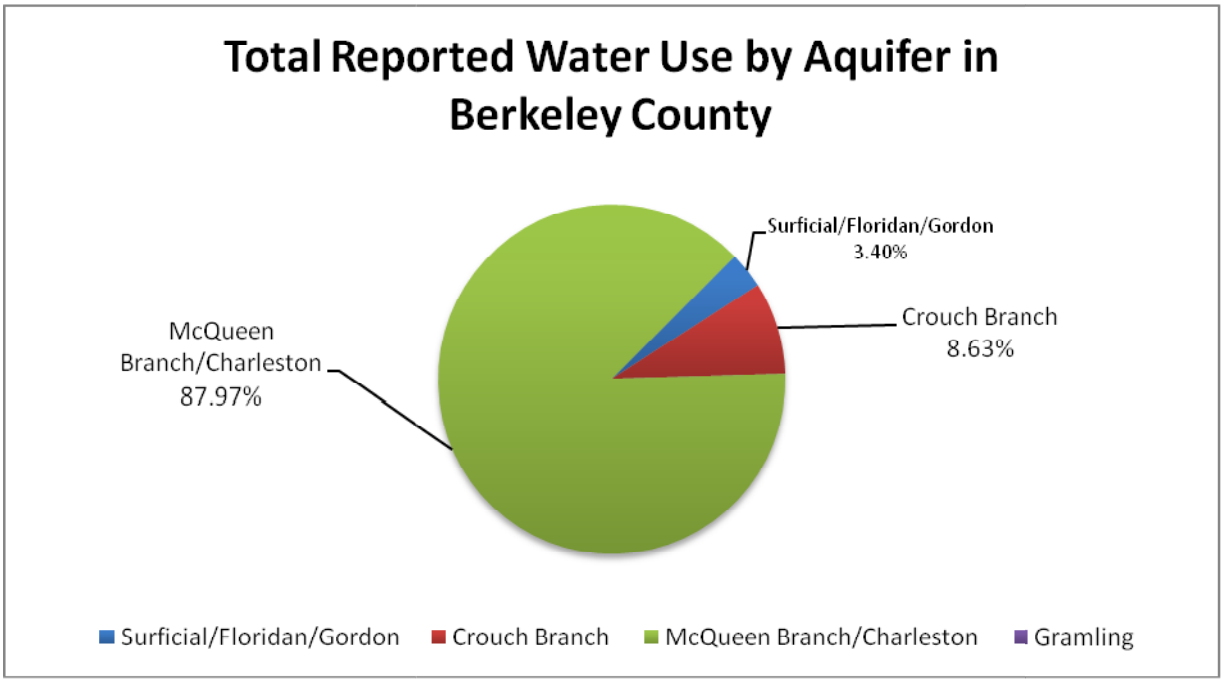

Figure 11: 2016 Permitted Use in Berkeley County by Aquifer.

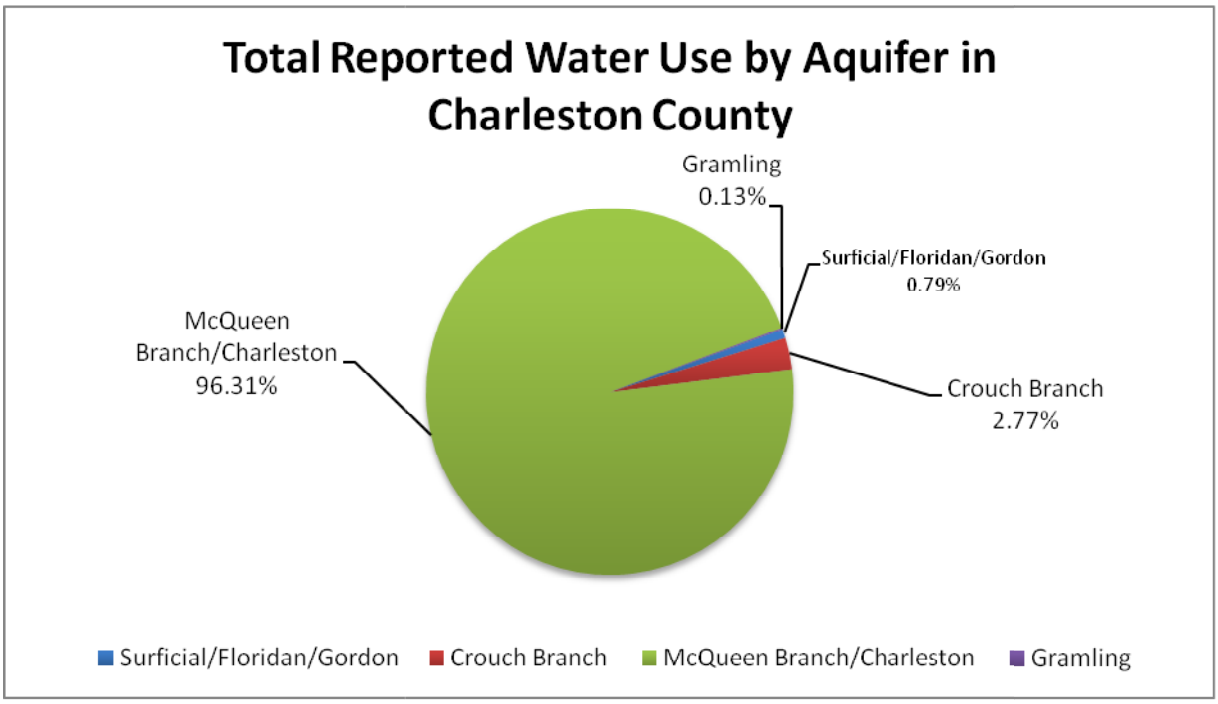

Figure 12: 2016 Permitted Use in Charleston County by Aquifer

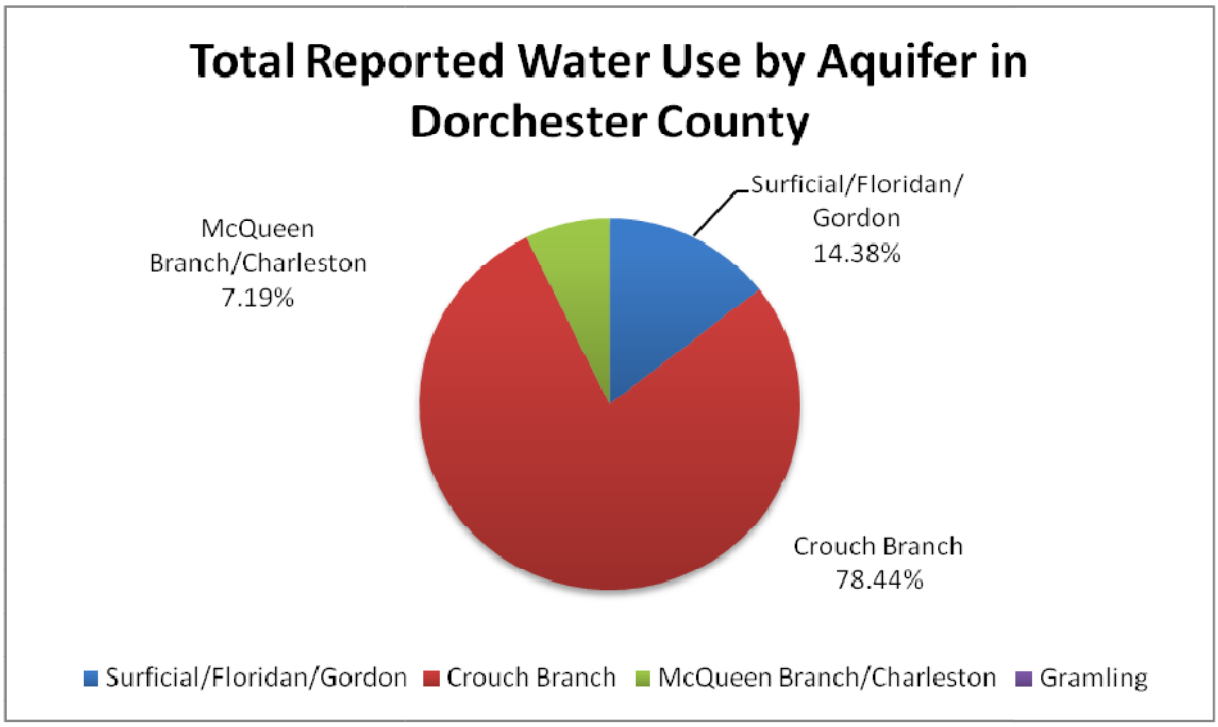

Figure 13: 2016 Permitted Use in Dorchester County by Aquifer

Groundwater Evaluation

The aquifers chiefly used in the Trident Capacity Use Area are the Crouch Branch, and McQueen Branch/Charleston Aquifers. After review of the most recent South Carolina Department of Natural Resources Potentiometric Surface Maps, the Department recognizes one (1) distinct area of concern within the McQueen Branch/Charleston aquifer in the region. The area of concern is in Mount Pleasant, Charleston County. This area is of concern because it has groundwater-levels that lie below mean sea-level, and has a record of decline, with increasing water use. These cones of depression are primarily caused by high capacity groundwater pumping and local aquifer properties.

High capacity groundwater pumping is a major concern as cones of depression effect the natural seaward movement of freshwater, which prevents saltwater from encroaching coastal aquifers. Under normal conditions, this interface between freshwater and saltwater is maintained near the coast or far below land surface. Groundwater pumping can reduce freshwater flow toward coastal discharge areas and cause saltwater to be drawn toward the freshwater zones of the aquifer. Saltwater intrusion decreases freshwater storage in the aquifers, and, in extreme cases, can result in the abandonment of supply wells. *(Groundwater, U. (2018). USGS Groundwater Information: Saltwater Intrusion. [online] Water.usgs.gov.)*

The primary area of concern is the severe cone of depression in Mount Pleasant, Charleston County. Groundwater levels here range from 50-to-101-feet below mean sea level, *Figure 7*. Between the release of the 2014 and 2016 potentiometric surface maps, groundwater levels in wells in the Mount Pleasant area declined.

Well	2014 Water Level (ft)	2016 Water Level (ft)	Change (ft)
CHN-163	-102	-101	**+1**
CHN-173	-44	-71	**-27**
CHN-185	-52	-81	**-29**
CHN-849	-56	-67	**-11**

Table 8: Water-level changes between 2014 and 2016 Potentiometric Surface Maps in wells in Mt. Pleasant, SC.

During this time, groundwater withdrawals in the region also increased. The only water user utilizing this aquifer in the area is 10WS006, Mt. Pleasant Waterworks. This facility is a public water supply company. The locations of the wells from this permittee are in the Mount Pleasant area in Charleston County. In 2016, Mt. Pleasant Waterworks reported water use of 1,700.04 million gallons of water for the year. This equates to approximately 4.66 million gallons of water pumped daily. The total water use in the McQueen Branch/Charleston aquifer in 2016 for Charleston County was 2,348.81 million gallons. Mt. Pleasant Waterworks accounts for 72% of the water pumped from the McQueen Branch/Charleston aquifer in the county. Between 2015 and 2016, Mt. Pleasant Waterworks increased their water usage by 286.99 million gallons, from 1,413.5 million gallons in 2015, to 1,700.04 million gallons in 2016.

Examining the past four reporting years, Mt. Pleasant Waterworks has increased pumping from a low of 970.61 million gallon in 2013, to 1,700.04 million gallons in 2016. Continual increases in pumping have shown reciprocal decreases in groundwater-levels in nearby monitoring wells. If high volumes of pumping from this aquifer persist, the cone of depression will continue to deepen, leading to further stress on the aquifer.

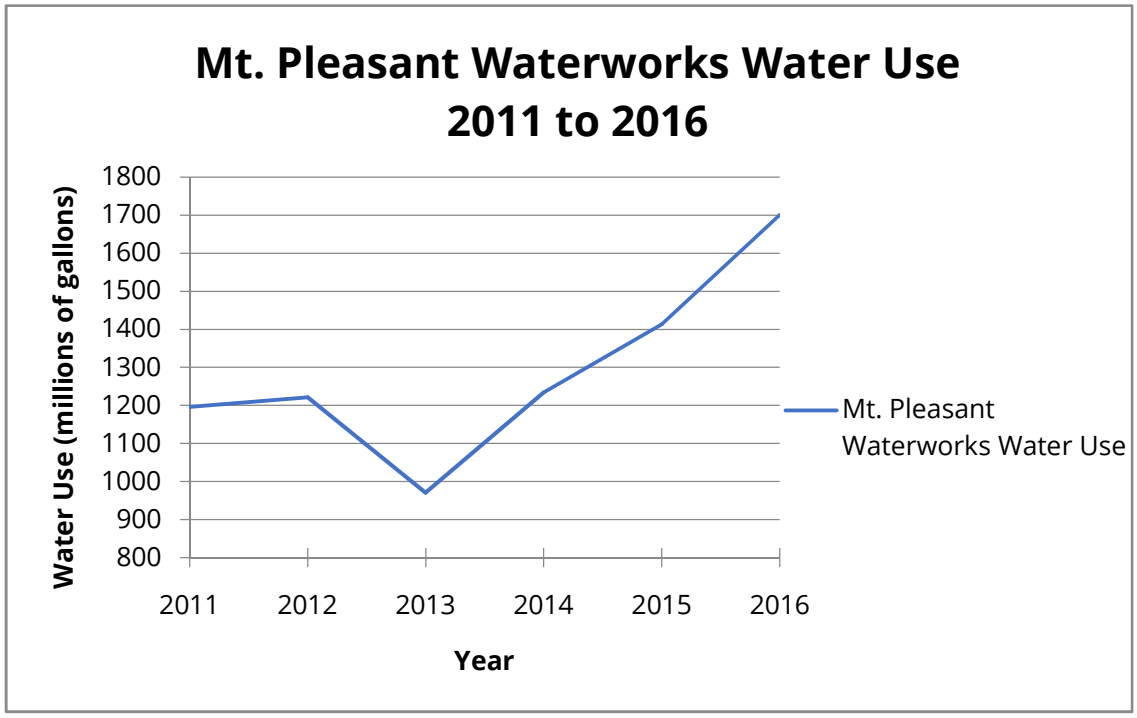

Figure 14: Mt. Pleasant Waterworks Water Use 2011 to 2016.

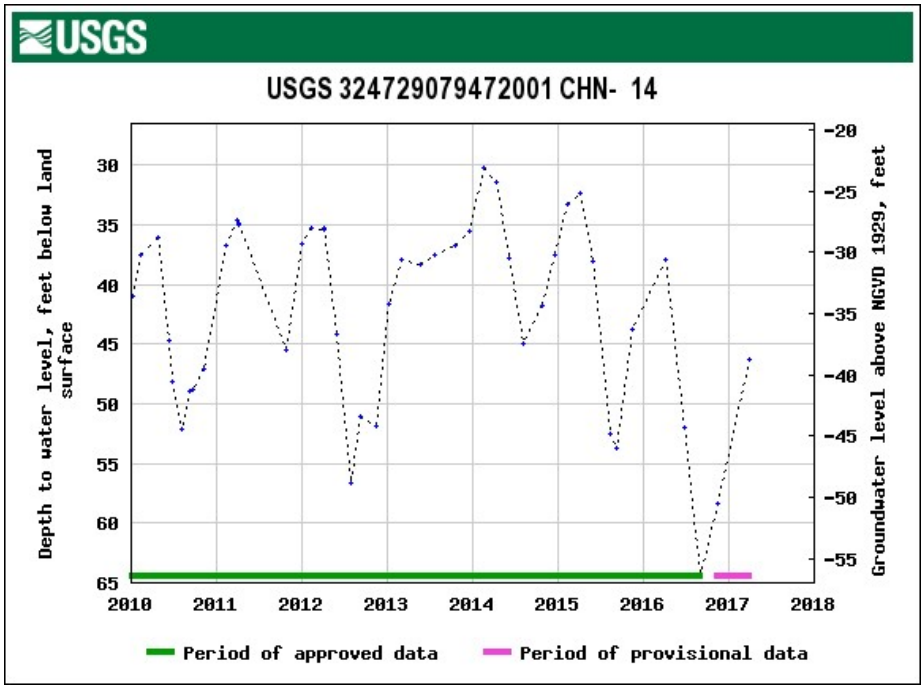

Figure 15: Water level data from USGS well CHN-14 in Charleston County, SC 2010-present.

This groundwater-level graph of a monitoring well in downtown Charleston, provided by the USGS, displays how increased pumping in Mt. Pleasant has led to an overall decrease in groundwater-levels over time. While seasonal variations are normal, the trend of rebound is negative since 2014.

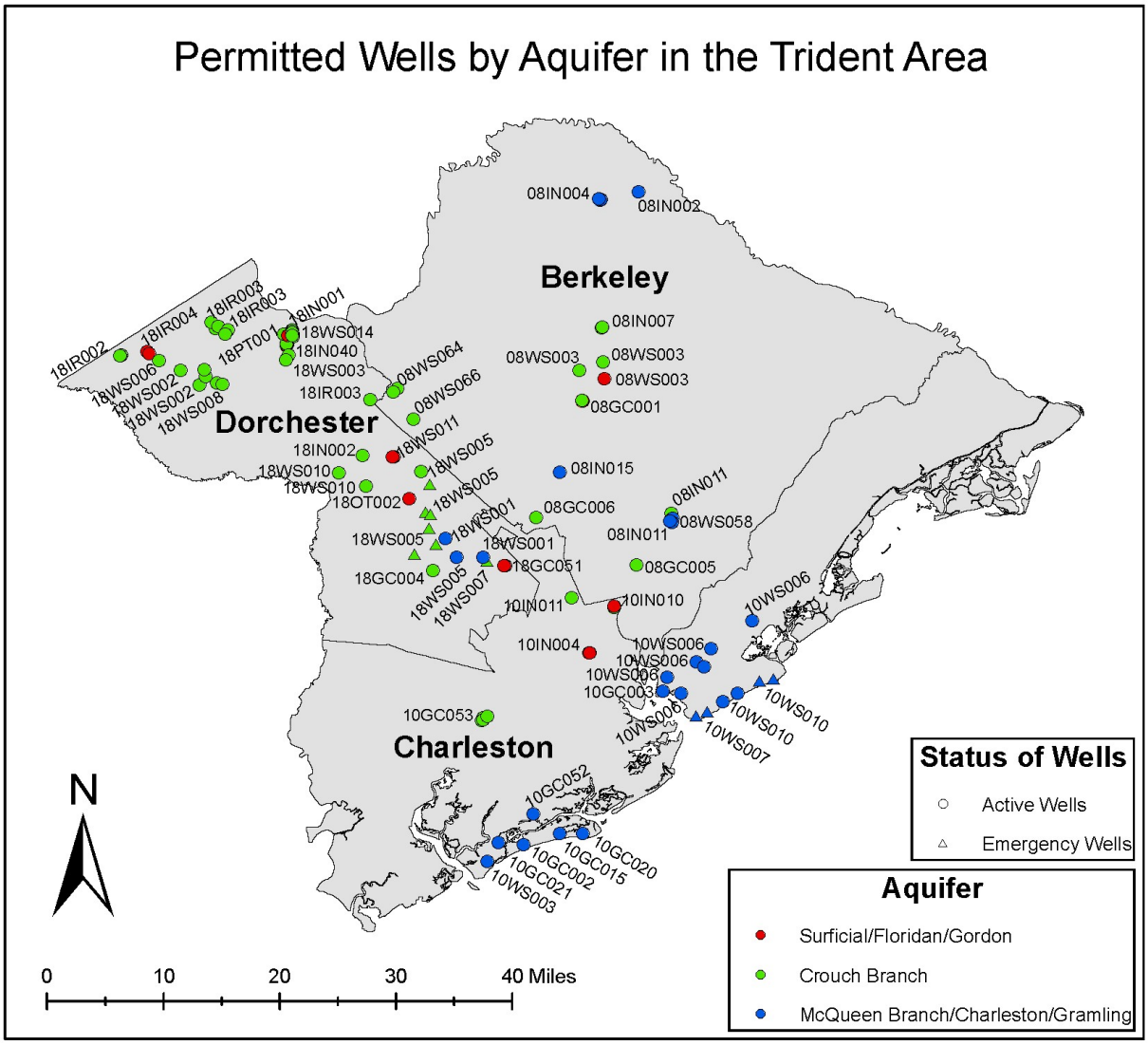

Figure 17: Well locations of permitted facilities in the Trident Capacity Use Area.

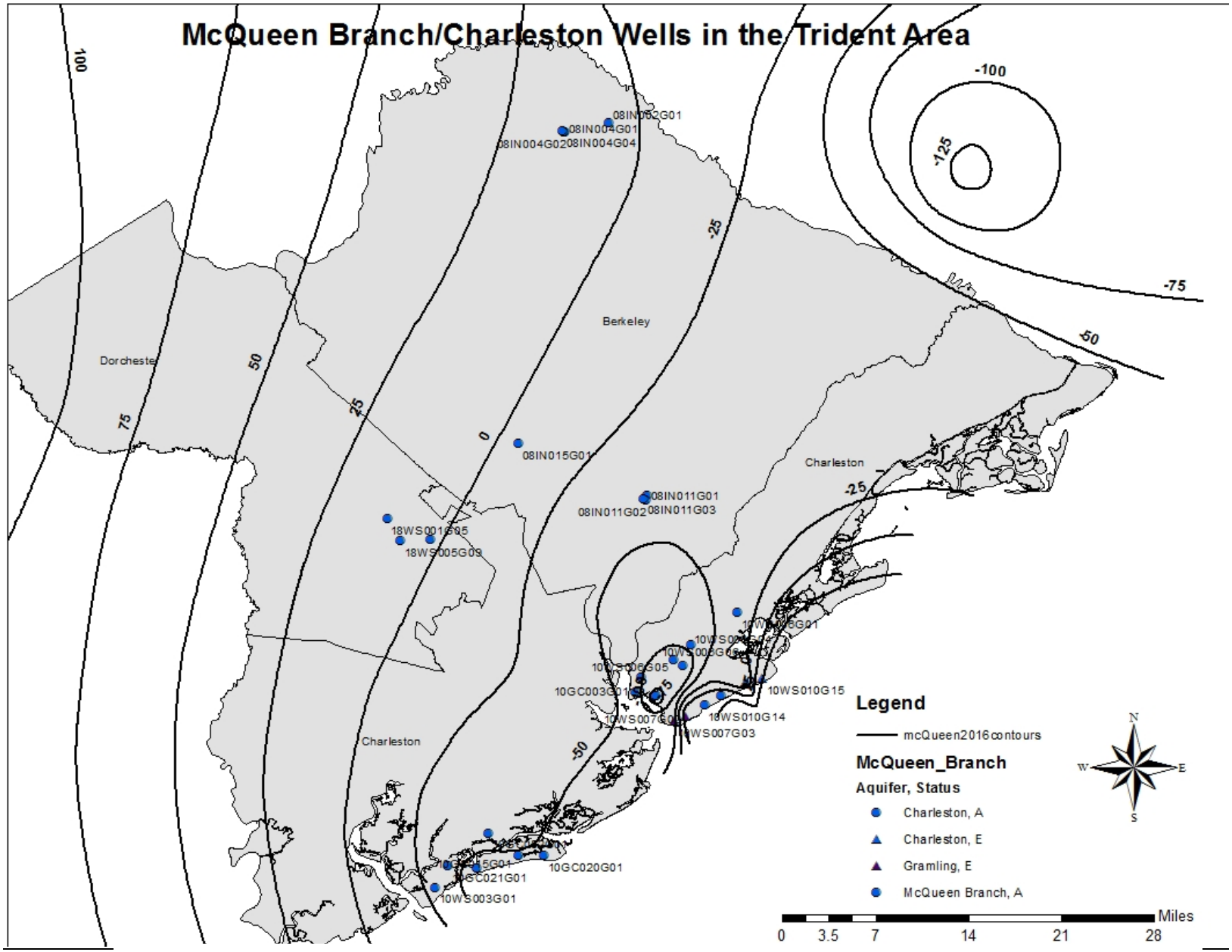

Figure 18: McQueen Branch/Charleston Wells and Potentiometric Surface in Trident Area.

Recommendations

Stress on the McQueen Branch/Charleston aquifer in the Mt. Pleasant, South Carolina portion of the aquifer needs to be mitigated in the Trident Capacity Use Area. Reducing withdrawals in this aquifer may be necessary to allow recovery of groundwater-levels within the cone of depression.

One method to limit the effects of high capacity pumping in the region may be to increase the use of Aquifer Storage and Recovery (ASR) wells and increase use of Artificial Recharge (AR). While these two processes are similar in that they both involve the process of replenishing groundwater in aquifers, ASR is used to store water which is later recovered for use, while AR is used to solely replenish the water in aquifers. Both processes may be viable to help in recovery of the cone of depression.

Public water supply facilities utilizing groundwater resources should undergo an in depth analysis of infrastructure to ensure there are no issues that are contributing to groundwater loss. Conservation efforts should also be encouraged to the public through education and incentive. Low-flow plumbing options in homes and a reduction in lawn irrigation can greatly decrease the demand on groundwater pumping.

In accordance with the recently implemented Initial Groundwater Management Plan for the Trident Capacity Use Area, these recommendations will take effect for the next permitting year: 2018. These recommendations follow both Strategy #1 and Strategy #2, as laid out in the Groundwater Management Plan. Implementation of these strategies will help ensure sustainability of the aquifers underlain in the area.