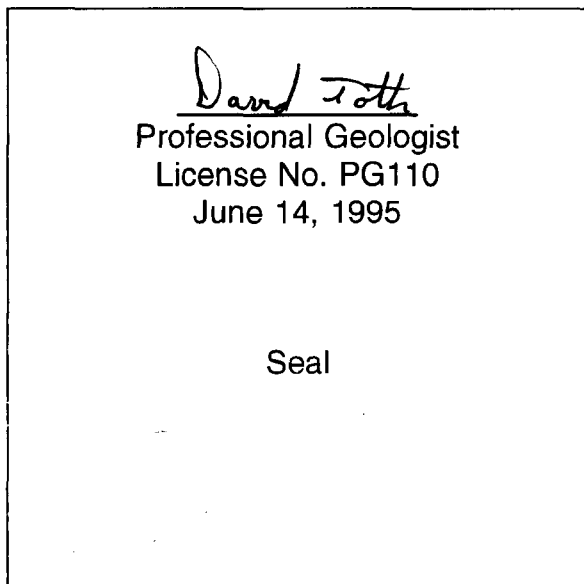


Professional Paper SJ95-PP2

**WATER QUALITY
IN THE FLORIDAN AQUIFER SYSTEM
CRESCENT CITY RIDGE
NORTHEAST FLORIDA**

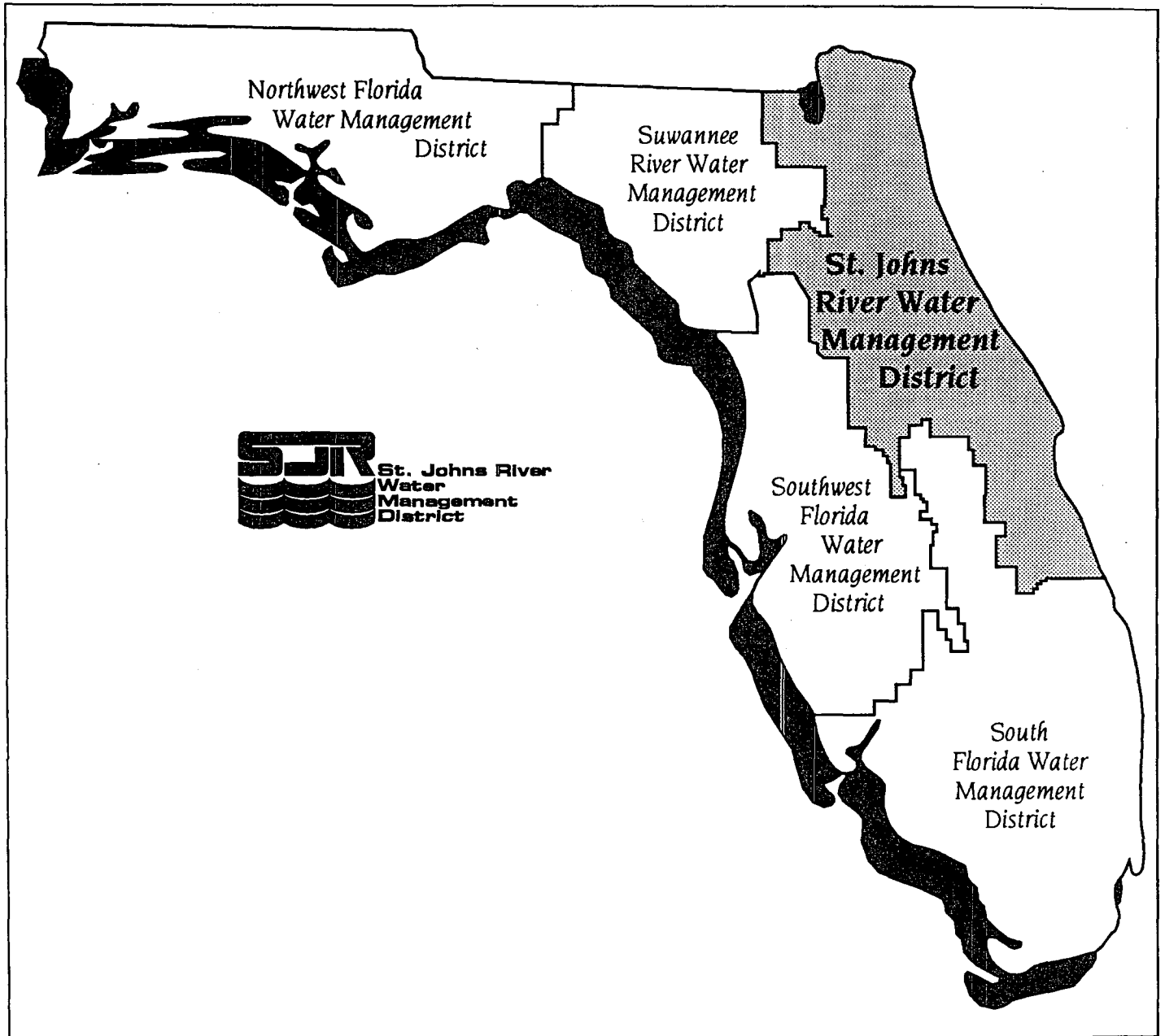
by

David Toth, Ph.D., P.G.



St. Johns River Water Management District
Palatka, Florida

1995



The **St. Johns River Water Management District (SJRWMD)** was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 19 counties in northeast Florida. The mission of SJRWMD is to manage water resources to ensure their continued availability while maximizing environmental and economic benefits. It accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management.

Professional papers are published to disseminate information collected by SJRWMD in pursuit of its mission. Copies of this report can be obtained from:

Library
St. Johns River Water Management District
P.O. Box 1429
Palatka, FL 32178-1429

Phone: (904) 329-4132

ABSTRACT. Staff of the St. Johns River Water Management District collected ground water samples from 187 wells throughout the Crescent City Ridge area in 1992 and 1993. The Crescent City Ridge is located in southeast Putnam and northwest Volusia counties. The purpose of the sampling was to determine the chloride, sulfate, and total dissolved solids concentrations of the Floridan aquifer system in this area. The Floridan aquifer system beneath the Crescent City Ridge generally contains good quality water. Chloride, sulfate, and total dissolved solids concentrations generally were below 50, 25, and 250 milligrams per litre (mg/L), respectively. Concentrations became elevated near the St. Johns River. Chloride, sulfate, and total dissolved solids concentrations were above 250, 250, and 500 mg/L, respectively, at Welaka, on the southern half of Drayton Island, and on the eastern and southern sides of Lake George in Volusia County.

In 1990, the Governing Board of the St. Johns River Water Management District (SJRWMD) established the Task Force on Water Resource Issues Affecting the Fern Growing Areas of Southeast Putnam and Northwest Volusia Counties. The purpose of the task force was to review the water resource issues of this area and to make recommendations to the Governing Board of SJRWMD. This task force was created because of water resource problems caused by a 3-day freeze in December 1989. During this 3-day period, ferneries in Putnam and Volusia counties withdrew an estimated 158 and 775 million gallons per day (598 and 2,933 litres) of ground water, respectively, for frost-and-freeze protection. These quantities were estimated by assuming an application rate of 100 gallons per minute per acre (V. Singleton, SJRWMD, pers. com. 1993) for frost-and-freeze protection and irrigated acreage as contained in Florence (1992). The drawdown resulting from this withdrawal caused many domestic wells to go dry. Many residents complained of poor water quality. Many residents were concerned that withdrawals for frost-and-freeze protection were degrading the water quality in the Floridan aquifer system in this area.

In 1991, the task force recommended that SJRWMD construct maps of the chloride, sulfate, and total dissolved solids (TDS) concentrations in the area of the Crescent City Ridge. The Crescent City Ridge is bounded by Dunns Creek to the north; the St. Johns River to the west; Crescent Lake, Haw Creek, the Volusia-Flagler county line, and State Road 11 to the east; and State Road 40 to the south (Figure 1). The maps would allow citizens to determine where potable water might occur in the Floridan aquifer system. This information also would provide local governments with a better understanding of ground water quality in this area.

The U.S. Environmental Protection Agency (1993) recommended a maximum chloride, sulfate, and TDS concentration of 250, 250, and 500 milligrams per litre (mg/L), respectively, for public drinking water. The State of Florida adopted these concentrations as secondary drinking water standards for public water supplies (Chapter 62-550, *Florida Administrative Code*). The standard for TDS may be exceeded only if no other standard is exceeded. Chloride in concentrations of 300 mg/L or more in combination with sodium gives a salty taste to water and increases the corrosiveness of water. High sulfate concentrations may cause severe scaling problems in pipes and boilers. In drinking water, high sulfate concentrations also

may produce undesirable laxative effects. A TDS concentration is the total weight of dissolved substances in a measured volume of water. These substances include sodium (Na^+), potassium (K^+), calcium (Ca^{+2}), magnesium (Mg^{+2}), iron (Fe^{+2}), chloride (Cl^-), sulfate (SO_4^{-2}), bicarbonate (HCO_3^-), and other minor dissolved constituents of ground water. Sulfate and TDS concentrations above 250 and 500 mg/L, respectively, cause increasing taste problems to water supplies.

METHODS

In May and October 1992 and January and February 1993, SJRWMD staff collected ground water samples from 187 wells throughout the Crescent City Ridge area (Figure 1, Table 1). Ground water samples were collected in October 1992 and January and February 1993 to fill in the gaps of the areal coverage of the May 1992 sampling effort. Most of the wells sampled were domestic wells. Well depths were not known for all wells; however, known depths of the wells sampled ranged from 15 to 120 meters (50–400 feet). The top of the Floridan aquifer system ranges from 3 to 30 meters (10–100 feet) below mean sea level in this area. An assumption inherent in this approach was that all sampled wells penetrate the Floridan aquifer system.

The wells were purged or allowed to flow for approximately 15 minutes prior to collecting the sample. Conductivity and pH were measured at the beginning of each sampling activity and every 5 minutes thereafter until both pH and conductivity had changed by less than 10% between the last two measurements. The samples were collected and placed on ice and returned to the SJRWMD laboratory for analysis. The data were then loaded into the SJRWMD scientific data base. A geographic information system (GIS) was used to construct water quality contour maps of the area.

RESULTS

Chloride concentrations generally were below 50 mg/L throughout the Crescent City Ridge—well below the potable limit of 250 mg/L (Table 1 and Figure 2). Chloride concentrations, however, became elevated near the St. Johns River. Chloride concentrations were above 250 mg/L at Welaka and were above 1,000 mg/L on the southern half of Drayton Island. Chloride concentrations also were above 1,000 mg/L on the eastern and southern sides of Lake George in Volusia County.

Sulfate concentrations generally were below 25 mg/L throughout the Crescent City Ridge—well below the potable limit of 250 mg/L (Table 1 and Figure 3). Sulfate concentrations, however, became elevated near the St. Johns River and were above 500 mg/L on the southern half of Drayton Island and on the eastern and southern sides of Lake George in Volusia County.

TDS concentrations generally were below 250 mg/L throughout the Crescent City Ridge—below the potable limit of 500 mg/L (Table 1 and Figure 4). TDS concentrations, however, became elevated near the St. Johns River and were above 500 mg/L at Welaka. TDS concentrations were above 1,000 mg/L on the southern half of Drayton Island and on the eastern and southern sides of Lake George in Volusia County.

DISCUSSION

Non-potable water occurred at Welaka, on the southern half of Drayton Island, and on the eastern and southern ends of Lake George in Volusia County. Based on water quality data collected in this study, a geologic fault or fracture probably exists on the southern half of Drayton Island. Potable water occurred on one side of the possible fault or fracture and non-potable water on the other side. Water quality data are more reliable than geophysical logs because more wells were sampled for water quality than were geophysically logged. Similar or other geological features such as joints may be responsible for the non-potable water at Welaka and at the eastern and southern sides of Lake George. All of the above three geologic features (i.e., faults, fractures, and joints) have one thing in common—these features are breaks in the limestone and dolomite that could allow more mineralized waters at depth to move upward and degrade the aquifer.

The water quality mapped in this report was the most detailed for this area. Previous reports covering this area were concerned primarily with chloride concentrations in the Floridan aquifer system; not as many wells were sampled. Wyrick (1960) mapped the chloride concentrations in the Floridan aquifer system in Volusia County. Bermes, Leve, and Tarver (1963) mapped the chloride concentrations in the Floridan aquifer system in Flagler, Putnam, and St. Johns counties. Munch, Ripy, and Johnson (1979) mapped the chloride concentrations in the Floridan aquifer system in St. Johns, Putnam, and Flagler counties in March, July, and September 1975 and in May and September 1976 (Figure 5). Ross and Munch (1980) measured the chloride and sulfate concentrations from selected Floridan aquifer system wells on the Crescent City Ridge. Rutledge (1982, Figure 6; 1985) mapped the chloride concentrations in the Floridan aquifer system in Volusia County. All of these reports showed elevated chloride concentrations near the St. Johns River and at Lake George in Volusia County. Most chloride concentrations on the Crescent City Ridge were below 250 mg/L. The water quality for this area as reported in this study essentially is no different from that reported in other studies. The results of the current sampling, when compared to previous reports, did not show any long-term degradation in water quality (i.e., chloride concentrations) in the Floridan aquifer system in the study area.

CONCLUSION

The Floridan aquifer system beneath the Crescent City Ridge contains good quality water. Chloride, sulfate, and TDS concentrations generally were below 50, 25, and 250 mg/L, respectively. Concentrations of each substance became elevated near the St. Johns River. Non-potable water occurred at Welaka, on the southern half of Drayton Island, and on the eastern and southern sides of Lake George in Volusia County. There is no evidence of water quality degradation between 1976 and 1992 in the Floridan aquifer system in this area.

REFERENCES

- Bermes, B.J., G.W. Leve, and G.R. Tarver. 1963. *Geology and ground-water resources of Flagler, Putnam, and St. Johns counties, Florida*. Report of Investigations No. 32. Tallahassee, Fla.: Florida Geological Survey.
- Florence, B.L. 1992. *Annual water use survey: 1990*. Technical Publication SJ92-4. Palatka, Fla.: St. Johns River Water Management District.
- Munch, D.A., B.J. Ripy, and R.A. Johnson. 1979. *Saline contamination of a limestone aquifer by connate intrusion in agricultural areas of St. Johns, Putnam, and Flagler counties, northeast Florida*. Technical Publication SJ79-4. Palatka, Fla.: St. Johns River Water Management District.
- Ross, F.W., and D.A. Munch. 1980. *Hydrologic investigation of the potentiometric high centered about the Crescent City Ridge, Putnam County, Florida*. Technical Publication SJ80-3. Palatka, Fla.: St. Johns River Water Management District.
- Rutledge, A.T. 1982. *Hydrology of the Floridan aquifer in northwest Volusia County, Florida*. Water-Resources Investigations Open-File Report 82-108. Tallahassee, Fla.: U.S. Geological Survey.
- . 1985. *Ground-water hydrology of Volusia County, Florida, with emphasis on occurrence and movement of brackish water*. Water-Resources Investigations Report 84-4206. Tallahassee, Fla.: U.S. Geological Survey.
- U.S. Environmental Protection Agency. 1993. National secondary drinking water regulations. *U.S. Code*. Title 40, part 143, section 143.3.
- Wyrick, G.G. 1960. *The ground-water resources of Volusia County, Florida*. Report of Investigations No. 22. Tallahassee, Fla.: U.S. Geological Survey.

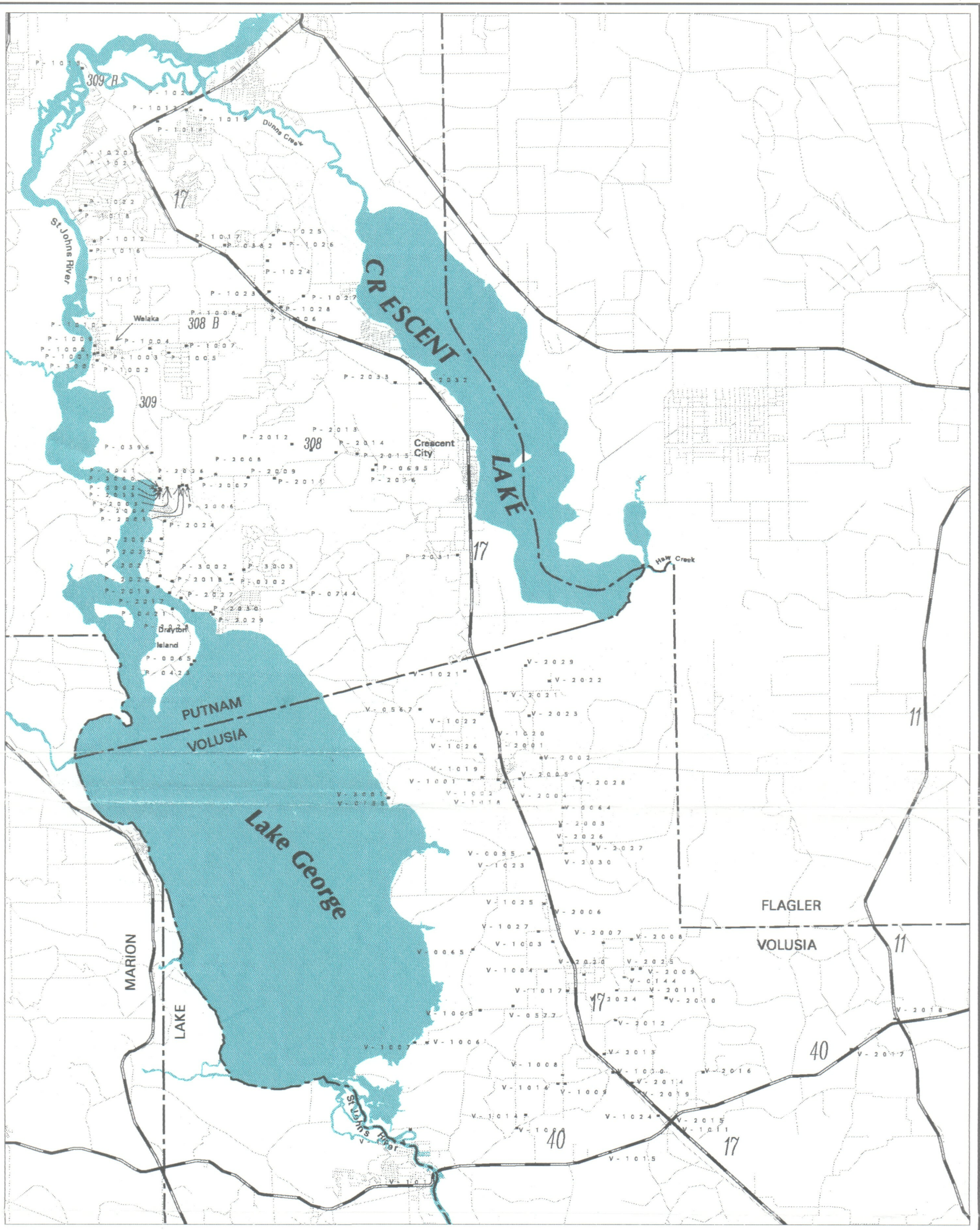


Figure 1. Location of wells used to determine water quality in the Floridan aquifer system beneath the Crescent City Ridge

LEGEND

- Highway
- Secondary road
- County boundary
- Hydrology
- Well

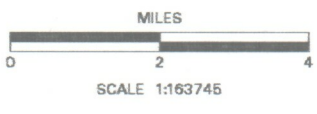


Table 1. Chloride (Cl), sulfate (SO₄), and total dissolved solids (TDS) concentrations in the Floridan aquifer system beneath the Crescent City Ridge

Well	Latitude	Longitude	Depth (ft*)	Cl (mg/L)	SO ₄ (mg/L)	TDS (mg/L)	Date ¹	Owner
P-0065	292138	813751	100	3,630	630	6,430	05211992	George Sauter
P-0102	292337	813639	53	15	3	275	05201992	W.A. Wilson
P-0382	293113	813703	240	4	1	113	05191992	Dave Main
P-0396	292628	813855	-	10	2	123	05191992	U.S. Fish & Wildlife
P-0410	292218	813331	156	29	5	276	01191993	SJRWMD
P-0411	293304	813423	-	27	21	364	10161992	SJRWMD
P-0421	292254	813821	100	42	2	322	05211992	Undetermined
P-0423	292143	813746	180	1,410	262	2,800	05211992	Gramps
P-0695	292613	813304	96	5	3	131	05181992	Arthur Schaefer
P-0744	292318	813457	140	87	12	328	05271992	SJRWMD
P-1000	292843	814026	-	49	1	313	05181992	Welaka Bait & Tackle
P-1001	292844	814020	-	48	1	315	05181992	Connie's Fashion Center
P-1002	292841	814012	-	62	1	347	05181992	Maricano Predeveio
P-1003	292851	813958	-	18	1	251	05181992	Mary E. Johnson
P-1004	292851	813859	116	23	2	130	05181992	C.C. Moore
P-1005	292845	813829	94	26	5	155	05181992	Pangman
P-1006	292944	813548	-	5	4	117	05181992	Marion Hazen
P-1007	292855	813802	225	4	2	97	05181992	Stephen Jones
P-1008	292937	813638	-	4	1	110	05181992	Donna Craft
P-1009	292854	814025	124	47	1	292	05191992	Putnam Well Drillers
P-1010	292922	814010	65	38	5	193	05191992	Clifford Collins
P-1011	293028	814032	97	169	26	418	05191992	De Moustes
P-1012	293117	814027	-	6	3	90	05191992	James Smith
P-1013	293418	813805	10	20	2	150	05201992	Richard Walker
P-1014	293402	813850	-	6	1	120	05201992	John Delarm
P-1015	293514	814048	250	96	12	271	05201992	Richard Gordon
P-1016	293104	814032	120	8	2	127	05201992	C.H. Hill

Table 1—Continued

Well	Latitude	Longitude	Depth (ft*)	Cl (mg/L)	SO ₄ (mg/L)	TDS (mg/L)	Date†	Owner
P-1017	293112	813741	198	176	33	482	05201992	Harold Meister
P-1018	293159	814049	-	112	12	321	05201992	Keith Baker
P-1019	293418	813742	120	11	2	160	05211992	B.G. Taylor
P-1020	293319	813924	186	6	6	127	05211992	Joseph Montana
P-1021	293306	813918	-	7	2	162	05211992	Tommy Thompson
P-1022	293206	814041	180	6	2	111	05211992	Rodney Bootle
P-1023	293010	813553	130	11	1	149	05271992	John Garringer
P-1024	293052	813556	120	8	1	121	05271992	Julian Lee
P-1025	293127	813547	180	10	1	115	05271992	Terrell Daughtrey
P-1026	293115	813530	105	10	1	170	05271992	John Steakley
P-1027	293004	813459	-	9	1	137	05271992	Alden Butler
P-1028	292949	813534	-	4	1	101	05271992	John Edwards
P-1029	293435	813749	185	1	1	174	05271992	Lonnie Belcher
P-2000	292537	813849	-	6	1	180	05181992	Richard Roundy
P-2001	292539	813843	100	6	1	194	05181992	James Kellogg
P-2002	292537	813841	100	5	2	189	05181992	Leonard White
P-2003	292540	813831	79	6	1	209	05181992	Floyd Hardrick
P-2004	292542	813812	87	5	1	135	05181992	John Thomas
P-2005	292544	813807	100	5	4	124	05181992	Joe Frakes
P-2006	292543	813800	90	6	1	156	05181992	John Allender
P-2007	292553	813738	-	5	3	118	05181992	Norman Simpson
P-2008	292559	813715	160	7	1	161	05181992	John Hughes
P-2009	292555	813624	125	6	1	165	05181992	Eleanor Moller
P-2011	292554	813543	90	8	1	179	05191992	Causey Jones, Sr.
P-2012	292641	813516	85	6	1	132	05191992	Ernest Huber
P-2013	292633	813446	180	27	1	312	05191992	Everard Jones
P-2014	292630	813407	66	17	2	262	05191992	Fred Amato
P-2015	292628	813334	100	8	1	140	05191992	Martin Blake
P-2016	292606	813309	80	7	10	140	05191992	James Eastham
P-2017	292316	813826	-	29	1	306	05191992	Glenda Anderson

Table 1—Continued

Well	Latitude	Longitude	Depth (ft*)	Cl (mg/L)	SO ₄ (mg/L)	TDS (mg/L)	Date†	Owner
P-2018	292332	813822	300	12	1	204	05191992	Julian Ferguson
P-2019	292324	813844	80	25	1	256	05201992	Leroy Irvine
P-2020	292339	813841	65	10	1	207	05201992	William Atkinson
P-2021	292358	813845	80	12	1	228	05201992	Dorothy Ulrich
P-2022	292409	813840	120	11	1	230	05201992	Clarence Herbst
P-2023	292430	813839	85	17	1	251	05201992	Charlie Goss
P-2024	292454	813834	80	12	3	228	05201992	A.E. Ornat
P-2025	292536	813841	-	12	4	274	05201992	William Lovell
P-2026	292553	813843	-	8	2	138	05211992	Leon Furley
P-2027	292309	813808	69	19	3	262	05211992	Jim Raiford
P-2028	292252	813749	-	36	3	321	05211992	Neal Bramlett
P-2029	292247	813718	100	90	3	437	05211992	George Meierdierck
P-2030	292250	813721	100	82	2	407	05211992	George Meierdierck
P-2031	292410	813056	-	13	1	216	05211992	Lilly M. Woolwine
P-2032	292805	813155	95	70	2	310	05211992	William K. Ellis
P-2033	292806	813234	-	7	2	179	05211992	Mary Mitchell
P-3001	292834	814021	-	61	1	345	05211992	William Manilla
P-3002	292345	813545	90	11	1	270	05211992	Marilyn Clark
P-3003	292353	813504	120	13	3	301	05211992	Muriel Fox
P-4002	292942	813759	290	12	2	111	10121992	Undetermined
P-4003	292853	813838	160	98	15	257	10121992	City of Welaka
P-4004	292852	813853	140	33	8	142	10121992	Undetermined
P-4005	292841	813859	200	161	24	342	10121992	Promthromp
P-4006	292842	813920	120	245	35	519	10121992	Ellen Heaton
P-4007	292808	814025	-	267	29	710	10141992	Southern States
P-4008	292513	813850	-	10	1	270	10141992	Undetermined
P-4009	292342	813901	-	157	8	485	10141992	Undetermined
P-4010	292313	813824	265	30	2	307	10141992	Parks
P-4011	292509	813826	140	11	1	270	10141992	Undetermined

Table 1—Continued

Well	Latitude	Longitude	Depth (ft*)	Cl (mg/L)	SO ₄ (mg/L)	TDS (mg/L)	Date†	Owner
P-4012	292416	813902	90	99	1	397	10141992	Undetermined
P-4013	292559	813941	-	119	7	281	10141992	Undetermined
P-4015	292842	813850	147	233	30	496	10191992	Elwell
P-4016	292838	813850	110	274	40	497	10191992	Undetermined
P-4017	292830	813851	-	240	35	633	10191992	Undetermined
P-4018	292820	814007	400	565	74	1,180	10191992	U.S. Fish & Wildlife
P-4019	292830	814018	100	150	7	506	10191992	U.S. Fish & Wildlife
P-4021	292426	813325	85	12	29	157	01141993	James A. Johnson
P-4022	292422	813345	-	5	5	156	01141993	M.H. Strawder
P-4023	292322	813536	-	10	6	330	01141993	James D. Redd
P-4024	292311	813531	-	2	1	263	01181993	L.W. Richards
P-4025	292810	813902	180	272	40	495	01181993	Division of Forestry
P-4026	292629	813844	-	26	6	130	01181993	Andrew Currie
P-4027	292715	813637	110	111	21	289	01181993	Tom Langan
P-4028	292258	812758	-	26	2	254	01281993	Herman E. Fugate
P-4029	292256	812757	-	31	3	254	01281993	Herman E. Fugate
P-4030	292252	812821	187	12	4	226	01281993	Jean Blankenship
P-4031	292253	812953	-	14	2	247	01281993	Skinners Wholesale Nursery
P-4032	292316	812946	-	18	1	285	01281993	Tony McLaughlin
P-4033	292257	812936	-	15	5	222	01281993	Tony McLaughlin
P-4034	292247	812958	150	13	7	218	01281993	Wesknofsky Farms
P-4035	292232	813341	-	31	2	280	01281993	Old Hunt Club Well
V-0064	291823	812808	166	11	3	185	05271992	SJRWMD
V-0065	291508	813028	180	11	8	216	05271992	SJRWMD
V-0095	291726	812854	180	6	2	146	05181992	Armand Vadnais
V-0144	291431	812631	125	6	1	108	05271992	SJRWMD

Table 1—Continued

Well	Latitude	Longitude	Depth (ft*)	Cl (mg/L)	SO ₄ (mg/L)	TDS (mg/L)	Date†	Owner
V-0155	291835	813242	155	20	4	190	05201992	USACE
V-0567	292038	813153	120	8	3	232	05181992	SJRWMD
V-0577	291351	812925	120	4	1	183	05181992	SJRWMD
V-1000	291104	812918	100	7	12	211	05181992	Floyd Isbell
V-1001	291901	813035	125	4	4	142	05181992	Wallace Henenqren
V-1002	291902	812950	130	8	2	183	05181992	James Mew
V-1003	291519	812823	-	11	1	274	05191992	Ruby Ralph
V-1004	291439	812834	130	16	20	221	05191992	Robert D. Roberts
V-1005	291345	813016	-	7	2	184	05191992	Beulah Beer
V-1006	291300	813139	68	22	2	280	05191992	Waston Phillips
V-1007	291300	813158	75	32	4	300	05191992	Undetermined
V-1008	291217	812807	117	6	5	171	05191992	William Cunningham
V-1009	291205	812803	-	5	2	145	05191992	Undetermined
V-1010	291221	812648	100	10	3	181	05191992	Grace Bishop
V-1011	291110	812519	-	8	1	189	05191992	Steve Shamblin
V-1012	291006	813117	120	18	1	302	05201992	William Molton
V-1013	291101	813204	125	14	3	240	05201992	Robert Passmore
V-1014	291122	812904	-	10	13	207	05201992	Frelong
V-1015	291031	812652	168	7	1	178	05201992	Judith Lee Dixon
V-1016	291205	812814	84	6	4	166	05201992	Undetermined
V-1017	291412	812800	200	12	3	257	05201992	Ebenezer Lutheran Church
V-1018	291858	812940	150	11	20	219	05201992	Henry Oglesby
V-1019	291905	813015	-	11	14	157	05201992	Undetermined
V-1020	291936	812948	-	16	30	244	05201992	Teresa Loadholtz
V-1021	292131	813043	120	12	1	128	05211992	James W. Register
V-1022	292032	813016	120	8	4	152	05211992	Gary Davis
V-1023	291720	812901	100	8	1	146	05211992	Mike Vadnais
V-1024	291122	812537	150	7	1	189	05211992	Kathy Roland

Table 1—Continued

Well	Latitude	Longitude	Depth (ft*)	Cl (mg/L)	SO ₄ (mg/L)	TDS (mg/L)	Date†	Owner
V-1025	291611	812837	120	7	1	147	05211992	Jody Ruth
V-1026	291937	813017	100	9	2	142	05211992	Floyd Bennett
V-1027	291533	812846	50	9	6	180	05211992	Nettie McMicken
V-2001	291932	812948	-	8	11	187	05181992	Florida Forestry Service
V-2002	291932	812843	118	7	2	166	05181992	George Prevat
V-2003	291757	812812	-	5	1	130	05181992	Christin E. Cowart
V-2004	291834	812925	196	7	2	184	05181992	Solen Hartley
V-2005	291903	812916	-	5	1	145	05181992	Leon Graddock
V-2006	291606	812825	186	3	1	155	05181992	Norman Butler
V-2007	291518	812704	-	5	1	125	05181992	A. Phillips
V-2008	291523	812620	150	6	1	160	05181992	Carl Anderson
V-2009	291443	812606	110	12	24	162	05191992	Roy Barnhart
V-2010	291403	812525	120	7	2	119	05191992	Bill Lawrence
V-2011	291405	812549	137	7	3	120	05191992	Michael Braddock
V-2012	291332	812644	150	10	3	281	05191992	Esther Sprung
V-2013	291246	812702	90	11	2	228	05191992	Clyde Richardson
V-2014	291207	812618	105	8	6	147	05191992	Frank Roberts
V-2015	291116	812520	145	8	2	190	05191992	Lee Jenson
V-2016	291222	812427	128	8	1	212	05191992	Gladys Clifton
V-2017	291254	812035	110	15	2	175	05201992	Steve Ross
V-2018	291336	811927	117	10	1	189	05201992	Barnard Clifton
V-2019	291154	812607	140	9	5	166	05201992	Anne Mills
V-2020	291434	812734	151	9	3	125	05201992	Fleming Price
V-2021	292101	812940	120	9	2	177	05201992	Vernon Gamble
V-2022	292118	812831	-	11	25	162	05201992	Wayne Prevatt
V-2023	292030	812902	110	14	8	151	05201992	Sammy Miles
V-2024	291413	812643	180	9	1	139	05211992	H.R. Osmer
V-2025	291442	812618	-	7	7	121	05211992	James Elwood
V-2026	291731	812812	110	7	2	198	05211992	V.L. Shipp
V-2027	291733	812720	-	7	1	218	05211992	Dean Hagstrom

Table 1—Continued

Well	Latitude	Longitude	Depth (ft*)	Cl (mg/L)	SO ₄ (mg/L)	TDS (mg/L)	Date†	Owner
V-2028	291901	812746	-	8	3	199	05211992	Ronald Jones Fernery
V-2029	292139	812908	100	13	33	200	05211992	John Cade
V-2030	291720	812803	-	7	3	185	05211992	Ronald W. Smith
V-3001	291836	813241	-	20	6	190	05201992	USACE
V-4001	291829	813242	50	1,020	69	2,020	10151992	Wiles Charles
V-4002	291743	813150	80	4,740	712	8,200	10151992	Stella Spence
V-4003	291210	813334	-	15,000	2,850	27,700	10151992	Volusia Bar Fish Camp
V-4004	291017	813145	-	114	11	494	10201992	Olson
V-4005	291017	813139	-	129	3	484	10201992	Rafford
V-4006	291041	813156	-	16	2	286	10201992	Everett Blair
V-4007	291103	813247	100	2,530	406	4,240	10201992	Kerry McPherson
V-4008	291917	812803	180	14	13	165	10201992	Louisa Woodman
V-4009	291301	813137	-	24	2	276	01141993	W.V. Phillips
V-4010	291257	813135	-	33	5	285	01141993	USGS
V-4011	291623	813050	108	162	8	462	01181993	Linden S. Kelly
V-4012	291622	813048	100	163	13	445	01181993	Linden S. Kelly
V-4013	292005	813146	-	11	12	131	02021993	Undetermined

*One foot equals 0.305 meters.

†First two digits represent the month, second two represent the day, and the last four represent the year (e.g., 05211992 is May 21, 1992).

Note: ft = foot
 m = meter
 mg/L = milligrams per litre
 - = depth not available

SJRWMD = St. Johns River Water Management District
 USACE = U.S. Army Corps of Engineers
 USGS = U.S. Geological Survey

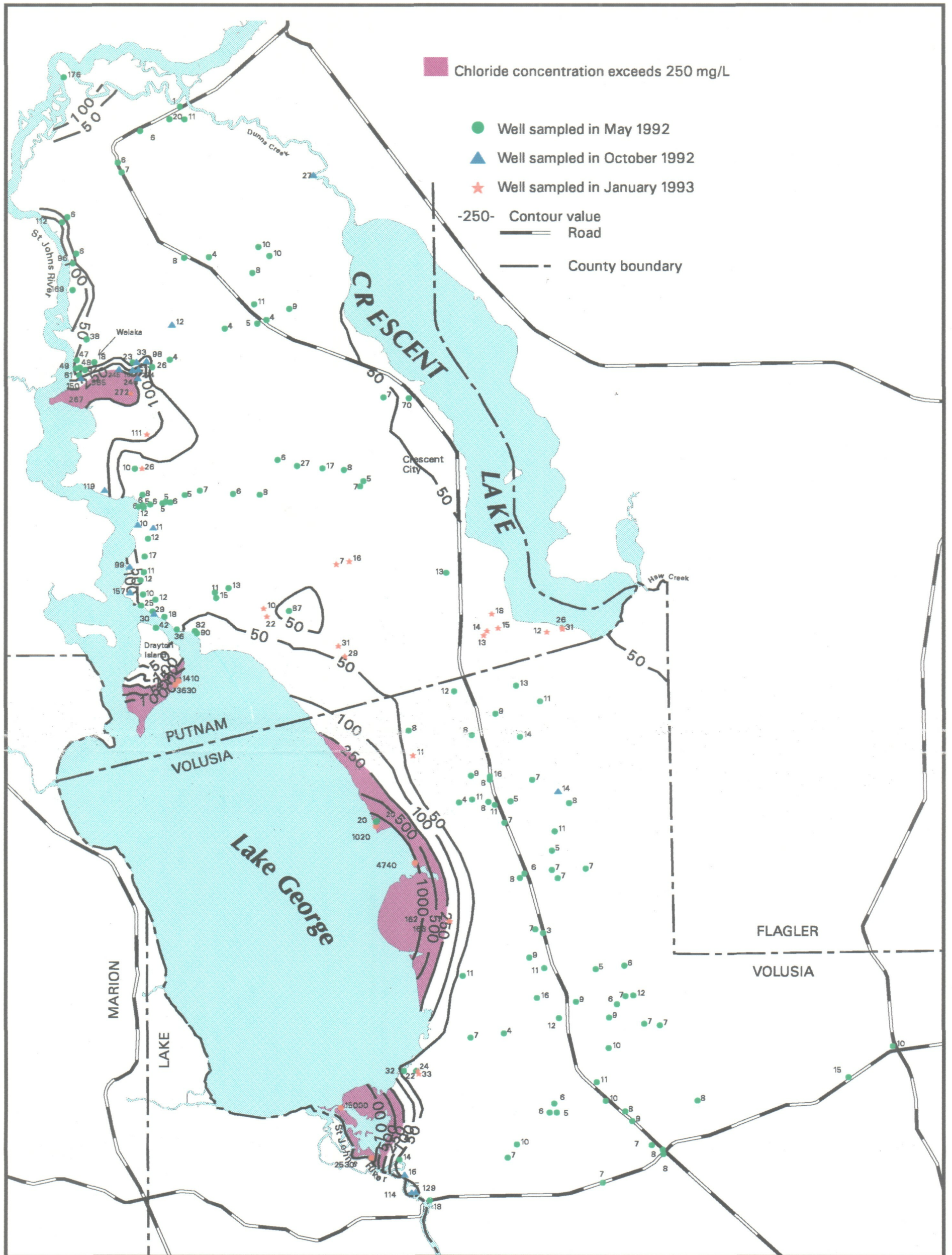


Figure 2. Chloride concentrations in the Floridan aquifer system beneath the Crescent City Ridge

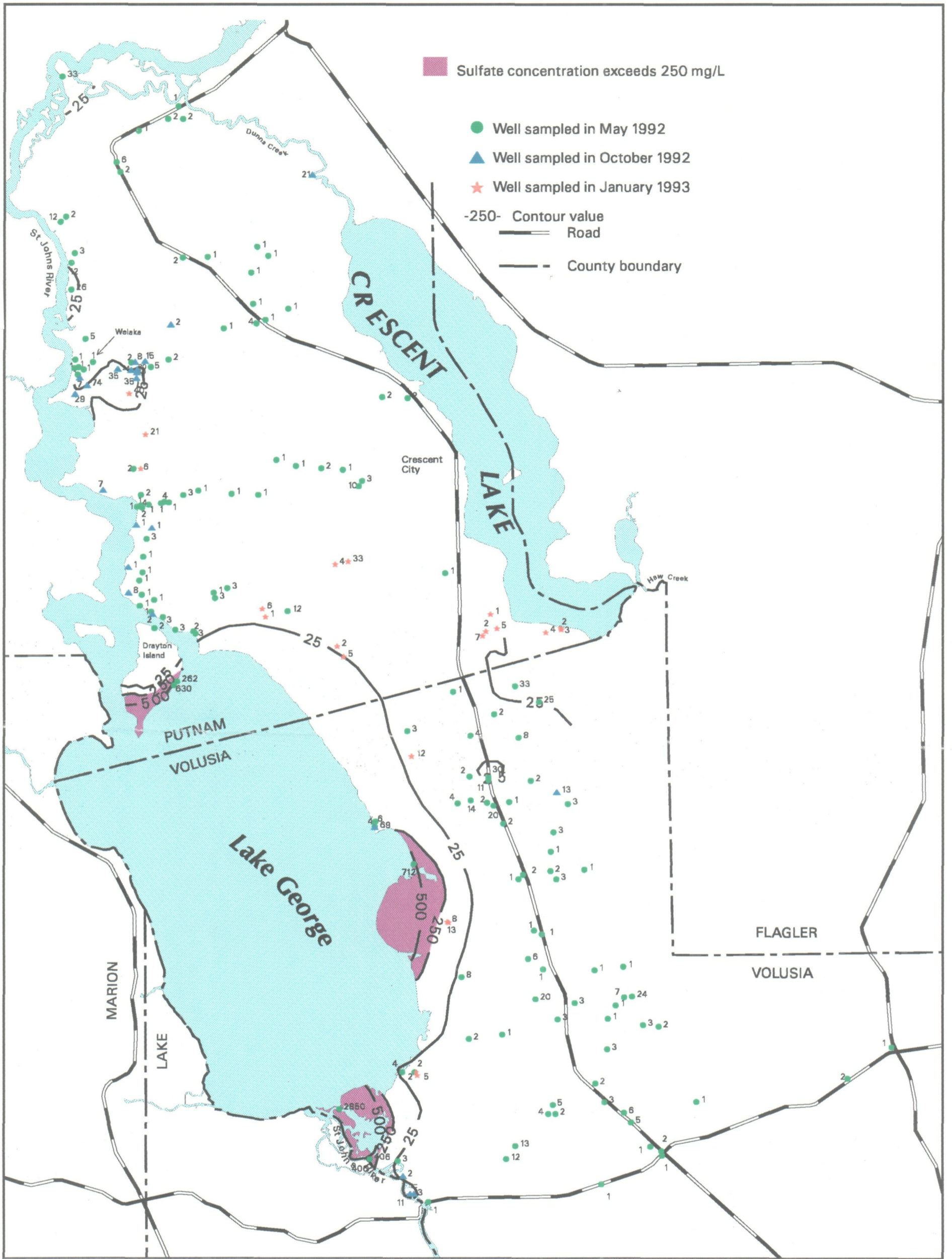


Figure 3. Sulfate concentrations in the Floridan aquifer system beneath the Crescent City Ridge

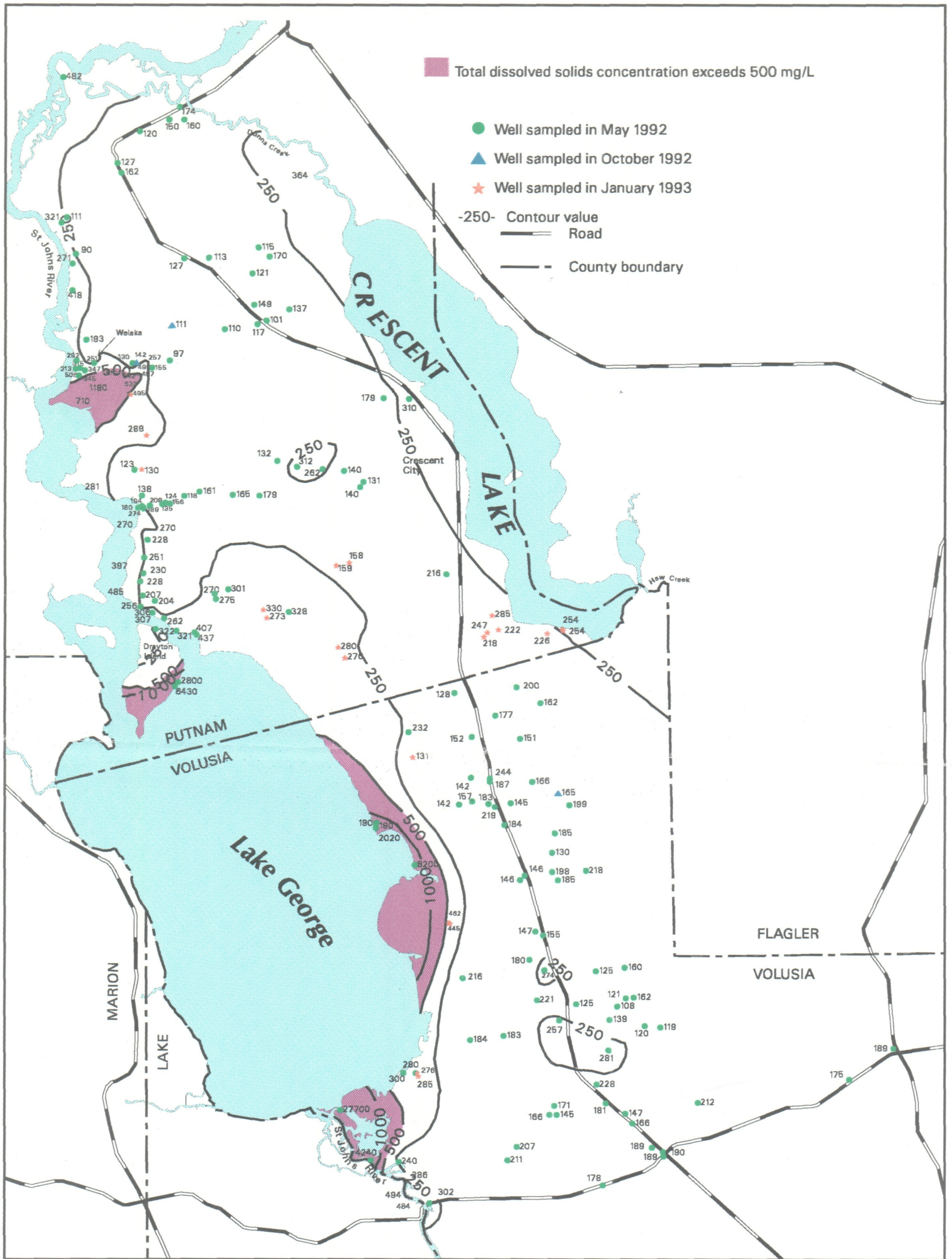


Figure 4. Total dissolved solids concentrations in the Floridan aquifer system beneath the Crescent City Ridge

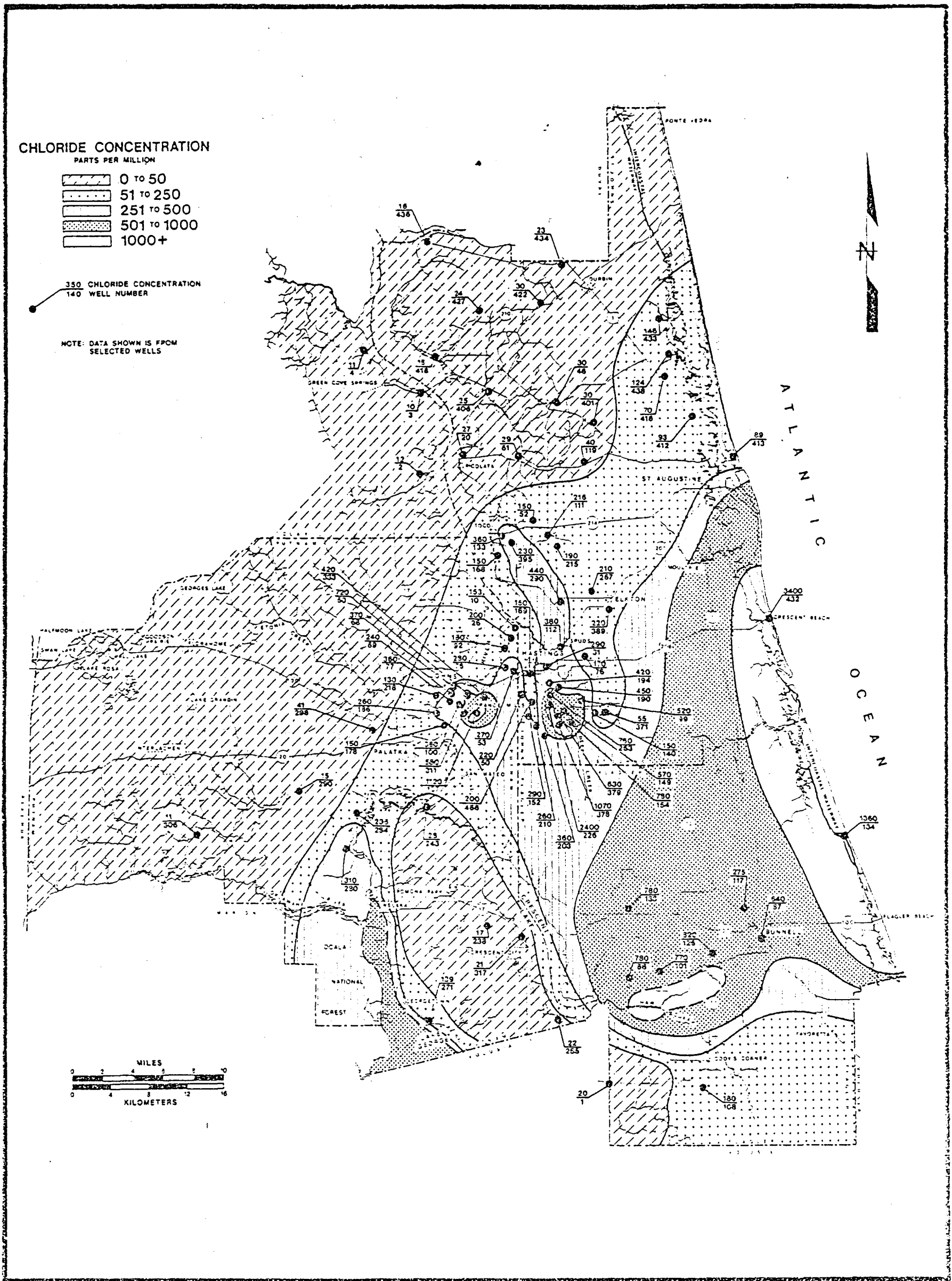


Figure 5. Chloride concentrations in the Floridan aquifer system in Putnam, St. Johns, and Flagler counties in May 1976. Part of the Crescent City Ridge occurs in southeastern Putnam County. (Munch et al. 1979)

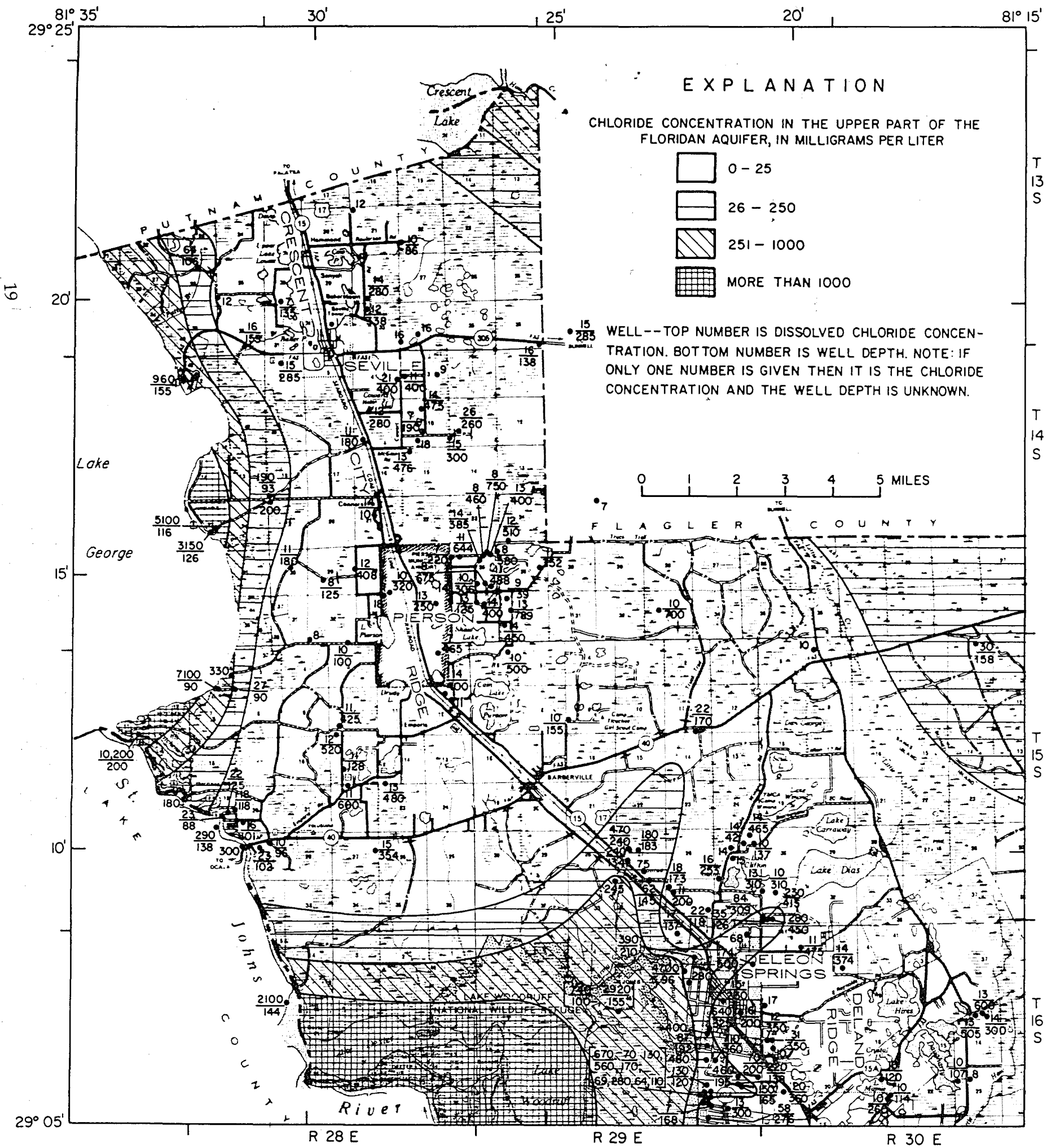


Figure 6. Chloride concentrations in water from wells that tap the upper part of the Floridan aquifer system on the Crescent City Ridge in northwestern Volusia County and well locations showing chloride concentrations and depths of wells (Rutledge 1982)