GROUND-WATER QUALITY IN GEORGIA FOR 1996-1997

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GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
GEORGIA GEOLOGIC SURVEY

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This report, covering the calendar years 1996 and 1997, is the thirteenth in a series of summaries discussing the chemical quality of ground water in Georgia. This report is the first to cover the subject on a biennial basis. These summaries are among the tools used by the Georgia Environmental Protection Division (EPD) to assess trends in the quality of the State's ground-water resources. EPD is the State organization with regulatory responsibility for maintaining and, where possible, improving ground-water quality and availability. EPD has implemented a comprehensive statewide ground-water management policy of anti-degradation (EPD, 1991; 1998). Five components constitute EPD's ground-water quality assessment program:

1. The Georgia Ground-Water Monitoring Network. The Geologic Survey Branch of EPD maintains this program, which is designed to evaluate the ambient ground-water quality of nine aquifer systems throughout the State of Georgia. The data collected from sampling on the Ground-Water Monitoring Network form the basis for this report.

2. Sampling of public drinking water wells as part of the Safe Drinking Water Program (Water Resources Management Branch). This program provides data on the quality of ground water that the residents of Georgia are using.

3. Special studies addressing specific water quality issues. A survey of nitrite /nitrate levels in shallow wells located throughout the State of Georgia (Shellenberger, et al., 1996; Stuart, et al., 1995) and the operation of a Pesticide Monitoring Network, currently conducted jointly by the Geologic Survey Branch and the Georgia Department of Agriculture (GDA), (Webb, 1995; Tolford, 1997) are examples of these types of studies.

4. Ground-water sampling at environmental facilities such as municipal solid waste landfills, RCRA facilities, and sludge disposal facilities. The primary agencies responsible for monitoring these facilities are EPD's Land Protection, Water Protection, and Hazardous Waste Management Branches.

5. The development of a wellhead protection program (WHP), which is designed to protect the area surrounding a municipal drinking water well from contaminants. The U.S. Environmental Protection Agency (EPA) approved Georgia's WHP Plan on September 30, 1992. The WHP Plan became a part of the Georgia Safe Drinking Water Rules, effective July 1, 1993. The protection of public water supply wells from contaminants is important not only for maintaining ground-water quality but also for ensuring that public water supplies meet health standards.

Analyses of water samples collected for the Georgia Ground-Water Monitoring Network during calendar years 1996 and 1997 and from previous years form the database for this summary. The Georgia Ground-Water Monitoring Network comprises 128 wells and springs. Beginning in 1996, most stations in the network were changed from an annual sampling frequency to a biennial sampling frequency. Certain stations, typically recent additions to the network or stations with past evidence of pollution or contamination, remain on an annual sampling frequency. Stations showing recent pollution or contamination may be subject to confirmatory sampling on a basis more frquent than annual. During the 1996-1997 period, EPD personnel collected 160 samples from 115 wells and 6 springs. A review of the 1996-1997 data and comparison of these data with those for samples collected as early as 1984 indicate that ground-water quality at most of the 128 sampling sites generally has changed little and remains excellent.

1.2 FACTORS AFFECTING CHEMICAL GROUND-WATER QUALITY

The chemical quality of ground water drawn for sampling is the result of complex physical, chemical, and biological processes. Among the more significant controls are the chemical quality of the water entering the ground-water flow system, the reactions of infiltrating water with the soils and rocks that are encountered, and the effects of the well-and-pump system.

Most water enters the ground-water system in upland recharge areas. Water seeps through interconnected pores and joints in the soils and rocks until discharged to a surface-water body (e.g., stream, river, lake, or ocean). The initial water chemistry, the amount of recharge, and the attenuation capacity of soils have a strong influence on the quality of ground water in recharge areas. Chemical interactions between the water and the aquifer host rocks have an increasing significance with longer underground residence times. As a result, ground water from discharge areas tends to be more highly mineralized than ground water in recharge areas.

The well-and-pump system can also have a strong influence on the quality of the well water. Well casings, through compositional breakdown, can contribute metals (e.g., iron from steel casings) and organic compounds (e.g., tetrahydrofuran from PVC pipe cement) to the water. Pumps often aerate the water being discharged. An improperly constructed well can present a conduit that allows local pollutants to enter the ground-water flow system.

1.3 HYDROGEOLOGIC PROVINCES OF GEORGIA

This report defines three hydrogeologic provinces in Georgia by their general geologic and hydrologic characteristics (Figure 1-1). These provinces consist of:

1. the Coastal Plain Province of south Georgia;

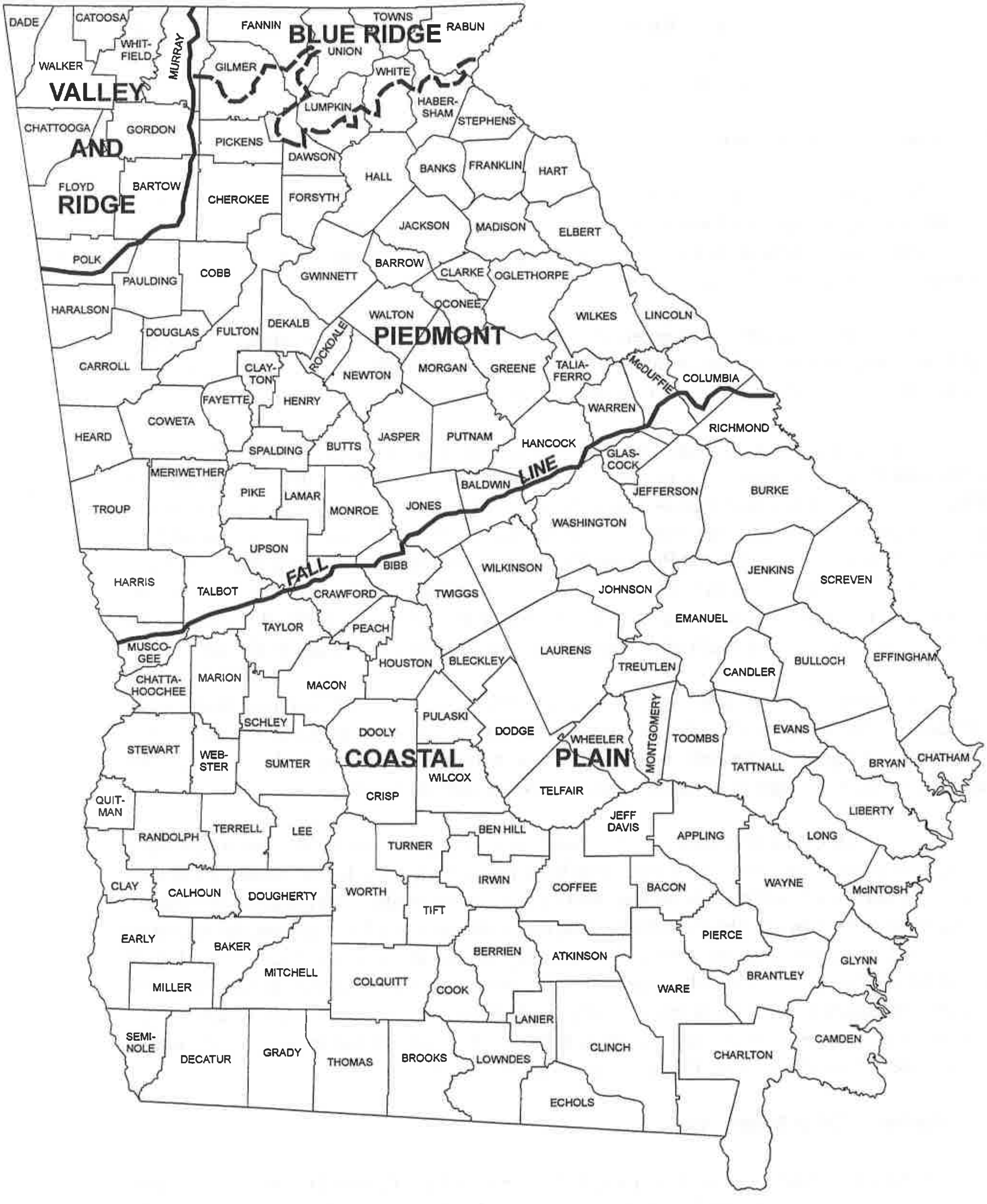


Figure 1-1. - The Hydrogeologic Provinces of Georgia

2. the Piedmont/Blue Ridge Province, which includes all but the northwest corner of Georgia; and
3. the Valley and Ridge Province of northwest Georgia.

1.3.1 Coastal Plain Province

Georgia's Coastal Plain Province generally comprises a wedge of loosely consolidated sediments that gently dip and thicken to the south and southeast. Ground water in the Coastal Plain Province flows through interconnected pore space between grains in the host rocks and through solution-enlarged voids.

The oldest outcropping sedimentary formations (Cretaceous) are exposed along the Fall Line, which is the northern limit of the Coastal Plain Province. Successively younger formations occur at the surface to the south and southeast.

The Coastal Plain contains Georgia's major confined (artesian) aquifers. Confined aquifers are those in which a layer of impermeable material (i.e., clay or shale) holds the top of the water column at a level below that to which it would normally rise. Water enters the aquifers in their up-dip outcrop areas, where the more permeable sediments of the aquifer tend to be exposed. Many Coastal Plain aquifers are unconfined in their up-dip outcrop areas, but become confined in down-dip areas to the southeast, where they are overlain by successively younger rock formations. Ground-water flow through confined Coastal Plain aquifers is generally to the south and southeast, in the direction of the dip of the rocks.

The sediments forming the seven major aquifers in the Coastal Plain range in age from Cretaceous to Miocene. Horizontal and vertical changes in the permeability of the rock units that form these aquifers determine the thickness and extent of the aquifers. Several aquifers may be present in a single geographic area, forming a vertical "stack".

The Cretaceous and Jacksonian aquifer systems (primarily sands) are a common source of drinking water within a 35-mile wide band that lies adjacent to and south of the Fall Line. Southwestern Georgia relies on four vertically stacked aquifers (sands and carbonates) for drinking-water supplies: the Providence, Clayton, Claiborne and Floridan aquifer systems. The Floridan aquifer system (primarily carbonates) serves most of south-central and southeastern Georgia. The Miocene aquifer system (primarily sands) is the principal "shallow" unconfined aquifer system occupying much of the same broad area underlain by the Floridan aquifer system. It becomes confined in the coastal counties and locally in the Grady, Thomas, Brooks and Lowndes County area of south Georgia.

1.3.2 Piedmont/Blue Ridge Province

Crystalline rocks of metamorphic and igneous origin (primarily Precambrian and Paleozoic in age) underlie the Piedmont and Blue Ridge Provinces. These two provinces differ geologically but are discussed together here because they share common hydrologic properties. The principal water-bearing features are fractures, compositional layers, and other geologic discontinuities in the rock, as well as intergranular porosity in the overlying soil and saprolite horizons. Thick soils and saprolites are often important as the "reservoir" that supplies water to the water-bearing fracture and joint systems. Ground water typically flows from local highlands toward discharge areas along streams. However, during prolonged dry periods or in areas of heavy pumpage, surface water may flow from the streams into the ground-water systems.

1.3.3 Valley and Ridge Province

Consolidated Paleozoic sedimentary formations characterize the Valley and Ridge Province. The principal permeable features of the Valley and Ridge Province are fractures and solution voids; intergranular porosity also is important in some places. Locally, ground-water and surface-water systems closely interconnect. Dolostones and limestones of the Knox Group are the principal aquifers where they occur in the axes of broad valleys. The greater hydraulic conductivities of the thick carbonate sections in this Province, in part due to solution-enlarged joints, permit development of higher yielding wells than in the Piedmont and Blue Ridge Province.

1.4 REGIONAL GROUND-WATER PROBLEMS

Data from ground-water investigations in Georgia, including those from the Ground-Water Monitoring Network, indicate that virtually all of Georgia has shallow ground-water sufficient for domestic supply. Iron, aluminum, and manganese are the only constituents that occur routinely in concentrations exceeding drinking-water standards. These metals are naturally occurring and do not pose a health risk. Iron and manganese can cause reddish to brownish stains on objects.

Only a few occurrences of polluted or contaminated ground waters are known from North Georgia (see Section 4). Aquifers in the outcrop areas of Cretaceous sediments south of the Fall Line typically yield acidic water that may require treatment. The acidity occurs naturally and results both from the inability of the sandy aquifer sediments to neutralize acidic rainwater and from acid-producing reactions between infiltrating water and soils and sediments. Nitrite/nitrate concentrations in shallow ground water from the farm belt of southern Georgia are usually within drinking-water standards, but are somewhat higher than levels found in other areas of the State.

The Floridan aquifer system contains two areas of naturally-occurring reduced ground-water quality besides the karst plain area (Dougherty Plain) in southwest Georgia. The first is the area of the Gulf Trough, a narrow, linear geological feature extending from southwestern Decatur County through central Bulloch County. Here, ground water is typically high in total dissolved solids and contains elevated levels of barium, sulfate, and radionuclides. The second is the coastal area of Georgia, where influx of water with high dissolved solids contents presents problems. In the Brunswick area, ground-water withdrawal from the upper Floridan results in up-coning of water with high dissolved solids contents from deeper parts of the aquifer. In the Savannah region, a cone of depression caused by pumping in and around Savannah induces saline ground water to flow down-gradient from the Port Royal Sound area of South Carolina toward Savannah.

2.0 GEORGIA GROUND-WATER MONITORING NETWORK

2.1 MONITORING STATIONS

Stations of the 1996-1997 Ground-Water Monitoring Network are situated in the seven major aquifers and aquifer systems of the Coastal Plain Province and in the unconfined ground-water systems of the Piedmont and Blue Ridge Provinces and of the Valley and Ridge Province (Table 2-1). Monitoring stations are located in three critical settings:

1. areas of surface recharge;
2. areas of potential pollution related to regional activities (e.g., agricultural and industrial areas); and
3. areas of significant ground-water use.

Most of the monitoring stations are municipal, industrial, and domestic wells that have reliable well-construction data. The Monitoring Network also includes monitoring wells in specific areas where the State's aquifers are recognized to be especially susceptible to contamination or pollution (e.g., the Dougherty Plain of southwestern Georgia and the State's coastal area).

2.2 USES AND LIMITATIONS

Regular sampling of wells and springs of the Ground-Water Monitoring Network permits analysis of ground-water quality with respect to location (spatial trends) and with respect to the time of sample collection (temporal trends). Spatial trends are useful for assessing the effects of the geologic framework of the aquifer and regional land-use activities on ground-water quality. Temporal trends permit an assessment of the effects of rainfall and drought periods on ground-water quantity and quality. Both trends are useful for the detection of non-point source pollution. Non-point source pollution arises from broad-scale phenomena such as acid rain deposition and application of agricultural chemicals on crop lands.

It should be noted that the data of the Ground-Water Monitoring Network represent water quality in only limited areas of Georgia. Monitoring water quality at 128 sites located throughout Georgia provides an indication of ground-water quality at the locality sampled and at the horizon corresponding to the screened interval in the well or to the head of the spring at each station in the Monitoring Network. Caution should be exercised in drawing strict conclusions and applying any results reported in this study to ground waters that are not being monitored.

Stations of the Ground-Water Monitoring Network intentionally are located away from known point sources of pollution. The wells provide baseline data on ambient water quality in Georgia. EPD requires other forms of ground-water monitoring for activities that

Table 2-1. Georgia Ground-Water Monitoring Network, 1996-1997

AQUIFER SYSTEM	NUMBER OF MONITORING STATIONS VISITED & SAMPLES TAKEN, 1996-1997	PRIMARY STRATIGRAPHIC EQUIVALENTS	AGE OF AQUIFER FORMATIONS
Cretaceous	16 stations (21 samples)	Ripley Formation, Cusseta Sand, Blufftown Formation, Eutaw Formation, Tuscaloosa Formation, and Gaillard Formation	Late Cretaceous
Providence	2 stations (3 samples)	Providence Sand	Late Cretaceous
Clayton	5 stations (6 samples)	Clayton Formation	Paleocene
Claiborne	5 stations (8 samples)	Claiborne Group	Middle Eocene
Jacksonian	8 stations (10 samples)	Barnwell Group	Late Eocene
Floridan	49 stations (69 samples)	Predominantly Suwannee Limestone and Ocala Group	Predominantly Middle Eocene to Oligocene
Miocene	8 stations (10 samples)	Predominantly Altamaha Formation and Hawthorne Group	Miocene-Recent
Piedmont/Blue Ridge	20 stations (24 samples)	Various igneous and metamorphic complexes	Predominately Paleozoic and Precambrian
Valley and Ridge	8 stations (9 samples)	Shady Dolomite, Knox Group, and Chickamauga Group	Paleozoic, mostly Cambrian and Ordovician

may result in point source pollution (e.g., landfills, hazardous waste facilities and land application sites) through its environmental facilities permit programs.

Ground-water quality changes gradually and predictably in the areally extensive aquifers of the Coastal Plain Province. The Monitoring Network allows for some definition of the chemical processes occurring in large confined aquifers. Unconfined aquifers in northern Georgia and the surface recharge areas of southern Georgia are of comparatively small areal extent and more open to interactions with land-use activities. The wide spacing of monitoring stations does not permit equal characterization of water-quality processes in these settings. The quality of water from monitoring wells completed in unconfined aquifers represents only the general nature of ground water in the vicinity of the monitoring wells. Ground water in the recharge areas of the Coastal Plain aquifers is the future drinking-water resource for down-flow areas. Monitoring wells in these recharge areas, in effect, constitute an early warning system for potential future water quality problems in confined portions of the Coastal Plain aquifers.

2.3 ANALYSES

Analyses are available for 160 water samples collected during the 1996-1997 period from 116 wells and 6 springs. In 1984, the first year of the Ground-Water Monitoring Network, hydrogeologists sampled water from 39 wells in the Piedmont/Blue Ridge and Coastal Plain Provinces. Since 1984, the Ground-Water Monitoring Network has been expanded through addition of further wells and springs to cover all three hydrogeologic provinces, with most of the monitoring done in the Coastal Plain.

Ground water from all monitoring stations is tested for the basic water quality parameters included in the Monitoring Network's standard analysis. The standard parameters include pH, conductivity, bromide (begun January, 1997), chloride, fluoride, sulfate, nitrite/nitrate, and thirty metals (Appendix, Table A-1). Where regional land-use activities have the potential to affect ground-water quality in the vicinity of a monitoring station, additional parameters, for instance, volatile organic compounds, are tested. The additional parameters are listed in the Appendix (Table A-2). The pH measurements are performed in the field, whereas, other parameters are typically measured in the laboratory. Tables 2-2 (cations) and 2-3 (anions) summarize the significance of some common major constituents found in ground water.

The Drinking Water Program of the EPD's Water Resources Management Branch has established Maximum Contaminant Levels (MCL's) for certain parameters included in the analyses done on Ground-Water Monitoring Network samples (EPD, 1994). Primary MCL's pertain to parameters that may have adverse effects on human health when their values are exceeded. Secondary MCL's pertain to parameters that may give drinking water objectionable, though not health-threatening, properties that may cause persons served by public water systems to cease its use. Foul odor and unpleasant taste are examples of such

Table 2-2. The Significance of Selected Parameters of a Basic Water Quality Analysis, Cations (after Wait, 1960).

PARAMETER(S)	SIGNIFICANCE
pH (Hydrogen ion concentration)	pH is a measure of the concentration of the hydrogen ion. Values of pH less than 7.0 denote acidity and values greater than 7.0 indicate alkalinity. Corrosiveness of water generally increases with decreasing pH. However, excessively alkaline waters may also corrode metals. A pH range between 6.0 and 8.5 is considered acceptable.
Calcium and magnesium*	Calcium and magnesium cause most of the hardness of water. Hard water consumes soap before a lather will form and deposits scale in boilers, water heaters, and pipes. Hardness is reported in terms of equivalent calcium carbonate. The hardness of a water can be estimated by the sum of multiplying the ppm of calcium by 2.5 and that of magnesium by 4.1.

Water Class	Hardness (parts per million)
Soft	Less than 60
Moderately Hard	60 to 120
Hard	121 to 180
Very Hard	More than 180

PARAMETER(S)	SIGNIFICANCE
Sodium and potassium*	Sodium and potassium have little effect on the use of water for most domestic purposes. Large amounts give a salty taste when combined with chloride. A high sodium content may limit the use of water for irrigation.
Iron and manganese	More than 300 ppb of iron stains objects red or reddish brown and more than 50 parts per billion of manganese stains objects black. Larger quantities cause unpleasant taste and promote growth of iron bacteria, but do not endanger health.

**Major metallic ions present in most ground waters.*

Table 2-3. The Significance of Selected Parameters of a Basic Water Quality Analysis, Anions (after Wait, 1960).

PARAMETER(S)	SIGNIFICANCE
Chloride	Chloride salts in excess of 100 ppm give a salty taste to water. Large quantities make the water corrosive. Water that contains excessive amounts of chloride is not suitable for irrigation. It is recommended that the chloride content should not exceed 250 ppm.
Nitrate/Nitrite	Excessive amounts of nitrate/nitrite in drinking water or formula water for infants may cause a type of methemoglobinemia ("blue babies"). Nitrate/nitrite in concentrations greater than 10 ppm (as nitrogen) is considered to be a health hazard.
Sulfate	Sulfate in hard water increases the formation of scale in boilers. In large amounts, sulfate in combination with other ions imparts a bitter taste to water. Concentrations above 250 ppm have a laxative effect, but concentrations up to 500 ppm are not considered unhealthful.

properties. MCL's apply only to treated water offered for public consumption, nevertheless, they are useful guidelines for evaluating the quality of untreated (raw) water. Tables A-1 and A-2 in the Appendix list the Primary and Secondary MCL's for Ground Water Monitoring Network parameters.

Most of the wells originally on the Monitoring Network had in-place pumps. Using such pumps to purge the wells and collect samples reduces the potential for cross-contamination of wells. For those wells that lacked in-place pumps, EPD personnel used portable pumps for purging and sampling. In recent years, however, all wells that lacked in-place pumps were dropped from the Monitoring Network, except for a flowing well tapping the lower Floridan, GWN-PA9C (see Appendix, Table A-8).

Sampling procedures are adapted from techniques used by the USGS and the EPA. Hydrogeologists purge the wells (three to five times the volume of the water column in the well) before the collection of a sample to minimize the influence of the well, pump and distribution system on water quality. Municipal, industrial, and domestic wells typically require approximately 30 to 45 minutes of purging before sample collection.

EPD personnel monitor certain water quality parameters prior to sample collection. The personnel observe and record pH, dissolved oxygen content, electrical conductivity, and temperature using field instruments. A manifold captures flow at the pump system discharge point before the water is exposed to the atmosphere and conducts it past the instrument probes. With increased purging time, typical trends include a lowering of pH, dissolved oxygen content, and conductivity, and a transition toward the mean annual air temperature. The hydraulic flow characteristics of unconfined aquifers, the depth of withdrawal, and pump effects may alter these trends.

Samples are collected once the parameters being monitored in the field stabilize or otherwise indicate that the effects of the well have been minimized. Files at the Geologic Survey Branch contain the records of the field measurements taken during sampling (i.e., pH, dissolved oxygen content, conductivity, and temperature). EPD personnel fill the sample bottles and then promptly place them on ice to preserve the water quality. The personnel next transport the samples to the laboratories for analysis on or before the Friday of the week in which they were collected.

During the 1996-1997 period, the Ground-Water Monitoring Network relied on three agencies to perform water quality testing: the EPD laboratories, the GDA laboratories, and the Cooperative Extension Service laboratories at the University of Georgia (UGA). The following paragraphs list the types of testing done by each facility.

The EPD laboratories measured the following standard water quality parameters for all samples: conductivity (in a few cases, the laboratory conductivity test failed and a field result is reported, see Appendix), the concentrations of various metals, nitrate/nitrite concentration (results reported as ppm nitrogen), and the concentrations of chloride, fluoride, bromide (begun in January of 1997), and sulfate. The EPD laboratories performed optional tests for semivolatile organic compounds on all designated samples and for volatile organic compounds on most of the designated samples (a few samples were sent to UGA). In August of 1997, the EPD laboratories became available for pesticide/PCB testing and began sharing this task with the UGA laboratories.

The GDA laboratories continued pesticide/PCB testing for the Ground-Water Monitoring Network through January of 1996, when this work shifted to the UGA laboratories. Beginning in August, 1997, the EPD laboratories began receiving some of the samples to be tested for pesticides and PCB's.

The EPD laboratories tested for metals, nitrate/nitrite, sulfate and halide ions, semivolatile organic compounds, and volatile organic compounds using the EPA-approved testing methods stated in the Appendix. The conductivity test employed at this facility is a standard laboratory procedure listed in Standard Methods for the Evaluation of Water and Waste Water (1995) (see Table 1 in Appendix). For the few samples sent to that agency for volatile organic testing, the UGA laboratories used the same EPA method as the EPD laboratories but used the term "Organic Screen #10" to refer to the method.

All three laboratories were involved in testing for four major classes of organic compounds used as pesticides. The table below gives the testing methods used by each of the facilities for these classes of compounds:

	Laboratory Facilities		
Test Methods	EPD	GDA	UGA
EPA 507 (OP)		X	X
EPA 8141 (OP)	X		
EPA 508.1 (OC)		X	X
EPA 608 (OC)	X		
EPA 8081 (OC)	X		
EPA 515.1 (PA)		X	X
EPA 8015 (PA)	X		
EPA 531.1 (UD&C)	X	X	
Organic Screen #5 (UD&C)			X

OP = organophosphorus pesticides
OC = organochlorine pesticides
PA = phenoxy-acid herbicides
UD&C = urea-derivative and carbamate pesticides. Note that EPA Method 531.1 is not effective for urea-derivative pesticides but gives good results for the carbamate aldicarb and its oxidation products. Organic Screen #5 is effective for the urea derivatives but gives unacceptable results for aldicarb and its oxidation products.

3.0 GROUND-WATER QUALITY IN GEORGIA

3.1 OVERVIEW

Georgia's nine major aquifers and aquifer systems are grouped into three hydrogeologic provinces for the purposes of this report.

The Coastal Plain Province comprises seven major aquifers or aquifer systems that are restricted to specific regions and depths within the province (Figure 3-1). These major aquifer systems, in many cases, incorporate smaller aquifers that are locally confined. Ground-Water Monitoring Network wells in the Coastal Plain aquifers are generally located in three settings:

1. Recharge (or outcrop) areas that are located in regions that are geologically up-dip and generally to the north of confined portions of these aquifers.

2. Up-dip, confined areas that are located in regions that are proximal to the recharge areas, yet are confined by overlying geologic formations. These areas are generally south to southeast of the recharge areas.

3. Down-dip, confined areas, located to the south and southeast in the deeper, confined portions of the aquifers distal to the recharge areas.

Small-scale, localized ground-water flow patterns characterize the two hydrogeologic provinces of north Georgia, the Piedmont/Blue Ridge Province and the Valley and Ridge Province. Deep regional flow systems are unknown in northern Georgia. Geologic discontinuities (such as fractures) and compositional changes within the aquifer generally control ground-water flow in the Piedmont/Blue Ridge Province. Local topographic features, such as hills and valleys, influence ground-water flow patterns. Many of the factors controlling ground-water flow in the Piedmont/Blue Ridge Province also apply in the Valley and Ridge Province. The Valley and Ridge Province additionally possesses widespread karst features, which significantly enhance porosity and permeability in localized areas and exert a strong influence on local ground-water flow patterns.

3.2 CRETACEOUS AQUIFER SYSTEM

The Cretaceous aquifer system is a complexly interconnected group of aquifer subsystems developed in the Late Cretaceous sands of the Coastal Plain Province. These sands crop out in an extensive recharge area immediately south of the Fall Line in west and central Georgia (Figure 3-2). Overlying Tertiary sediments restrict Cretaceous outcrops to valley bottoms in parts of the northeastern Coastal Plain. Five distinct subsystems of the Cretaceous aquifer system, including the Providence aquifer system, are recognized west of the Ocmulgee River (Pollard and Vorhis, 1980). These merge into three subsystems to the

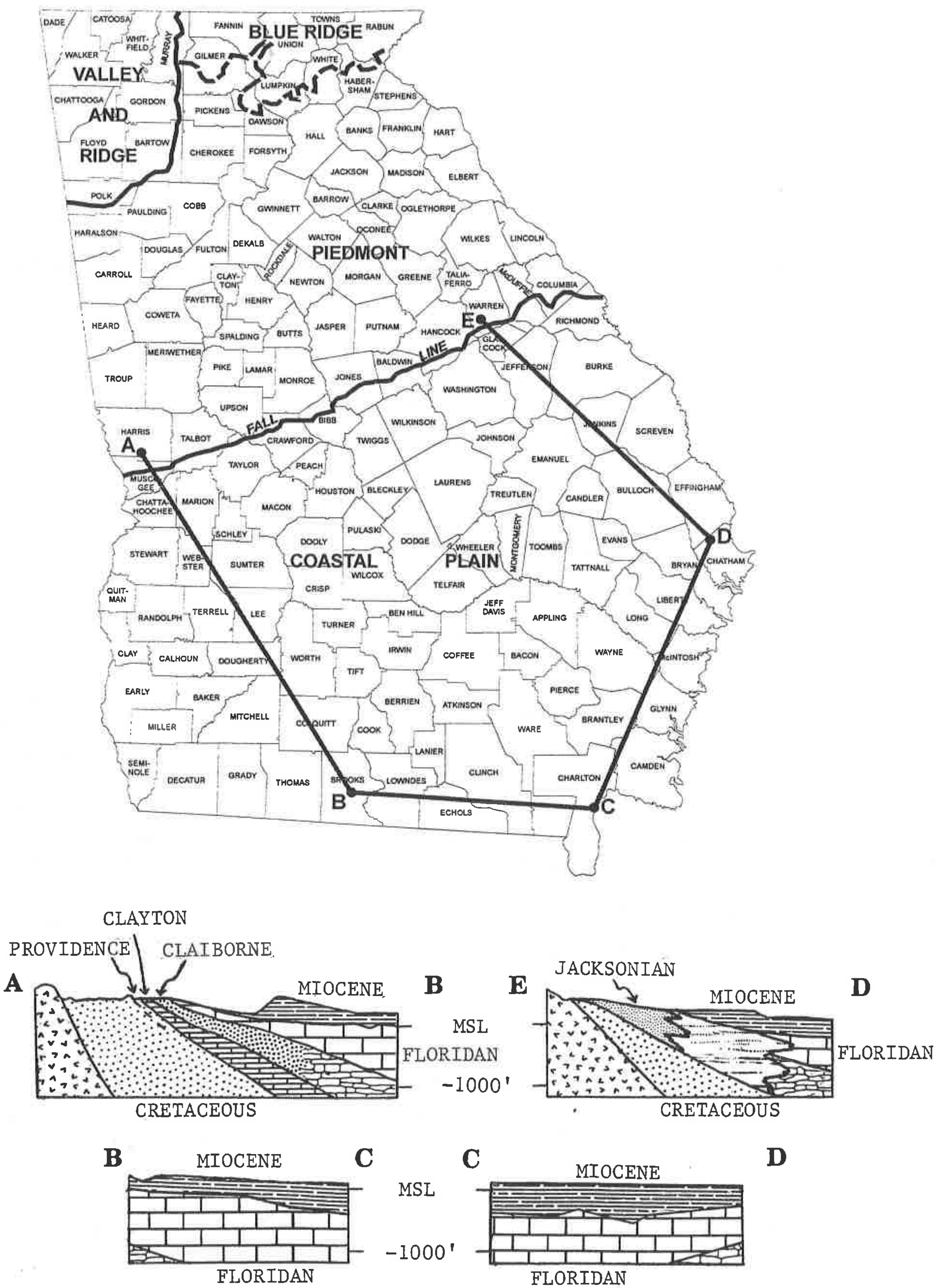


Figure 3-1. - The Seven Major Aquifer Systems of the Coastal Plain Province.

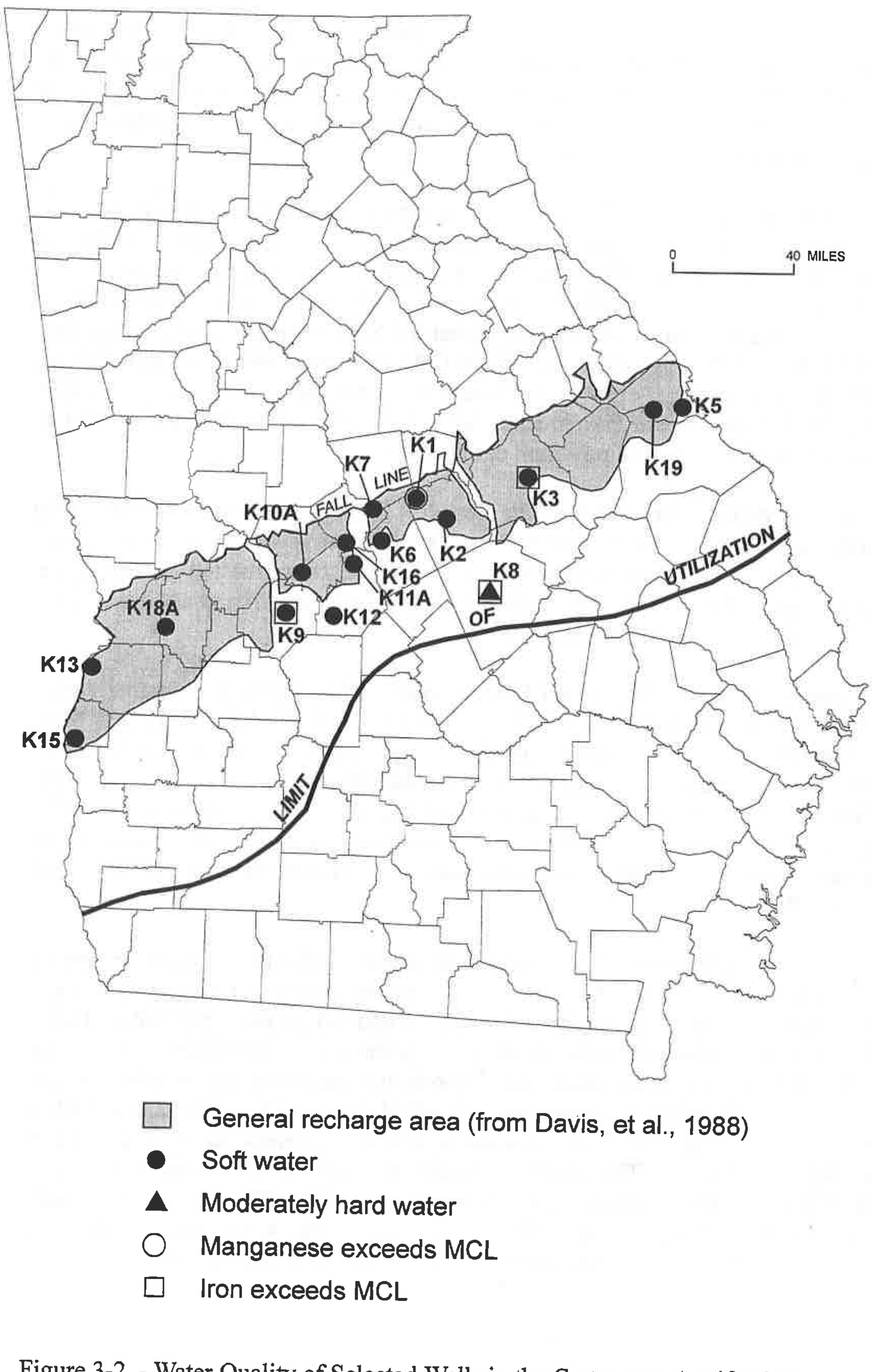


Figure 3-2. - Water Quality of Selected Wells in the Cretaceous Aquifer System.

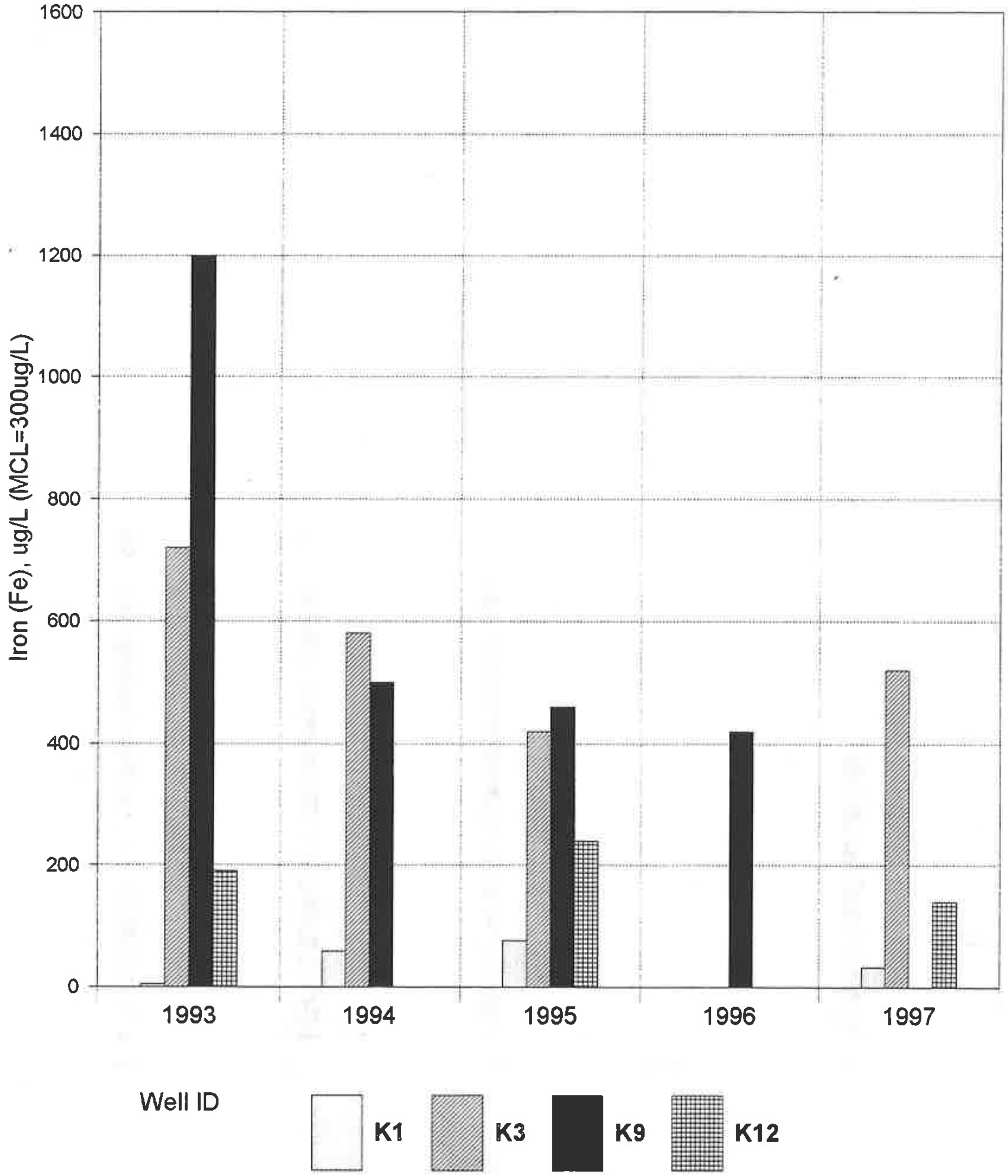
east (Clarke, et al., 1985). Aquifer sands thicken southward from the Fall Line, from where they pinch out against crystalline Piedmont rocks, to a sequence of sand and clay approximately 2,000 feet thick at the southern limits of the main aquifer-use area (limit of utilization, Figure 3-2). Vertical leakage from overlying members of the aquifer system provides significant recharge in down-dip areas.

EPD sampled 16 wells in the 1996-1997 period to monitor the water quality of the Cretaceous aquifer system, exclusive of the Providence aquifer system (Figure 3-2). Two of the sampled wells, GWN-K8 and GWN-K12, are located away from the Cretaceous outcrop and recharge area, while the remainder lie within the general recharge area. Thirteen of the wells yielded soft, acidic water. Wells GWN-K13 and GWN-K15 contained basic water, and, well GWN-K8 had moderately hard water. Wells GWN-K13 and GWN-K15, though lying in the general outcrop area, draw water from the deeper parts of the aquifer system (apparently the A_6 subsystem of Pollard and Vorhis, 1980, in the case of well GWN-K13), and, well GWN-K8 taps a downdip portion of the aquifer.

Iron concentrations exceeded the State secondary MCL of 300 parts per billion (ppb) in three wells: GWN-K3 (520 ppb), GWN-K8 (3000 ppb), and GWN-K9 (470 ppb). Only one well (GWN-K1) yielded a sample with a manganese concentration exceeding the applicable secondary MCL of 50 ppb. Figure 3-3 shows trends in iron concentrations for selected wells in the Cretaceous aquifer system.

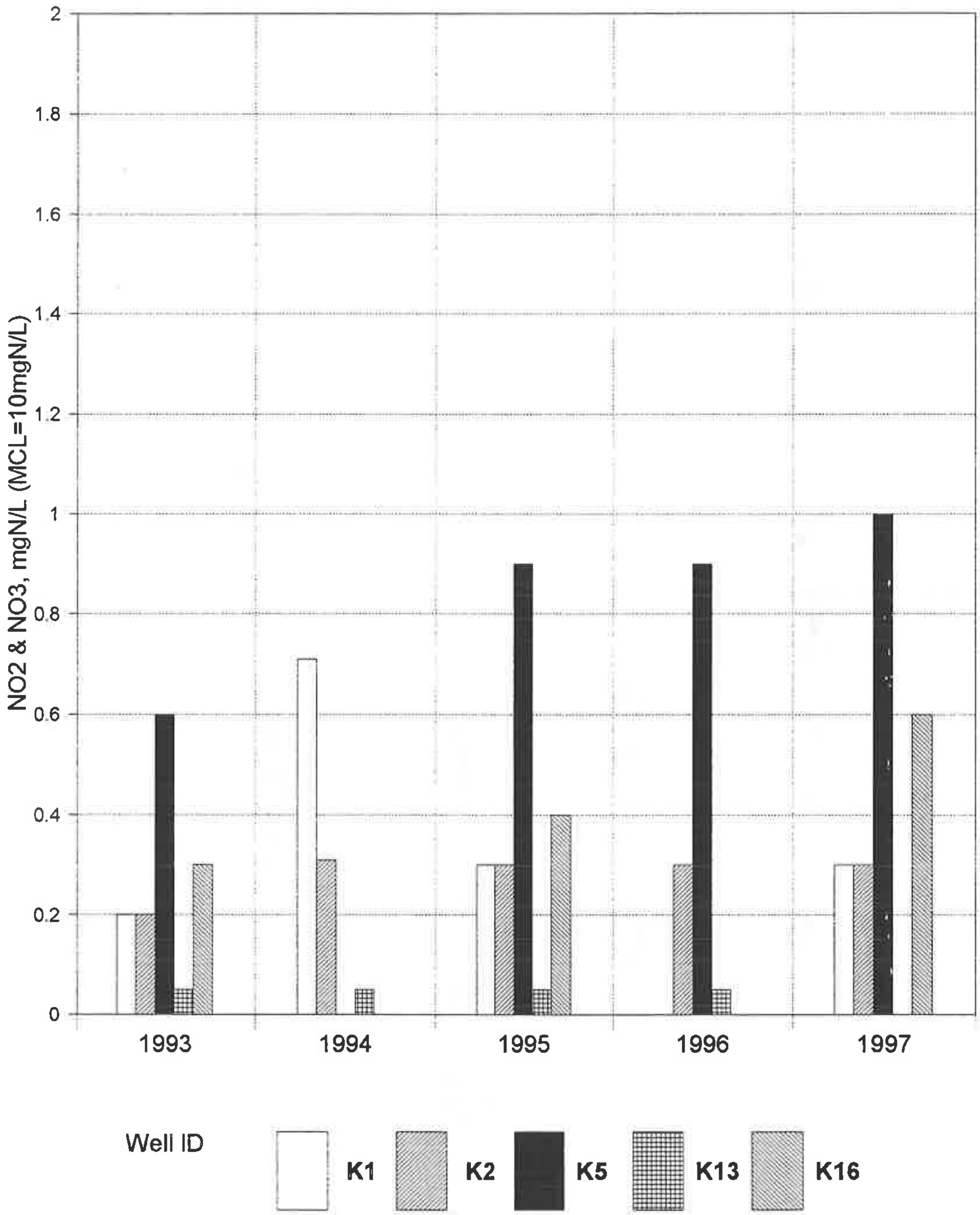
Aluminum concentrations exceeded the secondary MCL of 200 ppb in samples from three wells: GWN-K1 (2900 ppb), GWN-K9 (470 ppb), and GWN-K12 (390 ppb). Most samples contained low or undetectable levels of major alkali and alkaline earth metals (potassium, sodium, calcium, and magnesium). The exceptions consisted of samples from wells GWN-K3 and GWN-K8 (elevated calcium) and from wells GWN-K13 and K15 (elevated sodium). Water samples from various wells also had detectable levels of the following trace elements: copper, barium, strontium, zinc, yttrium, bromine (bromide), and fluorine (fluoride).

Water samples from six wells contained detectable levels of nitrite/nitrate, with the highest concentration, 1.0 ppm as nitrogen, occurring in a sample from well GWN-K5. Figure 3-4 shows trends in levels of nitrite/nitrate (reported as parts per million [ppm] nitrogen) for selected wells. All of the samples (except the one from well GWN-K1, which lacked a chloride analysis) contained detectable chloride; the majority of the samples also had measurable sulfate. In addition, municipal well GWN-K10 could not be sampled when scheduled, during 1997, as it had been taken out of service, reportedly due to high levels of tetrachloroethylene (PCE). The previous sample, collected in 1995, did not contain detectable PCE (detection limit equals the primary MCL, 5ppb). PCE is a volatile organic compound normally used as a solvent or dry cleaning fluid. Table A-3 in the Appendix lists the analytical results for samples collected from the Cretaceous aquifer system.



Iron levels below the detection limit are assigned a value of 5.1 ppb. A missing bar indicates that samples were not collected for that year.

Figure 3-3. - Iron Concentrations for Selected Wells in the Cretaceous Aquifer System.



Nitrate/nitrite levels below the detection limit are assigned a value of 0.05 ppm. A missing bar indicates that samples were not collected for that year.

Figure 3-4. - Nitrate/Nitrite Concentrations for Selected Wells in the Cretaceous Aquifer System

3.3 PROVIDENCE AQUIFER SYSTEM

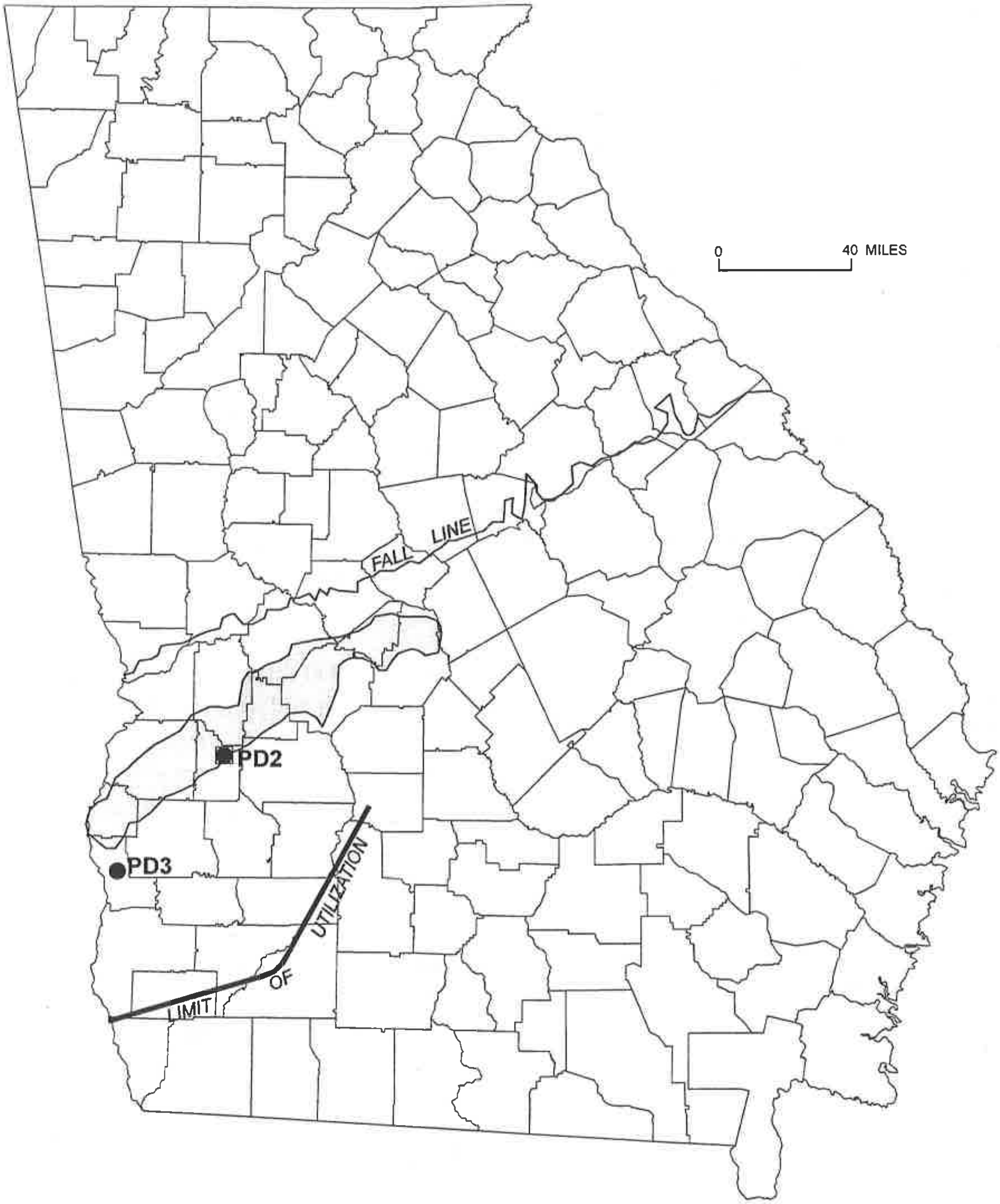
Sand and coquinoid limestones of the Late Cretaceous Providence Formation comprise the Providence aquifer system of southwestern Georgia. Outcrops of the aquifer system extend from northern Clay and Quitman Counties through eastern Houston County (Figure 3-5). At its up-dip extent, the aquifer system thickens both to the east and to the west of a broad area adjacent to the Flint River. The aquifer system also generally thickens downdip, with an area where the thickness exceeds 300 feet existing in Pulaski County and an area of similar thickness indicated in the Baker/Calhoun/Early county region (Clarke, et al., 1983). Figure 3-5 also shows the down-dip limit of the area in which the aquifer system is utilized.

The permeable Providence Formation-Clayton Formation interval forms a single aquifer in the up-dip areas (Long, 1989) and to the east of the Flint River (Clarke, et al., 1983). This same interval is recognized as the Dublin aquifer system to the east of the Ocmulgee River (Clarke, et al., 1985). Outcrop areas and adjacent covered areas to the east of the Flint River, where the aquifer is overlain by permeable sand units, are surface recharge areas. The Chattahoochee River forms the western discharge boundary for this flow system in Georgia.

EPD sampled two wells in the Providence aquifer system during 1996-1997 period (Figure 3-5). The sample waters were soft, with the recharge area well (GWN-PD2) yielding acidic water and the confined area well (GWN-PD3) yielding basic water. Iron exceeded the secondary MCL in one sample from well GWN-PD2, and, the sodium content of the sample from well GWN-PD3 was elevated. Table A-4 in the Appendix gives the analytical results.

3.4 CLAYTON AQUIFER SYSTEM

The Clayton aquifer system of southwestern Georgia is developed mainly in the middle limestone unit of the Paleocene Clayton Formation. Limestones and calcareous sands of the Clayton aquifer system crop out in a narrow belt extending from northeastern Clay County to southwestern Schley County (Figure 3-6). Aquifer thickness varies, ranging from 50 feet near outcrop areas to 265 feet in southeastern Mitchell County (Clarke, et al., 1984). Both the Flint River, to the east, and the Chattahoochee River, to the west, are areas of discharge for the aquifer system in its up-dip extent. Leakage from the underlying Providence aquifer system and from permeable units in the overlying Wilcox confining zone provides significant recharge in down-dip areas (Clarke, et al., 1984). The Clayton and Providence Formations merge to form a single aquifer unit in up-dip areas (Long, 1989) as well as east of the Flint River (Clarke, et al., 1983). West of the Flint River and down dip, the Clayton/Providence confining zone, a silt and clay-bearing interval, confines the aquifer below (McFadden and Perriello, 1983). In the area east of the Ocmulgee River, the combination of these two aquifers is referred to as the Dublin aquifer system (Clarke, et al., 1985). Figure 3-6 also shows the down-dip limit of the area in which the aquifer system is utilized.



General recharge area (from Davis, et al., 1988)

● Soft water

□ Iron exceeds MCL

Figure 3-5. - Water Quality for Two Wells in the Providence Aquifer System.

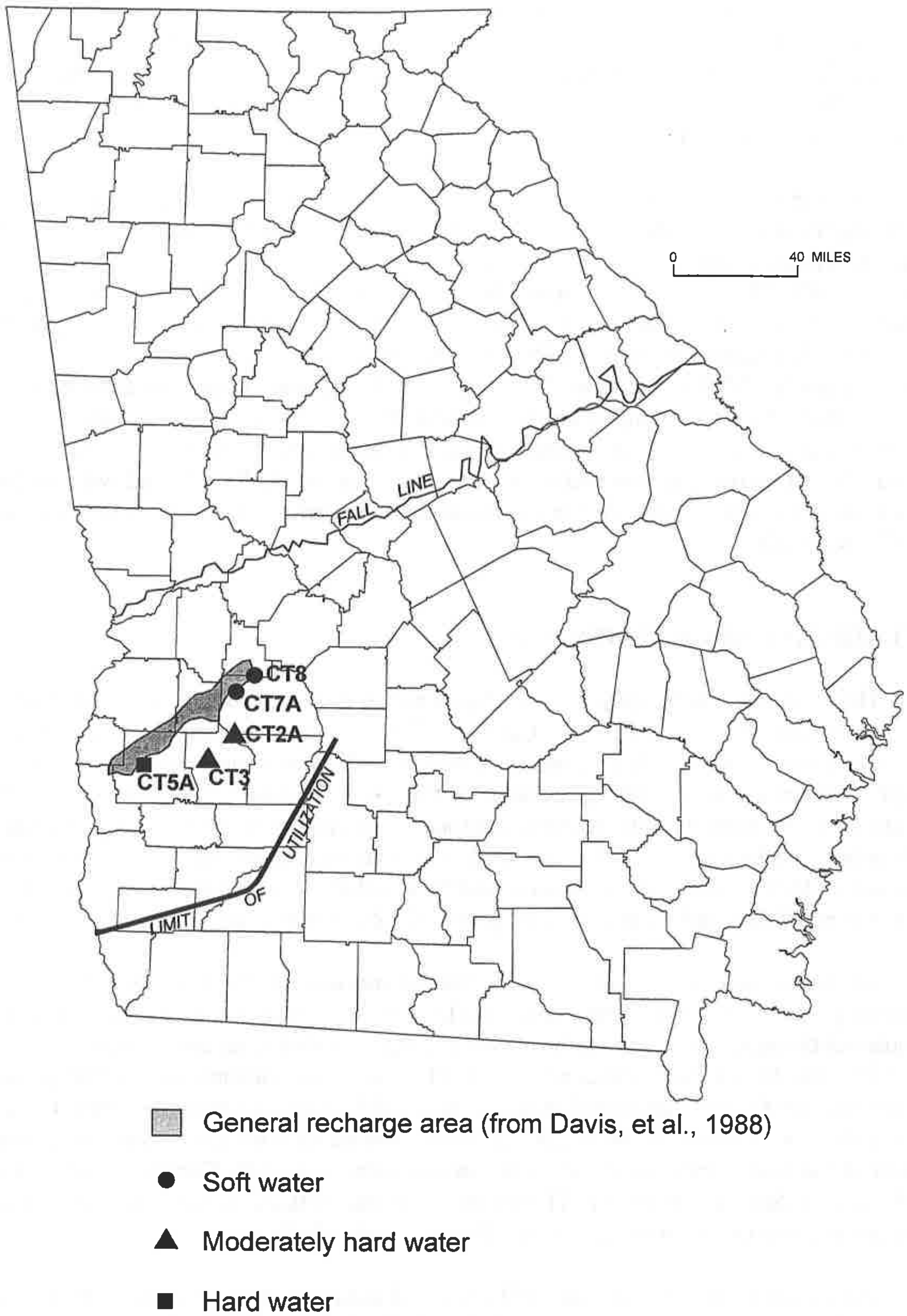


Figure 3-6. - Water Quality for Selected Wells in the Clayton Aquifer System.

During the 1996-1997 period, EPD used five wells to monitor the water quality in the Clayton aquifer system (Figure 3-6). Three wells (GWN-CT5A in , GWN-CT7A, GWN-CT8) are located in or near the recharge area, with the latter two wells being less than 100 feet deep. The other two wells (GWN-CT2A and GWN-CT3) were used to sample downdip portions of the aquifer system.

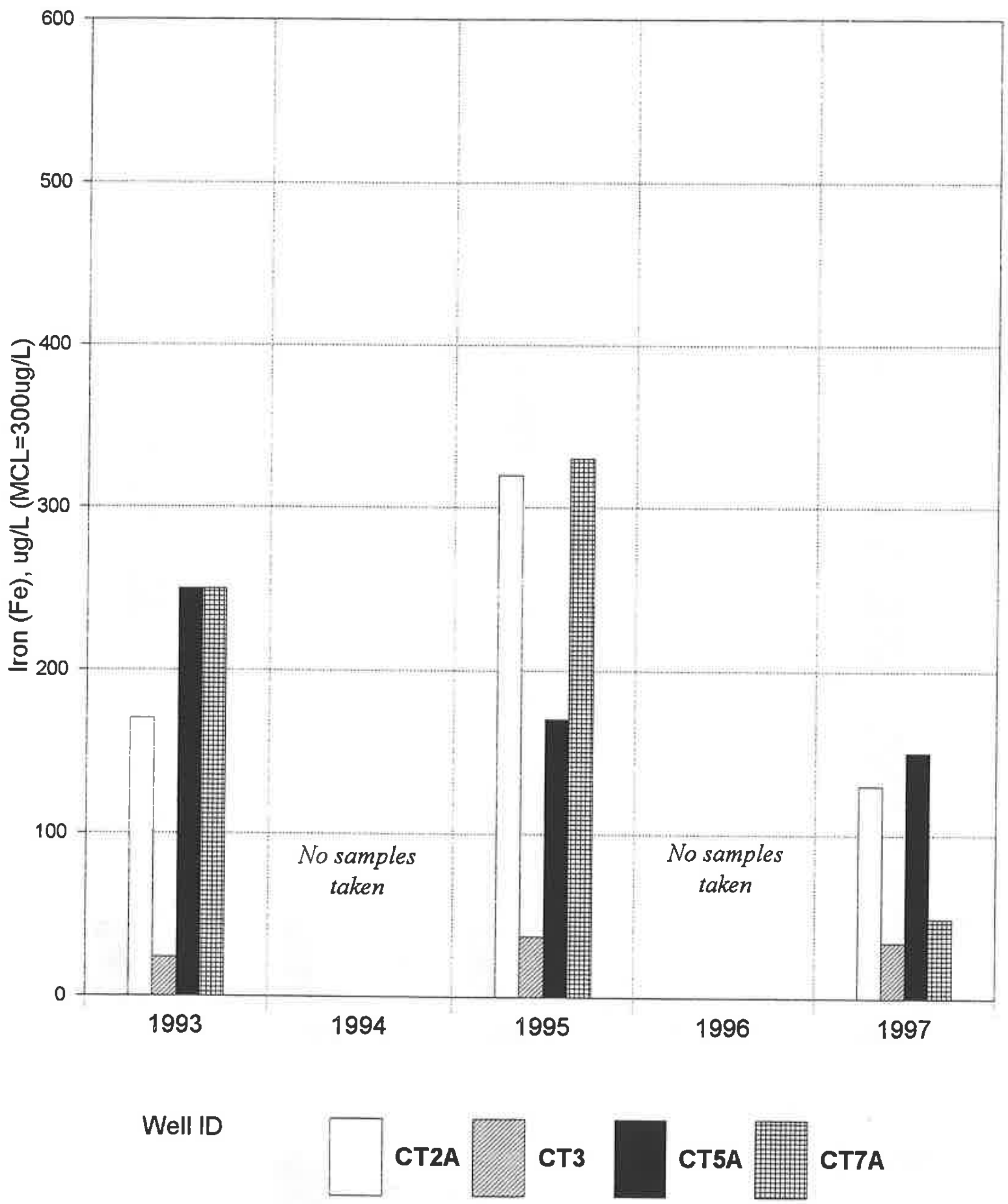
The hardness class of the samples ranged from soft to hard, and, the pH ranged from acidic to slightly basic. Samples from all wells contained sodium and chloride. Calcium and sulfate concentrations were lowest in the samples from the two shallow updip wells (GWN-CT7A and GWN-CT8). These same two wells contained detectable nitrate/nitrite, at 5.6 and 0.8 mgN/L, respectively. Iron concentrations fell below the secondary MCL of 300 ppb in all samples. The sample from well GWN-CT7A contained a concentration of aluminum above the secondary MCL of 200 ppb. The other elements detected in samples from various wells consisted of barium, magnesium, manganese, fluorine (fluoride) and strontium. No samples contained synthetic or volatile organic compounds. Figures 3-7 and 3-8, respectively, show trends in iron and nitrate/nitrite concentrations for selected wells in the Clayton aquifer system. Table A-5 in the Appendix lists analyses for water samples from these Clayton wells.

3.5 CLAIBORNE AQUIFER SYSTEM

The Claiborne aquifer system is developed primarily in the sandy units in the middle and lower portions of the Middle Eocene Claiborne Group of southwestern Georgia. (Figure 3-9). Claiborne Group sands crop out in a belt extending from northern Early County through western Dooly County. Recharge to the aquifer system occurs both as direct infiltration of precipitation in the recharge area and as leakage from the overlying Floridan aquifer system (Hicks, et al., 1981; Gorday, et al., 1997). Discharge boundaries of the aquifer system are the Ocmulgee River, to the east, and the Chattahoochee River, to the west. The aquifer is over 350 feet thick near its down-dip limit of utilization (Figure 3-9) (Tuohy, 1984).

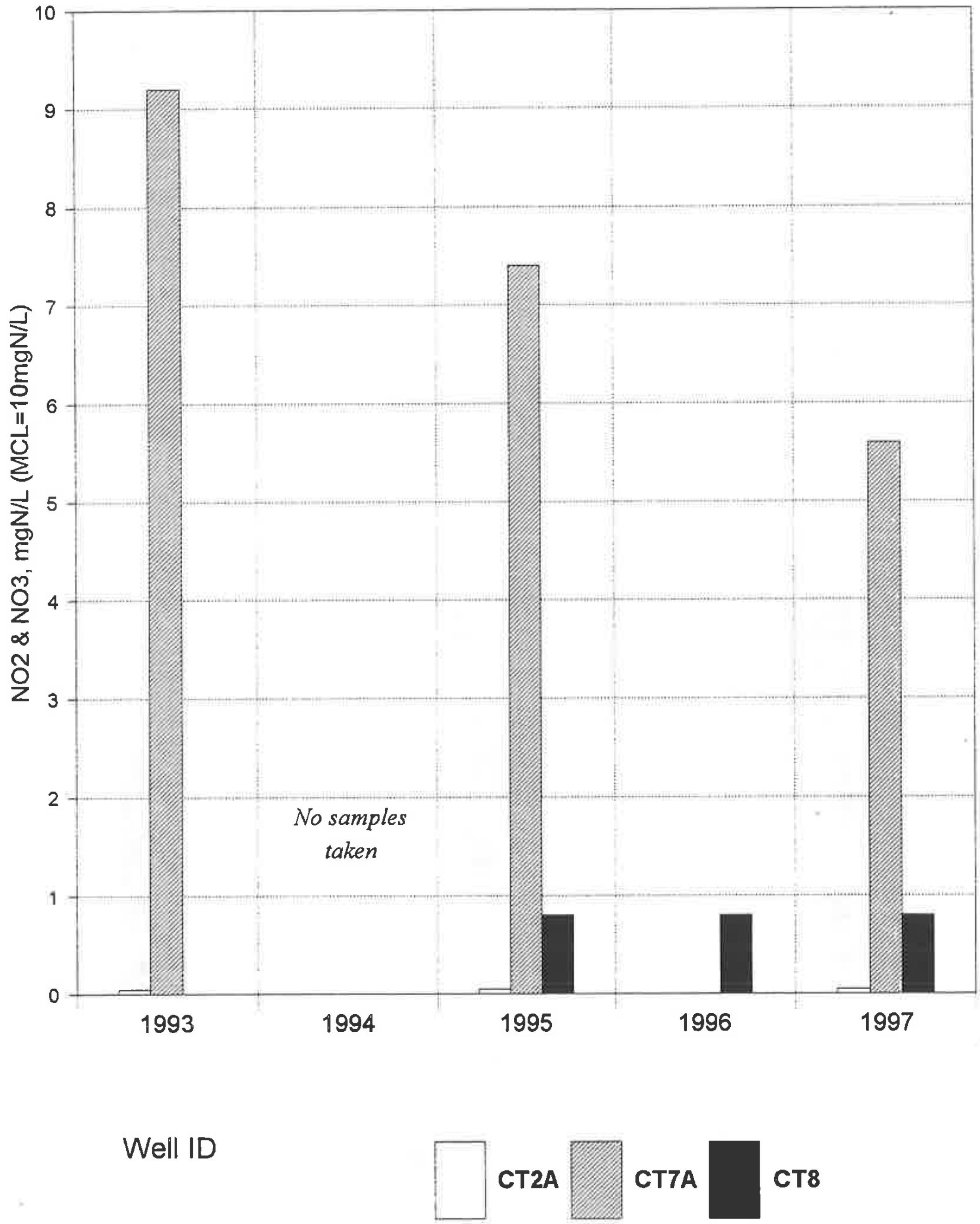
The aquifer generally thickens from the outcrop area towards the southeast. The clay-rich upper portion of the Claiborne Group, the Lisbon Formation, acts as a confining layer and separates the aquifer from the overlying Floridan aquifer (McFadden and Perriello, 1983; Long, 1989; Huddlestun and Summerour, 1995). The lower water-bearing parts of the group had been correlated to the Tallahatta Formation (e.g., McFadden and Perriello, 1983; Long, 1989; Clarke et al., 1996) or, more recently, have been divided into two formations, the upper one termed the Still Branch Sand and the lower one correlated to the Congaree Formation (Huddlestun and Summerour, 1995). The permeable lower units are included in the Gordon aquifer system east of the Ocmulgee River (Brooks, et al., 1985)

During the 1996-1997 period, EPD personnel used five wells to monitor the water quality of the Claiborne aquifer system. Wells GWN-CL4 and GWN-CL8 are relatively



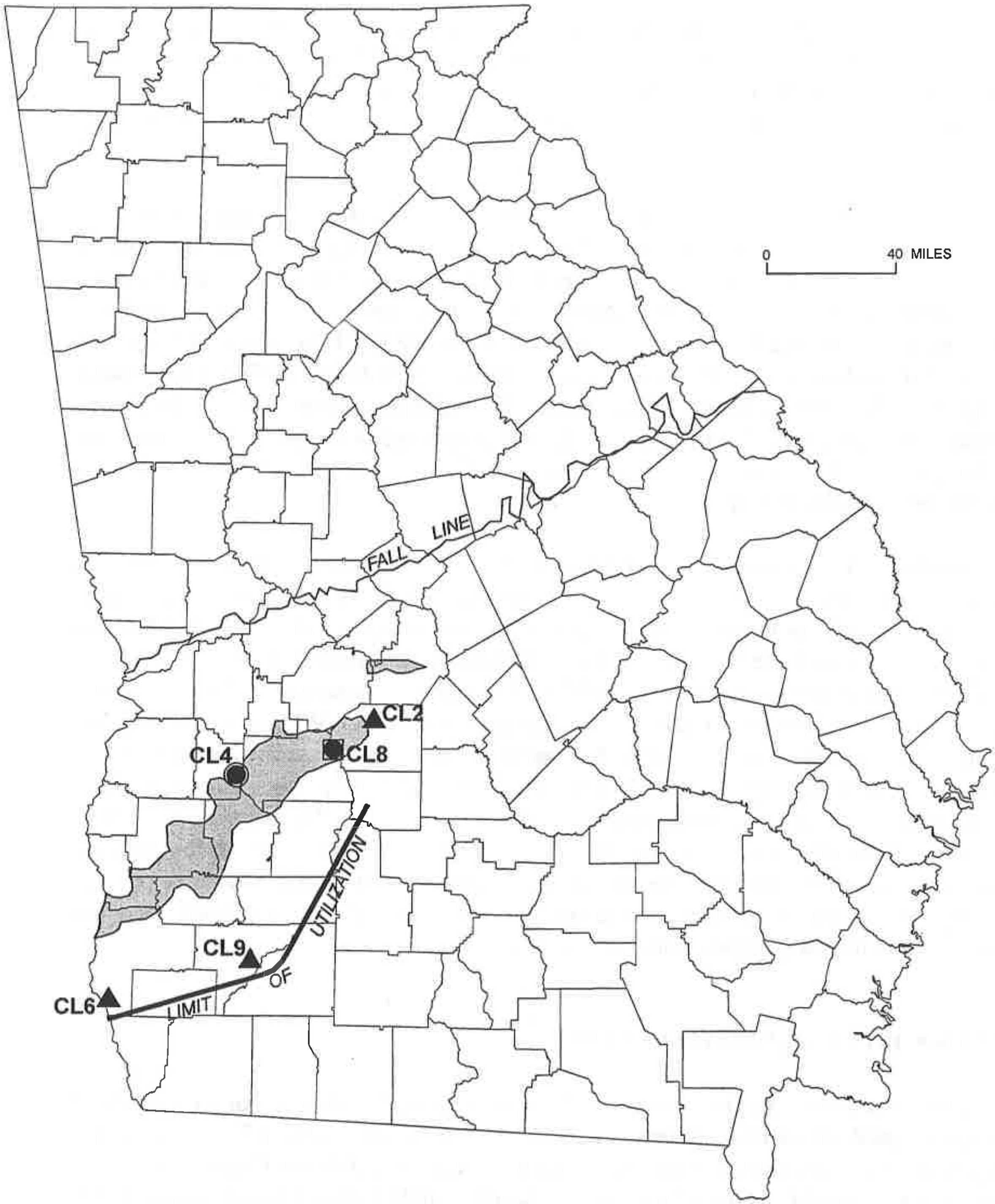
Iron levels below the detection limit are assigned a value of 5.1 ppb. A missing bar indicates that samples were not collected for that year.

Figure 3-7. - Iron Concentrations for Selected Wells in the Clayton Aquifer System.



Nitrate/nitrite levels below the detection limit are assigned a value of 0.05 ppm. A missing bar indicates that samples were not collected for that year.

Figure 3-8. - Nitrate/Nitrite Concentrations for Selected Wells in the Clayton Aquifer System.



General recharge area (from Davis, et al., 1988)
Soft water
Moderately hard water
Manganese exceeds MCL
Iron exceeds MCL

Figure 3-9. - Water Quality of Selected Wells in the Claiborne Aquifer System.

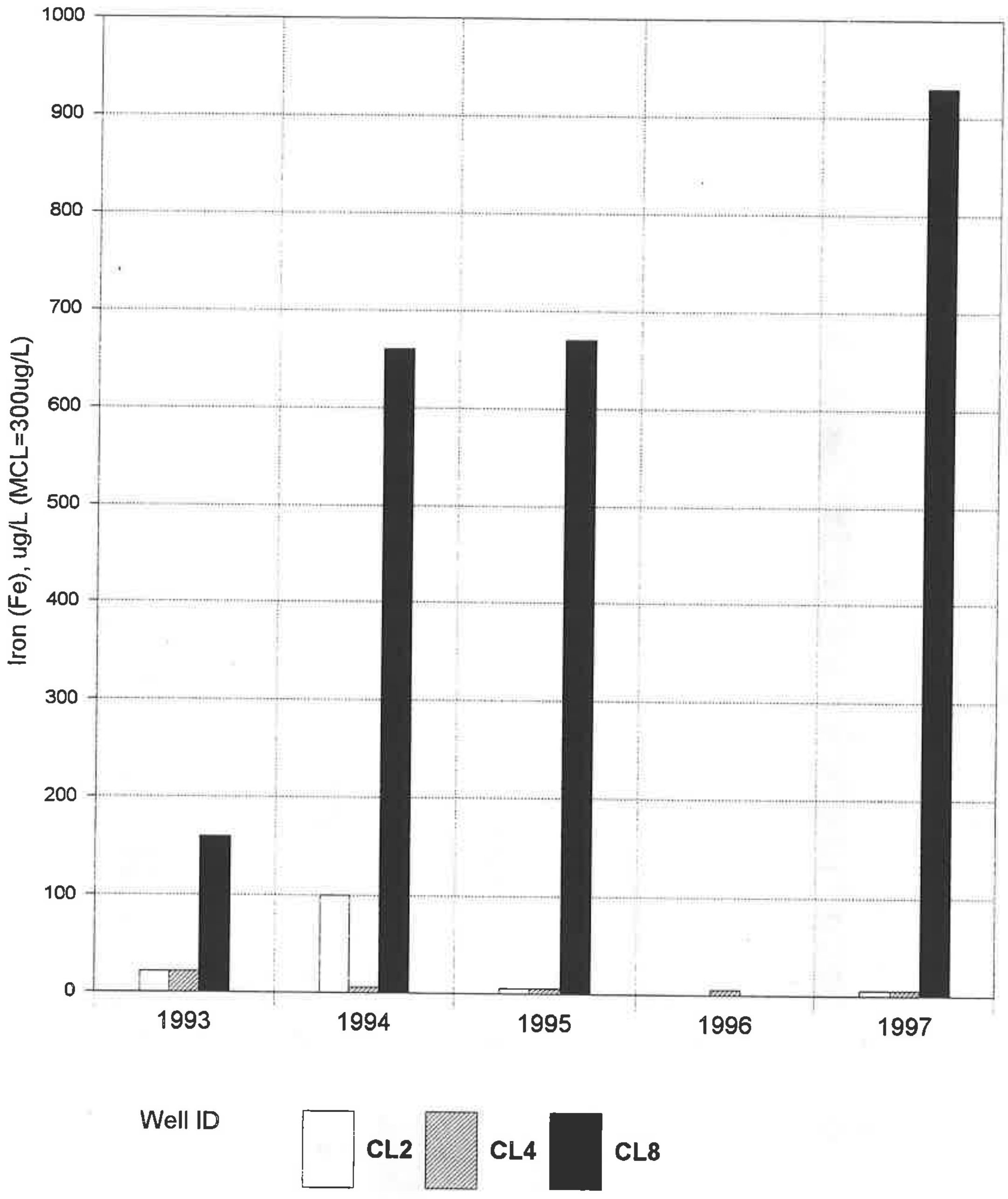
shallow (about 90 feet deep) and are located in the recharge area. Well GWN-CL2 is located near the recharge area and is deeper (315 feet). Wells GWN-CL6 and GWN-CL9 are deep and draw from down-dip portions of the aquifer, near the limit of utilization. The two recharge area wells yielded soft, acidic water, while the other wells yielded moderately hard, basic water.

Manganese levels in samples from well GWN-CL4 and iron in a sample from well GWN-CL8 exceeded the secondary MCL's for these elements (50 ppb for Mn, 300 ppb for Fe). A sample from well GWN-CL6 contained beryllium in excess of the 4 ppb primary MCL, however, the element went undetected in a follow-up sample. No detectable beryllium has been found in samples from previous years. The sample from the near down-dip well GWN-CL2 had the highest calcium concentration. The far down-dip well GWN-CL9 yielded the sample with the highest sodium concentration. The calcium concentrations in the down-dip samples are consistent with ground waters derived from limestone. Other metals detected included barium, strontium, zinc, and yttrium. Figure 3-10 shows trends in iron concentrations for selected wells.

Samples from two wells (GWN-CL2 and GWN-CL4) contained detectable levels of nitrite/nitrate, with the sample from GWN-CL4 having the highest concentration (3.5 ppm as N). Figure 3-11 shows nitrite/nitrate concentrations for selected wells. Samples from all wells contained measurable chloride, with a maximum of 12.5 ppm in a sample from well GWN-CL9. Samples from all wells except GWN-CL4 contained detectable sulfate. Fluoride was present in samples from two wells. The 1997 sample from well GWN-CL4 contained the following volatile organic chemicals: benzene, methyl tert-butyl ether, methyl tert-amyl ether, cyclopentane, methylcyclopentane, o-xylene, naphthalene, 2-propylbenzene, and 1,2,4-trimethyl benzene. All of these compounds derive from motor fuels. The benzene level, 59.3 ppb, exceeded the primary maximum contaminant level of 5 ppb. Although, in the past, the well has yielded samples containing motor fuel components, no synthetic or volatile organic compounds were detected in the 1996 sampling. Table A-6 in the Appendix gives the analytical results for the samples from Claiborne wells.

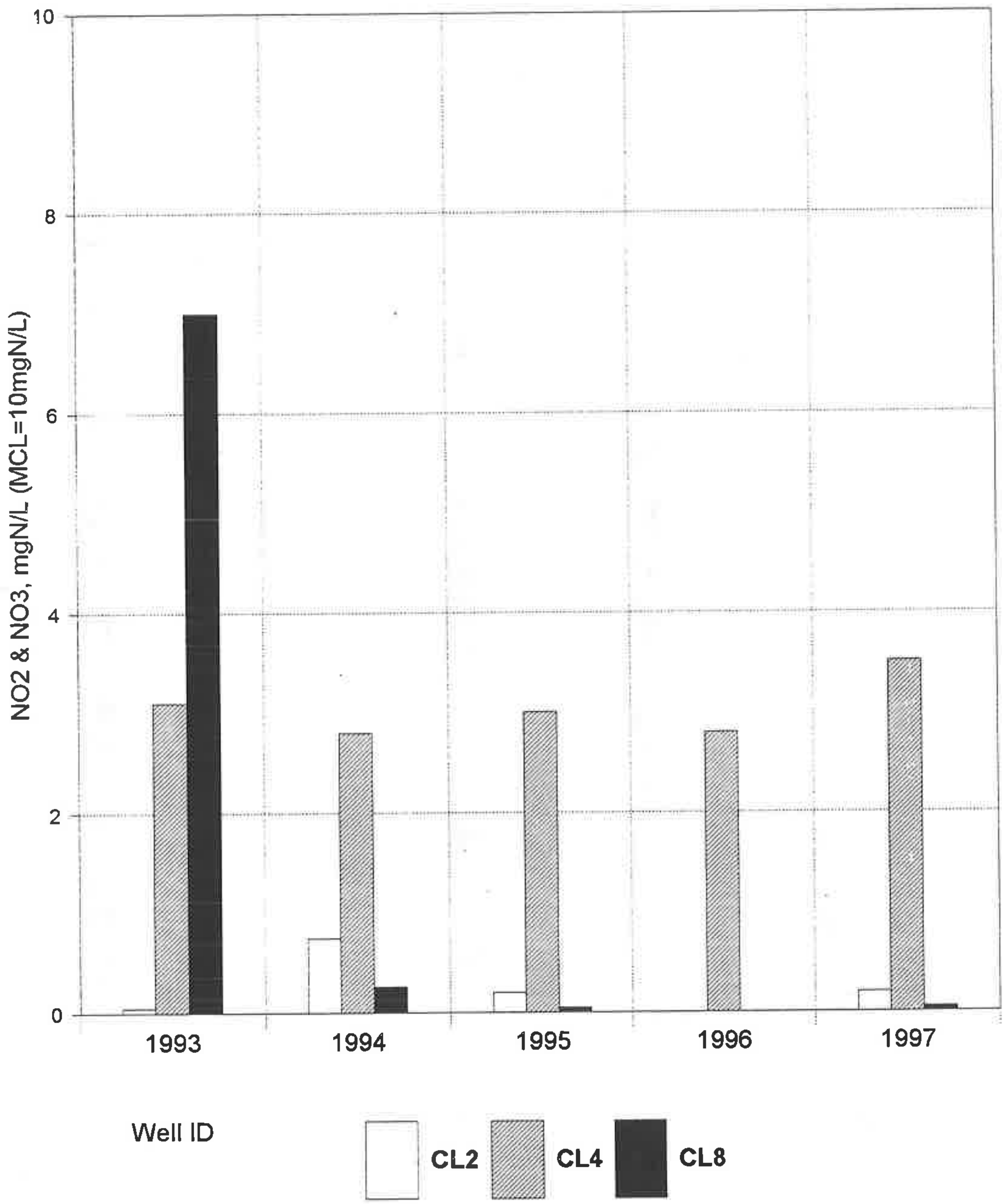
3.6 JACKSONIAN AQUIFER SYSTEM

The Jacksonian aquifer system of central and east-central Georgia comprises predominantly sands of the Eocene Barnwell Group, though, locally, isolated limestone bodies are important. Barnwell Group outcrops extend from Macon and Peach Counties eastward to Burke and Richmond Counties (Figure 3-12). Aquifer sands form a northern clastic facies of the Barnwell Group; the sands grade southward into less permeable silts and clays of a transition facies (Vincent, 1982). The water-bearing sands are relatively thin, ranging from ten to fifty feet in thickness. Limestones equivalent to the Barnwell Group form a southern carbonate facies and are included in the Floridan aquifer system. The Savannah River and Ocmulgee River are eastern and western discharge boundaries respectively for the up-dip flow system of the Jacksonian aquifer system.



Iron levels below the detection limit are assigned a value of 5.1 ppb. A missing bar indicates that samples were not collected for that year.

Figure 3-10. - Iron Concentrations for Selected Wells in the Claiborne Aquifer System.



Nitrate/nitrite levels below the detection limit are assigned a value of 0.05 ppm. A missing bar indicates that samples were not collected for that year.

Figure 3-11. - Nitrate/Nitrite Concentrations for Selected Wells in the Claiborne Aquifer System.

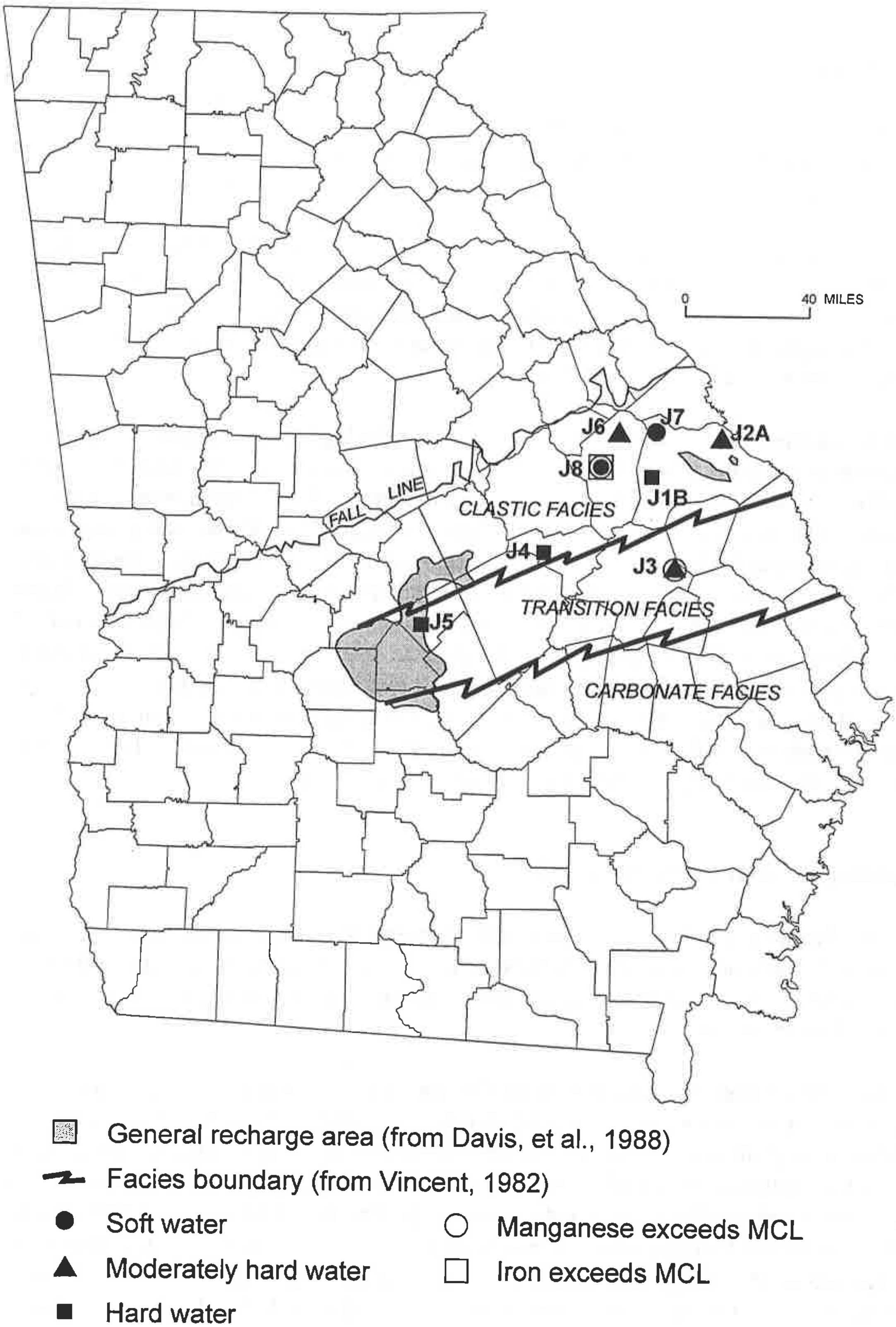


Figure 3-12. - Water Quality of Selected Wells in the Jacksonian Aquifer System.

EPD monitored the water quality of eight wells tapping the Jacksonian aquifer system in 1996-1997. Six wells are in the clastic facies (one, GWN-J2A, drawing from an isolated limestone body), and, two wells are in the transition facies. The pH of the water samples ranged from 4.44 to 7.80. Water hardness ranged from soft (up-dip wells GWN-J7 and GWN-J8) to hard.

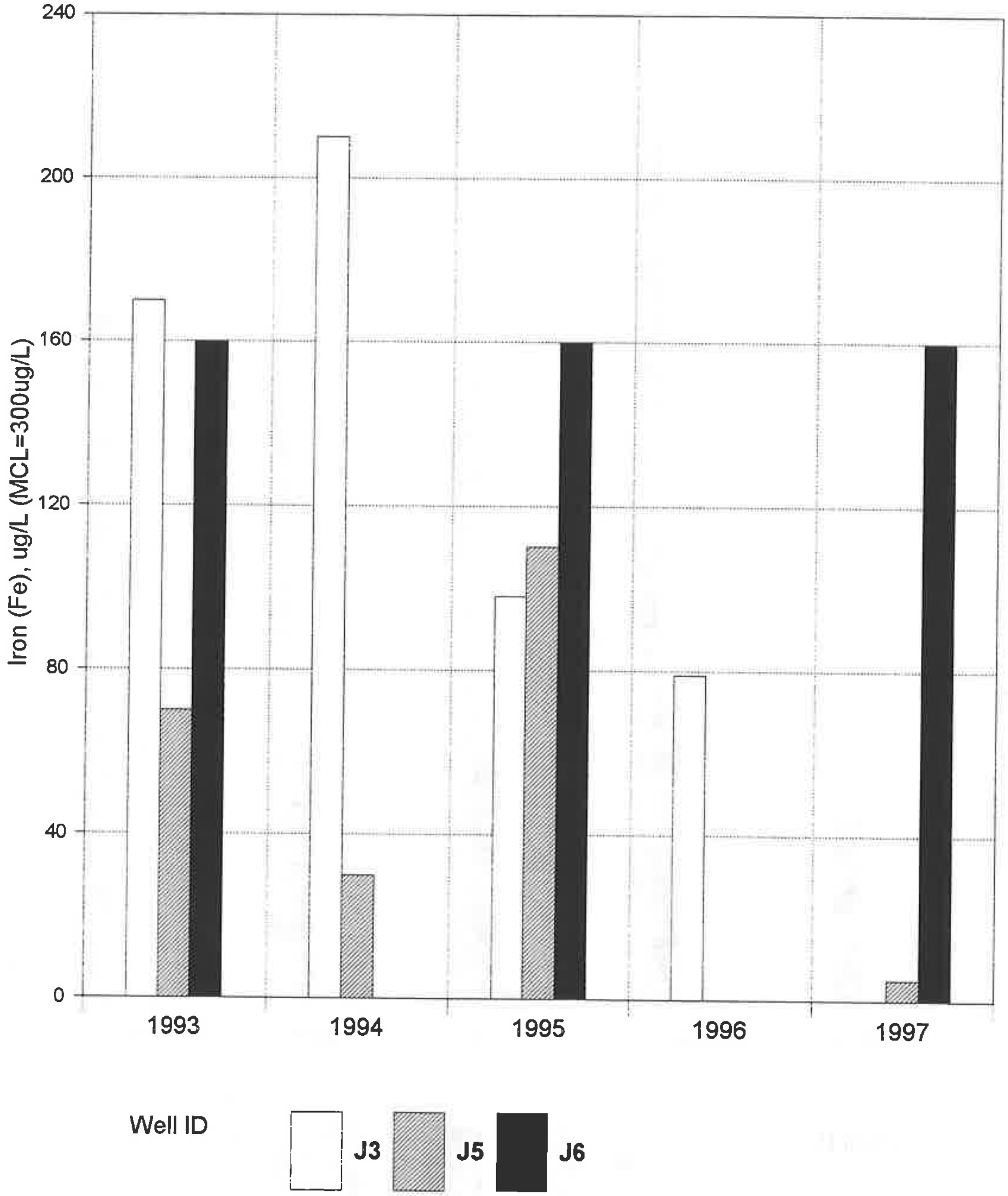
Concentrations of aluminum were equal to or below the secondary MCL for drinking water in samples from all wells. Iron exceeded the secondary MCL in a sample from well GWN-J8 (1300 ppb), and, manganese exceeded the secondary MCL in wells GWN-J3 and GWN-J8 (130 ppb and 79 ppb, respectively). Beryllium exceeded the primary MCL of 4 ppb in a sample from a domestic well, GWN-J8.

The samples tested generally low in sodium, with the highest concentration occurring in a sample from the transition well GWN-J3. Calcium concentrations ranged from 32 ppm to 65 ppm in samples from five of the wells but was detected below 15 ppm in samples from the up-dip wells GWN-J7 and GWN-J8. Samples from five of the wells contained magnesium, with the highest level of 5.7 ppm occurring in the sample from transition well GWN-J3. Other detected metals included barium, strontium, zinc, and cadmium. Higher nitrite/nitrate concentrations occurred in samples from the up-dip wells. Chloride occurred in samples from all wells and ranged from 1.9 ppm to 9.4 ppm. Sulfate was detected in samples from three wells and fluoride in samples from two wells, all down dip. None of the samples contained any detectable synthetic or volatile organic chemicals. Figures 3-13 and 3-14 depict trends in iron and nitrite/nitrate concentrations for selected wells. Table A-7 in the Appendix lists the analytical results for all the wells sampled.

3.7 FLORIDAN AQUIFER SYSTEM

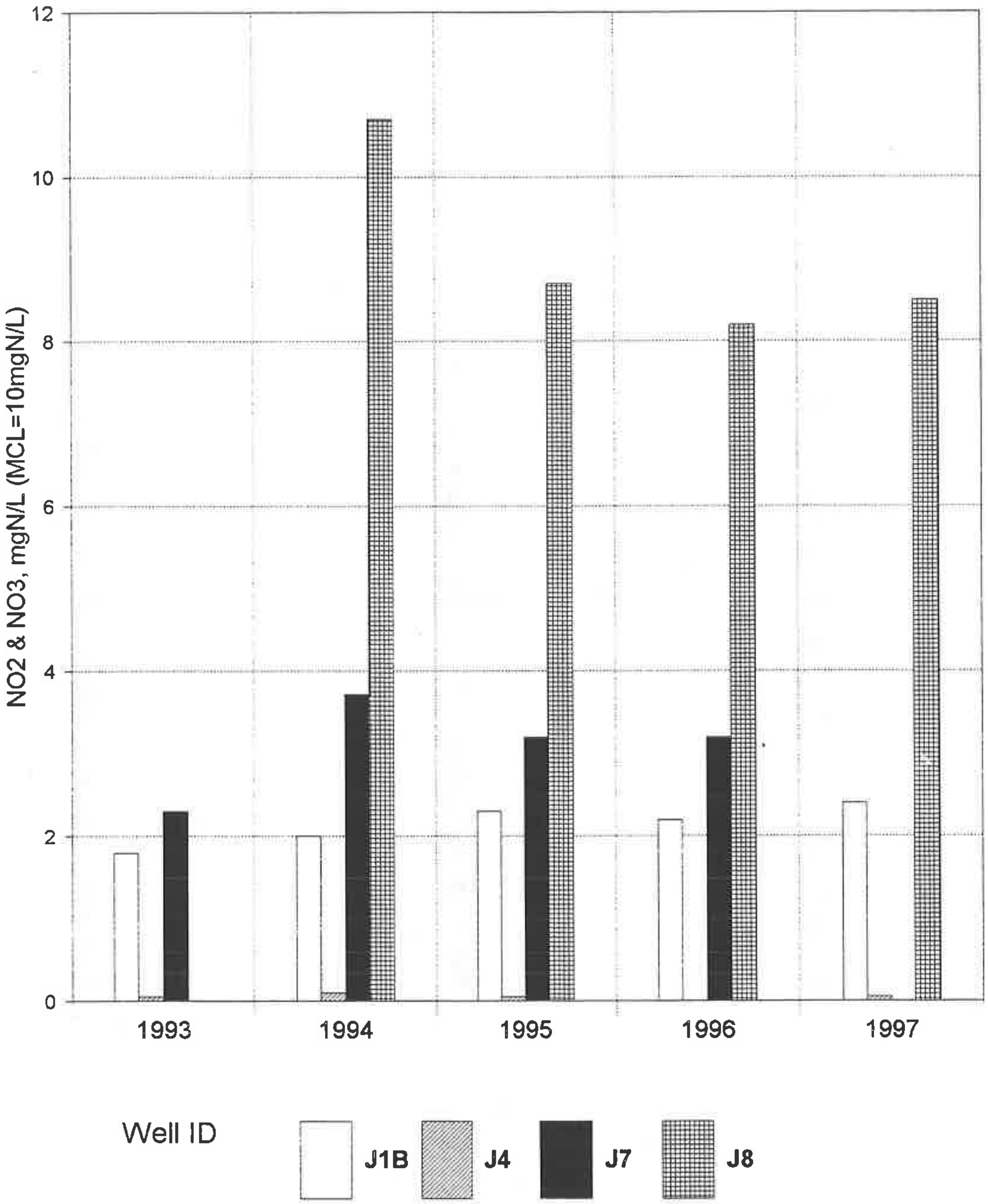
The Floridan aquifer system consists predominantly of Eocene and Oligocene limestones and dolostones that underlie most of the Coastal Plain Province. The aquifer is a major source of ground water for much of its outcrop area and throughout its down-dip extent to the south and east.

The upper water-bearing units of the Floridan are the Eocene Ocala Group and the Oligocene Suwanee Limestone (Crews and Huddlestun, 1984). These limestones crop out in the Dougherty Plain (a karstic area in southwestern Georgia) and in adjacent areas along a strike to the northeast. In Camden and Wayne counties the Oligocene unit is absent, and the upper part of the Floridan is restricted to units of Eocene age (Clarke, et al., 1990). The lower portion of the Floridan consists mainly of dolomitic limestone of middle and early Eocene age and pelletal, vuggy, dolomitic limestone of Paleocene age but extends into the late Cretaceous in Glynn County. The lower Floridan is deeply buried and not widely used, except in several municipal and industrial wells in the Savannah area (Clarke, et al., 1990). From its up-dip limit, defined in the east by clays of the Barnwell Group, the aquifer thickens to well over 700 feet in coastal Georgia. A dense limestone facies along the trend of the Gulf Trough locally limits ground-water quality and availability (Kellam and Gorday, 1990). The



Iron levels below the detection limit are assigned a value of 5.1 ppb. A missing bar indicates that samples were not collected for that year.

Figure 3-13. - Iron Concentrations for Selected Wells in the Jacksonian Aquifer System.



Nitrate/nitrite levels below the detection limit are assigned a value of 0.05 ppm. A missing bar indicates that samples were not collected for that year.

Figure 3-14. - Nitrate/Nitrite Concentrations for Selected Wells in the Jacksonian Aquifer System.

Gulf Trough is a linear depositional feature in the Coastal Plain that extends from southwestern Decatur County through central Bulloch County.

A ground-water divide separates a smaller southwestwardly flow regime in the Floridan aquifer system in the Dougherty Plain from the larger southeastwardly flow regime in the remainder of Georgia. Rainfall infiltration in outcrop areas and downward leakage from extensive surficial residuum recharge the Dougherty Plain flow system (Hayes, et al., 1983). The main body of the Floridan aquifer system, to the east, is recharged by leakage from the Jacksonian aquifer system and by rainfall infiltration in outcrop areas and in areas where overlying strata are thin. Significant recharge also occurs in the area of Brooks, Echols and Lowndes counties, where the Withlacoochee River and numerous sinkholes breach upper confining beds (Krause, 1979).

During the 1996-1997 period, EPD collected 69 samples from 49 wells in the Floridan aquifer system (Figure 3-15). The pH levels in all tested samples were basic, and, water hardness ranged from moderately hard to very hard. Iron and aluminum concentrations were below the secondary MCL in all samples. Trends in iron levels from selected wells in the Floridan aquifer are shown on Figure 3-16. Most wells yielding water with detectable manganese fall within the Gulf Trough area (wells GWN-PA16, GWN-PA18, GWN-PA19, GWN-PA29, GWN-PA32, GWN-PA33A, GWN-PA34, GWN-PA35, and GWN-PA36). The manganese concentration in samples from wells GWN-PA18 and GWN-PA34 exceeded the secondary MCL of 50 ppb.

Sodium concentrations ranged from 1.6 ppm to 74 ppm, and, magnesium ranged from undetected to 42 ppm. Both elements are most abundant in samples from wells in the coastal area, with the highest concentrations of these elements occurring in a sample from well GWN-PA10B. Calcium ranged from 22 ppm in a sample from well GWN-PA1 to 73 ppm in well GWN-PA10B. Other metals detected in measurable concentrations included barium, molybdenum, strontium, copper, and zinc. None of these substances exceeded applicable MCL's.

All water samples underwent tests for the anions: chloride, sulfate, fluoride, nitrate/nitrite, and, beginning in January of 1997, bromide. Chloride occurred in all samples and ranged from 1.89 ppm (well GWN-PA33A) to 135 ppm (well GWN-PA10B). Sulfate ranged from undetected to 185 ppm (well GWN-PA10B). The concentrations of fluoride ranged from undetected to 0.757 ppm. A non-quantifiable trace of linuron was found in a sample from well GWN-PA51, however, follow-up testing and follow-up sampling failed to confirm the presence of the compound. No synthetic or volatile organic chemicals were found in other Floridan samples.

Most of the samples collected from the confined portions of the Floridan aquifer contained no detectable nitrite/nitrate, whereas, most samples in the unconfined portion contained detectable concentrations of nitrite/nitrate. The highest level, 4.7 ppm as nitrogen, was in a sample from well GWN-PA53 in the Dougherty Plain. Figure 3-17 presents trends

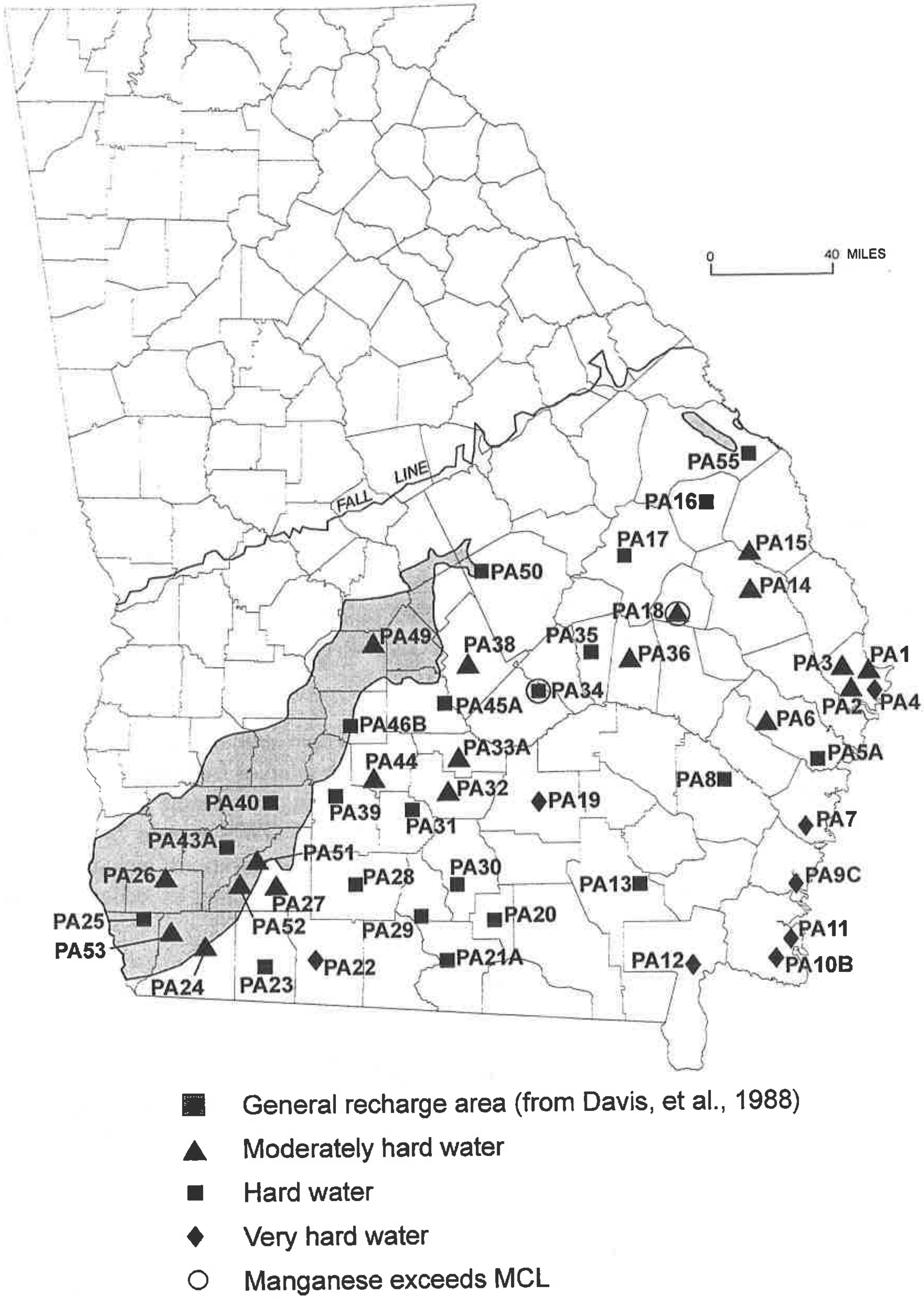
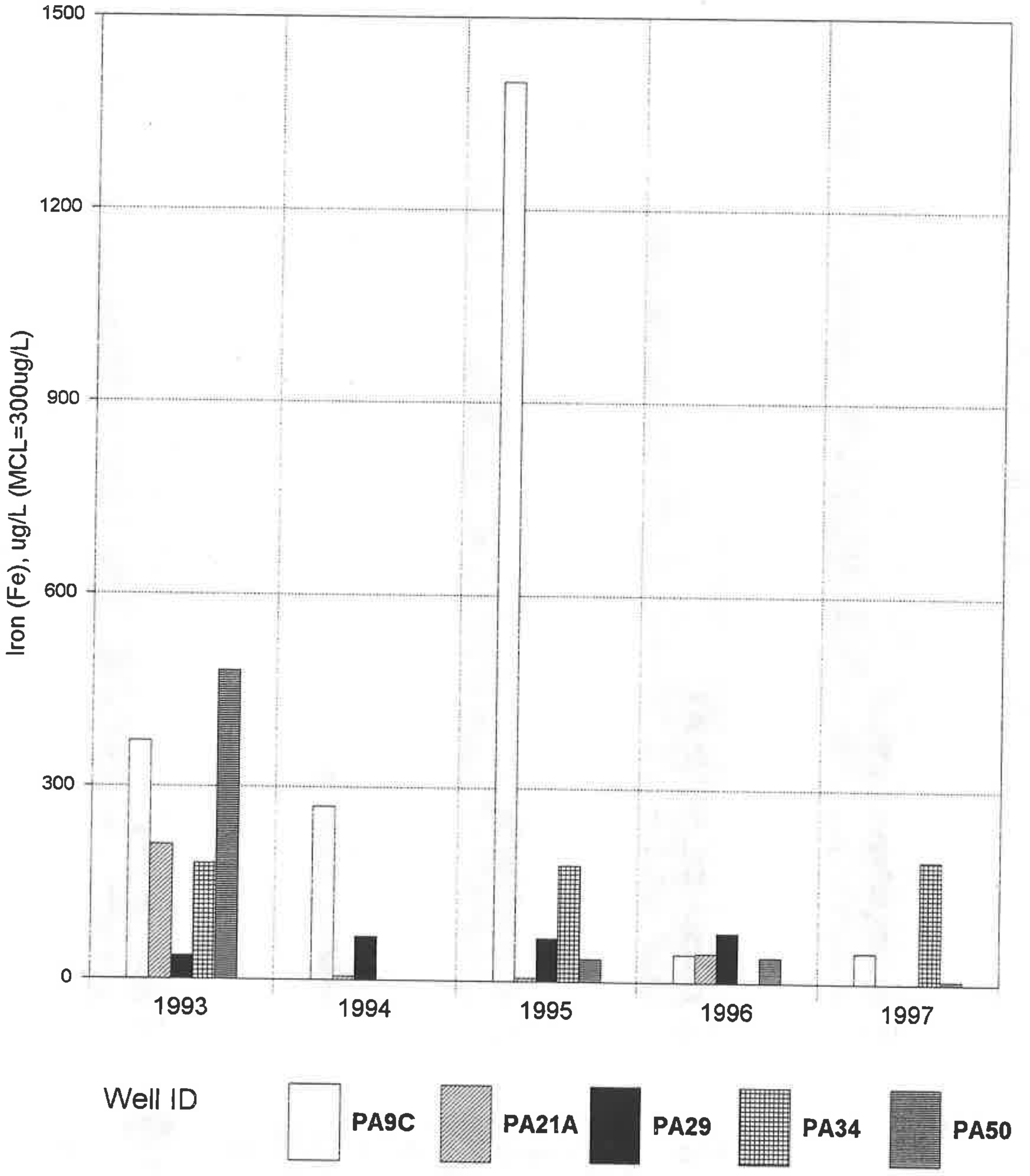
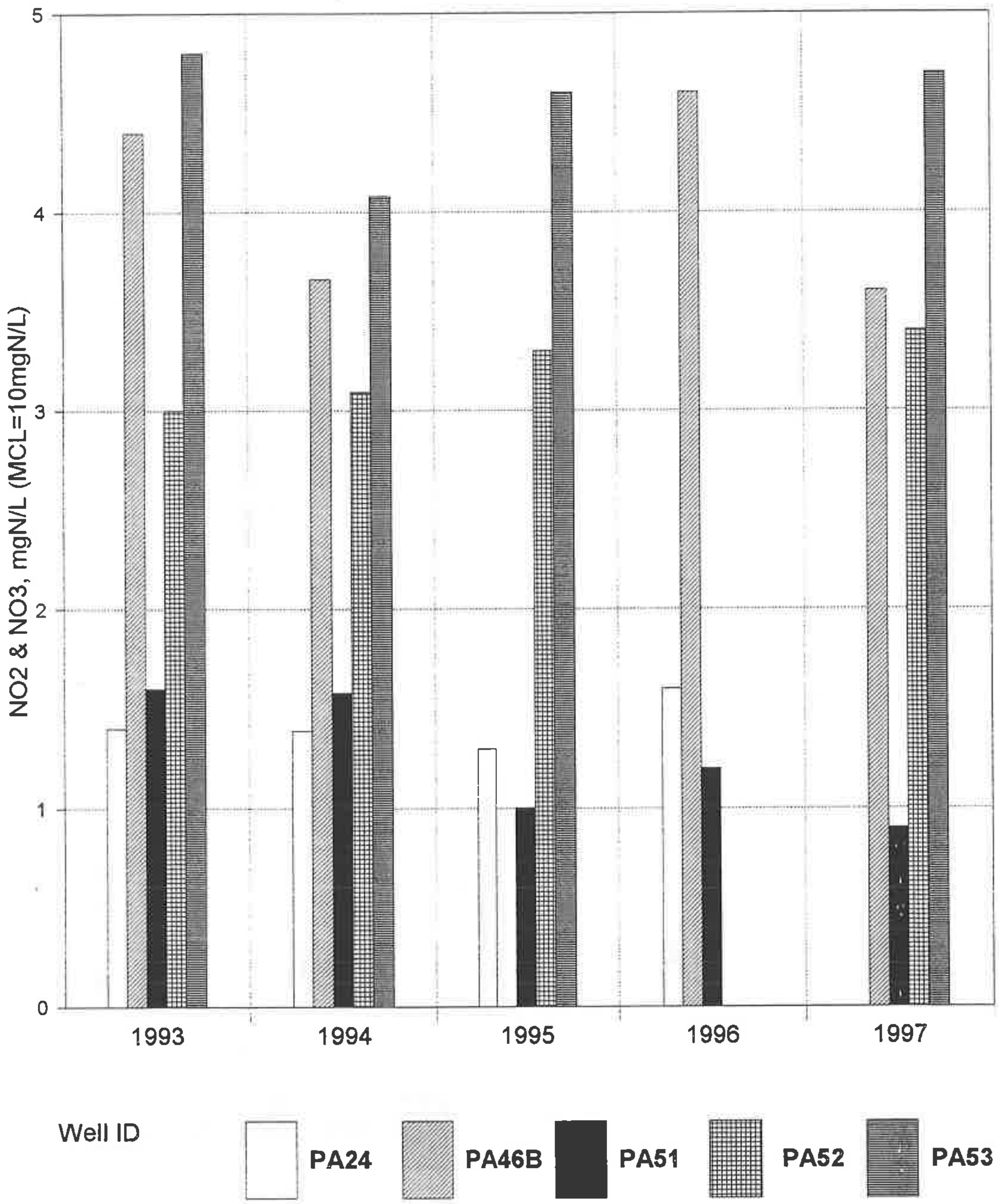


Figure 3-15. - Water Quality of Selected Wells in the Floridan Aquifer System.



Iron levels below the detection limit are assigned a value of 5.1 ppb. A missing bar indicates that samples were not collected for that year.

Figure 3-16. - Iron Concentrations for Selected Wells in the Floridan Aquifer System.



Nitrate/nitrite levels below the detection limit are assigned a value of 0.05 ppm. A missing bar indicates that samples were not available for that year.

Figure 3-17. - Nitrate/Nitrite Concentrations for Selected Wells in the Floridan Aquifer System.

in nitrate levels from selected wells in the Floridan Aquifer. The Appendix (Table A-8) gives the analytical results for samples from the Floridan aquifer system.

3.8 MIOCENE AQUIFER SYSTEM

Much of south-central and southeastern Georgia lies within outcrop areas of the Miocene Altamaha Formation and Hawthorne Group. Discontinuous lens-shaped bodies of sand, 50 to 80 feet thick, are the main permeable units. Miocene clays and sandy clays are thickest, more than 500 feet, in Wayne County (Watson, 1982).

Areas of confinement exist in the coastal counties. Leakage from overlying surface aquifers into the Miocene aquifer system and, in some areas, from the underlying Floridan aquifer system is significant in the coastal counties (Watson, 1982). Here, two principal aquifer units are present (Joiner, et al., 1988). Clarke (et. al, 1990) use the names upper and lower Brunswick aquifers to refer to these two sandy aquifer units.

EPD collected water samples from eight wells to monitor the water quality in the Miocene aquifer system (Figure 3-18). The pH of the samples ranged from 4.33 to 8.23 and hardness from soft to moderately hard. Iron and manganese levels ranged from undetected to 530 ppb and 140 ppb, respectively. The water sample from one well, GWN-MI9A, contained iron in excess of the secondary MCL (300 ppb). Water samples from two wells, GWN-MI5 and GWN-MI10B, exceeded the secondary MCL (50 ppb) for manganese. Figure 3-19 shows trends in iron concentrations in selected wells. Four wells yielded samples containing aluminum in excess of the secondary MCL: GWN-MI7 (570 ppb), GWN-MI8A (940 ppb), GWN-MI9A (1600 ppb), and GWN-MI15 (260 ppb). Sodium ranged from 2.3 ppm to 7.3 ppm , and, calcium ranged from 2.9 ppm to 23 ppm. Other metals detected were magnesium, barium, strontium, zinc, and titanium.

Chloride concentrations ranged from 2.6 ppm to 13.4 ppm and sulfate from undetected to 4.58 ppm. The deeper domestic wells (GWN-MI1, GWN-MI2, and GWN-MI10B) yielded samples with the lowest chloride concentrations. Samples from four wells contained detectable concentrations of fluoride. Detectable levels of nitrite/nitrate, ranging from 5.2 ppm to 15.3 ppm, occurred in samples from five wells (GWN-MI5, GWN-MI7, GWN-MI8A, GWN-MI9A, and GWN-MI15). Nitrate/nitrite concentrations in wells GWN-MI8A, GWN-MI9A, and GWN-MI15 exceeded the primary MCL (10 ppm as N). Concentrations of nitrate/nitrite for selected wells are illustrated in Figure 3-20. No samples contained detectable volatile or synthetic organic chemicals. Table A-9 in the Appendix gives analytical data for samples drawn from Miocene aquifer system wells.

3.9 PIEDMONT/BLUE RIDGE UNCONFINED AQUIFERS

Georgia's Piedmont and Blue Ridge Physiographic Provinces are developed on metamorphic and igneous rocks that are predominantly Precambrian and Paleozoic in age.

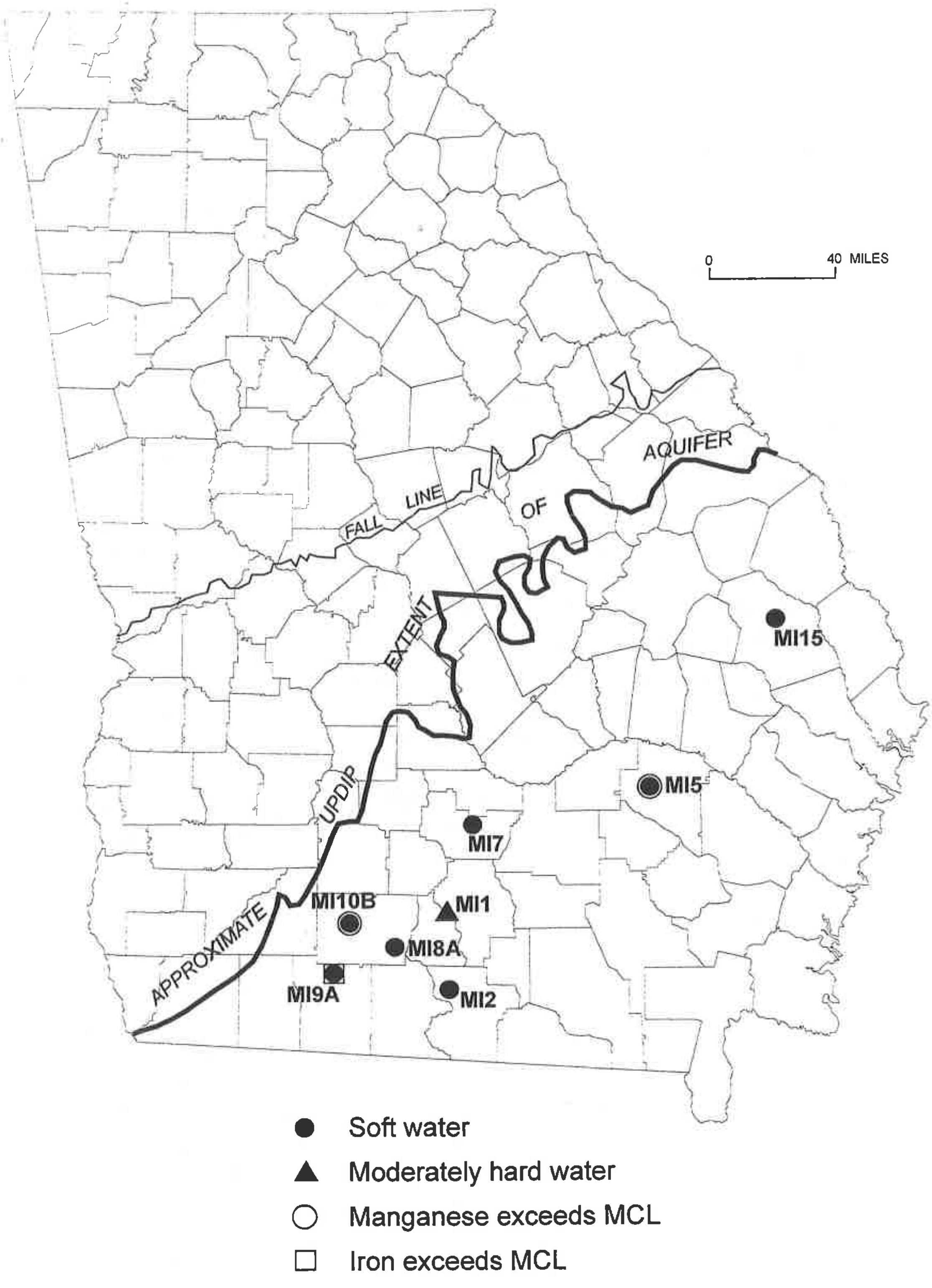
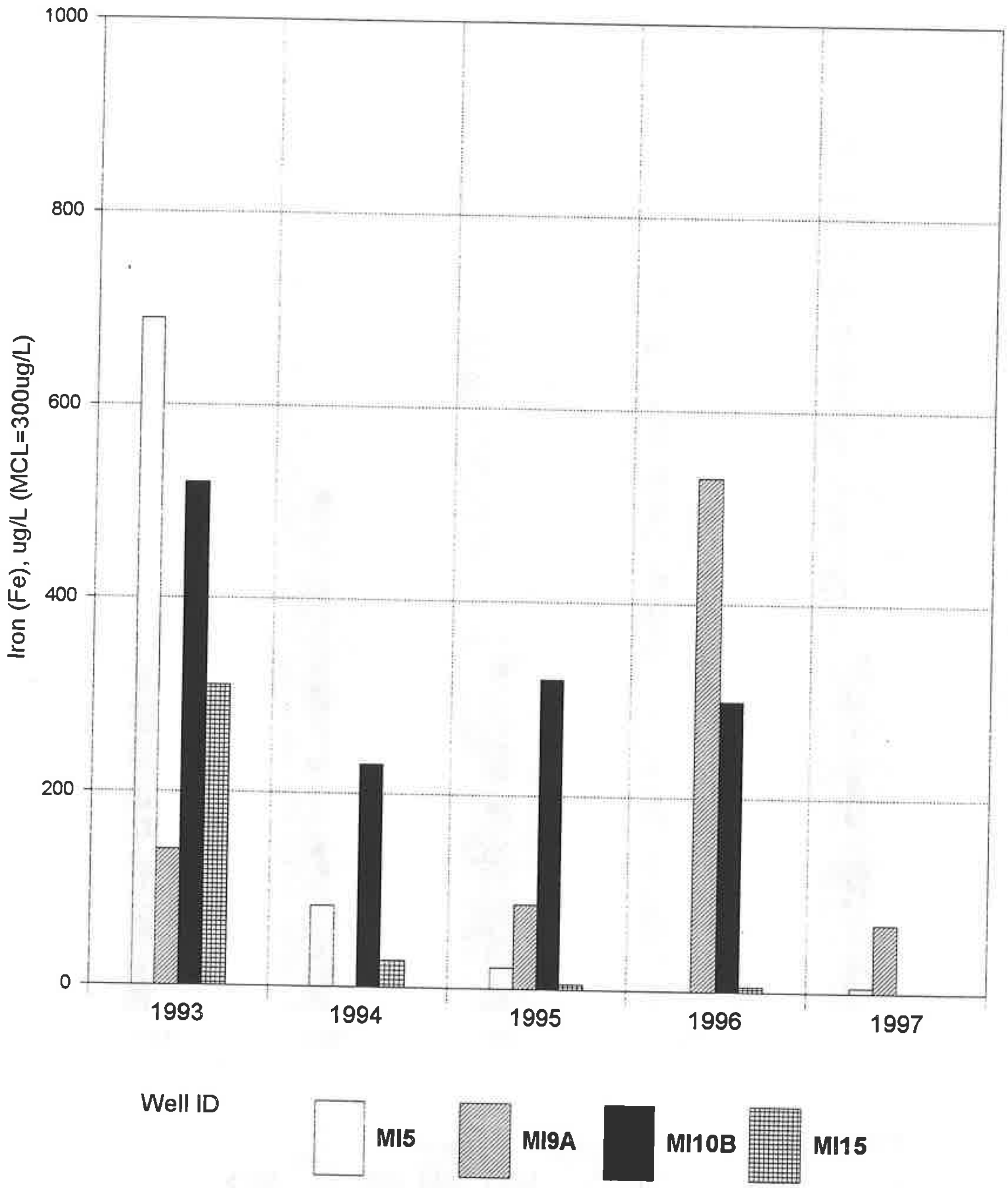
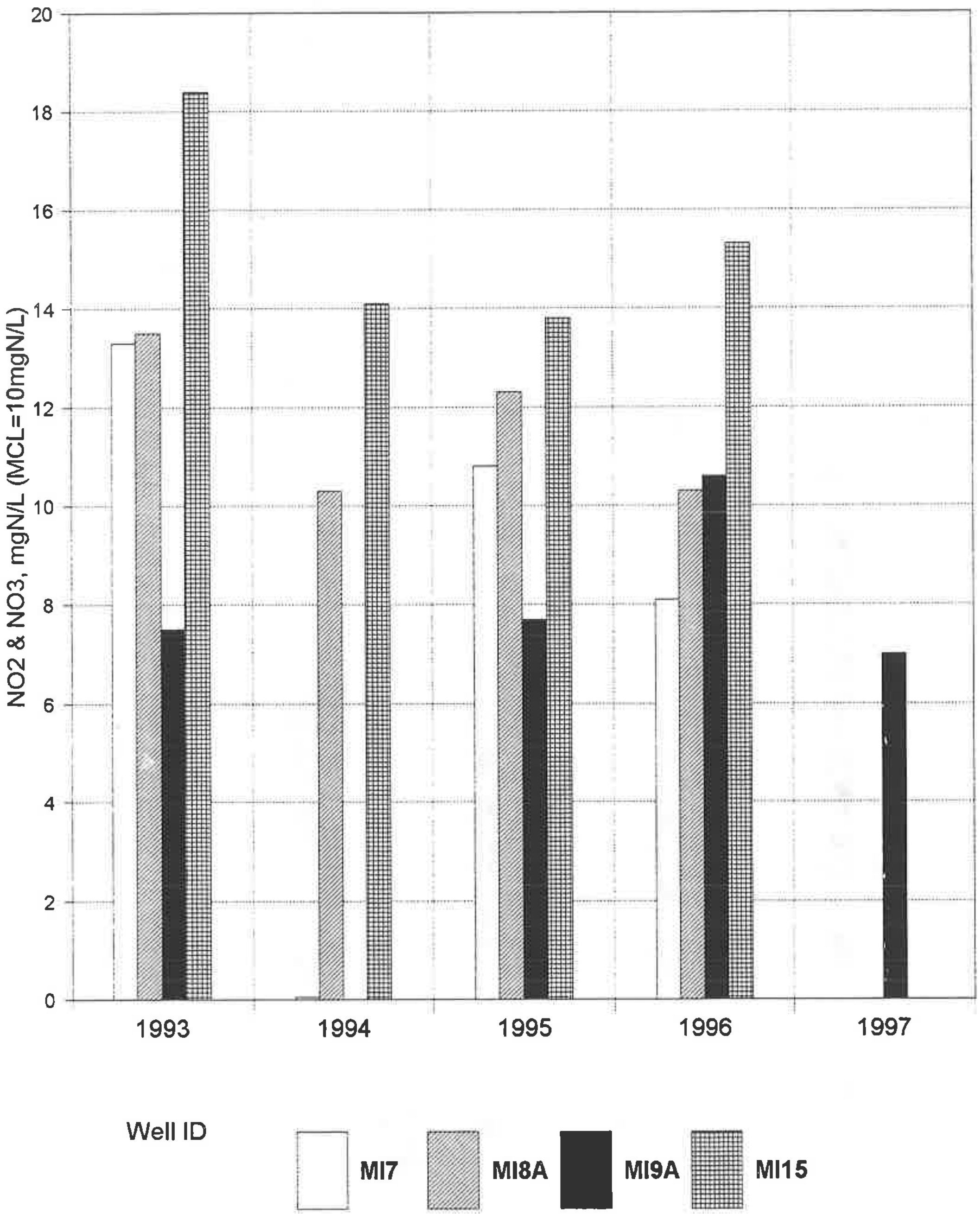


Figure 3-18. - Water Quality of Selected Wells in the Miocene Aquifer System.



Iron levels below the detection limit are assigned a value of 5.1 ppb. A missing bar indicates that samples were not collected for that year.

Figure 3-19. - Iron Concentrations for Selected Wells in the Miocene Aquifer System.



Nitrate/nitrite levels below the detection limit are assigned a value of 0.05 ppm. A missing bar indicates that samples were not collected for that year.

Figure 3-20. - Nitrate/Nitrite Concentrations for Selected Wells in the Miocene Aquifer System.

Soil and saprolite horizons, compositional layers, and openings along fractures and joints in the rocks are the major water-bearing features. Fracture density and interconnection provide the primary controls on the rate of water flow into wells completed in crystalline rocks. The permeability and thickness of soils and saprolite horizons determine the amount of well yield that can be sustained.

EPD used seventeen wells and three springs to monitor water quality in the Piedmont/Blue Ridge Province. Figure 3-21 shows the locations of the monitoring stations. Hardness ranged from soft to moderately hard. The pH of the water samples ranged from 4.71 to 7.80, with the majority of the stations yielding acidic water. Iron and manganese ranged from undetected to 21000 ppb and 200 ppb, respectively. Iron exceeded the secondary MCL (300 ppb) in water samples taken at eight stations, and, manganese exceeded the secondary MCL (50 ppb) at eight stations. Detectable aluminum occurred in samples from two stations and exceeded the secondary MCL (200 ppb) at one station. Figures 3-22 and 3-33 respectively show trends in iron concentrations for selected stations in the Piedmont and Blue Ridge sectors of the province.

Samples from all stations contained sodium, with concentrations ranging from 1.2 ppm to 36.0 ppm. All samples except the one from GWN-P14 contained calcium, and, all except GWN-P4C and GWN-P14 contained magnesium. The other metals detected consisted of barium, strontium, copper, cobalt, nickel, beryllium, gold, and zinc. Beryllium exceeded the primary MCL of 4 ppb in a sample from well GWN-P10A. No other metal concentrations exceeded any MCL's.

Chloride was present in samples from all stations, with concentrations ranging from 0.99 ppm to 11.8 ppm. Sulfate concentrations ranged from undetected to 53.0 ppm. Samples from ten stations contained detectable fluoride with the concentration exceeding the primary MCL (4 ppm) in the sample from spring GWN-P12A. Levels of nitrite/nitrate, present in water samples from nine stations, were below the primary MCL (10 ppm as N). Figures 3-24 and 3-25 show nitrite/nitrate concentrations in selected stations from the Piedmont and Blue Ridge sectors, respectively. No samples contained any synthetic or volatile organic compounds. An analytical summary for the Piedmont/Blue Ridge sampling stations is in Appendix Table A-10.

3.10 VALLEY AND RIDGE UNCONFINED AQUIFERS

Soil and residuum form low-yield unconfined aquifers across most of the Valley and Ridge Province of northwestern Georgia. Valley bottoms underlain by dolostones and limestones of the Cambro-Ordovician Knox Group are the locations of most higher-yielding wells and springs that are suitable for municipal supplies.

EPD collected water samples from five wells and three springs to monitor the water quality in the Valley and Ridge unconfined aquifers (Figure 3-26). Three of these wells and

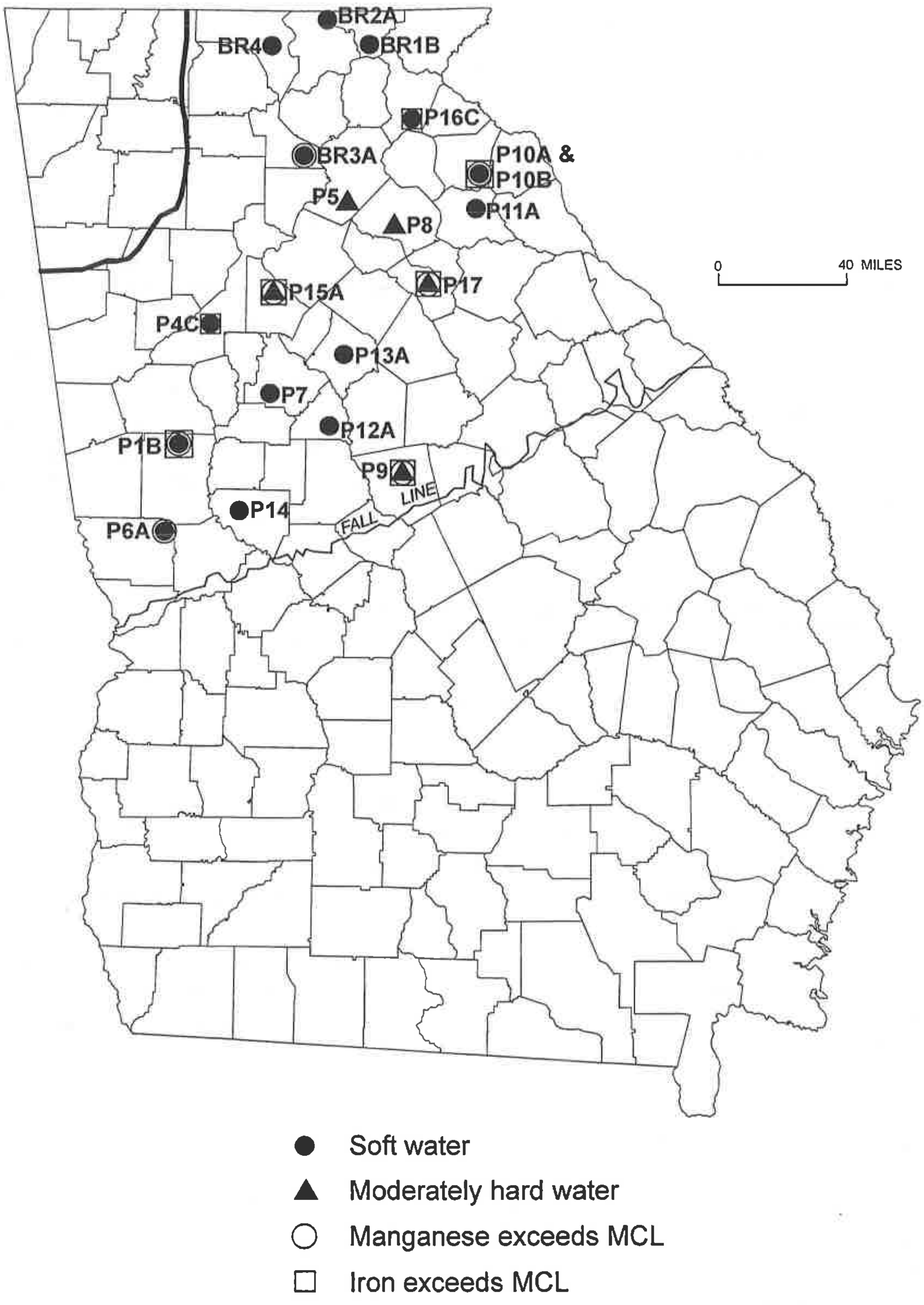
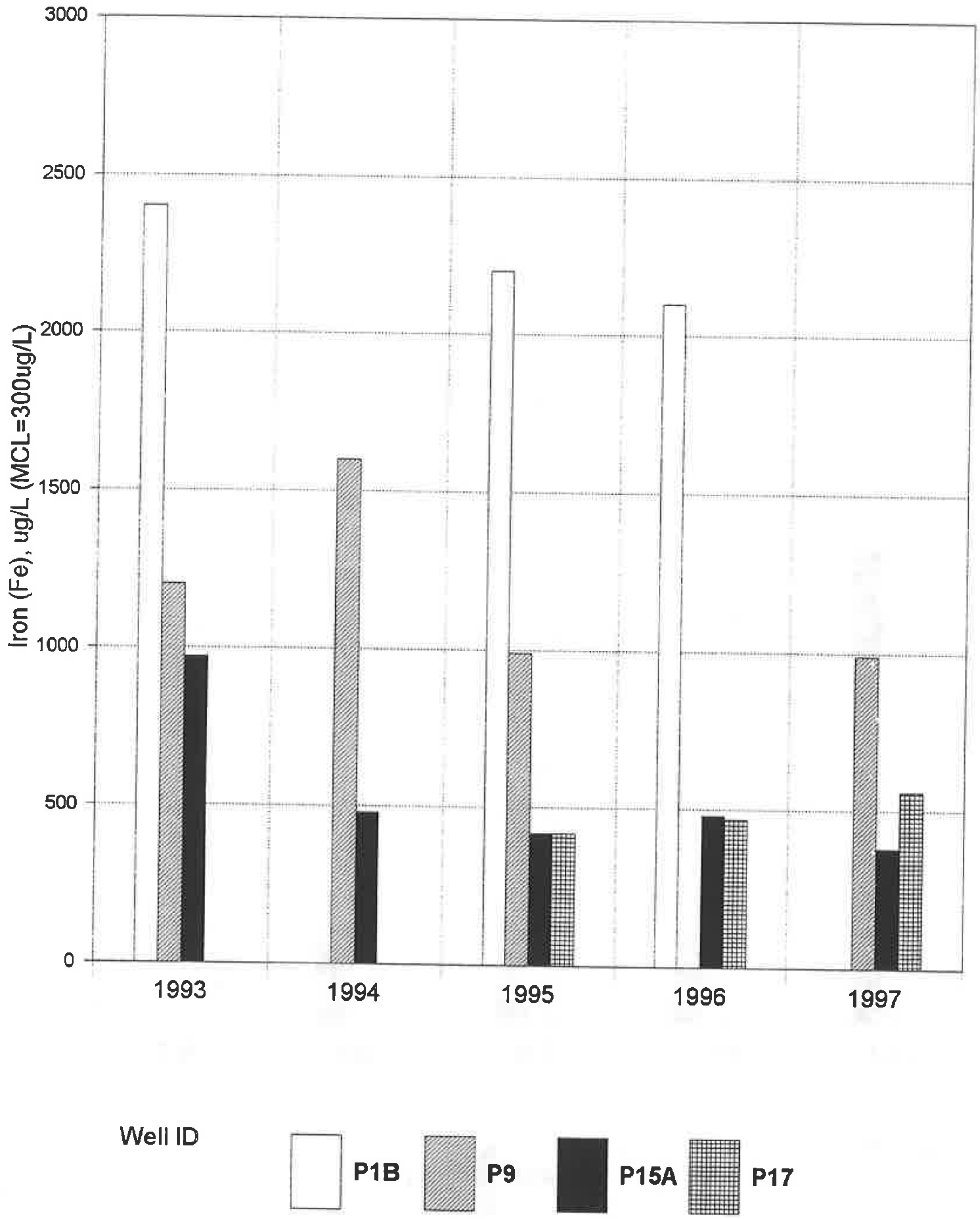
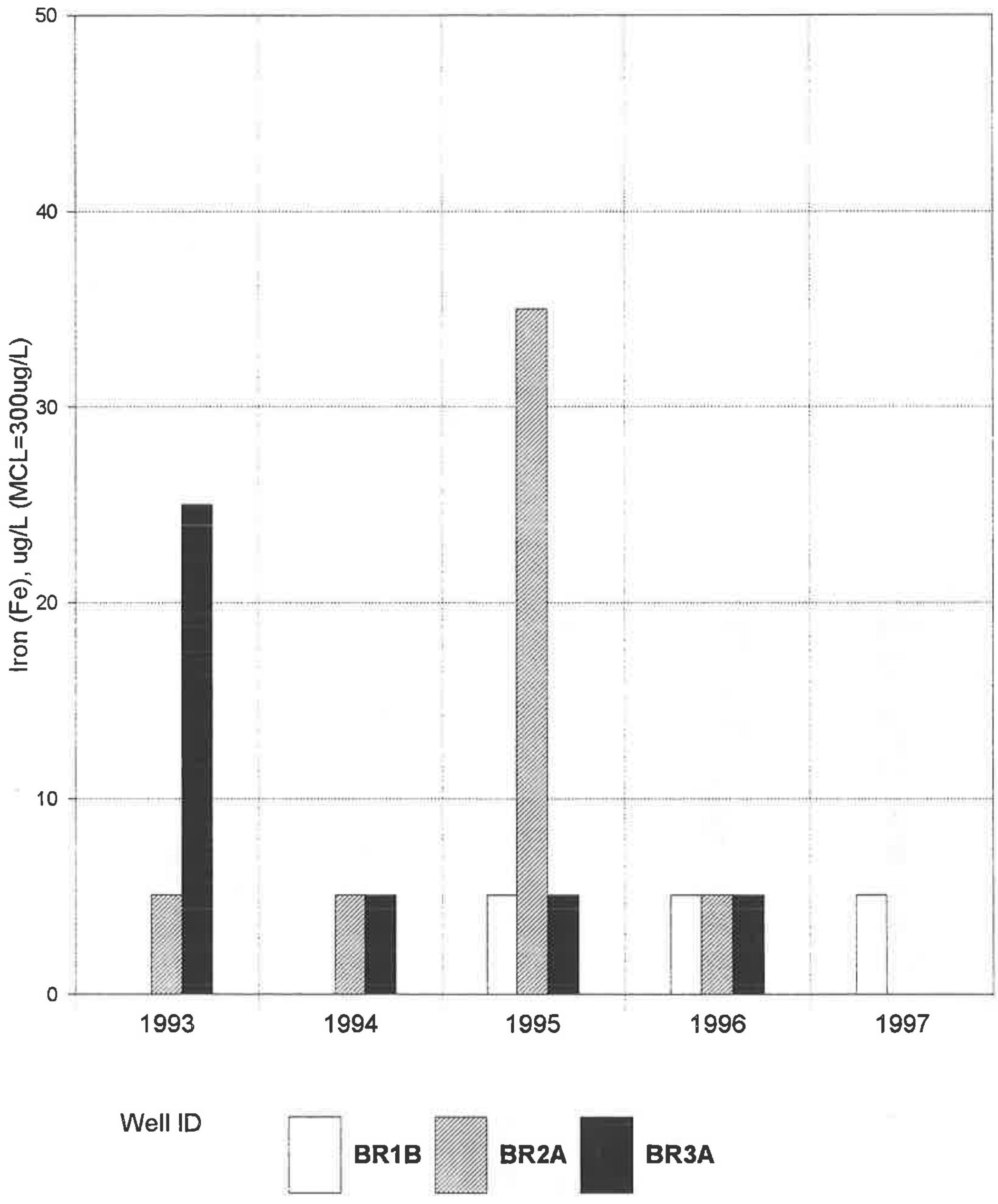


Figure 3-21. - Water Quality for Selected Wells in the Piedmont/Blue Ridge Unconfined Aquifers.



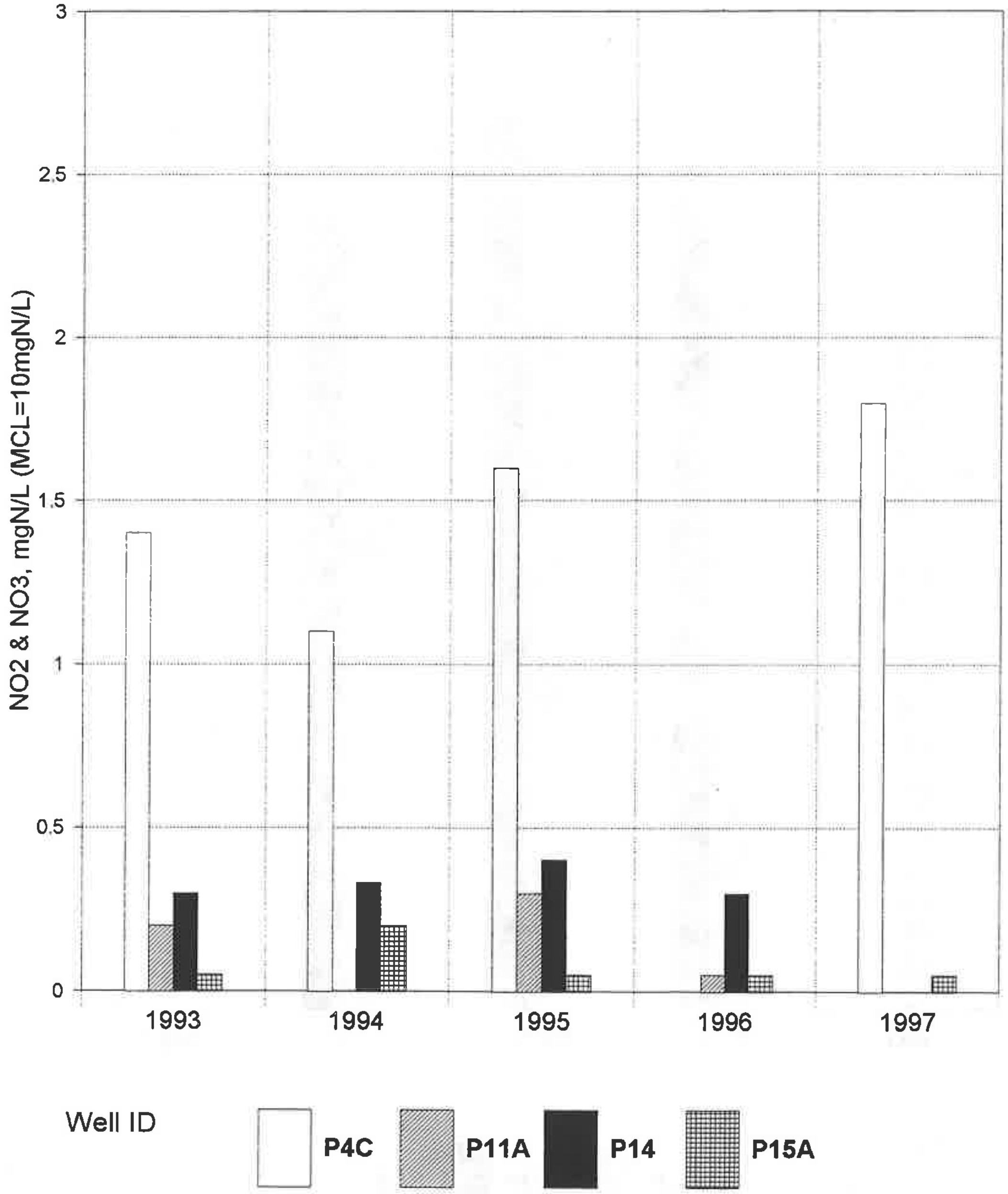
A missing bar indicates samples were not collected for that year.

Figure 3-22. - Iron Concentrations for Selected Wells in the Piedmont/Blue Ridge Unconfined Aquifer System: Piedmont Sector.



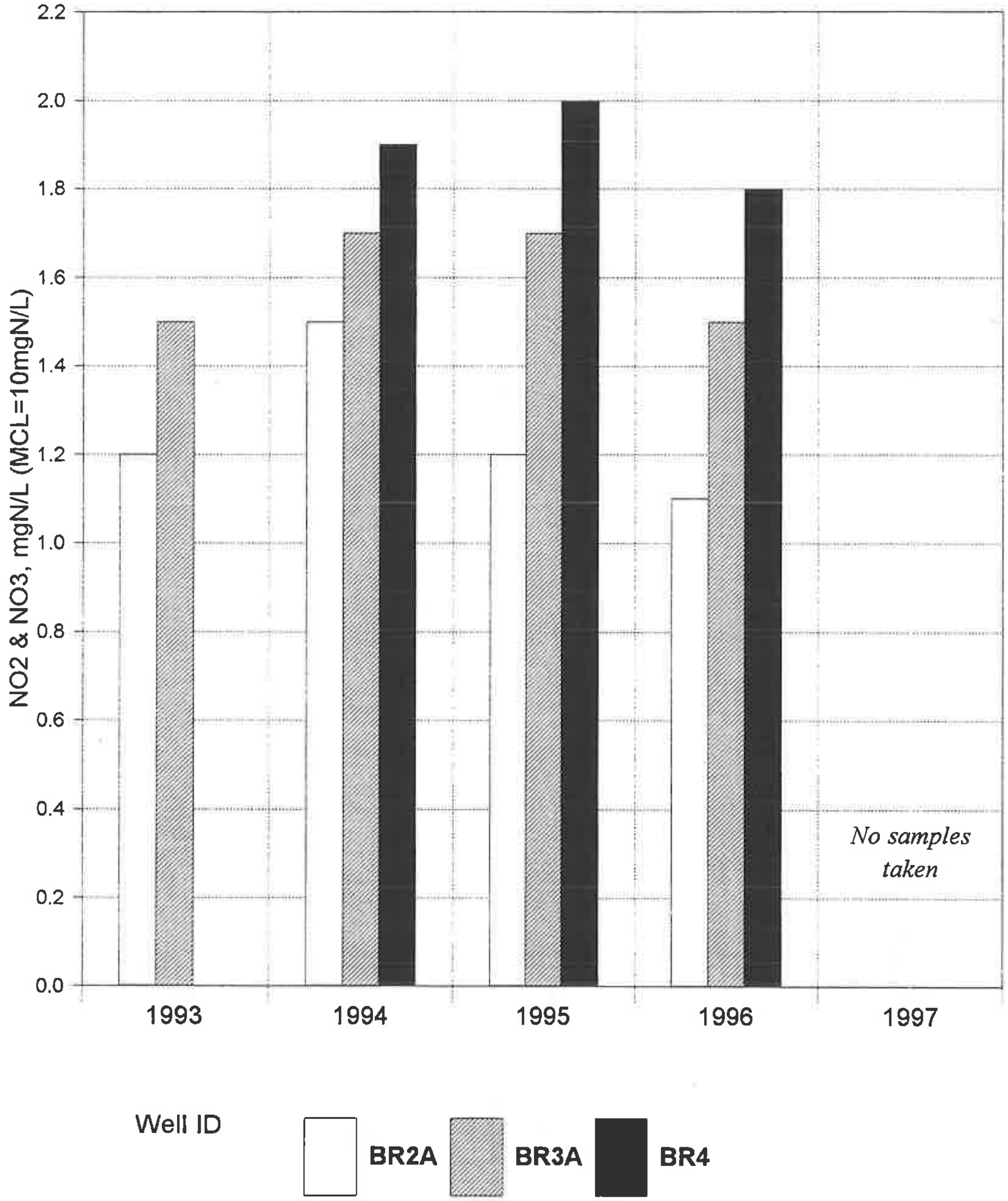
Iron levels below the detection limit are assigned a value of 5.1 ppb. A missing bar indicates that samples were not collected for that year.

Figure 3-23. - Iron Concentrations for Selected Wells in the Piedmont/Blue Ridge Unconfined Aquifer System: Blue Ridge Sector.



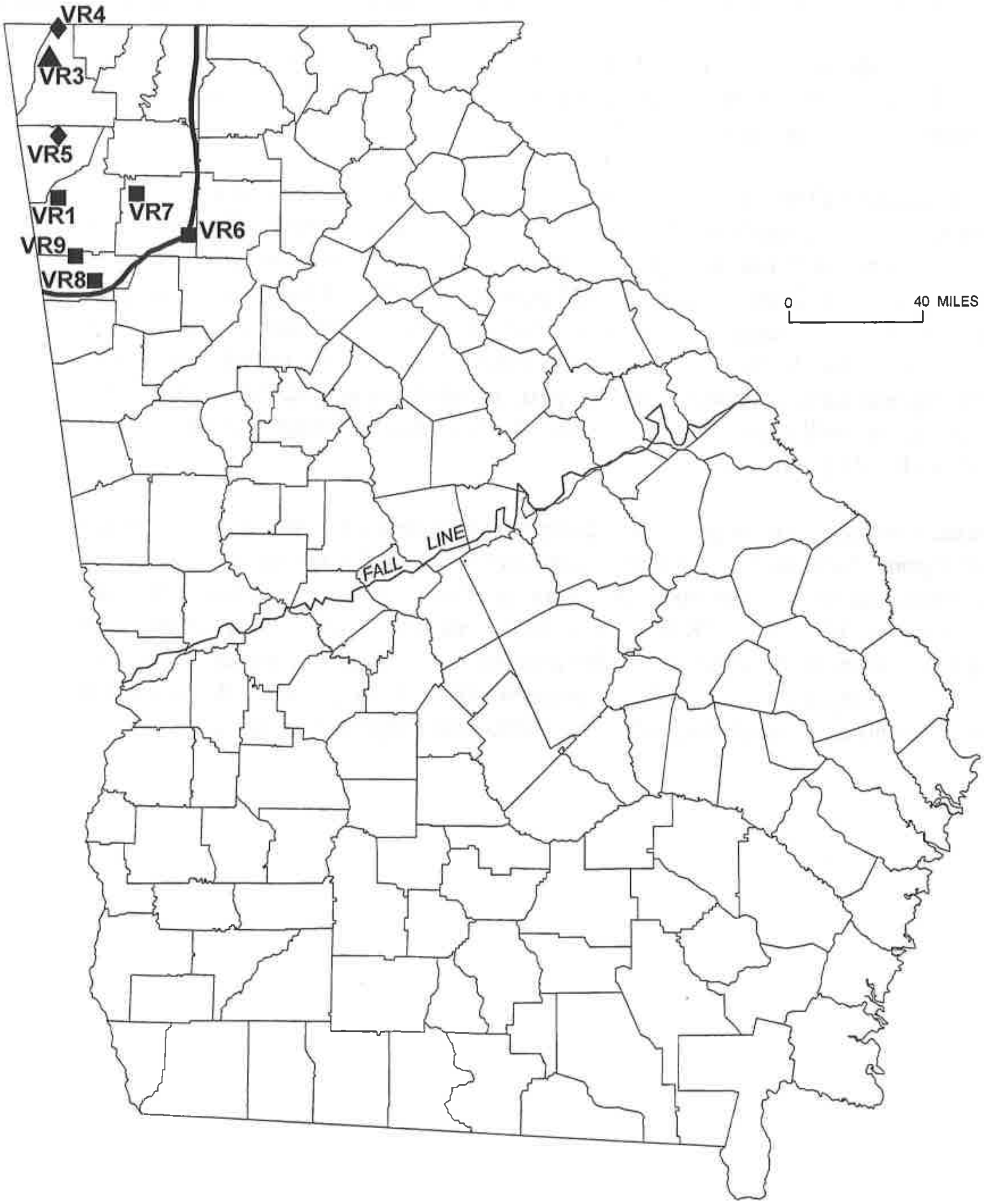
Nitrate/nitrite levels below the detection limit are assigned a value of 0.05 ppm. A missing bar indicates that samples were not collected for that year.

Figure 3-24. - Nitrate/Nitrite Concentrations for Selected Wells in the Piedmont/Blue Ridge Unconfined Aquifer System: Piedmont Sector.



A missing bar indicates that samples were not collected for that year.

Figure 3-25. - Nitrate/Nitrite Concentrations for Selected Wells in the Piedmont/Blue Ridge Unconfined Aquifer System: Blue Ridge Sector.



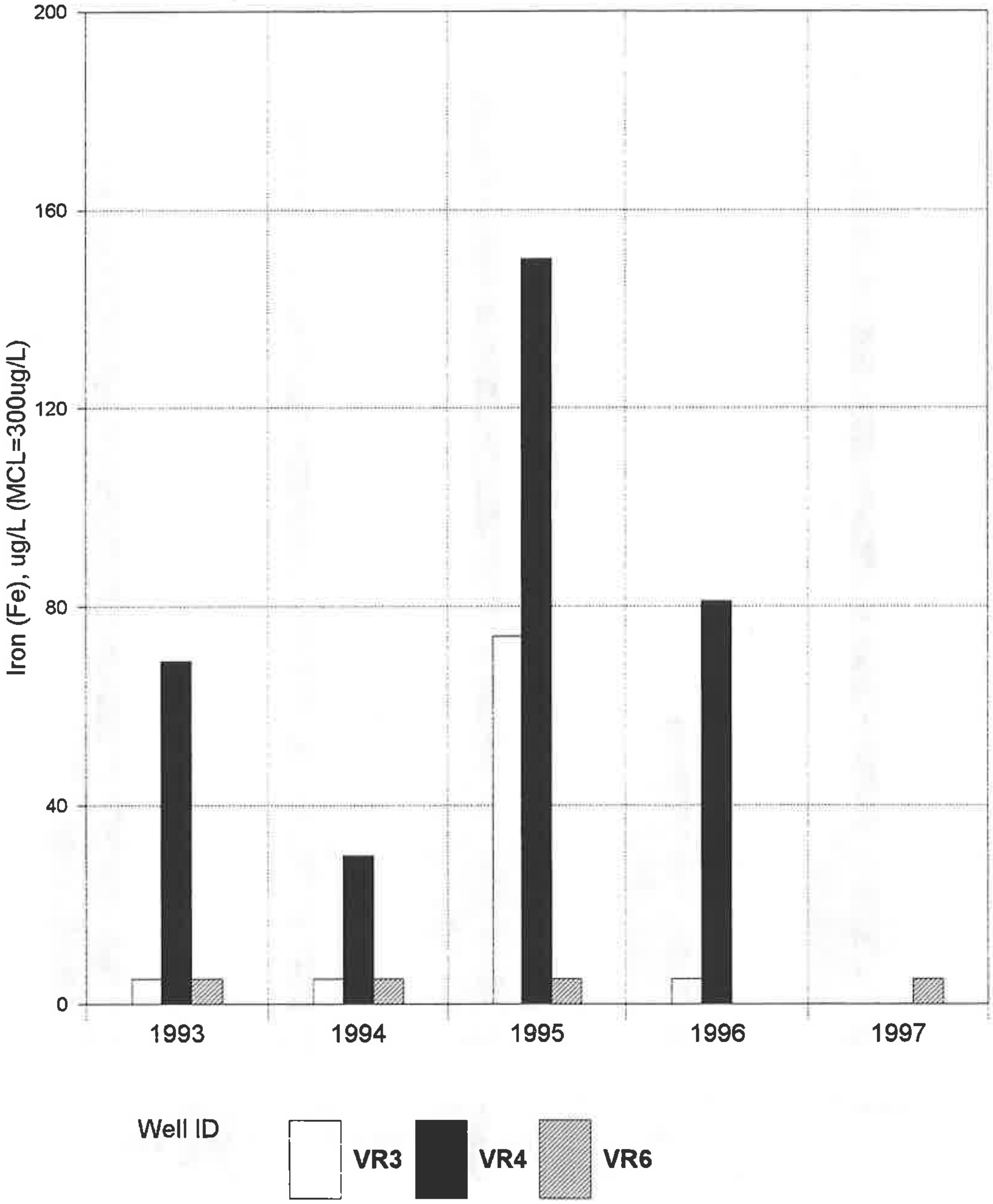
▲ Moderately hard water
■ Hard water
♦ Very hard water

Figure 3-26. - Water Quality of Selected Wells in the Valley and Ridge Unconfined Aquifers.

all three springs produced water from Knox Group carbonates. The other wells are representative of water from the Ordovician Chickamauga Group in Walker County and the Cambrian Shady Dolomite in Bartow County.

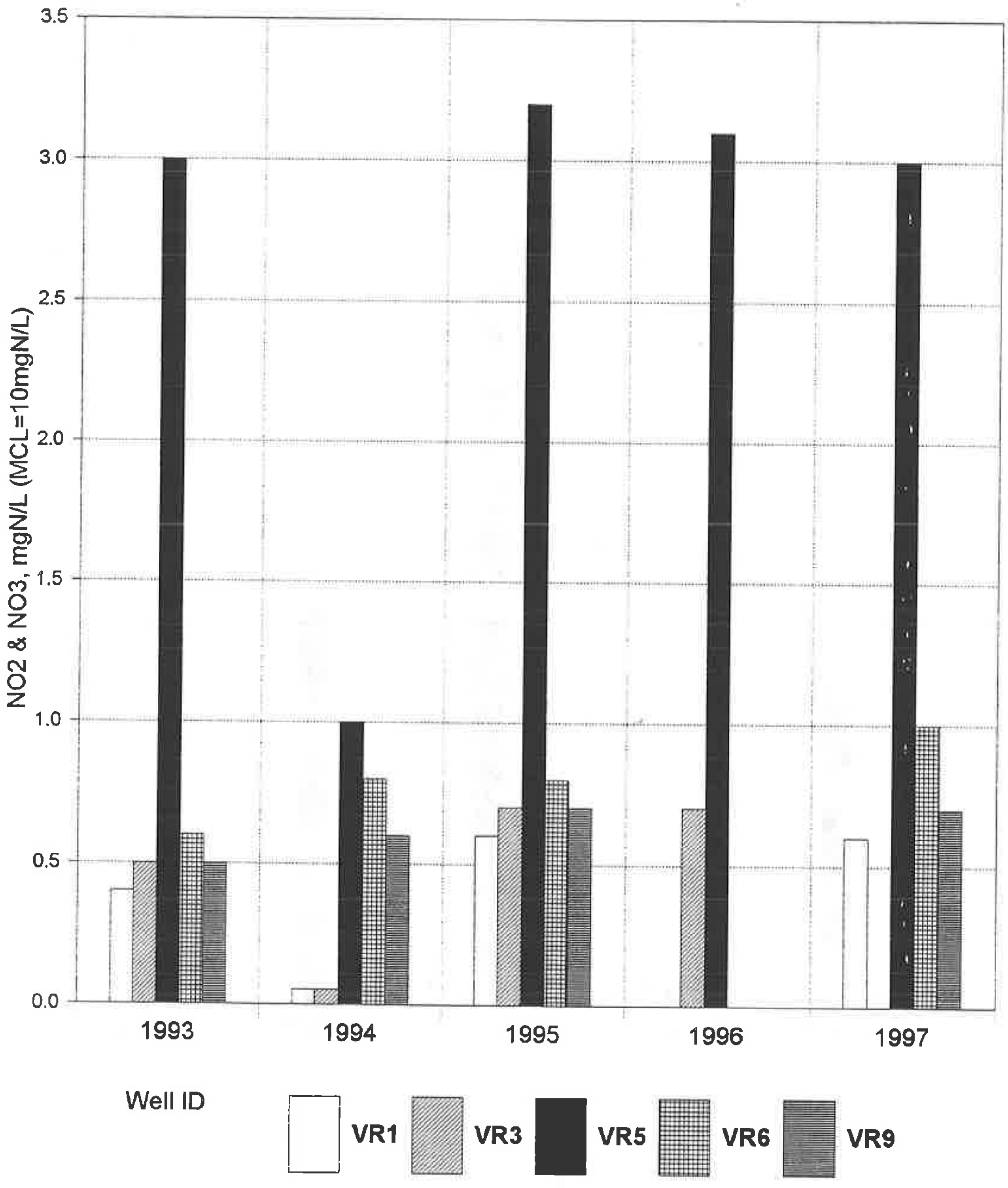
Water from the Valley and Ridge monitoring stations ranged in pH from 6.70 to 7.71 and in hardness from moderately hard to very hard. One station (GWN-VR4) yielded a sample containing detectable iron and manganese. Concentrations of these two metals fell below applicable MCL's. Calcium, ranging from 27 ppm to 75 ppm, and magnesium, ranging from 3.4 ppm to 16 ppm, occurred in samples from all stations. Sodium concentrations ranged from undetectable to 39 ppm. The trace metals present consisted of barium and strontium. The highest barium concentration, 560 ppb, occurred in a sample from well GWN-VR6. This particular well draws water from the Shady Dolomite Group, which contains numerous barite ($BaSO_4$) deposits.

Chloride concentrations ranged from 1.29 ppm to 80.8 ppm, and, sulfate ranged from 1.6 ppm to 30.2 ppm. Samples from all stations except GWN-VR4 contained nitrate/nitrite. The highest nitrate/nitrite concentration (3.1 ppm as N) occurred in a sample from well GWN-VR5. Figures 3-27 and 3-28 show iron and nitrite/nitrate levels, respectively, for selected sampling stations in the Valley and Ridge aquifers. No samples contained detectable synthetic or volatile organic compounds. Appendix Table A-11 presents the analytical summary for the wells and springs located in the Valley and Ridge unconfined aquifers.



Iron levels below the detection limit are assigned a value of 5.1 ppb. A missing bar indicates that samples were not collected for that year.

Figure 3-27. - Iron Concentrations for Selected Wells in the Valley and Ridge Unconfined Aquifers.



Nitrate/nitrite levels below the detection limit are assigned a value of 0.05 ppm. A missing bar indicates that samples were not collected for that year.

Figure 3-28. - Nitrate/Nitrite Concentrations for Selected Wells in the Valley and Ridge Unconfined Aquifers.

4.0 SUMMARY AND CONCLUSIONS

EPD personnel collected 160 raw water samples from 115 wells and 6 springs on the Ground-Water Monitoring Network during the period 1996-1997 for inorganic and organic analysis. These wells and springs monitor the water quality of nine aquifer systems in Georgia:

- Cretaceous aquifer system
- Providence aquifer system
- Clayton aquifer system
- Claiborne aquifer system
- Jacksonian aquifer system
- Floridan aquifer system
- Miocene aquifer system
- Piedmont/Blue Ridge unconfined aquifers
- Valley and Ridge unconfined aquifers

Comparisons of analyses of water samples collected during the 1996-1997 period were made with analyses for the Ground-Water Monitoring Network dating back to 1984, permitting the recognition of temporal trends. Table 4-1 lists the major contaminants and pollutants detected at the stations of the Ground-Water Monitoring Network during this two-year period. Although isolated water quality problems existed at specific localities, the quality of water from the majority of the Ground-Water Monitoring Network stations remains excellent.

Nitrate/nitrite are the most common substances present in ground water in Georgia that can have adverse health effects. Three wells (MI8A, MI9A and MI15), all shallow domestic wells tapping the Miocene aquifer system and located adjacent to or within row crop areas, yielded water samples with nitrite/nitrate concentrations exceeding the primary MCL of 10 ppm as nitrogen (Table 4-1). (The owners of these wells received notification about the excess nitrate/nitrite.) Spatial and temporal limitations of the Ground-Water Monitoring Network preclude the identification of the exact sources of the increasing levels of nitrogen compounds in some of Georgia's ground water. Nitrite/nitrate originates in ground water from direct sources and through oxidation of other forms of dissolved nitrogen, deriving from both natural and man-made sources. The most common sources of man-made dissolved nitrogen in Georgia usually consist of septic systems, agricultural wastes, and storage or application of fertilizers (Robertson, et. al, 1993). Dissolved nitrogen also is present in rainwater and can be derived from terrestrial vegetation and volatilization of fertilizers (Drever, 1988). The conversion of other nitrogen species to nitrate occurs in aerobic environments such as recharge areas. Anaerobic conditions in ground water, which commonly develop along the flow path of ground water, foster the denitrification process. However, the lack of denitrifying bacteria in ground water may inhibit this process (Freeze and Cherry, 1979).

Iron, manganese, and aluminum are the three naturally occurring substances responsible for the greatest incidence of ground-water quality problems in Georgia (Table 4-1). Although minor increases or decreases in iron, manganese, and aluminum occurred at some stations, no long-term

Table 4-1. Pollution and Contamination Incidents, 1996-1997.

Station	Contaminant/ Pollutant	Primary MCL	Secondary MCL
GWN-K1	Mn=76ppb Al=2900ppb		Mn=50ppb Al=200ppb
GWN-K3	Fe=520ppb		Fe=300ppb
GWN-K8	Fe=3000ppb		Fe=300ppb
GWN-K9	Fe=420ppb Al=470ppb		Fe=300ppb Al=200ppb
GWN-K12	Al=390ppb		Al=200ppb
GWN-PD2	Fe=890		Fe=300ppb
GWN-CT7A	Al=220ppb		Al=200ppb
GWN-CL4	benzene=U =59.3ppb methyl-tert-butyl ether=U =144ppb methyl-tert-amyl ether=U =6ppb 1,2,4-trimethylbenzene=U =5.62ppb cyclopentane=U =3.0ppb methylcyclopentane=U =4ppb o-xylene=U =12.9ppb naphthalene=U =tr 2-propylbenzene=U =tr Mn=55ppb =75ppb	benzene=5.0ppb (no MCL) (no MCL) (no MCL) (no MCL) (no MCL) total xylenes=10,000ppb (no MCL) (no MCL)	(no MCL) (no MCL) (no MCL) (no MCL) (no MCL) (no MCL) (no MCL) Mn=50ppb
GWN-CL6	Be=7.3ppb =U	Be=4.0ppb	
GWN-CL8	Fe=930ppb		Fe=300ppb
GWN-J3	Mn=130ppb		Mn=50ppb
GWN-J8	Be=5.0ppb =U Fe=1300ppb =200ppb Mn=79ppb =93ppb	Be=4.0ppb	Fe=300ppb Mn=50ppb
GWN-PA18	Mn=52ppb =56ppb		Mn=50ppb
GWN-PA34	Mn=100ppb		Mn=50ppb

Table 4-1 (continued). Pollution and Contamination Incidents, 1996-1997.

Station	Contaminant/Pollutant	Primary MCL	Secondary MCL
GWN-PA51	linuron=tr(?) =U =U	(no MCL)	(no MCL)
GWN-MI5	Mn=99ppb		Mn=50ppb
GWN-MI7	Al=570ppb		Al=200ppb
GWN-MI8A	NO_x=10.3ppm as N Al=940ppb	NO_x=10ppm as N	Al=200ppb
GWN-MI9A	NO_x=10.6ppm as N =7.0ppm as N Al=1600ppb =220ppb Fe=530ppb =70ppb	NO_x=10ppm as N	Al=200ppb Fe=300ppb
GWN-MI10B	Mn=140ppb		Mn=50ppb
GWN-MI15	NO_x=15.3ppm as N Al=260ppm	NO_x=10ppm as N	Al=200ppb
GWN-BR3A	Mn=60ppb		Mn=50ppb
GWN-P1B	Fe=2100ppb Mn=62ppb		Fe=300ppb Mn=50ppb
GWN-P4C	Fe=7100ppb		Fe=300ppb
GWN-P6A	Mn=99ppb		Mn=50ppb
GWN-P9	Fe=1400ppb Mn=180ppb		Fe=300ppb Mn=50ppb
GWN-P10A	Be=8.7ppb Al=3600ppb Fe=17000ppb Mn=110ppb	Be=4.0ppb	Al=300ppb Fe=300ppb Mn=50ppb
GWN-P10B	Fe=21000ppb Mn=200ppb		Fe=300ppb Mn=50ppb
GWN-P12A	F=4.11ppm	F=4.0ppm	
GWN-P15A	Fe=480ppb =380ppb Mn=110ppb =96ppb		Fe=300ppb Mn=50ppb

Table 4-1 (continued). Pollution and Contamination Incidents, 1996-1997.

Station	Contaminant/Pollutant	Primary MCL	Secondary MCL
GWN-P16C	Fe=500ppb =130ppb		Fe=300ppb
GWN-P17	Fe=470ppb =560ppb Mn=120ppb =130ppb		Fe=300ppb Mn=50ppb

Note: Listing of a substance more than once for one station means that the station was sampled more than once.
tr = trace
U = undetected

trends in concentrations of these metals were documented for the majority of the wells and springs sampled.

Samples from two stations, GWN-PA51 and GWN-CL4, contained some amount of synthetic organic compounds. Solvent pollution resulted in a third station (GWN-K10) being removed from service before the scheduled sampling could be undertaken. In the case of domestic well GWN-PA51, testing found a trace of the pesticide linuron in a sample taken in 1996. The well was resampled and the sample analyzed, with no linuron being detected. In the case of municipal well GWN-CL4, after the 1996 sampling found no pollution by volatile organic compounds, the 1997 sample was found polluted with motor fuel components, with benzene nearly twelve times the primary MCL.

In samples from three wells taken during the 1996-1997 period, testing indicated beryllium in excess of the primary MCL. In the case of one well, an industrial/public supply well within the Coastal Plain, beryllium was not found in any previous samples or in a follow-up sample. The excessive beryllium value appears to be spurious. The second well, a shallow domestic well also within the Coastal Plain, has irregularly yielded samples in the past with detectable beryllium, below the MCL. The cause of the excessive beryllium at this location is unknown. The third well, a municipal well in the Piedmont, has consistently yielded samples with detectable beryllium in the past. The source of the beryllium at this station is probably the local bedrock.

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APPENDIX

Laboratory Data

LABORATORY DATA

All water quality samples that are collected for the Georgia Ground-Water Monitoring Network are subjected to a standard analysis that includes tests for pH, conductivity, certain inorganic anions, and thirty metals (Table A-1). Bromide was added to the list of anions in January of 1997. Analyses for additional parameters may be included for samples that are collected from areas where the possibility of ground-water pollution exists due to regional activities. These optional tests consist of those for mercury, agricultural chemicals, semivolatile organic compounds, and volatile organic compounds (Table A-2). In previous editions of Circular 12, the metals analyses and the various organic chemical analyses were referred to as screens.

EPA has set forth a series of (serially numbered) analytical methods officially recognized as suitable for environmental purposes. For inorganic chemical analyses, the EPD laboratories cite EPA method numbers along with analysis results, and, Table A-1 lists the method numbers appropriate to the various analytes. For organic analyses other than for carbamate and urea-derivative pesticides, the various organic screens have equivalent EPA methods (page 2-7, section 2-3). The UGA laboratories have, since the beginning of the Monitoring Network, used screen #5, which is effective for most carbamates and urea-derivative pesticides. The EPD and GDA laboratories, however, have had only the capability of using EPA method 531.1, which is effective for carbamates but not urea-derivatives. Table A-2 makes note of this situation. (EPA has adopted a method equivalent to screen #5, under the designation 8321M. The EPD laboratories became capable of using method 8321M early in 1998.)

Other than the two physical parameters, four of the major anions, and nine of the metals, other parameters are listed in the following analytical results tables A-3 through A-11 only if they were detected.

For this appendix, the following abbreviations are used:

AAS	= atomic absorbtion spectrophotometry
SU	= standard units
mg/L	= milligrams per liter (parts per million)
mg/L as N	= milligrams per liter (parts per million), as nitrogen
ug/L	= micrograms per liter (parts per billion)
ICPOES	= ion coupled plasma optical emission spectroscopy
umho/cm	= micromhos per centimeter
U	= less than (below method detection limit)
a	= EPA methods 507.0, 8141, or UGA screen #1 (organophosphorus pesticides)
b	= EPA methods 508.1, 608, 8081, or UGA screen #2 (organochlorine pesticides and PCB's)
c	= EPA methods 515.1, 8015, or UGA combined screens #3 and #4 (chlorinated+acid-phenoxy herbicides)
d	=EPA method 531.1 (carbamate pesticides)

5	=UGA screen #5 (urea-derivative and certain carbamate pesticides)
s	=EPA method 8270B (semivolatile organic compounds)
v	=EPA method 8260 or UGA screen #10 (volatile organic compounds)
f	=field-measured conductivity

(Note: the method detection limit for the same substance can vary among different laboratories, and, can vary for a single laboratory if a sample is diluted to lower the concentration of interfering substances or if the array of standards used to develop the method detection limit is revised.)

Table A-1. Standard Water Quality Analyses: ICPOES Metals, AAS Metals, Anions, and Other Parameters.

ICPOES METALS TEST			
Parameter	**Test Method**	**Method Detection Limit**	**Max.Contaminant Level**
Silver (Ag)	EPA 200.7	30 ug/L	100 ug/L_2
Aluminum (Al)	EPA 200.7	50 ug/L	200 ug/L_2
Gold (Au)	EPA 200.7	10 ug/L	None
Barium (Ba)	EPA 200.7	10 ug/L	2000 ug/L_1
Bismuth (Bi)	EPA 200.7	30 ug/L	None
Calcium (Ca)	EPA 200.7	1.0 mg/L	None
Cobalt (Co)	EPA 200.7	10 ug/L	None
Chromium (Cr)	EPA 200.7	20 ug/L	100 ug/L_1
Copper (Cu)	EPA 200.7	20 ug/L	1000 ug/L_2
Iron (Fe)	EPA 200.7	20 ug/L	300 ug/L_2
Potassium (K)	EPA 200.7	5.0 mg/L	None
Magnesium (Mg)	EPA 200.7	1.0 mg/L	None
Manganese (Mn)	EPA 200.7	10 ug/L	50 ug/L_2
Molybdenum (Mo)	EPA 200.7	10 ug/L	None
Sodium (Na)	EPA 200.7	1.0 mg/L	None
Nickel (Ni)	EPA 200.7	20 ug/L	100 ug/L_1
Lead (Pb)	EPA 200.7	50 ug/L	None
Tin (Sn)	EPA 200.7	90 ug/L	None
Strontium (Sr)	EPA 200.7	10 ug/L	None
Titanium (Ti)	EPA 200.7	10 ug/L	None
Vanadium (V)	EPA 200.7	10 ug/L	None
Yttrium (Y)	EPA 200.7	10 ug/L	None
Zinc (Zn)	EPA 200.7	20 ug/L	5000 ug/L_2

ICPOES METALS TEST (continued)			
Parameter	**Test Method**	**Method Detection Limit**	**Max.Contaminant Level**
Zirconium (Zr)	EPA 200.7	10 ug/L	None

AAS METALS TESTS			
Parameter	**Test Method**	**Method Detection Limit**	**Max.Contaminant Level**
Arsenic (As)	EPA 206.2	25 ug/L	50 ug/L_1
Beryllium (Be)	EPA 210.2	2 ug/L	4 ug/L_1
Cadmium (Cd)	EPA 213.2	2.5 ug/L	5 ug/L_1
Antimony (Sb)	EPA 204.2	3 ug/L	6 ug/L_1
Selenium (Se)	EPA 270.2	25 ug/L	50 ug/L_1
Thallium (Tl)	EPA 279.2	1 ug/L	2 ug/L_1

ANIONS TESTS			
Parameter	**Test Method**	**Method Detection Limit**	**Max.Contaminant Level**
Bromide (Br^-)	EPA 300.0	0.1 mg/L	None
Chloride (Cl^-)	EPA 300.0	0.1 mg/L	250 mg/L_2
Sulfate ($SO_4^=$)	EPA 300.0	2.0 mg/L	250 mg/L_2
Nitrate/Nitrite (NO_x^-)	EPA 353.1	0.2 mg/L as N	10 mg/L as N_1
Fluoride (F^-)	EPA 300.0	0.1 mg/L	4.0 mg/L_1, 2.0 mg/L_2

OTHER PARAMETERS*		
Parameter	**Units**	**Maximum Contaminant Level**
pH	0.01 SU	None
Conductivity	1.0 umho/cm	None

*pH is measured in the field (see Chapter 2); conductivity is typically measured in the laboratory according to Standard Methods of Water Quality Analysis method 2510B. (Franson, ed., 1995).

$_1$=Primary Maximum Contaminant Level (MCL).
$_2$=Secondary MCL.

MCL's from Georgia Rules for Safe Drinking Water, March 1994 edition (EPD, 1994).

Table A-2. Additional Water Quality Analyses: Organophosphorus Pesticides, Organochlorine Pesticides/PCB's, Phenoxy Herbicides, Carbamate/Urea-Derived Pesticides, Semivolatile Organic Compounds, Volatile Organic Compounds, and Mercury.

ORGANOPHOSPHORUS PESTICIDES *(Screen #1)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Alachlor	a	1.0 ug/L	2.0 ug/L
Aspon	a	0.25 ug/L	None
Atrazine	a	0.3 ug/L	3.0 ug/L
Azinphos Ethyl	a	0.5 ug/L	None
Azodrin	a	1.0 ug/L	None
Bolstar	a	0.25 ug/L	None
Carbophenothion	a	0.5 ug/L	None
Chlorphenvinphos	a	100 ug/L	None
Chlorpyrifos	a	0.5 ug/L	None
Methyl Chlorpyriphos	a	0.5 ug/L	None
Coumaphos	a	5.0 ug/L	None
Crotoxyphos	a	5.0 ug/L	None
Cyanazine	a	1.0 ug/L	None
DCPA	a	0.01 ug/L	None
Demeton	a	5.0 ug/L	None
Diazinon	a	1.0 ug/L	None
Dichlorofenthion	a	0.25 ug/L	None
Dichlorvos	a	5.0 ug/L	None
Dicrotophos	a	20 ug/L	None
Dimethoate	a	50 ug/L	None

ORGANOPHOSPHORUS PESTICIDES (continued) *(Screen #1)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Dioxathion	a	10 ug/L	None
Disyston	a	0.25 ug/L	None
Eptam	a	0.5 ug/L	None
EPN	a	0.5 ug/L	None
Ethion	a	0.25 ug/L	None
Ethoprop	a	0.5 ug/L	None
Famphur	a	10 ug/L	None
Fenitrothion	a	0.25 ug/L	None
Fensulfothion	a	10 ug/L	None
Fenthion	a	0.25 ug/L	None
Fonophos	a	0.5 ug/L	None
Guthion	a	2.0 ug/L	None
Isopropalin	a	1.0 ug/L	None
Leptophos	a	5.0 ug/L	None
Malathion	a	50 ug/L	None
Merphos	a	0.5 ug/L	None
Metolachlor	a	1.0 ug/L	None
Metribuzin	a	1.25 ug/L	None
Mevinphos	a	1.4 ug/L	None
Monocrotophos	a	1.0 ug/L	None
Parathion	a	0.25 ug/L	None
Methyl Parathion	a	0.5 ug/L	None
Pebulate	a	0.6 ug/L	None
Pendimethalin	a	0.8 ug/L	None

ORGANOPHOSPHORUS PESTICIDES (continued) *(Screen #1)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Phorate	a	0.5 ug/L	None
Phosmet	a	5.0 ug/L	None
Phosphamidon	a	100 ug/L	None
Profluralin	a	0.9 ug/L	None
Ronnel	a	0.25 ug/L	None
Simazine	a	0.9 ug/L	4.0 ug/L
Stirophos	a	1.0 ug/L	None
Sulfotepp	a	1.0 ug/L	None
Sutan	a	0.7 ug/L	None
Terbufos	a	0.5 ug/L	None
Thionazin	a	0.25 ug/L	None
Tokuthion	a	0.25 ug/L	None
Trichlorfon	a	5.0 ug/L	None
Trichloronate	a	0.5 ug/L	None
Trifluralin	a	1.0 ug/L	None
Vernam	a	0.5 ug/L	None

ORGANOCHLORINE PESTICIDES/PCB'S *(Screen #2)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
4,4-DDD	b	0.02 ug/L	None
4,4-DDE	b	0.01 ug/L	None
4,4-DDT	b	0.02 ug/L	None
Aldrin	b	0.01 ug/L	None

ORGANOCHLORINE PESTICIDES/PCB'S (continued) *(Screen #2)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Chlordane	b	0.05 ug/L	2.0 ug/L
Chlorpyrifos	b	0.05 ug/L	None
Dieldrin	b	0.01 ug/L	None
Dicofol	b	0.1 ug/L	None
Endosulfan I	b	0.02 ug/L	None
Endosulfan II	b	0.03 ug/L	None
Endosulfan Sulfate	b	0.05 ug/L	None
Endrin	b	0.03 ug/L	2.0 ug/L
Endrin Aldehyde	b	0.05 ug/L	None
Heptachlor	b	0.01 ug/L	0.001 ug/L
Heptachlorepoxide	b	0.01 ug/L	0.001 ug/L
Hexachlorobenzene	b	0.01 ug/L	1.0g/L
Methoxychlor	b	0.3 ug/L	40.0 ug/L
Mirex	b	0.04 ug/L	None
PCB 1016	b	0.3 ug/L	0.5 ug/L
PCB 1221	b	0.3 ug/L	0.5 ug/L
PCB 1232	b	0.3 ug/L	0.5 ug/L
PCB 1242	b	0.3 ug/L	0.5 ug/L
PCB 1248	b	0.3 ug/L	0.5 ug/L
PCB 1254	b	0.3 ug/L	0.5 ug/L
PCB 1260	b	0.3 ug/L	0.5 ug/L
PCB 1262	b	0.3 ug/L	0.5 ug/L
Permethrin	b	0.3 ug/L	None
Toxaphene	b	1.2 ug/L	3.0 ug/L
ά-HCH	b	0.01 ug/L	None

ORGANOCHLORINE PESTICIDES/PCB'S (continued) *(Screen #2)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
β-HCH	b	0.01 ug/L	None
δ-HCH	b	0.01 ug/L	None
Ƴ-HCH (Lindane)	b	0.01 ug/L	0.2 ug/L

PHENOXY HERBICIDES *(Screens #3 and #4)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
2,4,5-T	c	0.2 ug/L	None
2,4-D	c	5.2 ug/L	70.0 ug/L
2,4-DB	c	1.5ug/L	None
Acifluorfen	c	1.0 ug/L	None
Chloramben	c	0.2 ug/L	None
Dalapon	c	0.6 ug/L	200 ug/L
Dicamba	c	0.2 ug/L	None
Dichloroprop	c	1.5 ug/L	None
Dinoseb	c	0.1 ug/L	7ug/L
MCPA	c	320 ug/L	None
Mecoprop	c	430 ug/L	None
Pentachlorophenol	c	0.05 ug/L	1.0 ug/L
Silvex	c	0.1 ug/L	50.0 ug/L
Trichlorfon	c	2.0 ug/L	None

CARBAMATE/UREA-DERIVATIVE PESTICIDES			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
3-Hydroxycarbofuran	d	1.98 ug/L	None
Aldicarb	d	1.1 ug/L	None
Aldicarb Sulfone	d	1.76 ug/L	None
Aldicarb Sulfoxide	d	1.1 ug/L	None
Baygon	d 5	1.98 ug/L	None
Carbaryl	d 5	1.98 ug/L	None
Carbofuran	d 5	1.98 ug/L	40.0 ug/L
Diuron	5	1.0 ug/L	None
Fluometron	5	1.0 ug/L	None
Linuron	5	1.0 ug/L	None
Methomyl	d 5	1.98 ug/L	None
Methiocarb	d 5	4.4 ug/L	None
Monuron	5	1.0 ug/L	None
Oxamyl	d 5	4.4 ug/L	200 ug/L

SEMIVOLATILE ORGANIC COMPOUNDS *(Screens #8 and #9)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
N-Nitrosodimethyl-amine	s	10.0 ug/L	None
2-Picoline	s	10.0 ug/L	None

SEMIVOLATILE ORGANIC COMPOUNDS (continued) *(Screens #8 and #9)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Methylmethanesul-fonate	s	10.0 ug/L	None
Ethylmethanesul-fonate	s	20.0 ug/L	None
Aniline	s	10.0 ug/L	None
Phenol	s	10.0 ug/L	None
Bis(2-Chloroethyl) Ether	s	10.0 ug/L	None
2-Chlorophenol	s	10.0 ug/L	None
1.3-Dichlorobenzene (M)	s	10.0 ug/L	None
1,4-Dichlorobenzene (P)	s	10.0 ug/L	75.0 ug/L
Benzyl Alcohol	s	20.0 ug/L	None
1,2-Dichlorobenzene (O)	s	10.0 ug/L	600.0 ug/L
2-Methylphenol	s	10.0 ug/L	None
Bis(2-Chloroiso-propyl) Ether	s	10.0 ug/L	None
Acetophenone	s	10.0 ug/L	None
4-Methylphenol	s	10.0 ug/L	None
N-Nitrosodi-N-Propylamine	s	10.0 ug/L	None
Hexachloroethane	s	10.0 ug/L	None
Nitrobenzene	s	10.0 ug/L	None
N-Nitrosopiperidine	s	20.0 ug/L	None
Isophorone	s	10.0 ug/L	None
2-Nitrophenol	s	10.0 ug/L	None

SEMIVOLATILE ORGANIC COMPOUNDS (continued) *(Screens #8 and #9)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
2,4-Dimethylphenol	s	10.0 ug/L	None
Bis(2-Chloroethoxy) Methane	s	10.0 ug/L	None
Benzoic Acid	s	50.0 ug/L	None
2,4-Dichlorophenol	s	10.0 ug/L	None
1,2,4-Trichlorobenzene	s	10.0 ug/L	None
A,a-Dimethyl-phenylethylamine	s	10.0 ug/L	None
Naphthalene	s	10.0 ug/L	None
4-Chloroaniline	s	20.0 ug/L	None
2,6-Dichlorophenol	s	10.0 ug/L	None
Hexachlorobutadi-ene	s	10.0 ug/L	None
N-Nitroso-Di-N-Butylamine	s	10.0 ug/L	None
4-Chloro-3-Methylphenol	s	20.0 ug/L	None
2-Methyl Naphthalene	s	10.0 ug/L	None
1,2,4,5-Tetrachlorobenzene	s	10.0 ug/L	None
Hexachlorocyclo-pentadiene	s	10.0 ug/L	50 ug/L
2,4,6-Trichlorophenol	s	10.0 ug/L	None
2-Chloronaphthalene	s	10.0 ug/L	None
2,4,5-Trichlorophenol	s	10.0 ug/L	None

SEMIVOLATILE ORGANIC COMPOUNDS (continued) *(Screens #8 and #9)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
1-Chloronaphthalene	s	10.0 ug/L	None
2-Nitroanaline	s	50.0 ug/L	None
Dimethylphthalate	s	10.0 ug/L	None
Acenaphthylene	s	10.0 ug/L	None
2,6-Dinitrotoluene	s	10.0 ug/L	None
3-Nitroaniline	s	50.0 ug/L	None
Acenaphthene	s	10.0 ug/L	None
2,4-Dinitrophenol	s	50.0 ug/L	None
4-Nitrophenol	s	50.0 ug/L	None
Dibenzofuran	s	10.0 ug/L	None
Pentachlorobenzene	s	10.0 ug/L	None
2,4-Dinitrotoluene	s	10.0 ug/L	None
1-Naphthylamine	s	10.0 ug/L	None
2-Naphthylamine	s	10.0 ug/L	None
2,3,4,6-Tetrachlorobenzene	s	10.0 ug/L	None
Diethylphthalate	s	10.0 ug/L	None
Fluorene	s	10.0 ug/L	None
4-Chlorophenyl Phenyl Ether	s	10.0 ug/L	None
4-Nitroaniline	s	20.0 ug/L	None
Diphenylamine	s	10.0 ug/L	None
4,6-Dinitro-2-Methylphenol	s	50.0 ug/L	None
N-Nitroso-diphenylamine	s	10.0 ug/L	None

SEMIVOLATILE ORGANIC COMPOUNDS (continued) *(Screens #8 and #9)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
1,2-diphenyl-hydrazine	s	10.0 ug/L	None
4-Bromophenyl-Phenyl Ether	s	10.0 ug/L	None
Phenacetin	s	20.0 ug/L	None
Hexachlorobenzene	s	10.0 ug/L	1 ug/L
4-Aminobiphenyl	s	20.0 ug/L	None
Pentachlorophenol	s	50.0 ug/L	1.0 ug/L
Pronamide	s	10.0 ug/L	None
Pentachloronitro-benzene	s	20.0 ug/L	None
Phenanthrene	s	10.0 ug/L	None
Anthracene	s	10.0 ug/L	None
Di-N-Butyl Phthalate	s	10.0 ug/L	None
Fluoranthene	s	10.0 ug/L	None
Benzidine	s	80.0 ug/L	None
Pyrene	s	10.0 ug/L	None
P-Dimethyl-aminoazobenzene	s	10.0 ug/L	None
N-Butylbenzylphthalate	s	10.0 ug/L	None
Benzo (A) Anthracene	s	10.0 ug/L	None
3,3-Dichlorobenzidine	s	20.0 ug/L	None
Chrysene	s	10.0 ug/L	None

SEMIVOLATILE ORGANIC COMPOUNDS (continued) *(Screens #8 and #9)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Bis(2-Ethyl-hexyl) Phthalate	s	10.0 ug/L	6 ug/L
Di-N-Octyl Phthalate	s	10.0 ug/L	None
Benzo (B)Fluoranthene	s	10.0 ug/L	None
Benzo (K)Fluoranthene	s	10.0 ug/L	None
7,12-Dimethylbenz (A)Anthracene	s	10.0 ug/L	None
Benzo (A)Pyrene	s	10.0 ug/L	0.2ug/L
3-Methyl-cholanthrene	s	10.0 ug/L	None
Dibenz(A,J)Acridine	s	10.0 ug/L	None
Indeno(1,2,3-C-D)Pyrene	s	10.0 ug/L	None
Dibenz(A.H)Anthra-cene	s	10.0 ug/L	None
Benzo(GHI)-Perylene	s	10.0 ug/L	None
ά-HCH	s	10.0 ug/L	None
'Y-HCH (Lindane)	s	10.0 ug/L	0.2 ug/L
δ-HCH	s	10.0 ug/L	None
β-HCH	s	10.0 ug/L	None
Heptachlor	s	10.0 ug/L	0.4 ug/L
Aldrin	s	10.0 ug/L	None
Heptachlorepoxide	s	25.0 ug/L	0.2 ug/L
Endosulfan 1	s	50.0 ug/L	None

SEMIVOLATILE ORGANIC COMPOUNDS (continued) *(Screens #8 and #9)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Dieldrin	s	10.0 ug/L	None
P,P'-DDE	s	10.0 ug/L	None
Endrin	s	20.0 ug/L	2.0 ug/L
Endosulfan 2	s	50.0 ug/L	None
P,P'-DDD	s	10.0 ug/L	None
Endrin Aldehyde	s	10.0 ug/L	None
Endosulfan Sulfate	s	25.0 ug/L	None
P,P'-DDT	s	10.0 ug/L	None

VOLATILE ORGANIC COMPOUNDS *(Screen #10)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Dichlorodifluoro-methane	v	5.0 ug/L	None
Chloromethane	v	10.0 ug/L	None
Bromomethane	v	10.0 ug/L	None
Chloroethane	v	10.0 ug/L	None
Vinyl Chloride	v	10.0 ug/L	2.0 ug/L
Dichloromethane	v	5.0 ug/L	5.0 ug/L
Trichlorofluoro-methane	v	5.0 ug/L	None
Acetone	v	100 ug/L	None
Dibromomethane	v	5.0 ug/L	None

VOLATILE ORGANIC COMPOUNDS (continued) *(Screen #10)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Trans-1,2-Dichloroethylene	v	5.0 ug/L	100 ug/L
Iodomethane	v	5.0 ug/L	None
Carbon Disulfide	v	5.0 ug/L	None
1,1-Dichloro-ethylene	v	5.0 ug/L	7.0 ug/L
1,1-Dichloroethane	v	5.0 ug/L	None
Cis-1,2-Dichloro-ethylene	v	5.0 ug/L	70.0 ug/L
2,2-Dichloropropane	v	5.0 ug/L	None
Bromochloro-methane	v	5.0 ug/L	None
Chloroform	v	5.0 ug/L	100 ug/L*
1,1-Dichloro-propylene	v	5.0 ug/L	None
1,2-Dichloroethane	v	5.0 ug/L	5.0 ug/L
Methyl Ethyl Ketone	v	100 ug/L	None
1,1,1-Trichloro-ethane	v	5.0 ug/L	200 ug/L
Carbon Tetrachloride	v	5.0 ug/L	5.0 ug/L
Vinyl Acetate	v	50 ug/L	None
Bromodichloro-methane	v	5.0 ug/L	100 ug/L*
1,2-Dichloropropane	v	5.0 ug/L	5.0 ug/L
Trichloroethylene	v	5.0 ug/L	5.0 ug/L
Benzene	v	5.0 ug/L	5.0 ug/L
2-Chloroethyl Vinyl Ether	v	5.0 ug/L	None

VOLATILE ORGANIC COMPOUNDS (continued) *(Screen #10)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Cis-1,3-Dichloropropylene	v	5.0 ug/L	None
Trans-1,3-Dichloropropylene	v	5.0 ug/L	None
Chlorodibromo-methane	v	5.0 ug/L	100 ug/L*
1,1,2-Trichloroethane	v	5.0 ug/L	5.0 ug/L
Bromoform	v	5.0 ug/L	100 ug/L*
1,2,3-Trichloro-propane	v	5.0 ug/L	None
Methyl Isobutyl Ketone	v	50 ug/L	None
Methyl N-butyl Ketone	v	50 ug/L	None
Tetrachloroethylene	v	5.0 ug/L	5.0 ug/L
1,3-Dichloropropane	v	5.0 ug/L	None
1,1,2,2,-Tetra-chloroethane	v	5.0 ug/L	None
Toluene	v	5.0 ug/L	1000 ug/L
1,2-Dibromoethane	v	5.0 ug/L	0.05 ug/L
Chlorobenzene	v	5.0 ug/L	100 ug/L
Ethylbenzene	v	5.0 ug/L	700 ug/L
1,1,1,2-Tetra-chloroethane	v	5.0 ug/L	None
Styrene	v	5.0 ug/L	100 ug/L
Xylenes (total)	v	5.0 ug/L	10,000 ug/L

VOLATILE ORGANIC COMPOUNDS (continued) *(Screen #10)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Isopropylbenzene	v	5.0 ug/L	None
Bromobenzene	v	5.0 ug/L	None
N-Propylbenzene	v	5.0 ug/L	None
2-Chlorotoluene	v	5.0 ug/L	None
1,3,5-Trimethyl-benzene	v	5.0 ug/L	None
4-Chlorotoluene	v	5.0 ug/L	None
Tert-Butylbenzene	v	5.0 ug/L	None
1,2,4-Trimethyl-benzene	v	5.0 ug/L	None
Sec-Butylbenzene	v	5.0 ug/L	None
1,3-Dichlorobenzene (M)	v	5.0 ug/L	None
1,4-Isopropyltoluene	v	5.0 ug/L	None
1,4-Dichlorobenzene (P)	v	5.0 ug/L	75.0 ug/L
N-Butylbenzene	v	5.0 ug/L	None
1,2-Dichlorobenzene (O)	v	5.0 ug/L	600 ug/L
1,2-Dibromo-3-Chloropropane	v	5.0 ug/L	0.2ug/L
1,2,4-Trichlorobenzene	v	5.0 ug/L	70.0 ug/L
Hexachlorobutadi-ene	v	5.0 ug/L	None

VOLATILE ORGANIC COMPOUNDS (continued) *(Screen #10)*			
Parameter	**Type of Test**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Naphthalene	v	5.0 ug/L	None
1,2,3-Trichlorobenzene	v	5.0 ug/L	None
Cyclopentane**	v		None
Methylcyclo-pentane**	v		None
Methyl-Tert-Butyl Ether**	v		None
Methyl-Tert-Amyl Ether**	v		None

* *Indicates a trihalomethane compound. The primary MCL for total trihalomethanes is 100 ug/L.*

** *No actual method detection limit for compound. Concentration is estimated.*

MERCURY			
Parameter	**Test Method**	**Method Detection Limit**	**Primary Maximum Contaminant Level**
Mercury (Hg)	EPA 245.2	0.2 ug/L	2.0 ug/L

Table A-3. 1996-1997 Ground-Water Quality Analyses of the Cretaceous Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-K1		4.53	2.1	5U	2.5	1.0	16	10U	33	76	2900	2.4	0.2	27	0.3	74	Y=33	b,c,v
	Well Name:		Englehard Kaolin Company #2															
	County:		Wilkinson															
	Date Sampled:		1997/05/29															
GWN-K2		--	1.5	5U	1.1	1U	10U	10U	35	10U	50U	2.2	0.1U	4.3	0.3	30		b,c,v
	Well Name:		Irwinton #2															
	County:		Wilkinson															
	Date Sampled:		1996/08/19															
GWN-K2		4.46	1.5	5U	1.1	1U	10U	10U	39	10U	50U	2.1	0.1U	4.1	0.3	27	Cu=22	b,c,v
	Well Name:		Irwinton #2															
	County:		Wilkinson															
	Date Sampled:		1997/05/29															
GWN-K3		6.10	2.0	5U	17	1.4	56	24	520	32	50U	2.4	0.1U	7.7	0.2U	100		v
	Well Name:		Sandersville #7B															
	County:		Washington															
	Date Sampled:		1997/05/29															
GWN-K5		4.88	1.8	5U	1U	1U	10U	10U	20U	10U	50U	1.67	0.1U	1U	0.8	18	Cu=31	b,c,s,v
	Well Name:		Richmond County #101															
	County:		Richmond															
	Date Sampled:		1996/01/29															
GWN-K5		4.99	1.8	5U	1U	1U	10U	10U	20U	10U	50U	1.58	0.1U	1U	0.9	18		b,c,s,v,Hg
	Well Name:		Richmond County #101															
	County:		Richmond															
	Date Sampled:		1996/06/05															
GWN-K5		4.85	1.4	5U	1U	1U	10U	10U	20U	10U	50U	1.9	0.1U	2U	1.0	21		a,b,c,v
	Well Name:		Richmond County #101															
	County:		Richmond															
	Date Sampled:		1997/08/26															
GWN-K6		5.59	2.9	5U	4.0	1U	47	14	20U	10U	50U	2.5	0.1U	4.9	0.2U	41		
	Well Name:		J.M. Huber #6															
	County:		Twiggs															
	Date Sampled:		1997/06/25															

Table A-3 (Continued). 1996-1997 Ground-Water Quality Analyses of the Cretaceous Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-K7		5.30	1.4	5U	1.7	1U	10	13	20U	10U	50U	2.4	0.1U	2U	0.2U	21		
	Well Name:		Jones County #4															
	County:		Jones															
	Date Sampled:		1997/06/15															
GWN-K8		7.01	2.2	5U	41	1.6	160	78	3000	36	50U	2.0	0.1U	13.0	0.2U	233		v
	Well Name:		Mohawk Carpet #3															
	County:		Laurens															
	Date Sampled:		1997/12/17															
GWN-K9		4.16	1U	5U	1U	1U	10U	10U	420	10U	470	1.6	0.1U	9.3	0.2U	49		
	Well Name:		Marshallville #1															
	County:		Macon															
	Date Sampled:		1996/08/20															
GWN-K10A		4.94	1.1	5U	1U	1U	10U	10U	20U	10U	50U	1.4	0.1U	2U	0.4	19		b,c,v
	Well Name:		Fort. Valley #5															
	County:		Peach															
	Date Sampled:		1997/12/16															
GWN-K11A		4.59	1.4	5U	1U	1U	10U	10U	20U	10U	50U	1.6	0.1U	2U	0.8	19f	Br=800	b,c,v
	Well Name:		Warner Robins #2															
	County:		Houston															
	Date Sampled:		1997/02/20															
GWN-K11A		4.93	1.4	5U	1U	1U	10U	10U	41	10U	50U	1.7	0.1U	2U	0.8	20		b,c,v
	Well Name:		Warner Robins #2															
	County:		Houston															
	Date Sampled:		1997/12/16															
GWN-K12		4.14	1.0	5U	1U	1U	10U	10U	140	12	390	1.7	0.1U	9.4	0.2U	52	Zn=50	a,b,c,5,v
	Well Name:		Perry/Holiday Inn Well															
	County:		Houston															
	Date Sampled:		1997/12/16															
GWN-K13		9.07	40	5U	2.0	1U	36	10U	20U	10U	50U	9.0	0.3	8.4	0.2U	203		
	Well Name:		Omaha #1															
	County:		Stewart															
	Date Sampled:		1996/08/21															

Table A-3 (Continued). 1996-1997 Ground-Water Quality Analyses of the Cretaceous Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Screens Tested
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-K15		9.32	72	5U	1U	1U	13	10U	20U	10U	50U	7.8	0.4	1.6	0.2U	337		
	Well Name:		Georgetown #2															
	County:		Quitman															
	Date Sampled:		1996/08/21															
GWN-K16		5.40	5.0	5U	1U	1U	10U	10U	20U	10U	50U	2.2	0.1U	2.5	0.5	30f		b,c,v
	Well Name:		Tenneco Packaging North Well															
	County:		Bibb															
	Date Sampled:		1997/02/20															
GWN-K16		5.27	6.0	5U	1U	1U	10U	10U	49	10U	50U	2.5	0.1U	3.6	0.6	35		b,c,v
	Well Name:		Tenneco Packaging North Well															
	County:		Bibb															
	Date Sampled:		1997/12/16															
GWN-K18A		4.97	1.1	5U	1.9	1U	10U	10U	20U	10U	50U	--	--	--	0.2U	21f		b,c,v
	Well Name:		Buena Vista #6															
	County:		Marion															
	Date Sampled:		1996/08/20															
GWN-K19		4.95	1.5	5U	1U	1U	10U	10U	20U	10U	50U	1.41	0.1U	1.60	0.2U	14		v
	Well Name:		Hephzibah Murphy St. Well															
	County:		Richmond															
	Date Sampled:		1996/06/06															

Table A-4. 1996-1997 Ground-Water Quality Analyses of the Providence Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Screens Tested
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PD2		5.86	4.3	5U	4.4	1U	13	19	890	44	50U	2.5	0.5	1.1	0.7	51	Cu=25 Zn=28	v
	Well Name:		Preston #2															
	County:		Webster															
	Date Sampled:		1996/08/21															
GWN-PD2		5.72	1.6	5U	5.1	1U	14	22	180	10U	50U	2.7	0.3	2U	1.0	45f	Cu=53	v
	Well Name:		Preston #2															
	County:		Webster															
	Date Sampled:		1997/08/19															
GWN-PD3		8.49	76	5U	5.9	1.1	96	10U	20U	10U	50U	9.4	0.7	9.2	0.2U	362f		
	Well Name:		Ft. Gaines #2															
	County:		Clay															
	Date Sampled:		1997/08/20															

Table A-5. 1996-1997 Ground-Water Quality Analyses of the Clayton Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-CT2A		7.79	5.0	5U	40	2.8	250	10U	130	10U	50U	1.4	0.1	16.8	0.2U	241		a,b,c,d
	Well Name:		Burton Thomas Residence Well															
	County:		Sumter															
	Date Sampled:		1997/10/29															
GWN-CT3		7.70	6.5	5U	39 •	4.2	400	10U	34	10U	50U	1.8	0.1	12.5	0.2U	256		v
	Well Name:		Dawson Crawford St. Well															
	County:		Terrell															
	Date Sampled:		1997/10/29															
GWN-CT5A		7.73	1.6	5U	44	3.8	150	15	150	34	50U	1.8	0.1U	11.4	0.2U	247		a,b,c,d,v
	Well Name:		Cuthbert #3															
	County:		Randolph															
	Date Sampled:		1997/10/30															
GWN-CT7A		4.57	1.9	5U	3.7	4.2	50	24	49	13	220	8.7	0.1U	2U	5.6	94		a,b,c,d,v
	Well Name:		St. John Farm Well															
	County:		Sumter															
	Date Sampled:		1997/10/29															
GWN-CT8		4.78	2.3	5U	1U	1U	10U	10U	20U	12	50U	3.0	0.1U	1U	0.8	25		a,b,c,5,v
	Well Name:		Weathersby house well															
	County:		Schley															
	Date Sampled:		1996/10/31															
GWN-CT8		4.87	2.0	5U	1U	1U	10U	10U	20U	13	50U	2.8	0.1U	2U	0.8	25		a,b,c,d,v
	Well Name:		Weathersby house well															
	County:		Schley															
	Date Sampled:		1997/10/29															

Table A-6. 1996-1997 Ground-Water Quality Analyses of the Claiborne Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-CL2		7.23	1.2	5U	41	1U	99	11	20U	10U	50U	1.60	0.1U	6.5	0.2	194f		
	Well Name:		Unadilla #3															
	County:		Dooly															
	Date Sampled:		1997/08/19															
GWN-CL4		4.62	3.8	5U	1.8	1.1	14	16	20U	55	50U	5.8	0.1U	2U	2.8	53	Zn=38	a,b,c,5,v
	Well Name:		Plains #3															
	County:		Sumter															
	Date Sampled:		1996/08/21															
GWN-CL4		4.57	4.1	5U	2.3	1.5	17	20	20U	75	50U	6.2	0.1U	2U	3.5	62f	Y=14 benzene=59.3 methyl tert-butyl ether=144 methyl tert-amyl ether=6 1,2,4-trimethylbenzene= 5.62 cyclopentane=3.0 methylcyclopentane=4 o-xylene=12.9 naphthalene=tr 2-propylbenzene=tr	a,b,c,d,v
	Well Name:		Plains #3															
	County:		Sumter															
	Date Sampled:		1997/08/19															
GWN-CL6		7.66	20	5U	34	7.9	430	10U	61	10U	50U	3.7	0.1	3.7	0.2U	303f	Be=7.3	
	Well Name:		Georgia Tubing Company Well															
	County:		Early															
	Date Sampled:		1997/08/20															
GWN-CL6		7.83	20	5U	35	7.6	410	10U	66	10U	50U	3.7	0.2	3.7	0.2U	192		
	Well Name:		Georgia Tubing Company Well															
	County:		Early															
	Date Sampled:		1997/11/06															
GWN-CL8		6.23	1.7	5U	12	1.2	44	36	930	49	50U	1.5	0.1U	8.3	0.2U	86f		a,b,c,v
	Well Name:		Flint River Nursery Office Well															
	County:		Dooly															
	Date Sampled:		1997/08/19															

Table A-6 (Continued). 1996-1997 Ground-Water Quality Analyses of the Claiborne Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-CL9		7.91	24	5U	24	6.1	350	10U	25	10U	50U	12.5	0.18	7.0	0.2U	261		a,b,c,5,v
	Well Name:		Newton #3															
	County:		Baker															
	Date Sampled:		1996/10/30															
GWN-CL9		7.91	22	5U	25	6.5	350	10U	25	10U	50U	2.4	0.1	6.6	0.2U	266		a,b,c,d,v
	Well Name:		Newton #3															
	County:		Baker															
	Date Sampled:		1997/10/30															

Table A-7. 1996-1997 Ground-Water Quality Analyses of the Jacksonian Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-J1B		7.29	4.1	5U	55	1U	25	21	20U	10U	50U	8.01	0.1U	1U	2.2	234		a,b,c,5
	Well Name:		Quick house well															
	County:		Burke															
	Date Sampled:		1996/06/06															
GWN-J1B		7.08	3.5	5U	52	1U	23	20	28	10U	50U	8.0	0.1U	2U	2.4	270		a,b,c,d,v
	Well Name:		Quick house well															
	County:		Burke															
	Date Sampled:		1997/08/26															
GWN-J2A		7.24	1.3	5U	47	1U	55	59	20U	10U	50U	1.9	0.1U	2U	0.5	231	Zn=20	a,b,c,d,v
	Well Name:		Oakwood Village Mobile Home Park #2															
	County:		Burke															
	Date Sampled:		1997/08/27															
GWN-J3		7.80	10	5U	35	5.7	280	670	79	130	50U	6.7	0.1U	1U	0.2U	211		a,b,c,5,v
	Well Name:		Black house well															
	County:		Emanuel															
	Date Sampled:		1996/06/05															
GWN-J4		7.55	3.0	5U	46	2.4	180	10U	23	10U	50U	2.6	0.2	6.8	0.2U	247		a,b,c,v
	Well Name:		Wrightsville #4															
	County:		Johnson															
	Date Sampled:		1997/08/27															
GWN-J5		7.33	2.9	5U	65	2.4	200	10U	20U	24	50U	2.5	0.2	12	0.2U	316		a,b,c,5,v
	Well Name:		Cochran #3															
	County:		Bleckley															
	Date Sampled:		1997/06/25															
GWN-J6		6.86	1.5	5U	32	1.1	110	11	160	10U	50U	1.9	0.1U	8.9	0.2U	164		a,b,c
	Well Name:		Wrens #3															
	County:		Jefferson															
	Date Sampled:		1997/08/26															
GWN-J7		4.77	3.7	5U	2.8	1.6	18	27	20U	16	63	6.56	0.1U	1U	3.2	48	Zn=47	a,b,5,d
	Well Name:		Templeton livestock well															
	County:		Burke															
	Date Sampled:		1996/06/06															

Table A-7 (Continued). 1996-1997 Ground-Water Quality Analyses of the Jacksonian Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-J8		4.44	5.4	5U	9.6	1.6	20	41	1300	79	88	8.9	0.1U	1U	8.2	92	Be=5.0 Cd=2.0 Zn=35	a,b,c,5
	Well Name:	Kahn house well																
	County:	Jefferson																
	Date Sampled:	1996/06/06																
GWN-J8		4.96	5.1	5U	11	2.0	23	50	200	93	200	9.4	0.1U	2U	8.5	21	Ni=21 Zn=110	a,b,c
	Well Name:	Kahn house well																
	County:	Jefferson																
	Date Sampled:	1997/08/26																

Table A-8. 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PA1		7.94	56	5U	22	12	290	10U	40U	10U	50U	94.4	0.52	20.1	0.2U	629		
	Well Name:		Thunderbolt #1															
	County:		Chatham															
	Date Sampled:		1996/09/25															
GWN-PA2		8.02	15	5U	24	7.9	310	11	40U	10U	50U	6.72	0.37	6.19	0.2U	225		
	Well Name:		Savannah #13															
	County:		Chatham															
	Date Sampled:		1996/09/25															
GWN-PA3		7.97	9.6	5U	28	7.1	300	20	70	10U	50U	5.40	0.34	6.02	0.2U	221		
	Well Name:		Grist Equipment Co. shop well															
	County:		Chatham															
	Date Sampled:		1996/09/25															
GWN-PA4		7.93	53	5U	33	25	1300	10U	40U	10U	50U	45.1	0.74	126	0.2U	580	Zn=32	
	Well Name:		Tybee Island #1															
	County:		Chatham															
	Date Sampled:		1996/10/24															
GWN-PA5A		8.03	17	5U	26	14	420	30	20U	10U	50U	5.80	0.53	36.4	0.2U	298		v
	Well Name:		Interstate Paper #2															
	County:		Liberty															
	Date Sampled:		1996/01/25															
GWN-PA6		8.10	15	5U	23	12	360	22	20U	10U	50U	4.70	0.50	24.8	0.2U	212		v
	Well Name:		Hinesville #5															
	County:		Liberty															
	Date Sampled:		1996/01/25															
GWN-PA7		7.97	25	5U	44	27	710	51	150	10U	50U	12.1	0.30	71.6	0.2U	423		v
	Well Name:		Darien #2 South															
	County:		McIntosh															
	Date Sampled:		1996/01/25															
GWN-PA8		7.75	17	5U	30	16	520	69	20U	10U	50U	3.55	0.27	27.3	0.2U	346		v
	Well Name:		ITT Rayonier #4D															
	County:		Wayne															
	Date Sampled:		1996/01/25															

Table A-8 (Continued). 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PA9C		8.45	31	5U	34	24	760	24	43	15	50U	16.8	0.26	49.2	0.2U	471		v
	Well Name:		Miller Ball Park TW25															
	County:		Glynn															
	Date Sampled:		1996/01/26															
GWN-PA9C		8.43	19	5U	36	26	740	35	47	20	50U	23.4	0.53	94.6	0.2U	466		v
	Well Name:		Miller Ball Park TW25															
	County:		Glynn															
	Date Sampled:		1997/01/30															
GWN-PA10B		7.56	69	5U	72	41	760	37	26	10U	50U	25.0	0.14	35.7	0.2U	726		
	Well Name:		Gilman Paper #11															
	County:		Camden															
	Date Sampled:		1996/01/24															
GWN-PA10B		7.43	74	5U	73	42	780	38	20U	10U	50U	135	0.1U	185	0.2U	1062		
	Well Name:		Gilman Paper #11															
	County:		Camden															
	Date Sampled:		1997/01/29															
GWN-PA11		7.64	24	5U	69	36	630	33	20U	10U	50U	8.5	0.18	44.9	0.2U	689		v
	Well Name:		St. Marys #2															
	County:		Camden															
	Date Sampled:		1996/01/24															
GWN-PA11		7.52	23	5U	67	36	630	33	20U	10U	50U	30.7	0.35	178	0.2U	704		v
	Well Name:		St. Marys #2															
	County:		Camden															
	Date Sampled:		1997/01/29															
GWN-PA12		7.62	23	5U	64	29	510	32	67	10U	50U	7.76	0.13	34.5	0.2U	602		
	Well Name:		Folkston #3															
	County:		Charlton															
	Date Sampled:		1996/01/24															
GWN-PA12		7.46	22	5U	65	29	510	32	23	10U	50U	27.4	0.33	133	0.2U	640		v
	Well Name:		Folkston #3															
	County:		Charlton															
	Date Sampled:		1997/01/29															

Table A-8 (Continued). 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PA13		7.82	17	5U	39	17	340	70	20U	10U	50U	13.0	0.32	52	0.2U	378		v
	Well Name:		Waycross #3															
	County:		Ware															
	Date Sampled:		1996/01/24															
GWN-PA13		7.79	16	5U	39	17	330	69	20U	10U	50U	13.9	0.58	51.8	0.2U	388		v
	Well Name:		Waycross #3															
	County:		Ware															
	Date Sampled:		1997/01/29															
GWN-PA14		8.05	8.2	5U	31	5.0	200	32	20U	10U	50U	2.96	0.43	6.23	0.2U	217		v
	Well Name:		Statesboro #7															
	County:		Bulloch															
	Date Sampled:		1996/01/30															
GWN-PA15		8.12	8.9	5U	24	8.4	400	10U	24	10U	50U	2.39	0.34	7.16	0.2U	221		v
	Well Name:		King Finishing Co. fire well															
	County:		Screven															
	Date Sampled:		1996/01/30															
GWN-PA16		7.77	5.3	5U	41	3.0	190	10U	20U	30	50U	5.51	0.1U	7.48	0.2U	259	Cu=28	
	Well Name:		Millen #1															
	County:		Jenkins															
	Date Sampled:		1996/01/30															
GWN-PA16		7.75	4.6	5U	44	3.0	190	10U	20U	12	50U	4.97	0.11	7.94	0.2U	270		
	Well Name:		Millen #1															
	County:		Jenkins															
	Date Sampled:		1997/01/28															
GWN-PA17		7.78	4.6	5U	46	1.7	140	170	110	10U	140	2.94	0.62	1.32	0.2U	241		
	Well Name:		Swainsboro #7															
	County:		Emanuel															
	Date Sampled:		1996/01/31															
GWN-PA17		7.77	3.7	5U	44	1.6	130	170	20U	10U	50U	2.97	0.76	2U	0.2U	248		
	Well Name:		Swainsboro #7															
	County:		Emanuel															
	Date Sampled:		1997/01/28															

Table A-8 (Continued). 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PA18		8.02	11	5U	27	3.2	240	25	20U	52	50U	3.53	0.19	3.74	0.2U	212		v
	Well Name:		Metter #2															
	County:		Candler															
	Date Sampled:		1996/01/30															
GWN-PA18		7.99	9.9	5U	29	3.3	240	24	20U	56	50U	3.48	0.17	3.75	0.2U	216		v
	Well Name:		Metter #2															
	County:		Candler															
	Date Sampled:		1997/01/28															
GWN-PA19		7.34	11	5U	45	18	440	55	53	25	50U	7.4	0.29	82	0.2U	415f		v
	Well Name:		Douglas #4															
	County:		Coffee															
	Date Sampled:		1997/02/19															
GWN-PA20		7.65	5.4	5U	44	16	190	28	20U	10U	50U	2.87	0.23	73.96	0.2U	349		
	Well Name:		Lakeland #2															
	County:		Lanier															
	Date Sampled:		1996/02/29															
GWN-PA20		7.64	4.6	5U	45	16	190	27	78	10U	50U	3.1	0.2	67	0.2U	330		v
	Well Name:		Lakeland #2															
	County:		Lanier															
	Date Sampled:		1997/04/02															
GWN-PA21A		7.73	3.6	5U	37	9.5	140	16	45	26	50U	2.85	0.22	42.81	0.2U	262		
	Well Name:		Valdosta New #4															
	County:		Lowndes															
	Date Sampled:		1996/02/29															
GWN-PA22		7.71	7.6	5U	44	20	330	23	20U	10U	50U	6.32	0.39	76.41	0.2U	386		
	Well Name:		Thomasville #6															
	County:		Thomas															
	Date Sampled:		1996/02/28															
GWN-PA23		7.81	10	5U	35	17	340	130	20U	10U	50U	5.9	0.4	38	0.2U	349f	Mo=53	
	Well Name:		Cairo #8															
	County:		Grady															
	Date Sampled:		1997/08/21															

Table A-8 (Continued). 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER Well ID#	UNITS	pH SU	Na mg/L	K mg/L	Ca mg/L	Mg mg/L	Sr ug/L	Ba ug/L	Fe ug/L	Mn ug/L	Al ug/L	Cl mg/L	F mg/L	SO4 mg/L	Nitrate/ Nitrite mgN/L	Conduc-tivity umho/cm	Other Parameters Detected ug/L	Other Tests
GWN-PA24	Well Name: Bainbridge #1 County: Decatur Date Sampled: 1996/03/27	7.90	2.7	5U	40	3.2	36	10U	20U	10U	50U	3.0	0.1U	1.3	1.6	210		a,b,c,5,v
GWN-PA25	Well Name: Donalsonville 7th Street Well County: Seminole Date Sampled: 1996/03/27	7.73	4.5	5U	57	1U	24	10U	20U	10U	50U	4.6	0.1U	4.5	1.6	274		a,b,c,5,v
GWN-PA25	Well Name: Donalsonville 7th Street Well County: Seminole Date Sampled: 1997/06/26	7.58	3.5	5U	55	1U	23	10U	20U	10U	50U	4.7	0.1U	2U	1.6	270		a,b,c,5,v
GWN-PA26	Well Name: Colquitt #3 County: Miller Date Sampled: 1996/03/27	7.67	2.8	5U	46	1U	18	10U	20U	10U	50U	3.1	0.1U	1U	1.8	218		a,b,c,5,v
GWN-PA27	Well Name: Camilla New Well County: Mitchell Date Sampled: 1997/06/26	7.56	1.7	5U	45	1.2	34	10	20U	10U	50U	2.6	0.1U	2U	0.5	216		a,b,c,5,s,v
GWN-PA28	Well Name: Moultrie #1 County: Colquitt Date Sampled: 1996/02/26	7.91	27	5U	37	21	2000	91	20U	10U	50U	9.81	0.59	128.86	0.2U	460		
GWN-PA29	Well Name: Adel #6 County: Cook Date Sampled: 1996/02/28	7.87	4.2	5U	43	15	300	14	76	33	50U	3.36	0.21	56.62	0.2U	334		
GWN-PA30	Well Name: Amoco/Nashville Mills #2 County: Berrien Date Sampled: 1996/02/29	7.74	5.6	5U	40	16	230	54	36	10U	50U	3.93	0.26	69.99	0.2U	338		

Table A-8 (Continued). 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PA31		---	2.4	5U	43	7.9	260	65	20U	10U	50U	2.2	0.1U	2U	0.2U	254		
	Well Name:		Tifton #6															
	County:		Tift															
	Date Sampled:		1997/04/03															
GWN-PA32		7.81	2.3	5U	33	4.7	150	75	130	27	50U	2.4	0.1U	2U	0.2U	203f		v
	Well Name:		Ocilla #3															
	County:		Irwin															
	Date Sampled:		1997/02/19															
GWN-PA33A		7.84	3.4	5U	31	6.2	200	400	52	19	50U	1.89	0.16	2U	0.2U	187	Zn=64	v
	Well Name:		Fitzgerald Well G															
	County:		Ben Hill															
	Date Sampled:		1996/07/09															
GWN-PA33A		7.85	3.1	5U	32	6.1	200	380	20U	10U	50U	2.7	0.24	2U	0.2U	210f		v
	Well Name:		Fitzgerald Well G															
	County:		Ben Hill															
	Date Sampled:		1997/02/19															
GWN-PA34		7.66	6.4	5U	48	8.9	590	360	190	100	50U	6.5	0.2	3.5	0.2U	320		v
	Well Name:		McRae Telfair Ave. Well															
	County:		Telfair															
	Date Sampled:		1997/12/17															
GWN-PA35		7.86	5.5	5U	29	12	440	89	61	30	50U	3.3	0.3	7.6	0.2U	258		
	Well Name:		Mt. Vernon New Well															
	County:		Montgomery															
	Date Sampled:		1997/12/17															
GWN-PA36		7.85	10	5U	28	5.3	340	140	20U	11	50U	3.7	0.3	3.7	0.2U	214		
	Well Name:		Vidalia #1															
	County:		Toombs															
	Date Sampled:		1997/08/27															
GWN-PA38		7.65	1.9	5U	44	1.4	85	110	20U	10U	50U	2.3	0.1U	2U	0.2	207		v
	Well Name:		Eastman #4															
	County:		Dodge															
	Date Sampled:		1997/08/25															

Table A-8 (Continued). 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PA39		7.56	3.4	5U	46	7.0	360	200	20U	10U	50U	3.7	0.2	4.5	0.2U	258		v
	Well Name:		Sylvester #1															
	County:		Worth															
	Date Sampled:		1997/05/28															
GWN-PA40		7.56	3.4	5U	59	1.1	49	16	20U	10U	50U	3.5	0.1U	2U	1.8	283		v
	Well Name:		Merck and Co. #8															
	County:		Dougherty															
	Date Sampled:		1996/03/28															
GWN-PA40		7.41	2.4	5U	57	1.2	49	16	20U	10U	50U	3.9	0.2U	1.7	2.0	269		v
	Well Name:		Merck and Co. #8															
	County:		Dougherty															
	Date Sampled:		1997/05/28															
GWN-PA43A		7.55	3.1	5U	52	1U	32	10U	20U	10U	50U	4.99	0.1U	1U	2.5	253	Zn=20	a,b,c,5,v
	Well Name:		Pineland Fish Farm office well															
	County:		Baker															
	Date Sampled:		1996/05/22															
GWN-PA43A		7.61	2.1	5U	51	1U	32	10U	20U	10U	50U	5.4	0.1U	2U	2.6	237		a,b,c,5,v
	Well Name:		Pineland Fish Farm office well															
	County:		Baker															
	Date Sampled:		1997/05/28															
GWN-PA44		---	2.1	5U	30	4.0	270	140	30	10U	50U	1.9	0.1	2U	0.2U	177		v
	Well Name:		Sycamore #2															
	County:		Turner															
	Date Sampled:		1997/05/02															
GWN-PA45A		7.47	2.6	5U	54	1.0	65	66	31	10U	50U	2.30	0.1U	2U	0.4	251		v
	Well Name:		Abbeville #1															
	County:		Wilcox															
	Date Sampled:		1996/05/22															
GWN-PA45A		7.45	1.7	5U	52	1U	63	60	57	10U	50U	3.0	0.1U	2U	0.4	252f		v
	Well Name:		Abbeville #1															
	County:		Wilcox															
	Date Sampled:		1997/02/19															

Table A-8 (Continued). 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PA46B		7.29	3.3	5U	47	1.2	31	45	20U	10U	50U	6.66	0.1U	1.88	4.6	227		a,b,c,5,v
	Well Name:		Wenona Mobile Home Park Well															
	County:		Crisp															
	Date Sampled:		1996/06/12															
GWN-PA46B		7.59	3.2	5U	58	1.3	36	54	20U	10U	50U	6.1	0.1U	2U	3.6	250f		a,b,c,5,v
	Well Name:		Wenona Mobile Home Park Well															
	County:		Crisp															
	Date Sampled:		1997/08/21															
GWN-PA49		7.77	2.4	5U	40	1U	23	18	20U	10U	50U	2.23	0.1U	1U	1.9	192	Zn=24	a,b,c,5,v
	Well Name:		Harmony Church well															
	County:		Dooly															
	Date Sampled:		1996/03/28															
GWN-PA49		7.86	1.6	5U	38	1U	23	17	20U	10U	50U	2.6	0.1	2U	1.6	178		a,b,c,5,v
	Well Name:		Harmony Church well															
	County:		Dooly															
	Date Sampled:		1997/05/27															
GWN-PA50		7.58	3.6	5U	55	1.4	160	40	39	10U	50U	4.20	0.11	5.17	1.3	275		a,b,c,d,v
	Well Name:		Reynolds house well															
	County:		Laurens															
	Date Sampled:		1996/01/23															
GWN-PA50		7.45	2.5	5U	59	1.4	160	38	20U	10U	50U	4.00	0.1	5.0	1.1	309	Zn=20	a,b,c,d,v
	Well Name:		Reynolds house well															
	County:		Laurens															
	Date Sampled:		1997/09/23															
GWN-PA51		7.79	3.3	5U	47	1U	19	10U	20U	10U	50U	3.0	0.1U	1U	1.2	221	linuron=tr? Zn=28	a,b,c,5
	Well Name:		J.L. Adams house well															
	County:		Mitchell															
	Date Sampled:		1996/03/28															
GWN-PA51		7.14	2.6	5U	45	1U	19	10U	20U	10U	50U	2.99	0.1U	1U	1.2	198		a,b,c,5
	Well Name:		J.L. Adams house well															
	County:		Mitchell															
	Date Sampled:		1996/06/13															

Table A-8 (Continued). 1996-1997 Ground-Water Quality Analyses of the Floridan Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-PA51		7.57	2.0	5U	45	1U	18	10U	20U	10U	50U	3.1	0.1U	2U	0.9	210		a,b,c,5
	Well Name:		J.L. Adams house well															
	County:		Mitchell															
	Date Sampled:		1997/06/26															
GWN-PA52		7.88	2.0	5U	38	1U	21	10U	20U	10U	50U	3.9	0.1U	2U	3.4	193	Zn=29	a,b,c,5
	Well Name:		James Simmons house well															
	County:		Mitchell															
	Date Sampled:		1997/06/26															
GWN-PA53		7.81	2.3	5U	38	1.0	24	11	20U	10U	50U	5.2	0.1U	2U	4.7	215f	Zn=46	a,b,c,d
	Well Name:		Lorene Cato house well															
	County:		Decatur															
	Date Sampled:		1997/08/20															
GWN-PA55		7.75	3.4	5U	48	2.3	220	160	25	10U	50U	1.98	0.1U	4.61	0.2U	206	Zn=27	a,b,c,5
	Well Name:		W.A. Holland house well															
	County:		Burke															
	Date Sampled:		1996/06/05															
GWN-PA55		7.57	2.9	5U	48	2.4	220	160	20U	10U	50U	2.3	0.1	4.7	0.2U	160		a,b,c,d
	Well Name:		W.A. Holland house well															
	County:		Burke															
	Date Sampled:		1997/09/17															

Table A-9. 1996-1997 Ground-Water Quality Analyses of the Miocene Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-MI1		8.23	7.3	5U	22	13	120	20	20U	23	50U	2.63	0.45	4.58	0.2U	231		a,b,c,5,s
	Well Name:		McMillan house well															
	County:		Cook															
	Date Sampled:		1996/02/28															
GWN-MI1		7.84	6.5	5U	23	13	120	19	30	23	50U	2.7	0.4	4.5	0.2U	222		a,b,c,5,v
	Well Name:		McMillan house well															
	County:		Cook															
	Date Sampled:		1997/04/02															
GWN-MI2		5.60	2.3	5U	2.9	1U	10U	10U	20U	10U	50U	2.6	0.4	2U	0.2U	35		a,b,c,5,s,v
	Well Name:		Boutwell house well															
	County:		Lowndes															
	Date Sampled:		1997/04/02															
GWN-MI5		5.36	4.4	5U	5.1	2.5	36	86	20U	99	73	8.83	0.1U	2U	5.2	91		a,b,c
	Well Name:		Carter house well															
	County:		Appling															
	Date Sampled:		1997/01/28															
GWN-MI7		4.33	3.7	5U	4.5	4.0	45	68	20U	11	570	9.92	0.10	1U	8.1	122		a,b,c,v
	Well Name:		Chaudoin house well															
	County:		Irwin															
	Date Sampled:		1996/10/29															
GWN-MI8A		4.37	3.5	5U	6.3	5.1	58	130	20U	39	940	13.4	0.1U	1.07	10.3	154	Zn=21	a,b,c,5,v
	Well Name:		Barry house well															
	County:		Colquitt															
	Date Sampled:		1996/10/30															
GWN-MI9A		5.17	3.6	5.6	8.3	4.7	60	91	530	49	1600	10.8	0.1U	2U	10.6	144	Ti=98	a,b,c,5
	Well Name:		Murphy garden well															
	County:		Thomas															
	Date Sampled:		1996/10/30															
GWN-MI9A		5.28	2.5	5.5	6.3	3.4	41	65	70	23	220	8.6	0.1U	2U	7.0	111		a,b,c,d
	Well Name:		Murphy garden well															
	County:		Thomas															
	Date Sampled:		1997/10/30															

Table A-9 (Continued). 1996-1997 Ground-Water Quality Analyses of the Miocene Aquifer System.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-MI10B		6.61	7.2	5U	9.4	6.1	90	200	300	140	50U	2.80	0.56	2.14	0.2U	128		a,b,c,5,v
	Well Name:		Calhoun house well															
	County:		Colquitt															
	Date Sampled:		1996/10/30															
GWN-MI15		4.57	2.5	5U	10	7.9	100	61	40U	16	260	8.8	0.1U	1U	15.3	160		a,b,c,5
	Well Name:		Aldrich house well															
	County:		Bulloch															
	Date Sampled:		1996/09/26															

Table A-10. 1996-1997 Ground-Water Quality Analyses of the Piedmont/Blue Ridge Unconfined Aquifers.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-BR1B		7.18	3.6	5U	14	3.2	120	78	20U	10U	50U	1.09	0.1U	14.6	0.2U	127	Zn=24	v
	Well Name:		Young Harris New Well															
	County:		Towns															
	Date Sampled:		1996/08/17															
GWN-BR1B		7.80	3.6	5U	15	3.2	130	80	20U	10U	50U	1.3	0.1U	14.0	0.2U	125		v
	Well Name:		Young Harris New Well															
	County:		Towns															
	Date Sampled:		1997/07/30															
GWN-BR2A		4.92	3.1	5U	3.0	1.3	36	43	20U	15	50U	3.38	0.1U	1.78	1.1	52		v
	Well Name:		Notla Water Auth. #3															
	County:		Union															
	Date Sampled:		1996/08/14															
GWN-BR3A		4.71	3.6	5U	2.5	1.2	22	23	20U	60	50U	4.30	0.1U	1U	1.5	51		
	Well Name:		Dawsonville City Spring															
	County:		Dawson															
	Date Sampled:		1996/08/14															
GWN-BR4		6.21	8.3	5U	11	2.4	100	10U	20U	10U	50U	4.28	0.1U	1.98	1.8	88f		
	Well Name:		Morganton Old Well															
	County:		Fannin															
	Date Sampled:		1996/10/16															
GWN-P1B		5.54	9.4	5U	8.0	2.5	96	10	2100	62	50U	6.72	0.10	19.0	0.2U	113		
	Well Name:		Luthersville New Well															
	County:		Meriwether															
	Date Sampled:		1996/08/22															
GWN-P4C		6.21	6.7	5U	5.3	1U	59	22	7100	46	50U	1.7	0.1U	2U	1.8	71	Cu=40 Zn=140	
	Well Name:		Barton Brands #3															
	County:		Fulton															
	Date Sampled:		1997/05/21															
GWN-P5		6.60	1.7	5U	24	4.0	88	29	20U	10U	50U	1.71	0.1U	1.88	0.5	158		v
	Well Name:		Flowery Branch #1															
	County:		Hall															
	Date Sampled:		1996/10/23															

Table A-10 (Continued). 1996-1997 Ground-Water Quality Analyses of the Piedmont/Blue Ridge Unconfined Aquifers.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-P6A		7.40	7.7	5U	17	2.4	45	10U	48	99	50U	2.3	0.2	6.2	0.2U	143		
	Well Name:		Shiloh #1															
	County:		Harris															
	Date Sampled:		1996/08/20															
GWN-P7		5.71	8.3	5U	11	4.6	76	61	20U	10U	50U	2.85	0.1U	3.30	0.3	125		v
	Well Name:		Hampton #6															
	County:		Henry															
	Date Sampled:		1996/07/02															
GWN-P8		6.84	8.8	5U	27	8.1	72	10U	20U	10U	50U	11.8	0.22	6.01	0.5	234		
	Well Name:		Wayne Poultry #4															
	County:		Jackson															
	Date Sampled:		1996/10/24															
GWN-P9		6.12	12.0	5U	16	8.1	120	30	1400	180	53	6.7	0.1	53.00	0.2U	193	Co=11	
	Well Name:		Gray #4														Ni=21	
	County:		Jones														Zn=26	
	Date Sampled:		1997/05/29															
GWN-P10A		6.68	5.8	5U	5.0	3.2	59	16	17000	110	3600	2.61	0.13	12.8	0.2U	89	Be=8.7	v
	Well Name:		Franklin Springs #4														Zn=530	
	County:		Franklin															
	Date Sampled:		1996/10/23															
GWN-P10B		5.73	5.6	5U	9.7	5.2	87	18	21000	200	50U	2.9	0.12	64	0.2U	250	Au=13	v
	Well Name:		Franklin Springs #9														Be=2.3	
	County:		Franklin														Co=11	
	Date Sampled:		1997/12/04														Ni=21	
																	Zn=180	
GWN-P11A		6.56	6.4	5U	12	5.0	33	10U	200	25	50U	2.5	0.11	6.37	0.2U	130		
	Well Name:		Danielsville #2															
	County:		Madison															
	Date Sampled:		1996/10/23															
GWN-P12A		6.41	36	5U	16	2.5	160	10U	20U	20	50U	9.57	4.11	25.0	0.2U	225		
	Well Name:		Indian Spring															
	County:		Butts															
	Date Sampled:		1996/06/10															

Table A-10 (Continued). 1996-1997 Ground-Water Quality Analyses of the Piedmont/Blue Ridge Unconfined Aquifers.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-P13A		4.80	6.6	5U	4.3	1.1	38	28	20U	10U	50U	7.65	0.1U	1.59	0.6	56		
	Well Name:		Covington/Academy Spring															
	County:		Newton															
	Date Sampled:		1996/06/10															
GWN-P14		5.03	1.2	5U	1U	1U	10U	30	20U	10U	50U	1.9	0.1U	1U	0.3	19		
	Well Name:		Upson County Sunset Village well															
	County:		Upson															
	Date Sampled:		1996/08/20															
GWN-P15A		6.46	8.5	5.1	20	5.0	100	69	480	110	50U	7.64	0.13	7.49	0.2U	164	Cu=29 Zn=34	v
	Well Name:		Bolton garden well															
	County:		DeKalb															
	Date Sampled:		1996/06/12															
GWN-P15A		7.10	7.7	5.1	19	4.7	96	64	380	96	50U	6.1	0.1	7.4	0.2U	178	Zn=29	
	Well Name:		Bolton garden well															
	County:		DeKalb															
	Date Sampled:		1997/05/21															
GWN-P16C		5.65	1.8	5U	5.7	1.4	39	10U	500	42	50U	0.99	0.1U	6.35	0.2U	57		v
	Well Name:		Mt. Airy #4															
	County:		Habersham															
	Date Sampled:		1996/08/13															
GWN-P16C		6.03	1.5	5U	4.0	1.4	29	10U	130	25	50U	1.0	0.1U	6.8	0.2U	47		v
	Well Name:		Mt. Airy #4															
	County:		Habersham															
	Date Sampled:		1997/07/30															
GWN-P17		7.32	7.3	5U	27	2.2	130	11	470	120	50U	2.98	0.15	14.1	0.2U	186	Zn=29	a,b,c,5,v
	Well Name:		Oconee County Hillcrest #2															
	County:		Oconee															
	Date Sampled:		1996/11/18															
GWN-P17		7.13	7.2	5U	28	2.3	130	11	560	130	50U	3.1	0.1	14.1	0.2U	187		a,b,c,d,v
	Well Name:		Oconee County Hillcrest #2															
	County:		Oconee															
	Date Sampled:		1997/10/23															

Table A-11. 1996-1997 Ground-Water Quality Analyses of the Valley and Ridge Unconfined Aquifers.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc-tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-VR1		7.54	1.4	5U	27	15	15	10U	20U	10U	50U	2.1	0.1U	1.6	0.6	242		v
	Well Name:		Floyd County Kingston Rd, Well															
	County:		Floyd															
	Date Sampled:		1997/07/29															
GWN-VR3		6.85	1U	5U	28	12	21	68	20U	10U	50U	1.71	0.1U	2.53	0.7	68		v
	Well Name:		Chickamauga Crawfish Spring															
	County:		Walker															
	Date Sampled:		1996/08/15															
GWN-VR4		6.95	39	5U	67	16	460	110	81	18	50U	80.8	0.2	30.2	0.2U	699		v
	Well Name:		Coats-American #3															
	County:		Walker															
	Date Sampled:		1996/08/15															
GWN-VR5		6.70	4.5	5U	71	3.4	160	93	20U	10U	50U	7.62	0.1U	3.74	3.1	413		v
	Well Name:		Chattooga County #4															
	County:		Chattooga															
	Date Sampled:		1996/08/15															
GWN-VR5		7.09	4.5	5U	75	3.6	160	95	20U	10U	50U	7.1	0.1U	3.8	3.0	403		v
	Well Name:		Chattooga County #4															
	County:		Chattooga															
	Date Sampled:		1997/07/29															
GWN-VR6		7.71	4.8	5U	28	16	200	560	20U	10U	50U	4.0	0.1U	5.1	1.0	275		v
	Well Name:		Chemical Products Corp. East Well															
	County:		Bartow															
	Date Sampled:		1997/07/28															
GWN-VR7		7.00	1U	5U	27	13	21	29	20U	10U	50U	1.29	0.1U	3.74	0.3	244		v
	Well Name:		Adairsville/Lewis Spring															
	County:		Bartow															
	Date Sampled:		1996/08/15															
GWN-VR8		7.60	1.4	5U	33	15	19	12	20U	10U	50U	1.9	0.4	2.3	0.6	269		v
	Well Name:		Cedartown Spring															
	County:		Polk															
	Date Sampled:		1997/07/29															

Table A-11 (Continued). 1996-1997 Ground-Water Quality Analyses of the Valley and Ridge Unconfined Aquifers.

PARAMETER		pH	Na	K	Ca	Mg	Sr	Ba	Fe	Mn	Al	Cl	F	SO4	Nitrate/ Nitrite	Conduc- tivity	Other Parameters Detected	Other Tests
Well ID#	UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mgN/L	umho/cm	ug/L	
GWN-VR9		7.50	1.3	5U	39	13	25	12	20U	10U	50U	2.3	0.1U	2.6	0.7	279		v
	Well Name:		Polk County #2															
	County:		Polk															
	Date Sampled:		1997/07/29															

Quantity: 50
Cost: $150.00