Groundwater Quality Report
1998

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SUWANNEE RIVER WATER MANAGEMENT DISTRICT

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Executive Summary

Ground water from the Floridan aquifer system is the source of the drinking water in the Suwannee River Water Management District (District). It is also the source for most of the water used for agriculture and industry. Furthermore, ground water is important for healthy natural systems in the District due to the contribution to lakes and streams via springs and seeps. Thus, clean and abundant ground water is needed by all. There are three aquifer systems (Surficial, Intermediate, and Floridan) in the District. This report addresses the Floridan aquifer system only.

Only 0.23 percent of the analyses performed from October 1985 to September 1998 were in exceedance (violation) of Maximum Concentration Limits (MCL) for Primary Drinking Water Standards. However, nitrate-nitrogen is elevated in the Middle Suwannee River Watershed (Suwannee and Lafayette Counties) and within an area generally defined along an axis starting in northern Jefferson County and ending in eastern Alachua County. The elevated nitrate-nitrogen is due to human activities. Along the axis most of the Floridan aquifer system lacks a continuous overlying clay layer and is, therefore, defined as unconfined or semi-confined. This condition allows water soluble contaminants (such as nitrate-nitrogen) to leach into the Floridan aquifer system.

The District has the largest area of elevated nitrate-nitrogen concentrations in the Floridan aquifer system in the state. Springs in the Middle Suwannee River Watershed have nitrate-nitrogen concentrations ranging from 1.2 to 19.2 mg L^{-1}. The ground water in the Middle Suwannee River watershed flows toward the Suwannee River and affects the surfacewater quality of the Suwannee River via springs and seeps in the riverbed.

The District and the Department of Environmental Protection (DEP) cooperate in monitoring the quality of ground water through the Assurance Program.

Introduction

Ground water is the source of drinking water in the Suwannee River Water Management District (District). It is also the source for most of the water used for agriculture and industry. Furthermore, ground water is important for healthy natural systems in the District due to the contribution to lakes and streams via springs and seeps. Thus, clean and abundant ground water is needed by all. The primary source of ground water in the District is the Floridan aquifer system. The District and the Department of Environmental Protection (DEP) cooperate in monitoring the quality of ground water.

Assurance Act of 1983

In 1983, the Florida Legislature passed the Water Quality Assurance Act. A portion of the Act required DEP to "establish a groundwater quality monitoring network designed to detect or predict contamination of the State's groundwater resources" (Florida Statutes, Chapter 403.063). As a result, DEP entered into a series of agreements with the State's five Water Management Districts to establish the Ground Water Quality Monitoring Program (GWQMP). The three goals of the GWQMP are:

- to establish the baseline water quality of major aquifer systems within the State;
- to detect and predict changes in groundwater quality resulting from the effects of various land use activities and potential sources of contamination;
- to disseminate water quality data generated by the program to local governments and the public.

All data used in this report has been collected through the GWQMP.

Drinking Water Standards

To ensure public health and water quality, the State of Florida has adopted Primary and Secondary Drinking Water Standards for ground water. The Primary Drinking Water Standards are designed to meet Environmental Protection Agency (EPA) standards for protecting groundwater quality as a source of drinking water for human consumption. Primary Drinking Water Standards are based on the maximum contaminant level (MCL) which is a concentration threshold. All MCLs are defined in the Florida Administrative Code, Chapter 62-550. The Primary Drinking Water Standards are shown in Table 1 (all concentrations are in milligrams per liter [$mg\ L^{-1}$] unless otherwise stated). Secondary Drinking Water Standards, which pertain to nuisance parameters of ground water are shown in Table 2.

This report addresses groundwater quality in the Floridan aquifer system as it pertains to the Primary Drinking Water Standards in the background and VISA networks. Only 0.23 percent of the analyses performed for Primary Drinking Water Standards on the Floridan aquifer system were in exceedance (violation) of Primary Drinking Water Standards.

Table 1 . Primary Drinking Water Standards.

CONTAMINANT (CAS NUMBER)	MCL (mg L^{-1})
Inorganic	
Antimony (1074)	0.006
Arsenic (1005)	0.05
Asbestos (1094)	7 MFL
Barium (1010)	2
Beryllium (1075)	0.004
Cadmium (1015)	0.005
Chromium (1020)	0.1
Cyanide (1024)	0.2
Fluoride (1025)	4
Lead (1030)	0.015
Mercury (1035)	0.002
Nickel (1036)	0.1
Nitrate (1040)	10 (as N)
Nitrite (1041)	1 (as N)
Total Nitrate and Nitrite	10 (as N)
Selenium (1045)	0.05
Sodium (1052)	160
Thallium (1085)	0.002
Radiometrics	
Gross Alpha	15 pCi L^{-1}
Gross Beta	4 mrem yr^{-1}
Radium 226,228	5 pCi L^{-1}

Abbreviations Used: MCL = Maximum contaminant level
MFL = million fibers per liter greater than 10 micrometers
mg L^{-1} = milligrams per liter
CAS = chemical abstract service
pCi L^{-1} = picocuries per liter
mrem yr^{-1} = millirems per year

Table 1 . continued.

CONTAMINANT (CAS NUMBER)	MCL (mg L^{-1})
Organic	
1, 1, 1-Trichloroethane (71-55-6)	0.2
1, 1, 2-Tricholoroethane (79-00-5)	0.005
1, 1-Dichloroethylene (75-35-4)	0.007
1, 2, 4-Tricholorobenzene (120-82-1)	0.07
1, 2-Dichloroethane (107-06-2)	0.003
1, 2-Dichloropropane (78-87-5)	0.005
2, 3, 7, 8-TCDD (Dioxin) (1746-01-6)	3×10^{-8}
2, 4, 5-TP (Silvex) (93-72-1)	0.05
2, 4-D (94-75-7)	0.07
Alachlor (15972-60-8)	0.002
Atrazine (1912-24-9)	0.003
Benzene (71-43-2)	0.001
Benzo(a)pyrene (50-32-8)	0.0002
Carbofuran (1563-66-2)	0.04
Carbon tetrachloride (56-23-5)	0.003
Chlordane (57-74-9)	0.002
cis-1, 2-Dichloroethylene (156-59-2)	0.07
Dalapon (75-99-0)	0.2
Di(2-ethylhexyl)adipate (103-23-1)	0.4
Di(2-ethylhexyl)phthalate (117-81-7)	0.006
Dibromochloropropane(DBCP) (96-12-8)	0.0002
Dichloromethane (75-09-2)	0.005
Dinoseb (88-85-7)	0.007
Diquat (85-00-7)	0.02
Endothall (145-73-3)	0.1
Endrin (72-20-8)	0.002
Ethylbenzene (100-41-4)	0.7
Ethylene dibromide (EDB) (106-93-4)	0.00002

Table 1 . continued.

CONTAMINANT (CAS NUMBER)	MCL (mg L^{-1})
Glyphosate (1071-853-6)	0.7
Heptachlor (76-44-8)	0.0004
Heptachlor epoxide (1024-57-3)	0.0002
Hexachlorobenzene (118-74-1)	0.001
Hexachlorocyclopentadiene (77-47-4)	0.05
Lindane (58-89-9)	0.0002
Methoxychlor (72-43-5)	0.04
Methylene Chloride	0.005
Monochlorobenzene (108-90-7)	0.1
o-Dichlorobenzene (95-50-1)	0.6
Oxamyl (vydate) (23135-22-0)	0.2
para-Dichlorobenzene (106-46-7)	0.075
Pentachlorophenol (87-86-5)	0.001
Picloram (1918-02-1)	0.5
Polychlorinated biphenyl (PCB) (1336-36-3)	0.0005
Simazine (122-34-9)	0.004
Styrene (100-42-5)	0.1
Tetrachloroethylene (127-18-4)	0.003
Toluene (108-88-3)	1
Toxaphene (8001-35-2)	0.003
trans-1, 2-Dichloroethylene (156-60-5)	0.1
Trichloroethylene (79-01-6)	0.003
Vinyl chloride (75-01-4)	0.001
Xylenes (total) (1330-20-7)	10

Abbreviations Used: MCL = Maximum contaminant level
MFL = million fibers per liter greater than 10 micrometers
mg L^{-1} = milligrams per liter
CAS = chemical abstract service
pCi L^{-1} = picocuries per liter
mrem yr^{-1} = millirems per year

Table 2. Secondary Drinking Water Standards.

CONTAMINANT (CAS NUMBER)	MCL (mg L^{-1})
Aluminum (7429-90-5)	0.2
Chloride (16887-00-6)	250
Copper (7440-50-8)	1
Ethylbenzene (100-41-4)	0.03
Fluoride (7782-41-4)	2
Iron (7439-89-6)	0.3
Manganese (7439-96-5)	0.05
pH (C-010)	6.5 - 8.5 su
Silver (7440-22-4)	0.1
Sulfate (1480879-8)	250
Toluene (108-88-3)	0.04
Total Dissolved Solids (C-010)	500
Xylenes (1330-20-7)	0.02
Zinc (7440-66-6)	5

Abbreviations Used: MCL = Maximum contaminant level
mg L^{-1} = milligrams per liter
CAS = chemical abstract service
su = standard units

Hydrogeology

Physiography

Hydrogeology within the District is directly related to the physiography. The District can be divided into three general physiographic regions: Northern Highlands, Gulf Coastal Lowlands, and River Valley Lowlands (Figure 1).

The area in the north and east is the Northern Highlands. This region is mainly characterized by altitude and the thick clay formations that overlie the Floridan aquifer system. The altitude throughout the area is greater than 100 feet above mean sea level (MSL) and reaches heights up to 230 feet MSL.

Clayey sediments in the subsurface serve as a base for a surficial aquifer and retard infiltration of rainwater. The result is abundant surfacewater features (streams, lakes, and ponds) throughout the Highlands, and a surficial aquifer in portions of the area.

The area to the west and southwest is the Gulf Coastal Lowlands. The elevation of this area is less than 100 feet MSL and the majority of the clayey sediments have been eroded away. Carbonate rock is at or near land surface throughout the Lowlands. Whereas the surfacewater features in the Highlands reflect the water table in the surficial aquifer, those in the Lowlands (excluding the Waccasassa Flats and the San Pedro Bay) represent the water table of the Floridan aquifer system.

The most persistent topographic feature in the State of Florida is the Cody Scarp, which is the boundary between the Highlands and Lowlands. It is a very significant feature as it pertains to District hydrogeology. In some locations, there can be as much as 80 feet of relief along the scarp (e.g. Jefferson County). Every river or stream (except the Suwannee River) that originates in the Highlands disappears underground as it crosses the scarp. The few streams that exist in the Lowlands have eroded downward into the Floridan aquifer system and have intersected the water table in the Floridan aquifer. Base flow to Lowland streams is supplied by artesian spring flow from the Floridan aquifer system.

Superimposed on the land surface are marine terraces. The terraces were established during different stands of sea level as sea level fluctuated approximately 600 feet during the Pleistocene Epoch or the "Great Ice Age." These events occurred from ten thousand to one million years ago. The terraces stair step from the Gulf of Mexico in the west to the Highlands in the east. The processes that established the terraces deposited the sand that lies on the surface in most of Florida.

The third physiographic region is the River Valley Lowlands for the Santa Fe, Suwannee, Alapaha, Withlacoochee, Steinhatchee, Aucilla, and Wacissa Rivers. These are erosional features formed by the meandering rivers that originate in the Highlands and flow through the Lowlands to the Gulf of Mexico.

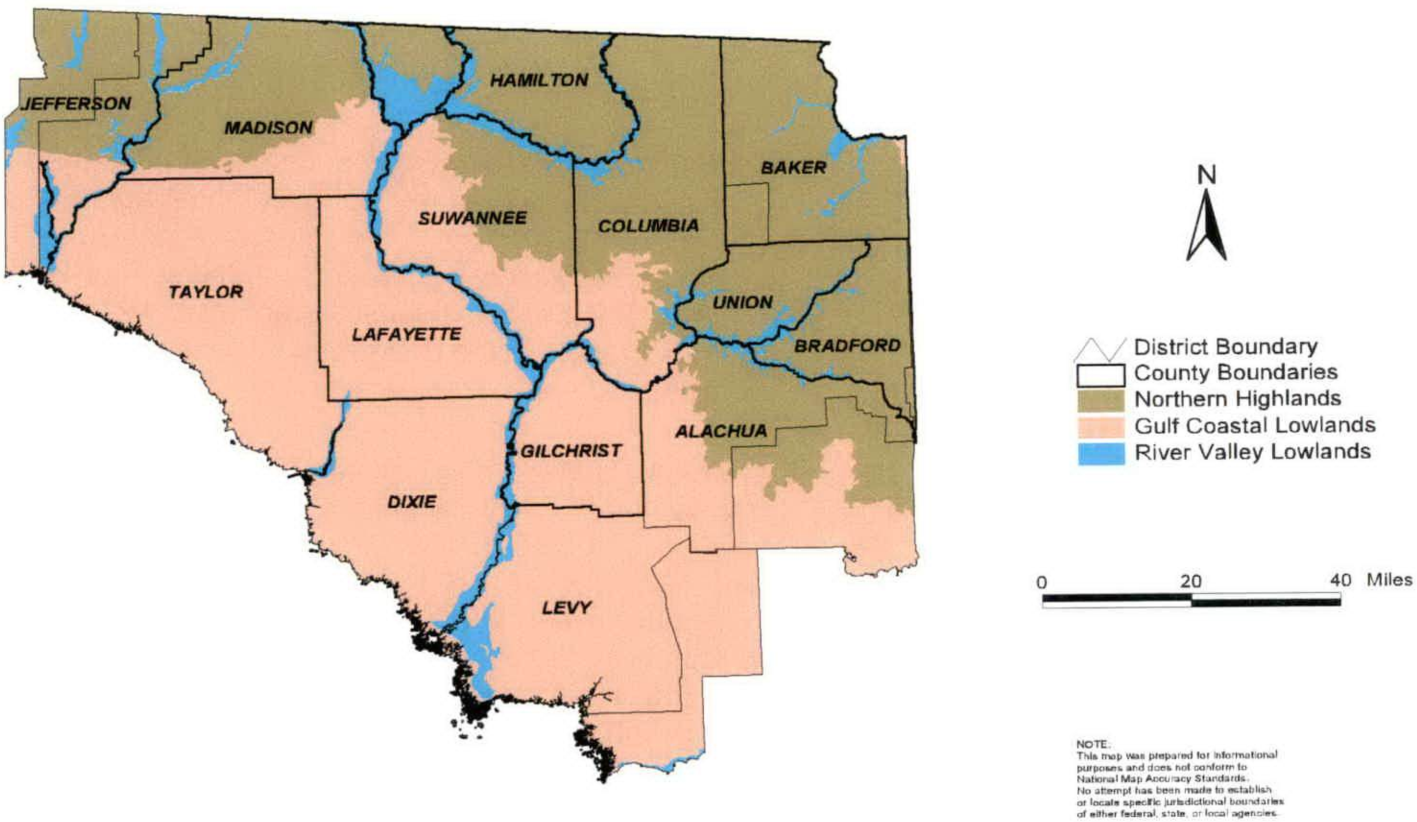

Figure 1. Physiographic region

Geology

A massive, thick sequence of carbonate rock underlies the entire District and constitutes the Floridan aquifer system. The majority of the rock is limestone, which is calcium carbonate. The remaining rock is dolomite, which is calcium-magnesium carbonate. Dolomite is basically harder than limestone but has similar hydrogeologic properties. Unconsolidated material (sand or clay) usually overlies the Floridan aquifer system. However, once the carbonate rock is encountered in the subsurface, it is rare to find sand or clay (except in sinkhole fill). The carbonates are up to 5,000 feet thick and are saturated with water.

The Floridan aquifer system extends throughout peninsular Florida and to the Appalachian Mountains in Georgia and South Carolina. It generally underlies all of the Southeastern Coastal Plain and partially extends under the Atlantic Ocean and the Gulf of Mexico.

At the zenith of the last ice age (approximately 13 thousand years ago), sea level was nearly 300 feet below its present altitude. It was from that time to the present that this regional aquifer system filled up with fresh water.

Aquifer Systems

Three different aquifer systems exist in the District: the Floridan aquifer system, the intermediate aquifer system, and multiple surficial aquifer systems. The carbonate Floridan aquifer system is the deepest and exists beneath the entire District. In the northeast District, the intermediate aquifer exists within a limestone unit in the Hawthorn Formation (above the Floridan). A third aquifer, the surficial aquifer, exists at land surface in sediments which overlie portions of the intermediate aquifer and Floridan aquifer system.

Surficial Aquifers

Extensive regional surficial aquifers exist in portions of all counties in the District, except Dixie and Alachua (Figure 2).

These aquifers exist where sand at land surface is underlain by clay. The sand is at least 10 feet thick and is saturated. The water table in the District's surficial aquifers fluctuates less than 10 feet.

This aquifer is occasionally used as a rural domestic water supply and for lawn irrigation.

The water chemistry in the aquifer is very similar to that of rainwater. The quartz sand which contains the ground water is relatively insoluble in water. Therefore, aquifer material does not impart any particular "flavor" to the water due to dissolution of aquifer material.

Surficial water is characterized by relatively high values for sodium, chloride, potassium, iron, and sulfate; however, concentrations for these parameters are low in comparison with the Intermediate and Floridan aquifer systems. The sodium and chloride are derived from marine aerosols, the potassium is possibly from fertilizers, and the sulfate from oxidation of organics. Iron is one of the most abundant minerals in the earth's crust and is present in all aquifers in

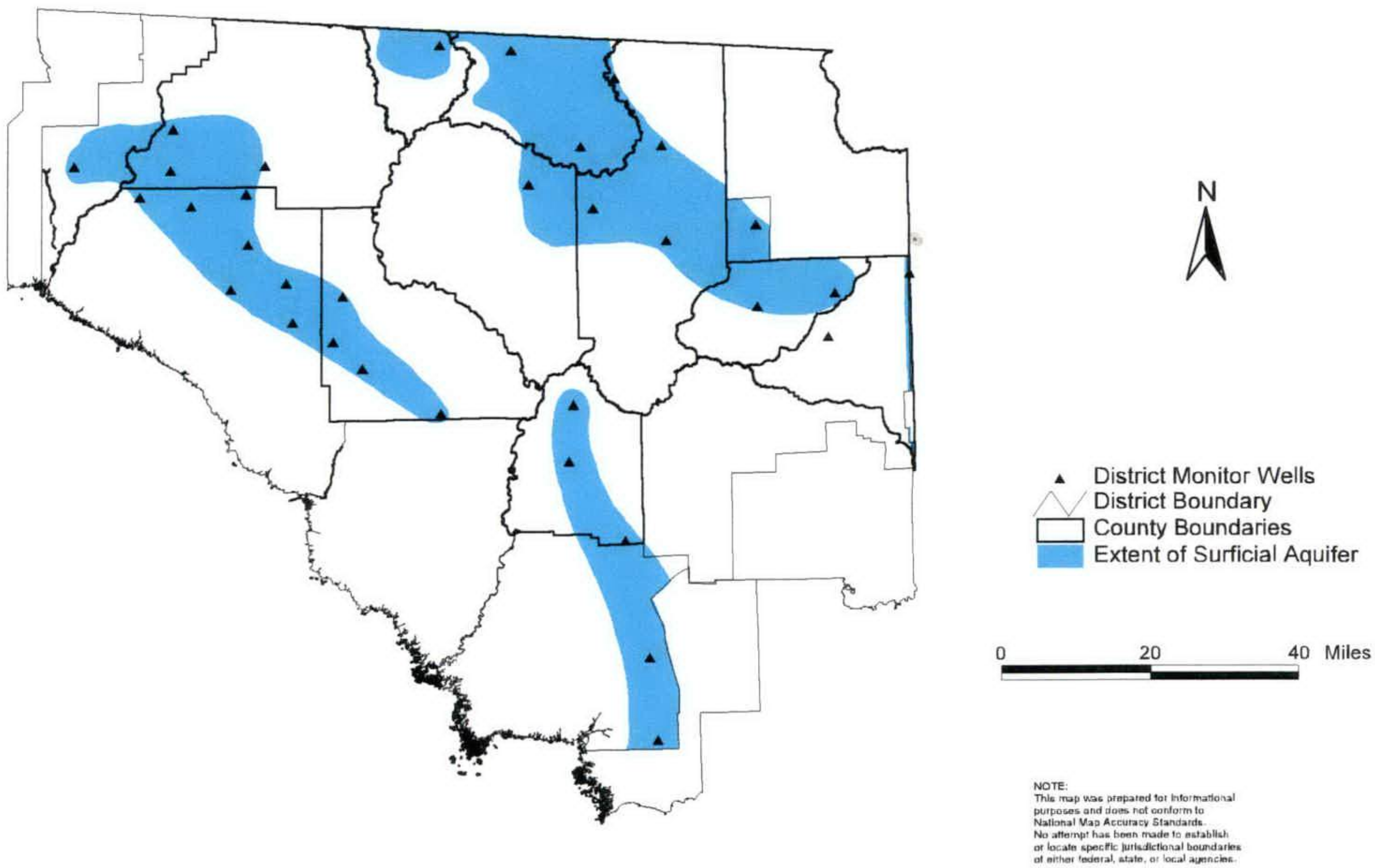

Figure 2. Extent of the Surficial aquifers and present Background Network monitor wells.

the District. The general chemical composition of the surficial aquifer is shown in Table 3.

Table 3. Chemical characterization of the Surficial aquifer systems (Florida Geological Survey Special Pub. No.34, 1992).

Parameter	Units	Minimum	Maximum	Median
pH	su	4.5	9.5	5.6
Calcium	mg L^{-1}	0.4	240.0	11.0
Magnesium	mg L^{-1}	0.1	44.0	1.6
Sodium	mg L^{-1}	0.8	30.0	5.0
Potassium	mg L^{-1}	<0.1	19.0	1.5
Total Iron	mg L^{-1}	<0.01	18	1.09
Mercury	µg L^{-1}	<0.2	3	<0.2
Lead	µg L^{-1}	<10.0	40	<10.0
Bicarbonate	mg L^{-1}	4	140	27
Total Carbonate	mg L^{-1}	<1.0	70	<1.0
Sulfate	mg L^{-1}	<1.0	33	4.3
Chloride	mg L^{-1}	1.4	32	6
Orthophosphate (as P)	mg L^{-1}	<0.01	0.2	<0.10
Fluoride	mg L^{-1}	<0.02	0.79	<0.20
Nitrate-Nitrogen	mg L^{-1}	<0.05	1.1	<0.05
Total Dissolved Solids	mg L^{-1}	27	320	70
Specific Conductance	µmhos cm^{-1}	20	500	90
Total Organic Carbon	mg L^{-1}	<1.0	50	5.9

Intermediate Aquifer

An intermediate aquifer underlies the majority of the Northern Highlands in the eastern portion of the District (Figure 3). The aquifer is usually within an upper carbonate unit within the Hawthorn Formation. This aquifer is the primary water supply for rural residences in Baker, Bradford, and portions of Union counties. The aquifer is confined and artesian. There is clay above and below the aquifer and the water is under pressure, so the water level in a well rises above the upper surface of the rock. This aquifer is usually 20 to 30 feet thick.

Water from the intermediate aquifer is generally alkaline because it is usually contained within a carbonate unit. It is characterized by high relative values for conductivity, bicarbonate, pH, magnesium, and calcium (Table 4). It also has relatively high values for fluoride and orthophosphate from the dissolution of fluorapatite, the most abundant phosphate mineral in the Hawthorn Formation. Iron values are relatively higher than other aquifer systems in the District.

Floridan Aquifer

Although the carbonate rock that contains the Floridan aquifer system is thousands of feet thick, the thickness of the fresh or potable water zone is variable. The estimated thickness of the potable water ranges from approximately 100 feet in southwest Levy County to 1,500 feet in the northeast corner of the District.

Where intermediate or surficial aquifers overlay the Floridan aquifer system, there is always the potential for downward recharge from the overlying aquifers. The water level in the upper aquifers is higher than in the Floridan aquifer system; therefore, the potential energy exists to create downward flow. The recharge can take place through leaky sediments at the base of the upper aquifers, at the edge of the upper

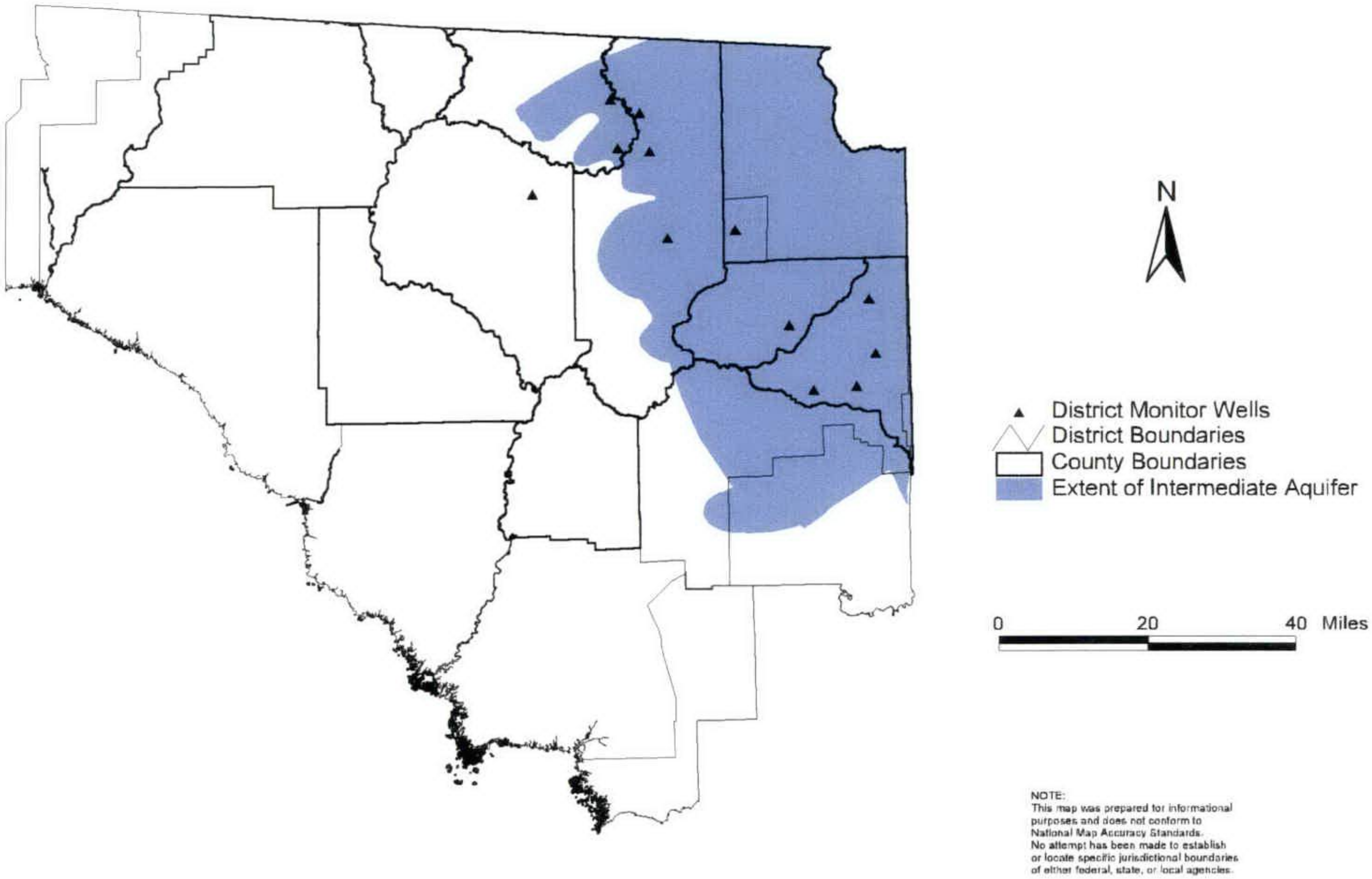

Figure 3. Extent of the Intermediate aquifer and present Background Network monitor wells.

aquifers where the clayey base becomes discontinuous, or through sinkholes that penetrate into the Floridan aquifer system. The unconfined areas in Figure 4, where limestone is at or near land surface, are recharged directly from percolating rainfall, since the only sediment overlying the aquifer is porous sand. Although there are thousands of feet of saturated limestone, the recharge, discharge, and the majority of the flow occurs in the upper few hundred feet of the aquifer.

Table 4. Chemical characterization of the Intermediate aquifer system (Florida Geological Survey Special Pub. No. 34, 1992).

Parameter	Units	Minimum	Maximum	Median
pH	su	4	9.3	6.5
Calcium	mg L^{-1}	1.5	220	28
Magnesium	mg L^{-1}	<0.1	52	8.7
Sodium	mg L^{-1}	2.3	23	4.3
Potassium	mg L^{-1}	<0.1	19	0.6
Total Iron	mg L^{-1}	<0.05	15	1.17
Mercury	μg L^{-1}	<0.2	2	<0.2
Lead	μg L^{-1}	<10.0	56	<10.0
Bicarbonate	mg L^{-1}	<1.0	490	90
Total Carbonate	mg L^{-1}	<1.0	22	<1.0
Sulfate	mg L^{-1}	<1.0	27	<1.0
Chloride	mg L^{-1}	3.1	54	4.5
Orthophosphate (as P)	mg L^{-1}	<0.01	2	<0.10
Fluoride	mg L^{-1}	<0.01	1	<0.20
Nitrate-Nitrogen	mg L^{-1}	<0.01	7.1	<0.05
Total Dissolved Solids	mg L^{-1}	18	350	100
Specific Conductance	μmhos cm^{-1}	25	500	160
Total Organic Carbon	mg L^{-1}	<1.0	12	<1.0

Different sediments, residence times, and human influences can impart particular "flavors" on ground water. Water from the Floridan aquifer system is generally alkaline and characterized by relatively high values for specific conductivity, bicarbonate, pH, magnesium, and calcium (Table 5). This is typical of ground water that occurs in a limestone aquifer where the limestone has undergone dissolution. In the majority of the District, the ground water has noticeable iron concentration. As water migrates

Table 5. Chemical characterization of the Floridan aquifer system (Florida Geological Survey Special Pub. No. 34, 1992).

Parameter	Units	Minimum	Maximum	Median
pH	su	4.9	12.5	7.1
Calcium	mg L^{-1}	0.6	1000	82
Magnesium	mg L^{-1}	<0.1	430	6.3
Sodium	mg L^{-1}	0.2	3200	6.3
Potassium	mg L^{-1}	0.1	320	1.1
Total Iron	mg L^{-1}	<0.01	17	0.61
Mercury	μg L^{-1}	<0.2	2	<0.2
Lead	μg L^{-1}	<10.0	100	<10
Bicarbonate	mg L^{-1}	<1.0	770	150
Total Carbonate	mg L^{-1}	<1.0	650	<1.0
Sulfate	mg L^{-1}	<1.0	2200	6.7
Chloride	mg L^{-1}	<1.0	5200	8.9
Orthophosphate (as P)	mg L^{-1}	<0.01	21	<0.1
Fluoride	mg L^{-1}	<0.02	2.5	<0.2
Nitrate-Nitrogen	mg L^{-1}	<0.01	8.4	<0.05
Total Dissolved Solids	mg L^{-1}	40	10200	220
Specific Conductance	μmhos cm^{-1}	50	15000	310
Total Organic Carbon	mg L^{-1}	<1.0	34	2

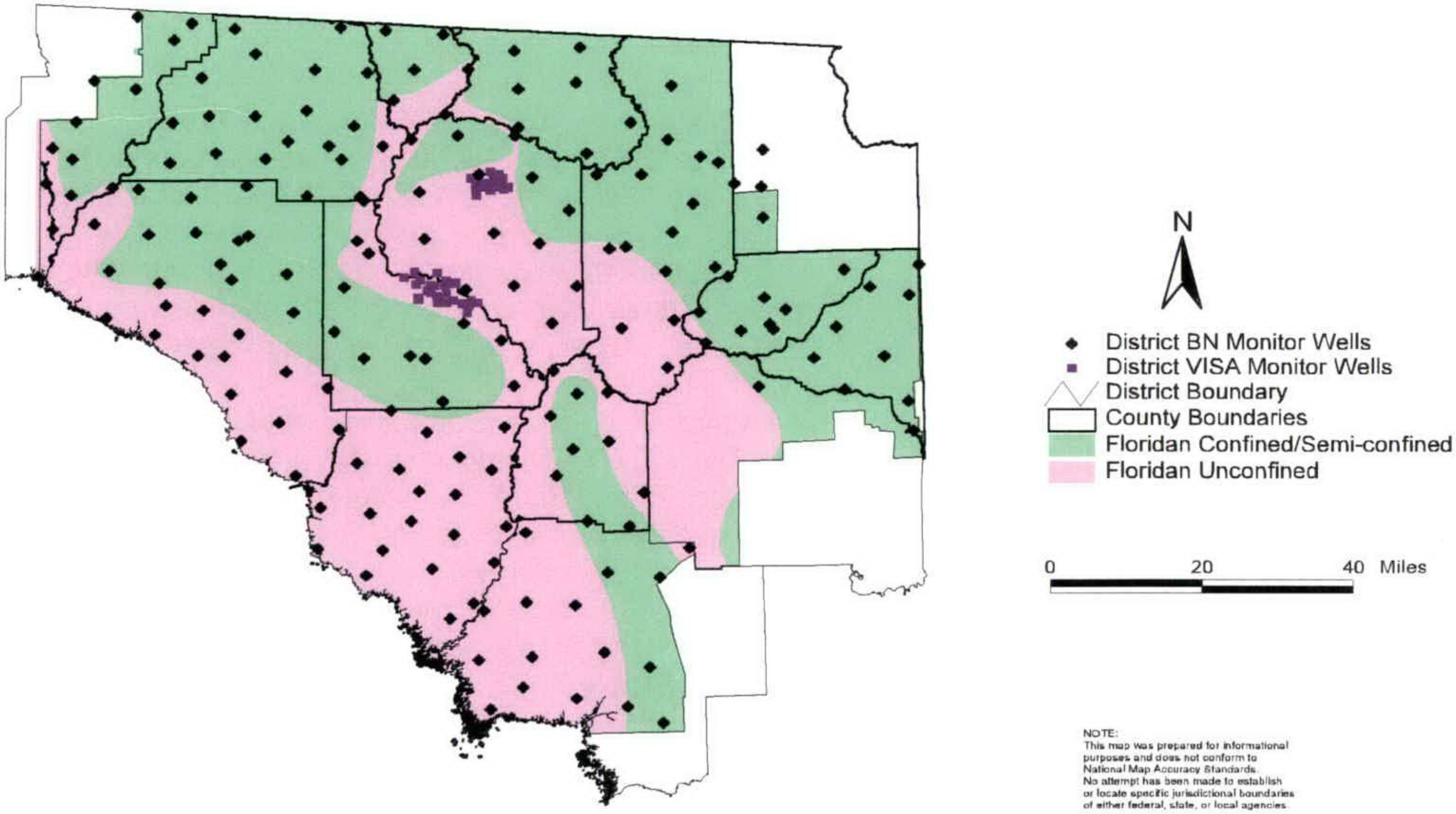

Figure 4. Floridan aquifer system and present Background and VISA Network monitor wells.

through these sediments, the iron can be leached out into the Floridan aquifer system. Sulfur water (water with dissolved sulfate and/or hydrogen sulfide gas) is common in areas where the Floridan aquifer system is confined (Figure 4). The presence of hydrogen sulfide results in a nuisance taste and odor in the ground water. The source(s) of the sulfur can be either decaying organic matter or from gypsum (calcium sulfate) that was deposited with the limestone.

Water Quality Sampling

All current District groundwater quality monitoring networks are funded through the DEP Ground Water Quality Monitoring Program (GWQMP), referred to as the "Assurance Program." Wells must meet specific criteria before they are placed in the network. Casing depth, well depth, a driller's log, a lithologic log, or a geophysical log for the well must be available. Owner's permission is required for private wells. Easements are required for wells drilled by the District and PVC casing is used. It is preferred to sample directly from the pump to reduce contamination from plumbing associated with the well system. For most networks, it is preferred to sample wells completed into the uppermost portion of the aquifer being sampled.

The number of wells in the network has changed over the years, primarily in response to available funding. The present BN density is one well, per aquifer, per four-Township block. The District's BN has satisfied the density in all areas for all aquifers in the District. More than 200 wells have been drilled to establish the BN network. There are currently 236 wells in the BN and an additional 85 municipal supply wells are sampled. The BN has been sampled four times since 1985, and the fifth round is being conducted.

The District has two Very Intense Study Areas (VISA): the Live Oak VISA, which is an urban assessment and the Lafayette County VISA, which is an agricultural assessment (Figure 4). There are 17 monitor wells in the Live Oak VISA, and 19 monitor wells and 7 springs in the Lafayette County VISA. These VISA monitoring wells are used to assess the effects of a specific land use on groundwater quality.

The monitoring scheme is a three-year rotation that covers the District. The District is divided into three blocks (Block A, Block B, and Block C), as seen in Figure 5. One block is sampled per year, thus taking three years to sample the District (e.g. monitor wells sampled in 1997 will be sampled again in 2000). The samples are analyzed for the analytes in Table 6 and the ten-year projected sampling schedule is shown in Table 7.

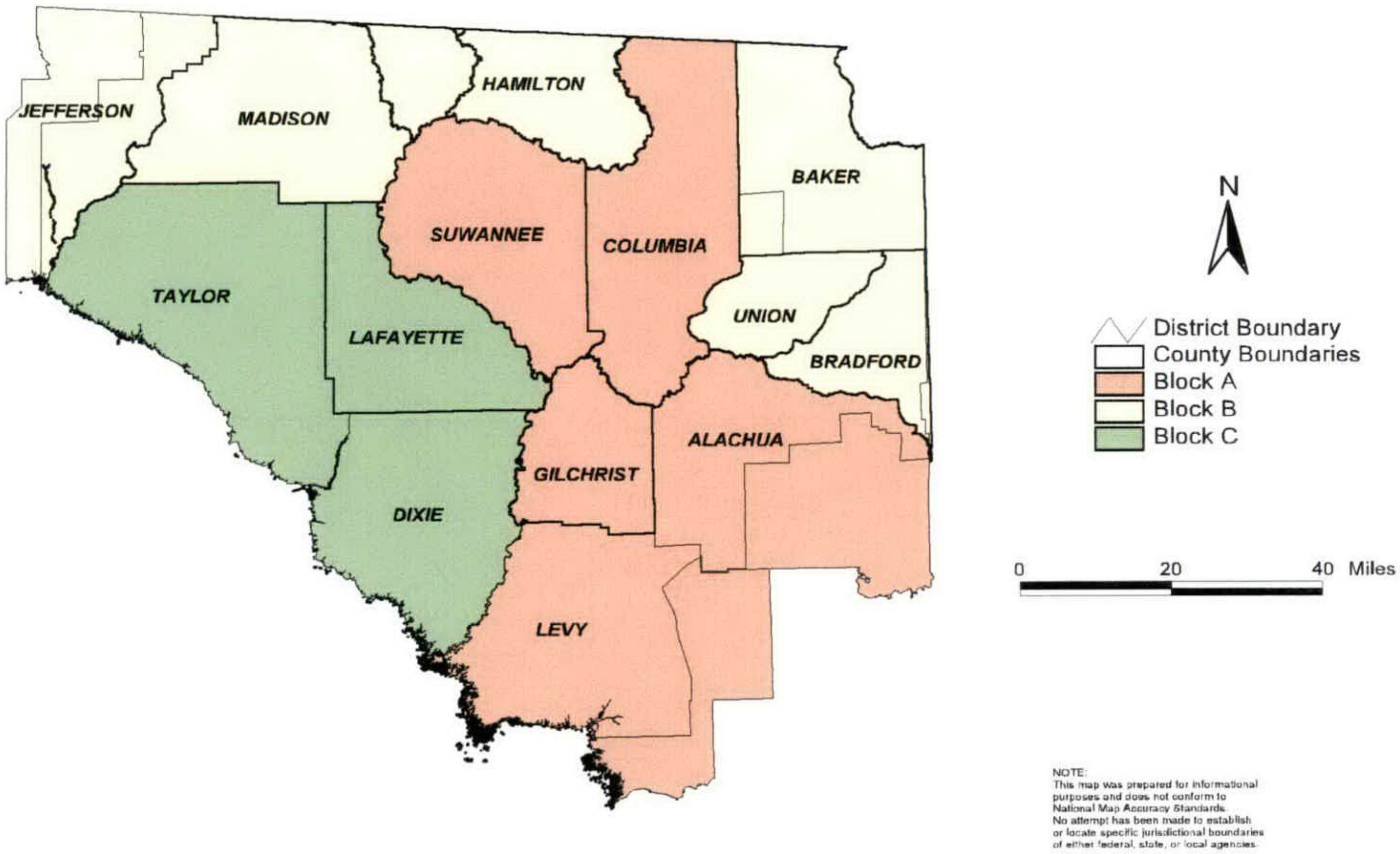

Figure 5. Sampling blocks for groundwater monitoring.

Table 6. Analyte Lists: Standard, Extended 1, Extended 2, and Extended 3.

Standard List
Field Parameters
Water Level
Conductivity at 25°C
Temperature
Dissolved Oxygen
Eh
pH
Turbidity
Major Ion
Sodium, Dissolved
Potassium, Dissolved
Calcium, Dissolved
Magnesium, Dissolved
Chloride, Dissolved
Sulfate, Dissolved
Alkalinity, Dissolved
Fluoride, Dissolved
Minor Ion
Iron, Dissolved
Manganese, Dissolved
Strontium, Dissolved
Aluminum, Dissolved
Sulfide
Nutrients
Nitrate+Nitrite nitrogen
Ammonium nitrogen
Total Kjeldahl Nitrogen
Soluble Reactive Phosphate

Extended List 1
Trace Metals
Iron, Total
Manganese, Total
Strontium, Total
Aluminum, Total
Zinc, Dissolved
Zinc, Total
Lead, Dissolved
Lead, Total
Copper, Dissolved
Copper, Total
Cadmium, Total
Barium, Dissolved
Barium, Total
Silver, Dissolved
Silver, Total
Mercury, Total
Selenium, Total
Chromium, Dissolved
Chromium, Total
Nickel, Dissolved
Nickel, Total
Arsenic, Total
Others
Dissolved Organic Carbon
Total Organic Carbon
Digestion (HCl)

Table 6. continued.

Extended List 2
Volatile Organic Carbon/BNA

Extended List 3
Carbamates
Cl-Pesticides
NP-Pesticides
Urea Herbicides

Table 7. Sampling scheme for groundwater monitoring.

Year	1995	1996	1997	1998	1999	2000
Sampling Block	A	B	C	A	B	C
Standard List	X	X	X	X	X	X
Extended List 1	X	X	X			
Extended List 2						
Extended List 3				X	X	X

Year	2001	2002	2003	2004	2005	2006
Sampling Block	A	B	C	A	B	C
Standard List	X	X	X	X	X	X
Extended List 1				X	X	X
Extended List 2	X	X	X			
Extended List 3						

Results and Discussion

This report is comprised of data collected from October 1985 to September 1998. Monitoring results are displayed in graphical and tabular form. In Figure 6, all monitor wells sampled by the District and other agencies that were used in the generation of mean contour maps are shown. Conductivity, pH, dissolved calcium, dissolved iron, and nitrate-nitrogen mean data are shown on contour maps (Figures 7, 8, 9, 10, and 11) for the period of record (October 1985 to September 1998). Conductivity, dissolved calcium, and pH are used to show the chemical characteristics of the Floridan aquifer system. Dissolved iron is shown because of the nuisance iron presents in drinking water. Nitrate-nitrogen is shown since it is the main contaminant generated by human activities that is detected by this monitoring network.

The District is currently in the fifth background sampling event. Thus, there have been four complete sampling events of the BN network. Each sampling event reflects the changing groundwater conditions due to environmental differences.

Surfer®, a computer contouring package, was used to generate the mean contour maps. Surfer® calculates the mean value of the data points and shows the mean value as an interpolated contour interval. It is important to remember that contour intervals represent a generalization of the data, and actual values for the analyte can be less than or greater than the generalized contour interval.

For all other analyses performed for the period of record (October 1985 to September 1998), exceedances of the Primary Drinking Water Standards in the Floridan aquifer system are shown in Table 7.

Conductivity

Conductivity is a measure of dissolved salts/minerals in the water. In the Floridan aquifer system, the highest conductivity readings were observed in the Northern Highlands and near the coast (Figure 7). In the Northern Highlands, the higher values are due to the long residence time of the water in the Floridan aquifer system. The high conductivities near the coast are due to marine influences. Typical values for conductivity in the Floridan aquifer system range from 200 to 500 μmhos cm^{-1}.

pH

pH is a measure of the alkalinity or acidity of water. The pH in the Floridan aquifer system is generally basic (pH > 7) in the confined/semi-confined region and slightly acidic (pH < 7) in the unconfined region (Figure 8). The observed pH values are associated with recharge and residence time of the water in the aquifer. The unconfined region of the Floridan aquifer system has the highest recharge and the lowest pH due to mixing from slightly acidic rain water and the lack of residence time within the limestone. The confined/semi-confined region has the lowest recharge and the highest pH due to the long residence time of the water.

Calcium (Dissolved)

The highest calcium concentrations (up to 100 mg L^{-1}) are observed in the unconfined region of the Floridan aquifer system (Figure 9). As seen in Figure 8, the pH is slightly acidic in this region. This results in the dissolution of calcium from the limestone into the ground water. Also, calcium can be leached from overlying soils by slightly acidic rainfall.

Iron (Dissolved)

The highest iron concentrations (up to 2.0 mg L^{-1}) are observed in the unconfined region of the Floridan aquifer system (Figure 10). The iron is primarily due to the leaching of iron from the overlying soils. Iron in drinking water is not a health hazard; however, it can be a nuisance in drinking water above 0.1 mg L^{-1} due to taste, odor, and staining. The Secondary Drinking Water Standard for iron is 0.3 mg L^{-1}.

Nitrate-Nitrogen

Mean nitrate-nitrogen concentrations above background concentration (0.05 mg L^{-1}) exist in all or part of every county in the District for the period of record (Figure 11).

The areas with consistently elevated nitrate-nitrogen concentrations are in Suwannee and Lafayette Counties. This area in the Middle Suwannee River Watershed is affecting the nitrate-nitrogen concentrations in the Suwannee River under low flow conditions when the river receives a large quantity of groundwater flow through springs and seeps in the riverbed. The possible sources of nitrate-nitrogen in ground water includes fertilizers, animal waste, and septic tanks.

Site specific studies, such as the private well survey conducted by Department of Health, identifies areas with concentrations of nitrate-nitrogen above MCL (i.e.,17 out of 140 wells exceeded the MCL).

In the Middle Suwannee River Watershed, the majority of the Floridan aquifer system is unconfined or semi-confined. The lack of a continuous clay layer allows water soluble contaminants (such as nitrate-nitrogen) to leach into the ground water of the Floridan aquifer system. Based on information collected by the DEP Ground Water Quality Monitoring Program, the District has the largest area of elevated groundwater nitrate-nitrogen concentrations in the state. As shown in the District Surfacewater Quality and Biological Report 1997, springs in the Middle Suwannee River Watershed have nitrate-nitrogen concentrations ranging from 1.2 to 19.2 mg L^{-1}. Thus, ground water from this watershed that flows to the Suwannee River is affecting the surfacewater quality of the Suwannee River via springs and seeps in the riverbed.

Analyte Relationships with Groundwater Levels

Figure 12 shows the dynamic characteristics of parameter values for conductivity, pH, calcium, and nitrate-nitrogen as groundwater levels change. Generally as groundwater levels increase, the observed values decrease due to mixing with rainwater and surface water which results in dilution. For example, the elevated nitrate-nitrogen concentrations seen in Dixie County (Figure 11) were observed only in the first background sampling (October 1985 to October 1987). The second, third, and fourth background samplings have observed less than 0.5 mg L^{-1} in that area.

(continued on page 31)

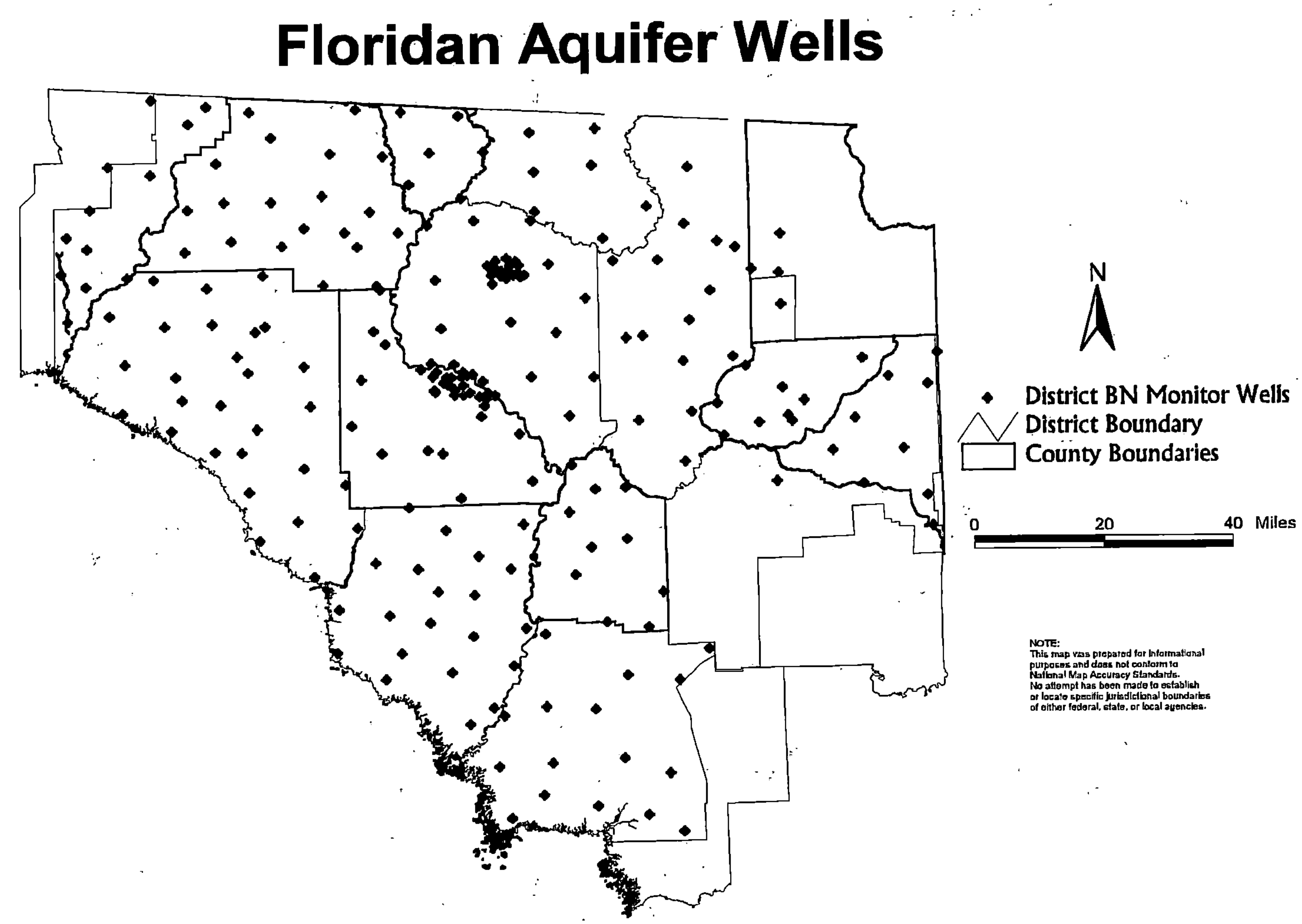

Figure 6. Location of sampled Background, Municipal Supply, and VISA monitoring wells.

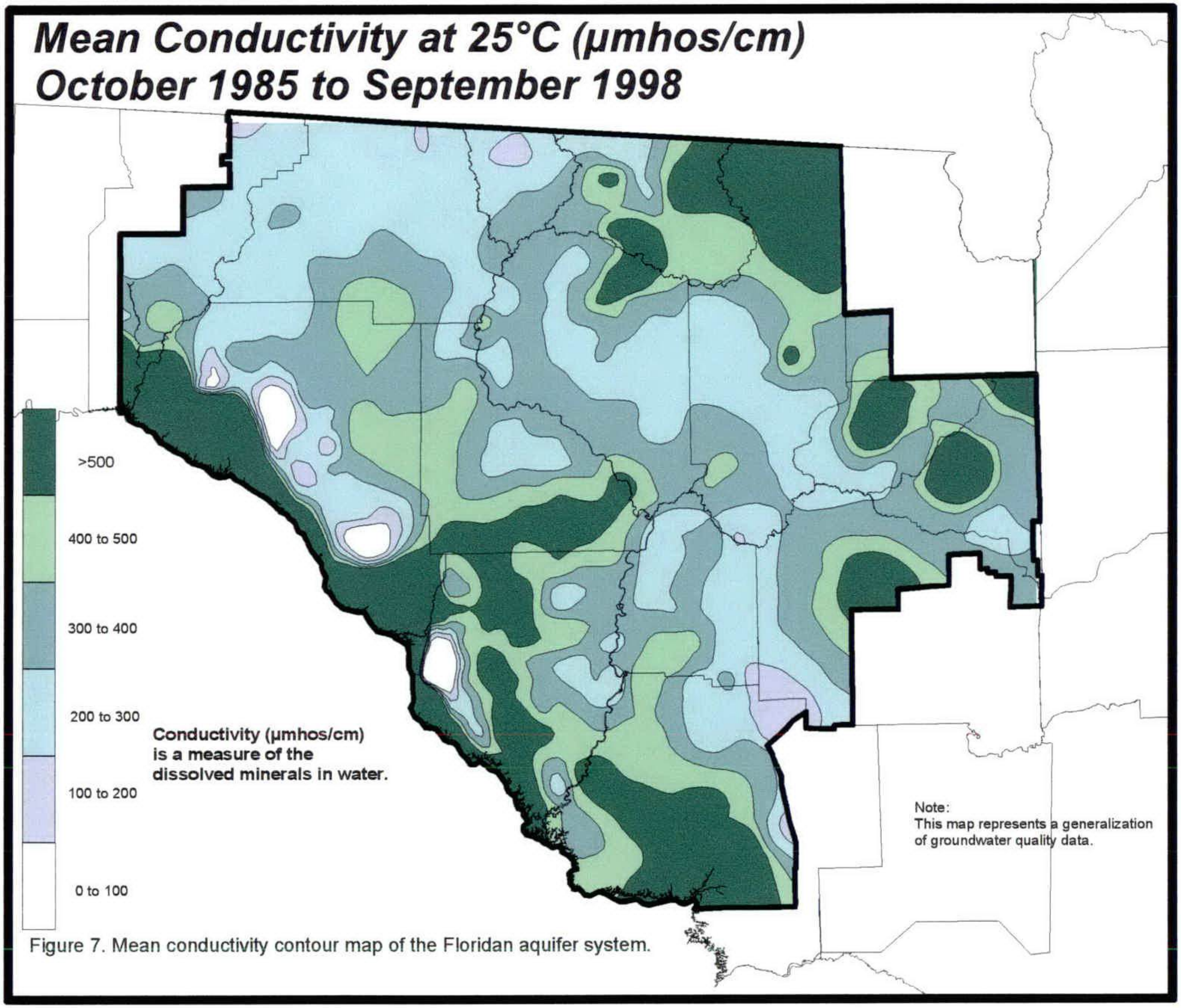

Figure 7. Mean conductivity contour map of the Floridan aquifer system.

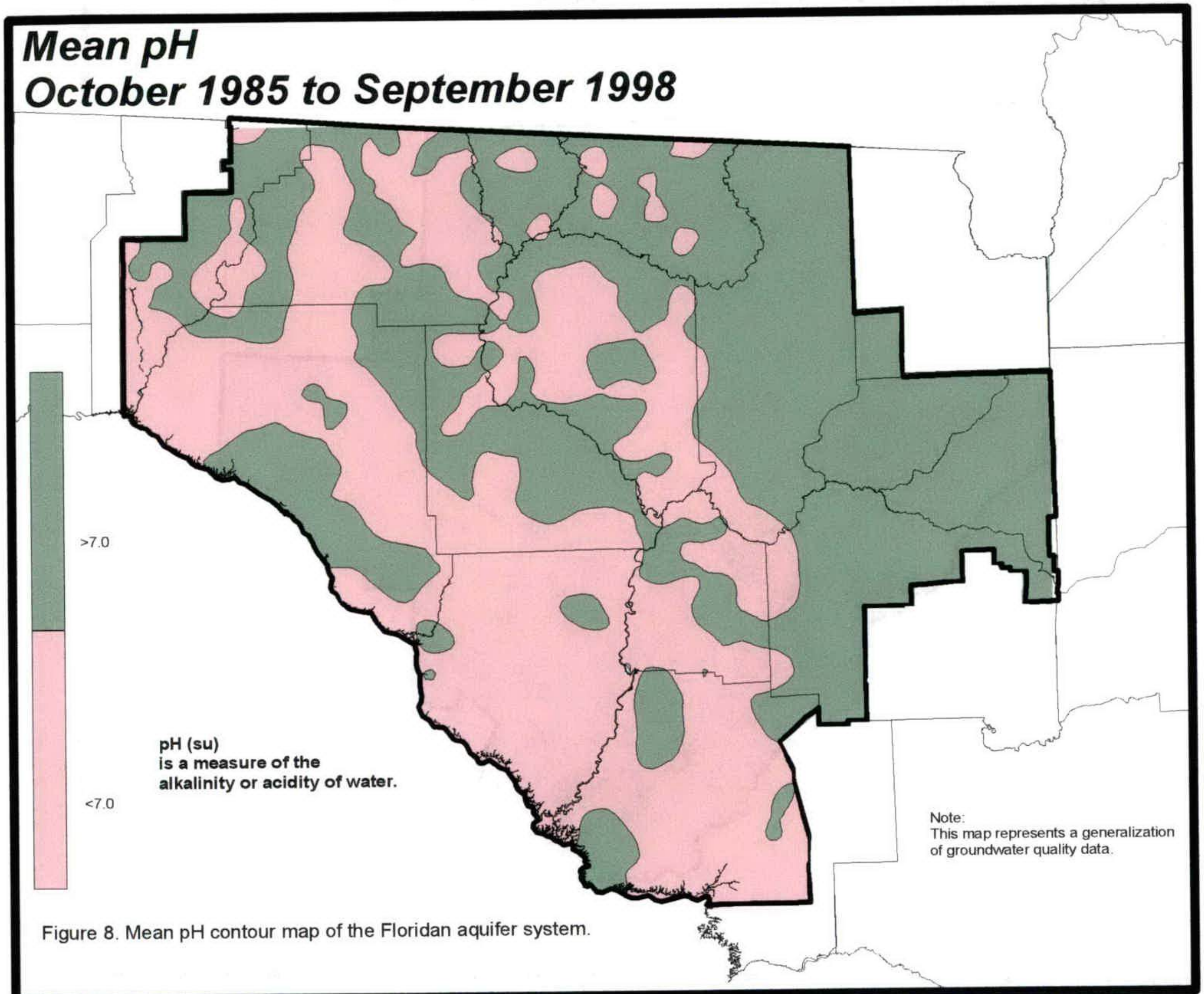

Figure 8. Mean pH contour map of the Floridan aquifer system.

Mean Calcium (Dissolved) Concentration (mg/L)
October 1985 to September 1998

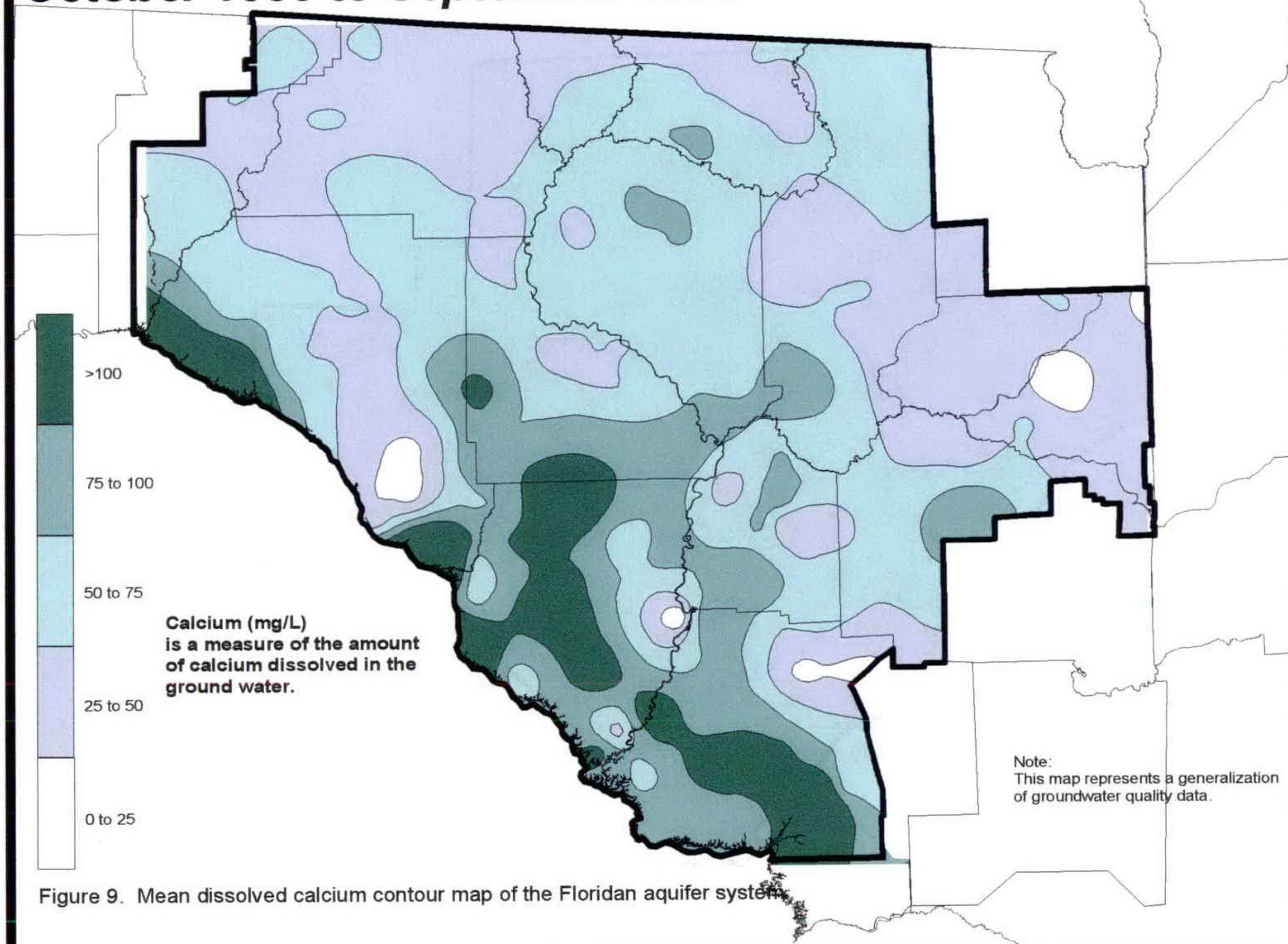

Figure 9. Mean dissolved calcium contour map of the Floridan aquifer system.

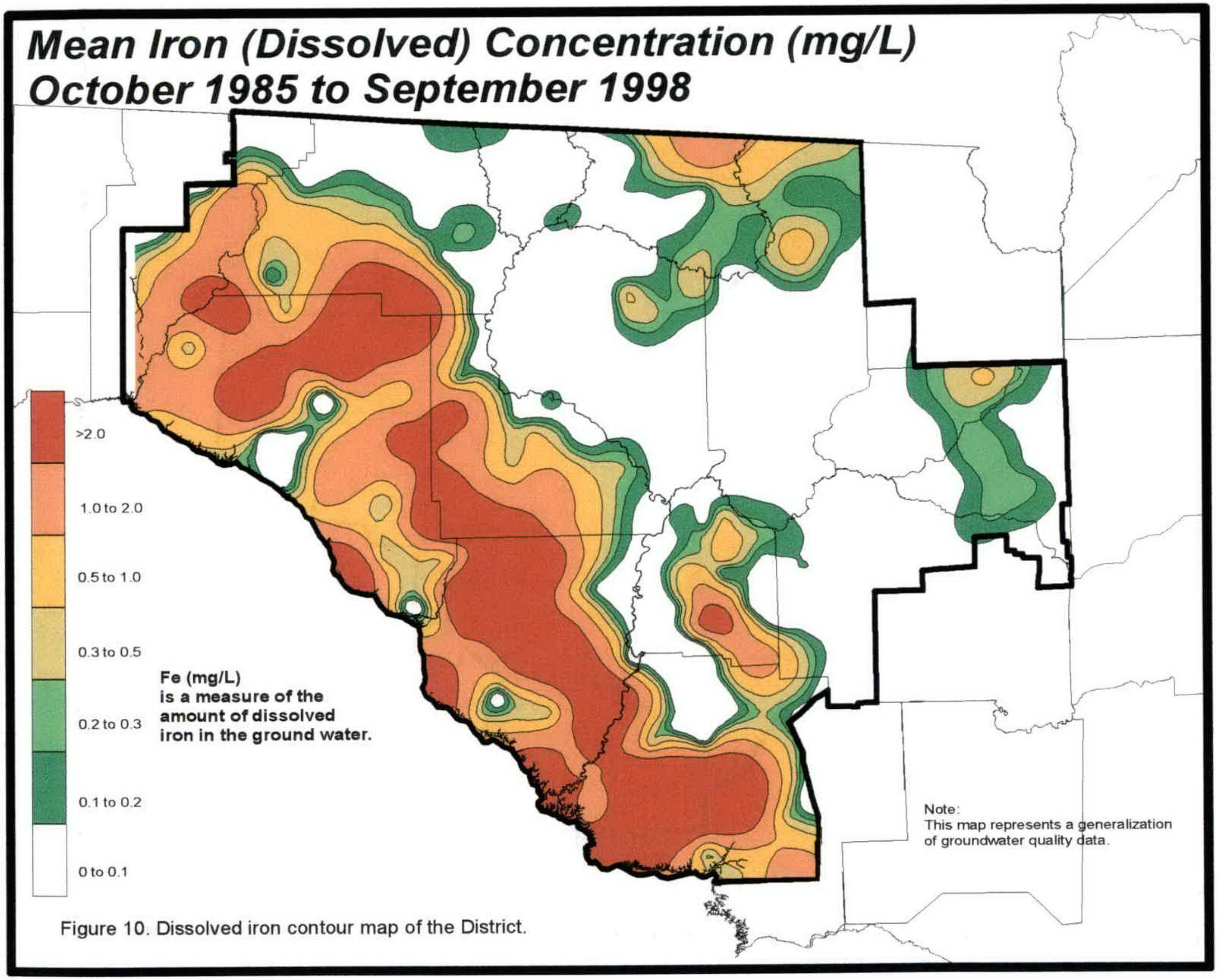

Figure 10. Dissolved iron contour map of the District.

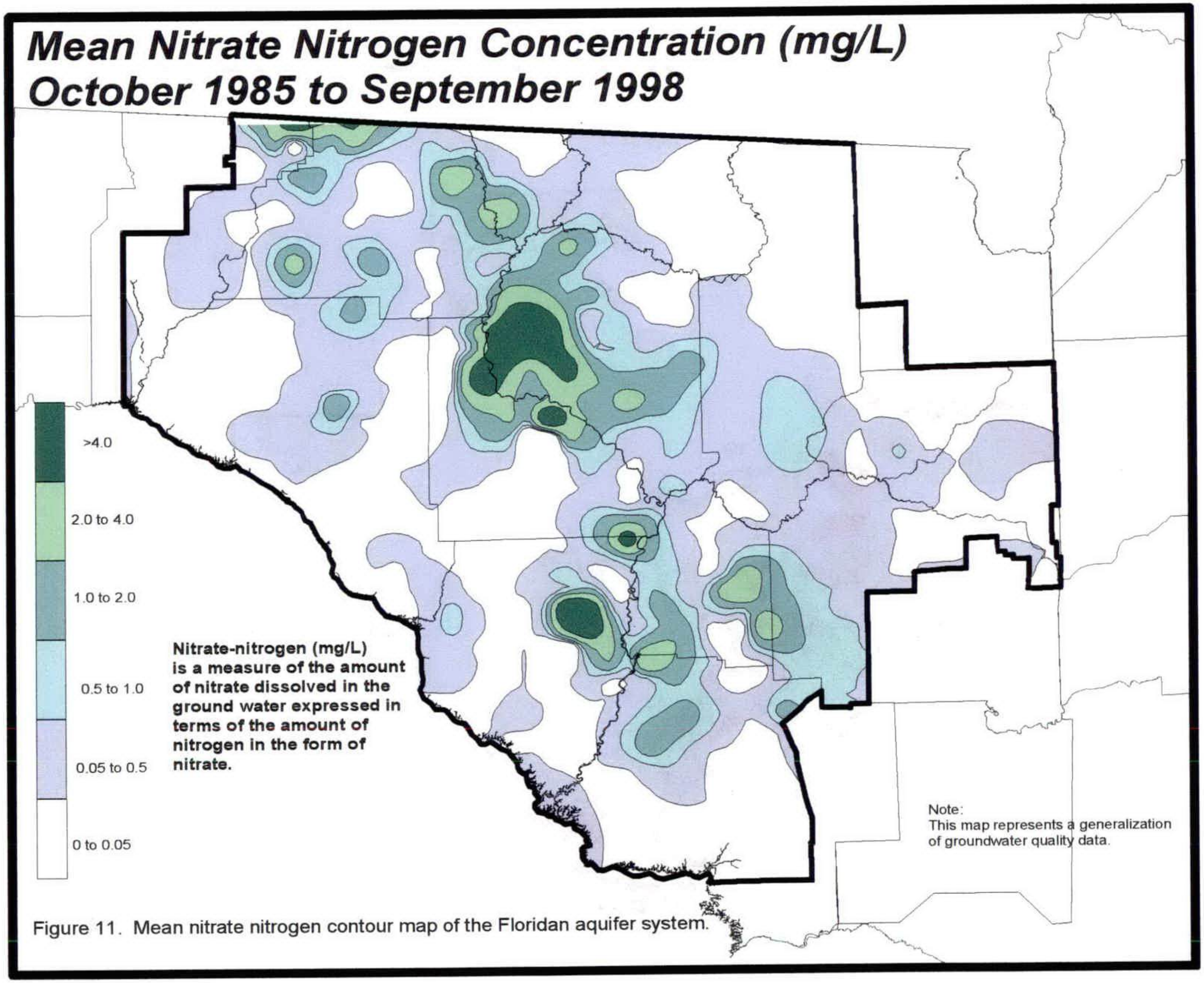

Figure 11. Mean nitrate nitrogen contour map of the Floridan aquifer system.

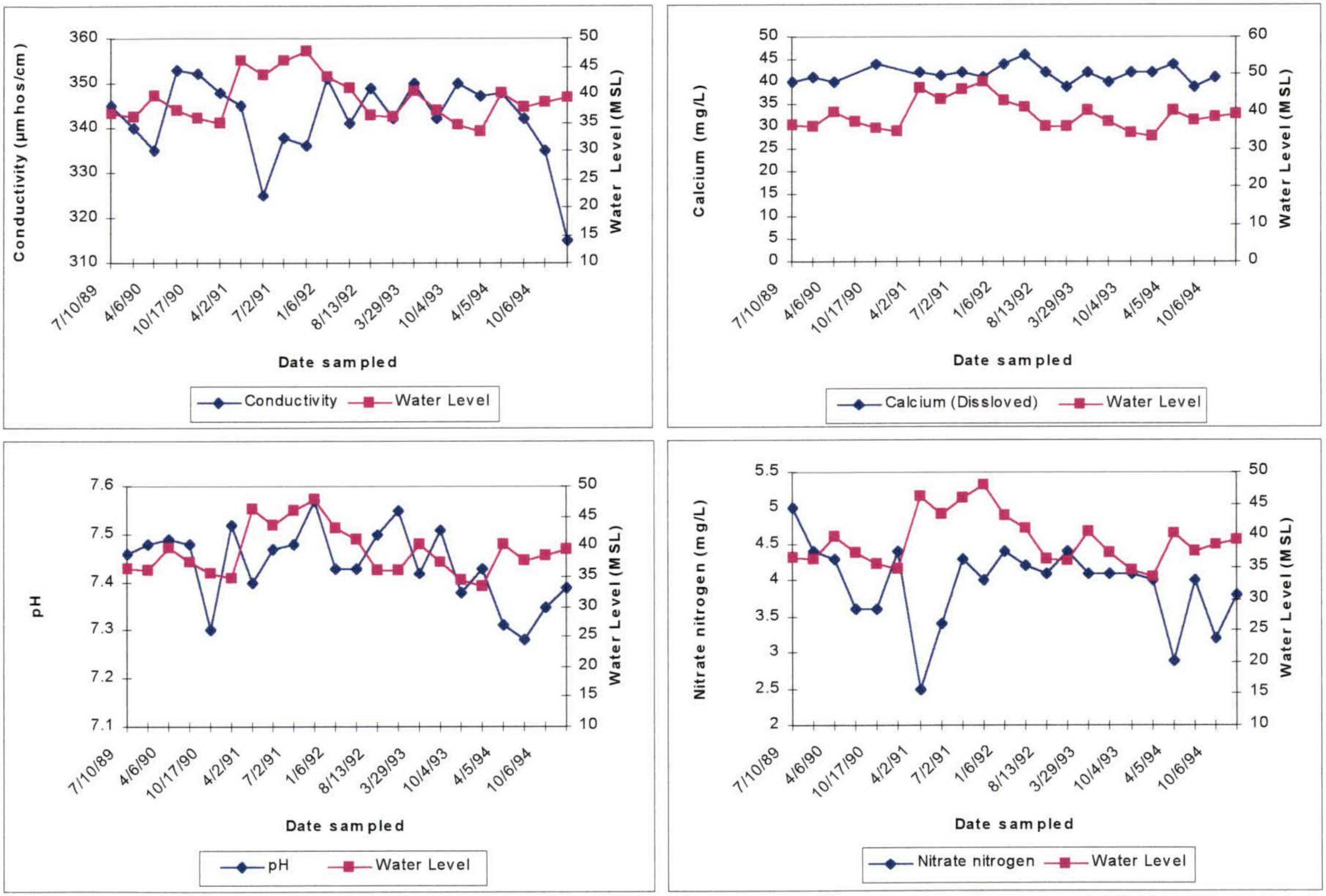

Figure 12. Example of relationship of groundwater levels with conductivity, pH, calcium, and nitrate-nitrogen.

Table 8. Primary Drinking Water Standard exceedances in the Floridan aquifer system.

CONTAMINANT (CAS NUMBER)	MCL ($mg\ L^{-1}$)	Exceedances in Floridan
Inorganic		
Antimony (1074)	0.006	NA
Arsenic (1005)	0.05	1
Asbestos (1094)	7 MFL	NA
Barium (1010)	2	0
Beryllium (1075)	0.004	0
Cadmium (1015)	0.005	4
Chromium (1020)	0.1	0
Cyanide (1024)	0.2	0
Fluoride (1025)	4	0
Lead (1030)	0.015	51
Mercury (1035)	0.002	0
Nickel (1036)	0.1	0
Nitrate (1040)	10 (as N)	20
Nitrite (1041)	1 (as N)	0
Total Nitrate and Nitrite	10 (as N)	20
Selenium (1045)	0.05	0
Sodium (1052)	160	18
Thallium (1085)	0.002	NA
Radiometrics		
Gross Alpha	15 $pCi\ L^{-1}$	17
Gross Beta	4 $mrem\ yr\ L^{-1}$	0
Radium 226,228	5 $pCi\ L^{-1}$	0

Abbreviations Used: MCL = Maximum contaminant level
MFL = million fibers per liter greater than 10 micrometers
$mg\ L^{-1}$ = milligrams per liter
CAS = chemical abstract service
$pCi\ L^{-1}$ = picocuries per liter
$mrem\ yr^{-1}$ = millirems per year
NA = no analysis

Table 8. continued

CONTAMINANT (CAS NUMBER)	MCL ($mg\ L^{-1}$)	Exceedances in Floridan
Organic		
1, 1, 1-Trichloroethane (71-55-6)	0.2	0
1, 1, 2-Tricholoroethane (79-00-5)	0.005	0
1, 1-Dichloroethylene (75-35-4)	0.007	0
1, 2, 4-Tricholorobenzene (120-82-1)	0.07	NA
1, 2-Dichloroethane (107-06-2)	0.003	0
1, 2-Dichloropropane (78-87-5)	0.005	0
2, 3, 7, 8-TCDD (Dioxin) (1746-01-6)	3×10^{-8}	NA
2, 4, 5-TP (Silvex) (93-72-1)	0.05	NA
2, 4-D (94-75-7)	0.07	NA
Alachlor (15972-60-8)	0.002	0
Atrazine (1912-24-9)	0.003	0
Benzene (71-43-2)	0.001	4
Benzo(a)pyrene (50-32-8)	0.0002	0
Carbofuran (1563-66-2)	0.04	0
Carbon tetrachloride (56-23-5)	0.003	0
Chlordane (57-74-9)	0.002	0
cis-1, 2-Dichloroethylene (156-59-2)	0.07	0
Dalapon (75-99-0)	0.2	NA
Di(2-ethylhexyl)adipate (103-23-1)	0.4	NA
Di(2-ethylhexyl)phthalate (117-81-7)	0.006	NA
Dibromochloropropane(DBCP) (96-12-8)	0.0002	NA
Dichloromethane (75-09-2)	0.005	NA
Dinoseb (88-85-7)	0.007	NA
Diquat (85-00-7)	0.02	NA
Endothall (145-73-3)	0.1	NA
Endrin (72-20-8)	0.002	0
Ethylbenzene (100-41-4)	0.7	0
Ethylene dibromide (EDB) (106-93-4)	0.00002	NA

Table 8. continued.

CONTAMINANT (CAS NUMBER)	MCL (mg L^{-1})	Exceedances in Floridan
Glyphosate (1071-853-6)	0.7	NA
Heptachlor (76-44-8)	0.0004	0
Heptachlor epoxide (1024-57-3)	0.0002	0
Hexachlorobenzene (118-74-1)	0.001	0
Hexachlorocyclopentadiene (77-47-4)	0.05	0
Lindane (58-89-9)	0.0002	NA
Methoxychlor (72-43-5)	0.04	0
Methylene Chloride	0.005	1
Monochlorobenzene (108-90-7)	0.1	0
o-Dichlorobenzene (95-50-1)	0.6	0
Oxamyl (vydate) (23135-22-0)	0.2	0
para-Dichlorobenzene (106-46-7)	0.075	NA
Pentachlorophenol (87-86-5)	0.001	0
Picloram (1918-02-1)	0.5	0
Polychlorinated biphenyl (PCB) (1336-36-3)	0.0005	0
Simazine (122-34-9)	0.004	0
Styrene (100-42-5)	0.1	0
Tetrachloroethylene (127-18-4)	0.003	0
Toluene (108-88-3)	1	0
Toxaphene (8001-35-2)	0.003	0
trans-1, 2-Dichloroethylene (156-60-5)	0.1	0
Trichloroethylene (79-01-6)	0.003	0
Vinyl chloride (75-01-4)	0.001	1
Xylenes (total) (1330-20-7)	10	0

Abbreviations Used: MCL = Maximum contaminant level
MFL = million fibers per liter greater than 10 micrometers
mg L^{-1} = milligrams per liter
CAS = chemical abstract service
pCi L^{-1} = picocuries per liter
mrem yr^{-1} = millirems per year
NA = no analysis

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Table 9. Primary Drinking Water Standard exceedances in the Floridan aquifer system by county.

SITEID	Date Sampled	County	STORET	PDWS	Concentration	Unit	Analyte
R18T07SEC2702	19870430	Alachua	1051	15	38	pCi L^{-1}	Gross Alpha
R18T10SEC2901	19870505	Alachua	1051	15	23	pCi L^{-1}	Gross Alpha
-031923004	19940801	Baker	1051	0.015	0.02	mg L^{-1}	Lead
-031923004	19940222	Baker	1051	0.015	0.02	mg L^{-1}	Lead
-021934001	19860915	Baker	39175	0.001	0.014	mg L^{-1}	Vinyl Chloride
-062118003	19860812	Bradford	929	160	180	mg L^{-1}	Sodium
-062118003	19931221	Bradford	1051	0.015	0.03	mg L^{-1}	Lead
-042236001	19860827	Bradford	1501	15	620	pCi L^{-1}	Gross Alpha
-072205001	19950207	Bradford	78124	0.001	0.0029	mg L^{-1}	Benzene
-031610007	19870923	Columbia	1002	0.05	0.07	mg L^{-1}	Arsenic
+011714002	19930811	Columbia	1051	0.015	0.04	mg L^{-1}	Lead
-031610007	19871007	Columbia	1051	0.015	0.02	mg L^{-1}	Lead
-041827002	19871014	Columbia	1051	0.015	0.06	mg L^{-1}	Lead
+011714002	19860310	Columbia	1501	15	27	pCi L^{-1}	Gross Alpha
-061610001	19871005	Columbia	1501	15	24	pCi L^{-1}	Gross Alpha
-061704004	19870922	Columbia	1501	15	21	pCi L^{-1}	Gross Alpha
-071710008	19860311	Columbia	1501	15	36	pCi L^{-1}	Gross Alpha
-091236001	19860310	Dixie	620	10	24	mg L^{-1}	Nitrate-Nitrogen
-091236001	19860325	Dixie	620	10	15	mg L^{-1}	Nitrate-Nitrogen
-121133005	19860819	Dixie	929	160	210	mg L^{-1}	Sodium
-110911002	19940913	Dixie	930	160	310	mg L^{-1}	Sodium
-110911002	19940314	Dixie	930	160	1010	mg L^{-1}	Sodium
-110911002	19940314	Dixie	930	160	1010	mg L^{-1}	Sodium
-081313005	19940801	Dixie	1050	0.015	0.109	mg L^{-1}	Lead
-081313005	19851016	Dixie	1051	0.015	0.11	mg L^{-1}	Lead
-081002001	19851015	Dixie	1051	0.015	0.03	mg L^{-1}	Lead
-091011004	19860310	Dixie	1051	0.015	0.04	mg L^{-1}	Lead
-101024001	19871022	Dixie	1051	0.015	0.02	mg L^{-1}	Lead

PDWS= Primary Drinking Water Standard

Table 9. continued.

SITEID	Date Sampled	County	STORET	PDWS	Concentration	Unit	Analyte
-111136001	19871001	Dixie	1051	0.015	0.02	mg L^{-1}	Lead
-121106001	19860815	Dixie	1051	0.015	0.02	mg L^{-1}	Lead
-121216002	19860325	Dixie	1051	0.015	0.023	mg L^{-1}	Lead
-131219008	19860815	Dixie	1051	0.015	0.081	mg L^{-1}	Lead
-091231003	19871005	Dixie	1501	15	23	pCi L^{-1}	Gross Alpha
-101516001	19870923	Gilchrist	1051	0.015	0.08	mg L^{-1}	Lead
-101516002	19871015	Gilchrist	1051	0.015	0.08	mg L^{-1}	Lead
-071630002	19870921	Gilchrist	1501	15	27	pCi L^{-1}	Gross Alpha
-101516006	19950216	Gilchrist	34423	0.005	0.037	mg L^{-1}	Methylene chloride
+011510003	19860822	Hamilton	1051	0.015	0.03	mg L^{-1}	Lead
+030732012	19860318	Jefferson	620	10	17	mg L^{-1}	Nitrate-Nitrogen
-020433001	19870925	Jefferson	1027	0.005	0.0339	mg L^{-1}	Cadmium
-020433001	19870924	Jefferson	1027	0.005	0.0339	mg L^{-1}	Cadmium
-010403007	19931221	Jefferson	1049	0.015	0.038	mg L^{-1}	Lead
-010403007	19940222	Jefferson	1050	0.015	0.072	mg L^{-1}	Lead
-010403007	19860325	Jefferson	1051	0.015	0.11	mg L^{-1}	Lead
+030524003	19871013	Jefferson	1051	0.015	0.049	mg L^{-1}	Lead
+030730004	19871013	Jefferson	1051	0.015	0.05	mg L^{-1}	Lead
-010430002	19860815	Jefferson	1051	0.015	0.02	mg L^{-1}	Lead
+020611002	19871016	Jefferson	1501	15	52	pCi L^{-1}	Gross Alpha
-051216011	19950906	Lafayette	631	10	26	mg L^{-1}	Nitrate-Nitrogen
-051216011	19950823	Lafayette	631	10	23	mg L^{-1}	Nitrate-Nitrogen
-051216011	19950816	Lafayette	631	10	23	mg L^{-1}	Nitrate-Nitrogen
-051209001	19900501	Lafayette	631	10	17.4	mg L^{-1}	Nitrate-Nitrogen
-051209001	19901001	Lafayette	631	10	17	mg L^{-1}	Nitrate-Nitrogen
-051216011	19940607	Lafayette	631	10	19	mg L^{-1}	Nitrate-Nitrogen
-051216011	19970607	Lafayette	631	10	19	mg L^{-1}	Nitrate-Nitrogen
-051209001	19970607	Lafayette	631	10	16	mg L^{-1}	Nitrate-Nitrogen

PDWS= Primary Drinking Water Standard

Table 9. continued.

SITEID	Date Sampled	County	STORET	PDWS	Concentration	Unit	Analyte
-051216011	19970607	Lafayette	631	10	19	mg L^{-1}	Nitrate-Nitrogen
-051216011	19970607	Lafayette	631	10	19	mg L^{-1}	Nitrate-Nitrogen
-051209001	19970607	Lafayette	631	10	16	mg L^{-1}	Nitrate-Nitrogen
-041235005	19980720	Lafayette	631	10	12	mg L^{-1}	Nitrate-Nitrogen
-051216011	19980707	Lafayette	631	10	20	mg L^{-1}	Nitrate-Nitrogen
-051319001	19980311	Lafayette	631	10	11	mg L^{-1}	Nitrate-Nitrogen
-051216011	19980309	Lafayette	631	10	14	mg L^{-1}	Nitrate-Nitrogen
-061005001	19851016	Lafayette	1051	0.015	0.03	mg L^{-1}	Lead
-061025003	19851016	Lafayette	1051	0.015	0.037	mg L^{-1}	Lead
-061115002	19871013	Lafayette	1051	0.015	0.073	mg L^{-1}	Lead
-061005001	19860318	Lafayette	1051	0.015	0.017	mg L^{-1}	Lead
-051321002	19860813	Lafayette	1051	0.015	0.016	mg L^{-1}	Lead
-061005001	19860317	Lafayette	1051	0.015	0.247	mg L^{-1}	Lead
-061005001	19860811	Lafayette	1051	0.015	0.176	mg L^{-1}	Lead
-061005001	19860814	Lafayette	1051	0.015	0.247	mg L^{-1}	Lead
-061005001	19860814	Lafayette	1051	0.015	0.176	mg L^{-1}	Lead
-101527001	19960901	Levy	1027	0.005	0.02	mg L^{-1}	Cadmium
-111631002	19960901	Levy	1027	0.005	0.02	mg L^{-1}	Cadmium
-151608001	19931221	Levy	1050	0.015	0.047	mg L^{-1}	Lead
-151608001	19860319	Levy	1051	0.015	0.048	mg L^{-1}	Lead
-101527001	19870923	Levy	1501	15	22	pCi L^{-1}	Gross Alpha
-111631002	19870923	Levy	1501	15	29	pCi L^{-1}	Gross Alpha
-141620002	19941212	Levy	78124	0.001	3.2	mg L^{-1}	Benzene
-141620002	19871015	Levy	78124	0.001	1.3	mg L^{-1}	Benzene
-141620002	19920610	Levy	78124	0.001	2.8	mg L^{-1}	Benzene
-010734002	19930811	Madison	1050	0.015	0.021	mg L^{-1}	Lead
-010734002	19860319	Madison	1051	0.015	0.022	mg L^{-1}	Lead
+021021001	19851021	Madison	1051	0.015	0.032	mg L^{-1}	Lead
-020603001	19851021	Madison	1051	0.015	0.07	mg L^{-1}	Lead

PDWS= Primary Drinking Water Standard

Table 9. continued.

SITEID	Date Sampled	County	STORET	PDWS	Concentration	Unit	Analyte
-011030002	19860815	Madison	1501	15	25	pCi L^{-1}	Gross Alpha
-021035002	19860815	Madison	1501	15	21	pCi L^{-1}	Gross Alpha
-031220001	19851021	Suwannee	620	10	11	mg L^{-1}	Nitrate-Nitrogen
-021321008	19970607	Suwannee	631	10	13	mg L^{-1}	Nitrate-Nitrogen
-021321010	19910422	Suwannee	1049	0.015	0.069	mg L^{-1}	Lead
-021324013	19910422	Suwannee	1049	0.015	0.072	mg L^{-1}	Lead
-021333005	19910213	Suwannee	1051	0.015	0.02	mg L^{-1}	Lead
-041402002	19920610	Suwannee	1051	0.015	0.07	mg L^{-1}	Lead
-011124009	19870922	Suwannee	1501	15	22	pCi L^{-1}	Gross Alpha
-031232002	19870923	Suwannee	1501	15	55	pCi L^{-1}	Gross Alpha
-050529001	19860813	Taylor	929	160	3200	mg L^{-1}	Sodium
-090921001	19870925	Taylor	929	160	2200	mg L^{-1}	Sodium
-090921001	19940216	Taylor	930	160	2400	mg L^{-1}	Sodium
-060608001	19961201	Taylor	930	160	180	mg L^{-1}	Sodium
-050529001	19970201	Taylor	930	160	4700	mg L^{-1}	Sodium
-050529001	19970201	Taylor	930	160	4330	mg L^{-1}	Sodium
-090921001	19970201	Taylor	930	160	2220	mg L^{-1}	Sodium
-080829001	19970301	Taylor	930	160	220	mg L^{-1}	Sodium
-060608001	19961201	Taylor	930	160	311	mg L^{-1}	Sodium
-050529001	19970201	Taylor	930	160	4330	mg L^{-1}	Sodium
-090921001	19970201	Taylor	930	160	2220	mg L^{-1}	Sodium
-080829001	19970201	Taylor	930	160	220	mg L^{-1}	Sodium
-060608001	19970301	Taylor	930	160	311	mg L^{-1}	Sodium
-030934001	19920610	Taylor	1050	0.015	0.021	mg L^{-1}	Lead
-030934001	19940609	Taylor	1051	0.015	0.022	mg L^{-1}	Lead
-020828001	19961101	Taylor	1051	0.015	0.03	mg L^{-1}	Lead
-030833001	19970801	Taylor	1051	0.015	0.1	mg L^{-1}	Lead
-090921001	19970801	Taylor	1051	0.015	0.04	mg L^{-1}	Lead
-020828001	19961101	Taylor	1051	0.015	0.078	mg L^{-1}	Lead

PDWS= Primary Drinking Water Standard

Table 9. continued.

SITEID	Date Sampled	County	STORET	PDWS	Concentration	Unit	Analyte
-020828001	19970801	Taylor	1051	0.015	0.078	mg L^{-1}	Lead
-030934001	19860318	Taylor	1501	15	49	pCi L^{-1}	Gross Alpha
-070905001	19870925	Taylor	1501	15	17	pCi L^{-1}	Gross Alpha
-071018001	19870924	Taylor	1501	15	16	pCi L^{-1}	Gross Alpha
-051922001	19970801	Union	1051	0.015	0.03	mg L^{-1}	Lead

PDWS = Primary Drinking Water Standard

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Exceedances of Primary Drinking Water Standards

To date, 119 values out of 51,354 values (0.23%) were in exceedance of Primary Drinking Water Standards (Table 8). All exceedances were reported to the Department of Health (DOH) by DEP (Table 8). All wells with exceedances were resampled to confirm exceedances. Table 9 is a breakdown by county of the exceedances of Primary Drinking Water Standards. Some wells have multiple contaminant exceedances and/or multiple exceedance of the same contaminant.

The following is a list of contaminants above MCL in the Floridan aquifer system with possible reasons for their presence in the ground water:

Arsenic

- One sample exceeded the Primary Drinking Water Standard.
- Well may be located near an old cattle dip vat.

Benzene

- Four samples exceeded the Primary Drinking Water Standard.
- Benzene is a component of gasoline. The average concentration for the samples that exceeded the Primary Drinking Water Standard (0.001 mg L^{-1}) is 0.003 mg L^{-1}.

Cadmium

- Four samples exceeded the Primary Drinking Water Standard.
- Cadmium is used as an additive in gasoline, so wells may be influenced by gasoline which has entered the ground water.

Gross Alpha particles

- Nineteen samples exceeded the Primary Drinking Water Standard.
- Alpha particles are the result of radioactivity decay. Small quantities of Uranium are associated with the phosphate minerals in the Hawthorn Formation. Thus, the presence of alpha particles in the District ground water is due to natural sources.

Lead

- Fifty-one samples exceeded the Primary Drinking Water Standard.
- Statewide 20 to 25 percent of all wells sampled exceeded the Primary Drinking Water Standard. This condition may be natural or due to man's activities. The average concentration for the 45 samples that exceeded the Primary Drinking Water Standard (0.015 mg L^{-1}) is 0.06 mg L^{-1}.

Methylene Chloride

- One sample exceeded the Primary Drinking Water Standard.
- The presence of methylene chloride in the Floridan aquifer system is due to human activities or is a lab contaminant.

Nitrate-Nitrogen

- Twenty samples exceeded the Primary Drinking Water Standard.
- Increased concentration in the Floridan aquifer system is due to human activities. The average concentration for the wells that exceeded the Primary Drinking Water Standard (10.00 mg L^{-1}) is 17.57 mg L^{-1}.

Sodium

- Eighteen samples exceeded the Primary Drinking Water Standard.
- Exceedance is mostly due to marine influences in the Gulf Coastal Lowlands, and human activities in the Northern Highlands. Average concentration for the wells that exceeded Primary Drinking Water Standard (160 mg L^{-1}) is 1642 mg L^{-1}.

Vinyl Chloride

- One sample exceeded the Primary Drinking Water Standard.
- The presence of vinyl chloride in the Floridan aquifer system is due to human activities.

Summary

The District, in cooperation with DEP, maintains BN and VISA networks. The BN network consists of 236 wells, and the VISA networks consist of 36 wells. Each well is sampled for the parameters listed in Table 6 on the frequency listed in Table 7.

Only 0.23 percent of the analyses performed from October 1985 to September 1998 were in exceedance of MCLs for Primary Drinking Water Standards. However, the District has a nitrate-nitrogen problem in the Middle Suwannee River Watershed (Suwannee and Lafayette Counties) and within an area generally defined along an axis starting in northern Jefferson County and ending in eastern Alachua County (Figure 11). The elevated nitrate-nitrogen is due to human activities in this region.