PREPARED IN COOPERATION WITH THE
SOUTH CAROLINA WATER RESOURCES COMMISSION

INTRODUCTION

This report, prepared by the U.S. Geological Survey in cooperation with the South Carolina Water Resources Commission, presents maps depicting the potentiometric surface in November 1989 for the Black Creek and Middendorf aquifers underlying the upper and lower Coastal Plain of South Carolina (fig. 1). These aquifers are extensive aquifers that underlie much of the Coastal Plain of South Carolina and are important sources of water for industrial, municipal, and agricultural uses. Also presented in this report are maps showing the declines in the potentiometric surfaces of these aquifers between 1982 and 1989. The decline maps are based in part on potentiometric maps showing 1982 conditions that were prepared by Aucott and Speiran (1985a).

GENERALIZED GEOHYDROLOGIC FRAMEWORK

The Coastal Plain province consists of a wedge of sand, clay, and limestone of Late Cretaceous and younger age deposited on a pre-Cretaceous basement of consolidated metamorphic and sedimentary rocks (figs. 2, 3, and 4). The wedge thickens from the Fall Line toward the present-day shoreline. This wedge can be divided into aquifers and confining units on the basis of relative permeabilities, areal extent, and lithologic continuity of the sediments. The aquifers consist of sand, silty sand, or highly permeable limestone. Water generally moves laterally in these aquifers. The confining units separating the aquifers consist of clay, silt, or low permeability limestone that impede the vertical movement of water between aquifers.

The clastic aquifers of the South Carolina Coastal Plain have been designated as the surficial, Floridan, Tertiary Sand, Black Creek, Middendorf, and Cape Fear aquifers. Names used to designate the aquifers have been adopted from common usage. This report addresses only the Black Creek and Middendorf aquifers. These aquifers generally coincide with the Black Creek and Middendorf Formations of Cretaceous age, but locally may contain parts of other formations.

The Black Creek aquifer is primarily composed of permeable sediments of the Black Creek Formation and is the uppermost regional aquifer consisting of Cretaceous-age deposits. It consists of thinly laminated sand and clay lenses. The updip limit of the Black Creek aquifer generally is parallel to and a few miles southeast of the Fall Line. The aquifer crops out in the eastern part of the Coastal Plain, and is present in the subsurface throughout much of the Coastal Plain of South Carolina.

The Middendorf aquifer, which underlies the Black Creek aquifer, is present throughout the Coastal Plain of South Carolina. In the upper part of the Coastal Plain, it generally consists of more massive sandbeds than does the Black Creek aquifer and generally consists of the Middendorf Formation. This unit also has been referred to as the Tuscaloosa Formation (Cooke, 1936). In the lower part of the Coastal Plain, the permeable sediments of the Middendorf aquifer are lithologically similar to those of the Black Creek aquifer but are stratigraphically equivalent to the Middendorf Formation. The updip limit of the Middendorf aquifer is the Fall Line.

GROUND-WATER FLOW SYSTEM

The major source of recharge to the Coastal Plain aquifers of South Carolina is infiltration of precipitation in aquifer outcrop areas. Potentiometric highs in the interstream uplands of the outcrop areas of the Black Creek and Middendorf aquifers result from this recharge.

The major discharge from the Black Creek and Middendorf aquifers is to streams where valleys are incised into these aquifers in the upper part of the Coastal Plain. Ground-water discharge to streams is reflected by the bending of the potentiometric contours upstream in the vicinity of the Savannah River and other major streams in the upper Coastal Plain. Discharge also occurs to smaller streams in the upper Coastal Plain, but the effects of these discharges on the potentiometric surfaces are depicted herein only where data are available to show effects mappable at a 25-foot contour interval.

Prior to ground-water development, discharge from the Black Creek and Middendorf aquifers occurred as upward leakage throughout much of the lower Coastal Plain, although flow quantities were probably small (Aucott and Speiran, 1985b). However, leakage is now downward in much of eastern South Carolina because the vertical hydraulic gradient has been reversed in much of the area as a result of large ground-water withdrawals from the Black Creek and Middendorf aquifers. The flow system has changed very little since 1982; water levels in 1989 generally were similar to or slightly lower than those measured in 1982.

The largest decline in water level in the Middendorf aquifer from November 1982 (Aucott and Speiran, 1985a) to November 1989 has been caused by ground-water withdrawals in the Charleston area. Within that area, withdrawals for Mount Pleasant and Summerville account for most of the withdrawals from the Middendorf aquifer. These withdrawals average 10 to 15 million gallons per day and have caused water-level declines as great as 65 feet between 1982 and 1989 in the Middendorf aquifer.

The largest decline in water level in the Black Creek aquifer during the period November 1982 to November 1989 was caused by withdrawals in the western region of Georgetown County. These withdrawals have caused water-level declines as great as 86 feet between 1982 and 1989. Other local water-level declines have also occurred in the Black Creek aquifer in areas of less pumpage.

COMPILATION OF MAPS

Most of the water-level data used in compiling the potentiometric surface maps in this report were collected during late October, November, and early December 1989. A small percentage of the water-level data was collected in late January and early February 1990. Water-level variations during the period of measurement generally were small (less than 1 foot) and, for purposes of this report, the measured water levels were considered representative of conditions in November 1989 and were used to prepare the potentiometric surface maps. Most of the measuring-point altitudes were derived from topographic quadrangle maps of 1:24,000 scales having land-surface altitude contour intervals of 5 to 20 feet.

Although many water-level measurements were made in areas of pumping, care was taken to assure that the measurements represented, as nearly as practical, the static water level of the aquifer at the time of measurement. A few measurements represent composite water levels in wells screened in more than one aquifer, but these measurements were verified by single-zone measurements whenever possible.

The potentiometric surface maps for the Black Creek and Middendorf aquifers (figs. 5 and 6) were constructed from water-level data collected at 233 wells (tables 1 and 2), 105 in the Black Creek aquifer and 128 in the Middendorf aquifer, taking into account the configuration of the potentiometric surface in 1982 as documented by Aucott and Speiran (1985a). Most of the wells in which water levels were measured in 1989 were the same wells used to prepare the 1982 potentiometric surface map. The maps showing declines in the potentiometric surfaces between 1982 and 1989 were prepared by comparing the two potentiometric surface maps as well as using the differences in measured water levels at the wells (figs. 7 and 8).

SELECTED REFERENCES

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
square mile	2.590	square kilometer(km^2)
million gallons per day	0.04381	cubic meter per second second (m^3)

Sea Level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

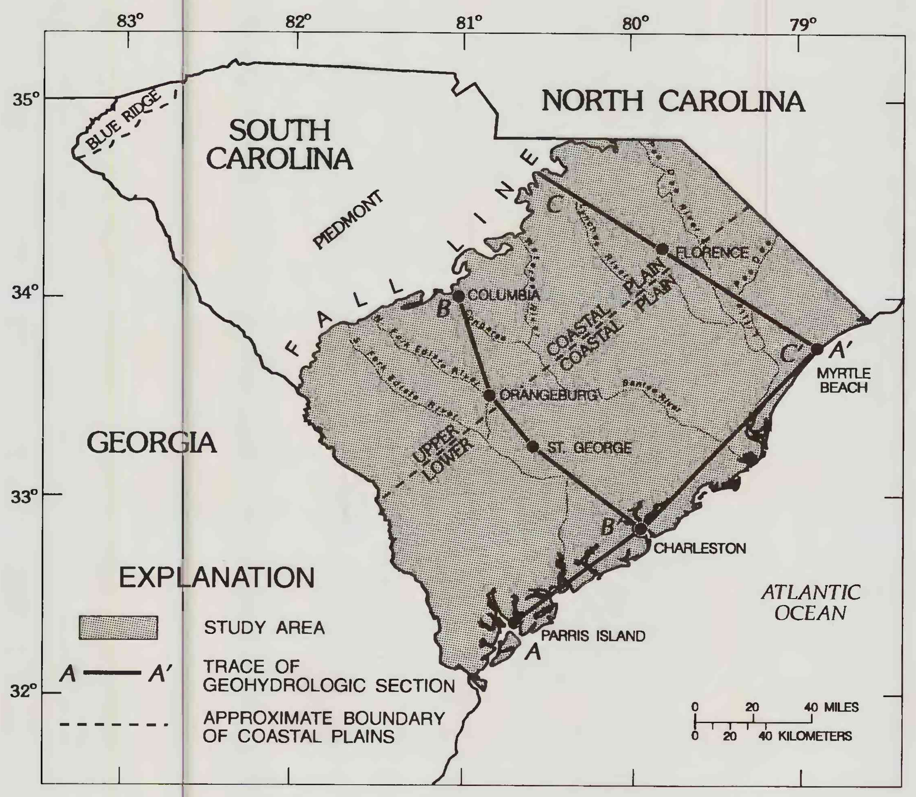

Figure 1.--Location of study area and geohydrologic sections.

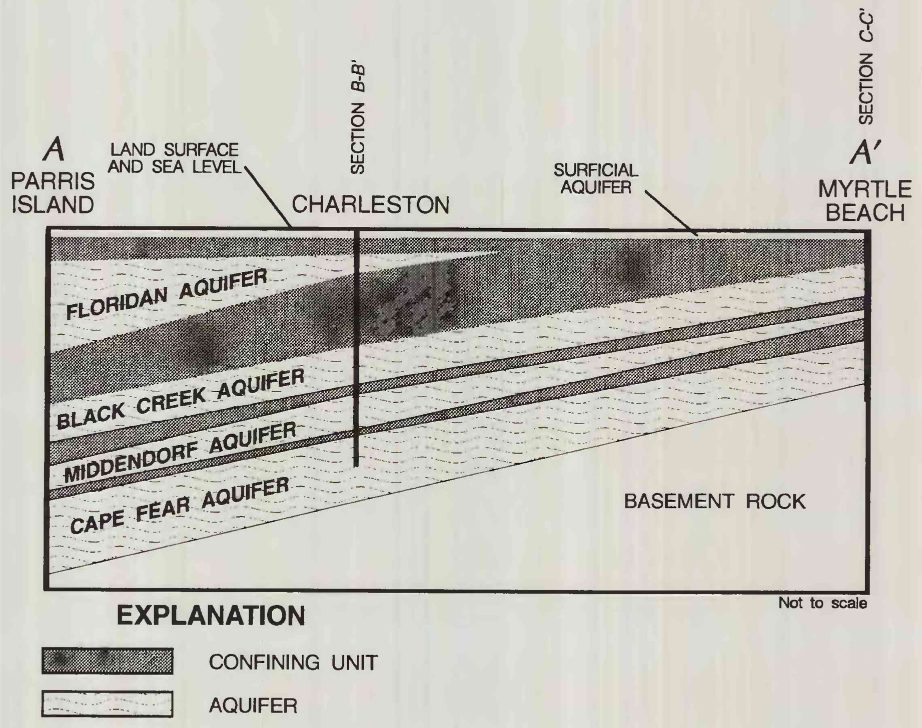

Figure 2.--Generalized geohydrologic section A – A'.

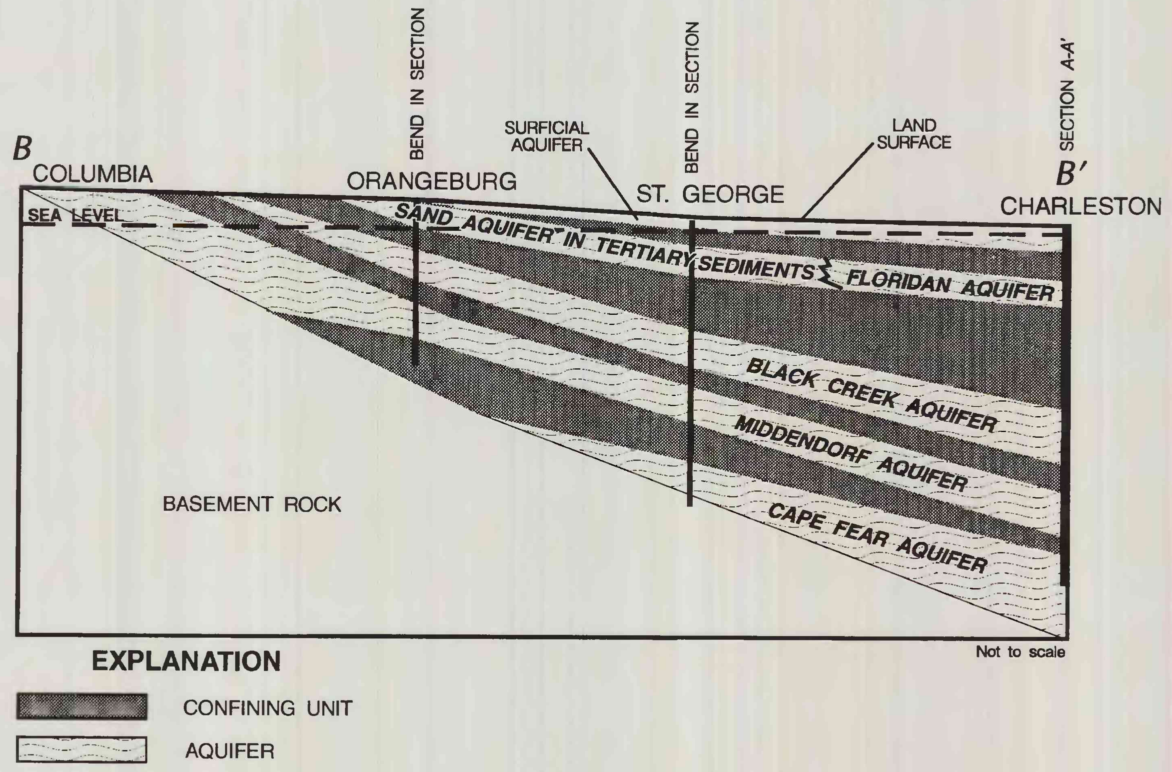

Figure 3.--Generalized geohydrologic section B – B'.

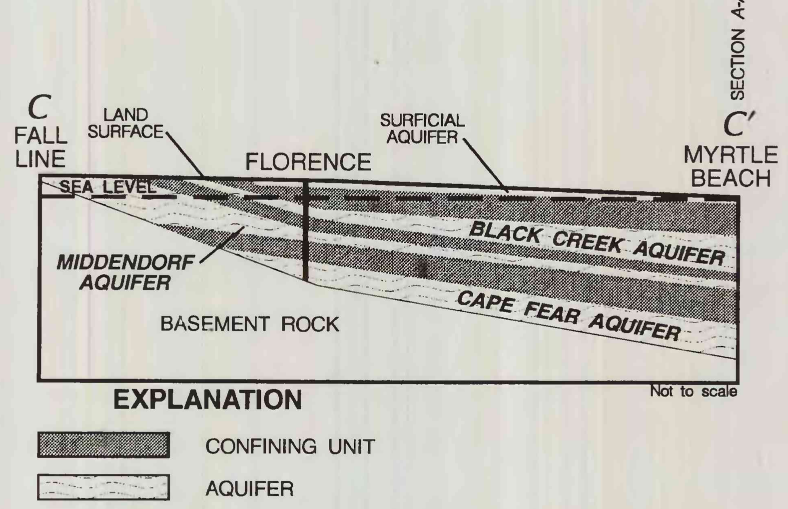

Figure 4.--Generalized geohydrologic section C – C'.

Table 1. --Water level altitudes in wells completed in the Black Creek aquifer in South Carolina, November 1989

County	Well number	Latitude	Longitude	Water level altitude above or below (-) sea level (feet)
Aiken	AK-824	33°26'16"	81°46'15"	240
Aiken	AK-825	33°26'16"	81°46'14"	241
Aiken	IDB-1A	33°18'39"	81°36'22"	189
Aiken	P-16TC	33°22'38"	81°38'27"	221
Aiken	P-18TD	33°15'10"	81°40'21"	170
Aiken	P-19TD	33°14'46"	81°36'58"	178
Aiken	P-22TD	33°11'28"	81°30'48"	174
Aiken	P-29A	33°17'12"	81°43'20"	167
Aiken	P-30TD	33°20'16"	81°42'31"	207
Aiken	P-3C	33°17'06"	81°38'60"	175
Allendale	AL-22	32°58'50"	81°16'34"	142
Allendale	AL-40	33°07'18"	81°33'19"	153
Allendale	AL-603	33°04'33"	81°26'42"	126
Bamberg	BAM-7	33°17'42"	81°02'15"	162
Bamberg	BAM-49	33°22'04"	81°11'22"	210
Barnwell	BW-355	33°10'44"	81°18'55"	168
Barnwell	P-13TD	33°12'08"	81°33'41"	173
Barnwell	P-15TD	33°12'46"	81°37'27"	169
Barnwell	P-17TD	33°20'40"	81°30'01"	215
Barnwell	P-20TD	33°16'30"	81°34'25"	188
Barnwell	P-21TD	33°08'48"	81°36'27"	165
Barnwell	P-23TD	33°10'57"	81°40'43"	163
Barnwell	P-24TD	33°13'47"	81°34'31"	176
Barnwell	P-25TE	33°12'39"	81°39'27"	169
Barnwell	P-27TE	33°17'09"	81°38'06"	178
Barnwell	P-28A	33°17'29"	81°40'29"	174
Berkeley	BRK-89	33°17'18"	79°41'38"	3
Calhoun	CAL-2	33°33'23"	80°43'04"	140
Calhoun	CAL-29	33°33'43"	80°42'36"	130
Calhoun	CAL-95	33°33'10"	80°38'12"	121
Calhoun	CAL-98	33°41'26"	80°41'36"	105
Calhoun	CAL-607	33°35'38"	80°40'42"	123
Calhoun	CAL-609	33°36'46"	80°45'07"	125
Charleston	CHN-1	33°12'03"	79°26'08"	2
Clarendon	CLA-7	33°50'54"	80°09'30"	103
Clarendon	CLA-22	33°53'30"	80°01'15"	78
Clarendon	CLA-32	33°39'06"	80°16'49"	110
Clarendon	CLA-600	33°34'52"	80°23'40"	99
Darlington	DAR-98	34°10'10"	80°04'02"	165
Darlington	DAR-118	34°17'16"	79°44'48"	107
Dillon	DIL-28	34°19'46"	79°15'53"	75
Florence	FLO-11	33°59'44"	79°34'08"	28
Florence	FLO-99	34°12'00"	79°44'41"	115
Florence	FLO-114	33°56'06"	79°56'01"	78
Florence	FLO-148	33°49'52"	79°26'40"	-57
Florence	FLO-180	33°48'34"	79°26'22"	-24
Florence	FLO-184	33°48'04"	79°26'52"	-35
Florence	FLO-188	33°55'00"	79°44'44"	41
Florence	FLO-191	34°14'13"	79°48'47"	106
Florence	FLO-207	34°02'10"	79°47'20"	64
Florence	FLO-600	34°08'13"	79°56'19"	125
Florence	FLO-603	33°51'49"	79°26'49"	2
Georgetown	GEO-9	33°22'06"	79°16'33"	-37
Georgetown	GEO-32	33°32'42"	79°21'18"	-36
Georgetown	GEO-37	33°19'03"	79°39'49"	4
Georgetown	GEO-77	33°24'15"	79°17'35"	-76
Georgetown	GEO 80	33°31'58"	79°03'22"	-98
Georgetown	GEO-84	33°26'09"	79°10'35"	-84
Georgetown	GEO-85	33°28'30"	79°16'43"	-39
Georgetown	GEO-87	33°28'46"	79°05'57"	-107
Georgetown	GEO-131	33°33'46"	79°01'45"	-91
Georgetown	GEO-193	33°27'29"	79°34'51"	-134
Horry	HO-1	33°50'58"	79°03'27"	-30
Horry	HO-203	33°42'01"	78°53'12"	-96
Horry	HO-225	33°59'55"	79°12'08"	16
Horry	HO-269	33°47'47"	78°44'57"	-70
Horry	HO-290	33°40'14"	78°56'23"	-125
Horry	HO-298	33°53'35"	78°35'02"	0
Horry	HO-301	33°53'33"	78°35'22"	-14
Horry	HO-302	33°53'34"	78°35'01"	1
Horry	HO-309	33°46'07"	78°58'05"	-79
Horry	HO-311	33°51'15"	78°39'25"	-31
Horry	HO-319	33°42'39"	79°01'23"	-80
Horry	HO-321	33°44'15"	78°51'37"	-82
Horry	HO-346	33°51'02"	78°42'18"	-53
Horry	HO-361	33°42'53"	79°04'14"	-60
Horry	HO-485	34°03'27"	78°53'29"	19
Horry	HO-673	33°38'23"	79°02'21"	-97
Horry	HO-976	33°57'08"	78°44'10"	-9
Horry	HO-977	34°08'24"	79°00'48"	41
Lee	LEE-55	34°09'38"	80°21'02"	194
Marion	MRN-9	34°09'57"	79°24'30"	-45
Marion	MRN-43	34°12'18"	79°15'32"	23
Marion	MRN-59	34°12'15"	79°15'32"	27
Marion	MRN-60	34°11'37"	79°15'23"	20
Marion	MRN-77	33°51'43"	79°19'50"	-3
Orangeburg	ORG-256	33°36'33"	81°00'25"	201
Orangeburg	ORG-607	33°27'50"	81°06'11"	204
Orangeburg	ORG-635	33°29'05"	81°08'53"	218
Richland	RIC- 79	33°56'31"	80°41'16"	183
Richland	RIC-318	33°49'49"	80°42'17"	113
Richland	RIC-324	33°51'11"	80°49'55"	125
Sumter	SUM-68	33°48'26"	80°32'19"	98
Sumter	SUM-158	33°59'30"	80°20'52"	159
Sumter	SUM-201	33°54'59"	80°31'03"	155
Sumter	SUM-204	33°53'02"	80°30'19"	148
Sumter	SUM-211	33°53'50"	80°09'10"	103
Williamsburg	WIL-11	33°39'56"	79°49'45"	10
Williamsburg	WIL-14	33°29'56"	79°55'21"	52
Williamsburg	WIL-20	33°40'30"	79°49'35"	8
Williamsburg	WIL-64	33°34'31"	79°59'26"	71
Williamsburg	WIL-76	33°43'40"	79°30'38"	2
Williamsburg	WIL-605	33°43'20"	79°34'23"	1
Williamsburg	WIL-607	33°38'16"	79°25'30"	-2
Williamsburg	WIL-608	33°44'16"	79°48'22"	40

Table 2. --Water-level altitudes in wells completed in the Middendorf aquifer in South Carolina, November 1989

County	Well number	Latitude	Longitude	Water level altitude above or below (-) sea level (feet)
Aiken	AK-275	33°31'12"	81°24'41"	248
Aiken	AK-278	33°33'14"	81°46'13"	247
Aiken	AK-290	33°25'10"	81°41'01"	254
Aiken	AK-361	33°39'45"	81°28'50"	348
Aiken	AK-411	33°33'45"	81°29'40"	280
Aiken	AK-430	33°19'40"	81°44'35"	201
Aiken	AK-817	33°26'17"	81°46'15"	238
Aiken	AK-818	33°26'17"	81°46'14"	241
Aiken	AK-826	33°32'30"	81°29'05"	272
Aiken	P-14TA	33°18'30"	81°29'22"	188
Aiken	P-15TB	33°12'46"	81°37'27"	178
Aiken	P-16TA	33°22'38"	81°38'27"	217
Aiken	P-18TB	33°15'10"	81°40'21"	171
Aiken	P-26TD	33°12'51"	81°45'32"	147
Aiken	P-28TB	33°17'29"	81°40'29"	171
Aiken	P-29TA	33°17'12"	81°43'20"	171
Aiken	P-30TB	33°20'16"	81°42'31"	201
Aiken	P-3A	33°17'05"	81°38'60"	173
Barnwell	BW-78	33°24'00"	81°25'22"	230
Barnwell	BW-349	33°10'42"	81°18'55"	192
Barnwell	BW-356	33°10'43"	81°18'56"	190
Barnwell	BW-358	33°19'28"	81°24'28"	208
Barnwell	P-13TB	33°12'08"	81°33'41"	182
Barnwell	P-17TB	33°20'40"	81°30'01"	215
Barnwell	P-19TA	33°14'46"	81°36'58"	179
Barnwell	P-21TB	33°08'48"	81°36'27"	180
Barnwell	P-22TB	33°11'28"	81°30'48"	188
Barnwell	P-23TB	33°10'57"	81°40'43"	167
Barnwell	P-24TB	33°13'47"	81°34'31"	184
Barnwell	P-25TB	33°12'39"	81°39'27"	172
Barnwell	P-27TB	33°17'09"	81°38'06"	178
Beaufort	BFT-11	32°21'09"	80°41'25"	143
Berkeley	BRK-245	33°24'23"	79°56'22"	60
Berkeley	BRK-418	33°10'20"	80°02'19"	60
Berkeley	BRK-444	33°04'36"	79°59'44"	33
Calhoun	CAL-31	33°52'03"	81°00'39"	132
Charleston	CHN-2	32°51'21"	79°57'41"	28
Charleston	CHN-11	32°47'10"	79°56'11"	10
Charleston	CHN-12	32°47'58"	79°56'23"	18
Charleston	CHN-13	32°47'39"	79°56'22"	15
Charleston	CHN-14	32°47'30"	79°55'53"	2
Charleston	CHN-172	32°50'48"	80°03'59"	32
Charleston	CHN-173	32°50'47"	79°49'39"	14
Charleston	CHN-174	32°34'49"	80°09'35"	61
Charleston	CHN-178	32°47'03"	79°56'35"	23
Charleston	CHN-183	32°52'33"	79°45'58"	42
Charleston	CHN-185	32°49'05"	79°50'05"	-10
Charleston	CHN-186	32°35'59"	80°06'21"	59
Charleston	CHN-219	32°48'20"	79°44'03"	71
Charleston	CHN-603	32°46'37"	79°48'35"	42
Charleston	CHN-604	32°48'12"	79°45'17"	41
Chesterfield	CTF-46	34°37'10"	79°52'43"	117
Chesterfield	CTF-49	34°30'23"	80°02'10"	215
Chesterfield	CTF-60	34°30'44"	80°14'52"	350
Clarendon	CLA-3	33°41'15"	80°12'16"	92
Clarendon	CLA-20	33°41'42"	80°12'25"	93
Clarendon	CLA-25	33°35'42"	80°21'24"	124
Clarendon	CLA-602	33°34'55"	80°12'16"	92
Clarendon	CLA-604	33°31'54"	80°25'49"	124
Colleton	COL-50	32°54'47"	80°38'46"	126
Darlington	DAR-69	34°18'35"	79°51'36"	72
Darlington	DAR-81	34°30'34"	79°51'19"	84
Darlington	DAR-82	34°21'15"	80°07'01"	192
Darlington	DAR-95	34°15'21"	79°50'18"	27
Darlington	DAR-100	34°24'06"	80°09'35"	219
Darlington	DAR-103	34°25'53"	80°05'45"	220
Darlington	DAR-208	34°18'22"	79°52'40"	73
Darlington	DAR-219	34°21'39"	80°11'41"	206
Darlington	DAR-221	34°17'33"	79°44'32"	31
Darlington	DAR-222	34°18'31"	79°44'55"	49
Dillon	DIL-70	34°28'22"	79°24'06"	84
Dillon	DIL-79	34°20'42"	79°10'04"	66
Dillon	DIL-90	34°27'53"	79°20'03"	81
Dorchester	DOR-206	33°01'50"	80°12'20"	-10
Dorchester	DOR-221	32°57'32"	80°09'46"	-15
Florence	FLO-128	34°11'44"	79°34'50"	22
Florence	FLO-146	34°10'11"	79°47'18"	-14
Florence	FLO-153	34°08'13"	79°56'14"	78
Florence	FLO-179	34°11'57"	79°50'57"	-37
Florence	FLO-181	34°10'47"	79°51'15"	-20
Florence	FLO-194	34°12'17"	79°43'54"	-38
Florence	FLO-209	34°13'15"	79°47'25"	-40
Georgetown	GEO-103	33°34'37"	79°23'21"	8
Horry	HOR-315	33°52'33"	78°37'02"	-17
Kershaw	KER-11	34°25'15"	80°21'15"	252
Kershaw	KER-73	34°07'54"	80°35'37"	134
Kershaw	KER-82	34°25'08"	80°19'35"	206
Kershaw	KER-87	34°21'12"	80°28'53"	230
Kershaw	KER-100	34°10'04"	80°47'40"	263
Lee	LEE-18	34°03'51"	80°03'56"	123
Lee	LEE-23	34°14'05"	80°11'01"	193
Lee	LEE-36	34°17'34"	80°20'29"	242
Lee	LEE-56	34°12'32"	80°25'40"	212
Lexington	LEX-168	33°48'52"	81°05'58"	305
Lexington	LEX-180	33°46'12"	81°15'25"	334
Lexington	LEX-181	33°45'40"	81°14'56"	329
Lexington	LEX-191	33°42'15"	81°03'10"	251
Lexington	LEX-192	33°51'01"	81°22'02"	390
Lexington	LEX-602	33°56'14"	81°16'43"	370
Marion	MRN-68	34°14'46"	79°30'03"	32
Marlboro	MRL-27	34°32'50"	79°31'17"	118
Marlboro	MRL-31	34°40'08"	79°32'36"	153
Marlboro	MRL-39	34°30'24"	79°39'26"	92
Marlboro	MRL-110	34°29'35"	79°43'10"	65
Marlboro	MRL-112	34°37'35"	79°41'22"	131
Marlboro	MRL-136	34°43'09"	79°50'19"	133
Marlboro	MRL-143	34°42'08"	79°36'27"	195
Orangeburg	ORG-49	33°27'50"	80°51'30"	174
Orangeburg	ORG-81	33°25'30"	80°51'00"	179
Orangeburg	ORG-108	33°21'00"	80°40'44"	166
Orangeburg	ORG-221	33°27'39"	80°40'01"	151
Richland	RIC-40	34°03'35"	80°58'35"	307
Richland	RIC-63	33°49'44"	80°38'01"	116
Richland	RIC-131	33°57'46"	80°51'44"	258
Richland	RIC-175	34°08'00"	80°52'07"	363
Richland	RIC-293	33°52'44"	80°53'36"	115
Richland	RIC-305	34°00'12"	80°49'34"	266
Richland	RIC-313	33°57'25"	80°48'42"	207
Sumter	SUM-80	33°58'43"	80°18'05"	139
Sumter	SUM-119	33°55'03"	80°19'16"	110
Sumter	SUM-151B	33°44'13"	80°28'10"	117
Sumter	SUM-161	33°54'59"	80°19'28"	109
Sumter	SUM-178	34°01'54"	80°25'35"	184
Sumter	SUM-179	34°02'35"	80°25'23"	188
Sumter	SUM-198	33°56'42"	79°58'47"	80
Sumter	SUM-207	33°57'19"	80°32'06"	142
Sumter				
Williamsburg	WIL-37	33°44'51"	79°27'10"	-8
Williamsburg	WIL-176	33°43'51"	79°27'43"	-8

For additional information write to:
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POTENTIOMETRIC SURFACES OF NOVEMBER 1989 AND DECLINES IN THE POTENTIOMETRIC SURFACES BETWEEN NOVEMBER 1982 AND NOVEMBER 1989 FOR THE BLACK CREEK AND MIDDENDORF AQUIFERS IN SOUTH CAROLINA

By
W.J. Stringfield and B.G. Campbell

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