GROUND-WATER QUALITY IN GEORGIA FOR 1991

by

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CIRCULAR 12H

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This report for calendar year 1991 is the eighth annual summary of ground-water quality in Georgia. These evaluations are one of 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. The EPD has implemented a comprehensive state-wide ground-water management policy of anti-degradation (EPD, 1991). Five components constitute EPD's ground-water quality assessment program. These components include:

1. The Georgia Ground-Water Monitoring Network. This program is maintained by the Geologic Survey Branch of EPD, and is designed to evaluate the ambient ground-water quality of ten aquifer systems throughout the State of Georgia. The data presented in this report were provided by this program.

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

3. Special studies that are conducted in order to address specific water quality issues. An ongoing survey of nitrite/nitrate levels in shallow wells located throughout the State of Georgia (currently being conducted by the Geologic Survey Branch) and the expansion of a Pesticide Monitoring Network (currently being conducted by the Geologic Survey Branch in conjunction with the Georgia Department of Agriculture) are examples of these types of studies.

4. Sampling of ground water at environmental facilities such as municipal solid waste landfills, RCRA facilities, sludge disposal facilities, etc. The primary responsibility for monitoring these

facilities are the EPD branches of Land and Water Protection, and Hazardous Waste Management.

5. The development of a wellhead protection program (WHP), which is designed to protect the area surrounding a municipal drinking water well from contaminants. Georgia's WHP Plan was approved by the Environmental Protection Agency (EPA) September 30, 1992 and was amended to the Georgia Safe Water Drinking Act June 30, 1993. The protection of public water supply wells from contaminants is important not only for groundwater quality, but also aids to ensure safe health standards for public ground-water usage.

Analyses of water samples collected for the Georgia Ground-Water Monitoring Network during calendar year 1991 and from previous years are the data base for this summary. The Georgia Geologic Survey Ground-Water Monitoring Network is comprised of 154 wells and springs which are monitored on a bi-annual, annual or semi-annual basis. Due to the delay in funding from EPA in 1990, some 41 wells which should have been sampled in 1990 were sampled in 1991 when funds became available. Representative water samples were collected from 127 wells and springs in 1991. A review of the 1991 data, and comparison of these data with analyses of samples collected as early as 1984, indicates that ground-water quality at most of the 127 sampling sites generally has changed little and remains excellent.

1.2 GROUND-WATER QUALITY CONTROLS

The quality of water from a well is the end result of complex physical and biochemical processes. Some of the more significant controls are the quality and chemistry 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 it is discharged to a surface-water body (e.g., stream, river, lake or ocean). The chemistry, amount of recharging water, and the attenuation capacity of soils have a strong influence on the quality of ground water in recharge areas. Chemical interaction of water with the aquifer host rocks has 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 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. Improperly constructed wells, on the other hand, can present a conduit for local pollution to enter the ground-water flow system.

1.3 HYDROGEOLOGIC PROVINCES OF GEORGIA

Three hydrogeologic provinces in Georgia are defined by their general geologic and hydrologic characteristics (Figure 1-1). These provinces include:

1. The Coastal Plain Province of south Georgia
2. The Piedmont and Blue Ridge Provinces, which include all but the northwest corner of northern Georgia
3. The Valley and Ridge Province of northwest Georgia

Each of these provinces is described in greater detail below.

1.3.1 Coastal Plain Province

Georgia's Coastal Plain Province is composed of 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.

Figure 1-1. - The three hydrogeologic provinces of Georgia

The Coastal Plain contains the State's major confined (artisan) aquifers. Confined aquifers are those which are overlain by a layer of impermeable material (e.g., clay or shale) and contain water at greater-than-atmospheric pressures. Water enters the aquifers in their up-dip outcrop areas where the permeable rocks of the aquifer are exposed. Many of the 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 dip of the rocks.

Rocks forming the seven major confined 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 and the quality of ground water they contain 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. A large area of south-central and southeastern Georgia is served by the Floridan aquifer system (primarily carbonates). The Miocene aquifer system (sands and carbonates) is the principal 'shallow' unconfined aquifer system occurring in the broad area underlain by the Floridan aquifer system. It becomes confined in the coastal counties and locally in the Grady-Thomas-Brooks-Lowndes Counties area.

1.3.2 Piedmont and Blue Ridge Provinces

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 towards discharge areas along streams. However, during prolonged dry periods or in the vicinity of heavy pumpage, ground water may flow from the streams into the fracture and joint systems.

1.3.3 Valley and Ridge Province

The Valley and Ridge Province is underlain by consolidated Paleozoic sedimentary formations. The permeable features of the Valley and Ridge Province are principally fractures and solution voids; intergranular porosity also is important in some places. Ground-water and surface-water systems are locally closely interconnected. Dolostones and limestones of the Knox Group are the principal aquifers where they occur in the axes of broad valleys. The greater permeabilities of the thick carbonate sections in this Province, in part due to solution-enlarged joints, permit development of more extensive aquifer systems than in the Piedmont and Blue Ridge Province.

1.4 REGIONAL GROUND-WATER QUALITY PROBLEMS

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

Only a few occurrences of polluted or contaminated ground waters are known from north Georgia (Table 4-1). 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 from the inability of the sandy aquifer sediments to buffer acidic rainwater and acid-producing reactions between infiltrating water and soils and sediments. Nitrite/nitrate concentrations in ground water from the farm belt of southeastern Georgia are almost always within drinking-water standards, but are somewhat higher than levels found in other areas of the State.

The Floridan aquifer system includes two areas of naturally-occurring reduced ground-water quality in addition to its karstic plain in southwestern Georgia. The Gulf Trough, a narrow, linear geologic feature extending from southwestern Decatur County through central Bulloch County, typically yields water with high total dissolved solids concentrations. Elevated levels of barium, sulfate and radionuclides have been reported in ground water from the Gulf Trough. High levels of total dissolved solids also are common to the lower section of the Floridan aquifer system along the Georgia coast. Ground-water withdrawals have allowed upconing of brine from deeper parts of the aquifer in the Brunswick area.

2.0 GEORGIA GROUND-WATER MONITORING NETWORK

2.1 MONITORING STATIONS

Stations of the 1991 Ground-Water Monitoring Network include five major aquifer systems of the Coastal Plain Province and unconfined ground-water systems of the Piedmont and Blue Ridge Provinces and 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 (agricultural and industrial areas)
3. areas of significant ground-water use.

The majority of monitoring stations are municipal, industrial and domestic wells that have reliable well-construction data. Many of the monitoring stations that are located in recharge areas are sampled more than once a year in order to more closely monitor changes in groundwater quality. The Monitoring Network also includes monitoring wells in specific areas where the State's aquifers are recognized to be susceptible to contamination or pollution (e.g., the Dougherty Plain of southwestern Georgia and the State's coastal area). These monitoring wells are maintained jointly by the Geologic Survey Branch and the United States Geological Survey.

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. Examples of non-point source pollution include acid rain and regional land-use activities (for example, application of agricultural chemicals on crop lands).

It should be noted that the data of the Ground-Water Monitoring Network represents water quality in only limited areas of the State. Monitoring water quality at 154 sites located throughout the State provides an indication of ground-water quality at the localities sampled and at depths corresponding to the screened interval in the well at each station in the Monitoring Network. Caution should be exercised in drawing broad conclusions and applying any results reported in this study to ground waters that are not being monitored.

Stations of the Ground-Water Monitoring Network are intentionally 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 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 aerially 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 comparatively small and more open to interactions with land-use activities. The wider spacing of monitoring stations does not permit equal characterization of water-quality processes in all of these settings. The quality of water from monitoring wells completed in unconfined north Georgia aquifers represents only the general nature of ground water in the vicinity of the monitoring wells. In contrast, ground water from monitoring wells located in surface recharge areas of Georgia Coastal Plain aquifers may more closely reflect the general quality of water that has entered these aquifers. 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 154 water samples collected during 1991 from 122 wells and 5 springs. Annual analyses of water samples from 28 of the wells span eight years with the addition of the 1991 data. In 1984, the first year of the Ground-Water Monitoring Network, hydrogeologists sampled water from 39 wells located in the Piedmont, Blue Ridge, and Coastal Plain Provinces. Nine of these wells have been sampled each year since 1984. During the past seven years, the Ground-Water Monitoring Network has expanded to cover additional wells and springs, encompassing all three hydrogeologic provinces, with the majority of 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, specific conductivity, chloride, 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 such as chlorinated pesticides (Organics Screen #2), and phenoxy herbicides (Organics Screen #4) are tested. These and additional chemical screens are listed in the Appendix (Tables A-1, A-2, A-3, and A-4). Tables 2-2a and 2-2b summarize the significance of the common major constituents of a water-quality analysis.

The Drinking Water Program of the Georgia Environmental Protection Division has promulgated Maximum Contaminant Levels (MCLs) for some of the parameters that are included in the analyses performed on Ground-Water Monitoring Network samples. Primary Maximum Contaminant Levels are established for parameters that may have adverse effects on the public health when the Primary MCLs are exceeded. Secondary Maximum Contaminant Levels are established for parameters that may give drinking water an objectionable odor or color, and consequently cause persons served by public water systems to discontinue its use. The Primary and Secondary

MCLs for Ground Water Monitoring Network parameters are given in the Appendix.

In-place pumps are used whenever possible to purge wells and collect water samples. Using these pumps minimizes the potential for cross-contamination of wells. Some wells that are included in the Ground-Water Monitoring Network are continuous water-level monitoring stations and do not have dedicated pumps. A two horse-power, trailer-mounted four-inch electric submersible pump and a three-inch, truck-mounted submersible pump are the principal portable purge-and-sampling devices used. A battery-powered, portable Fultz sampling pump and a PVC hand pump are occasionally used at stations that cannot be sampled using the principal sampling pumps.

Sampling procedures are adapted from techniques used by the U.S. Geological Survey and the U.S. Environmental Protection Agency. Hydrogeologists purge the wells (3 to 5 volumes of the well column) prior to 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 45 minutes of purging prior to sample collection. Wells without dedicated pumps often require much longer periods of purging.

Hydrogeologists monitor water quality parameters prior to sample collection. Measurements of pH, dissolved oxygen content, specific conductivity, temperature and ionic potential are observed using field instruments. The instruments are mounted in a manifold that captures flow at the pump system discharge point before the water is exposed to atmospheric conditions. Typical trends include a lowering of pH, dissolved oxygen content and specific conductivity, and a transition towards the mean annual air temperature with increased purging time. The hydraulic flow characteristics of unconfined aquifers and pump effects often 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 Georgia Geologic Survey contain records of the field measurements. The sample bottles are filled and then immediately placed in an ice water bath to preserve the water quality. After one to two hours, the bottles are transferred to a dry cooler refrigerated with an ice tray. The hydrogeologists then transport the samples to the laboratories for analysis on or before the Friday of the week in which they are collected. The EPD laboratories, which are currently expanding to perform all necessary chemical screens, will soon include facilities to allow organic screens 1, 2, 3, 4, 5, and 7 to be run along with inorganic chemical analysis. (Tables A-1 and A-2). Formerly performed by the Cooperative Extension Service at the University of Georgia in Athens, this newly expanded laboratory in Atlanta will provide a faster laboratory analysis turn around time, as well as reduce cost in transportation of samples and employee travel expense.

Table 2-1. - Georgia Ground-Water Monitoring Network, 1991

AQUIFER SYSTEM	NUMBER OF MONITORING STATIONS	PRIMARY STRATIGRAPHIC EQUIVALENTS	AGE OF AQUIFER FORMATIONS
Cretaceous	20 (16 sampled in 1991)	Ripley Formation, Cusseta Sand, Blufftown Formation, Eutaw Formation, and Tuscaloosa Formation	Late Cretaceous
Providence	4 (3 sampled in 1991)	Providence Sand	Late Cretaceous
Clayton	7 (6 sampled in 1991)	Clayton Formation	Paleocene
Claiborne	9 (7 sampled in 1991)	Tallahatta Formation	Middle Eocene
Jacksonian	10 (6 sampled in 1991)	Barnwell Group	Late Eocene
Floridan	58 (52 sampled in 1991)	Suwannee Limestone, Ocala Group, Bridgeboro Limestone and Claibornian Carbonates	Middle Eocene to Oligocene
Miocene	15 (8 sampled in 1991)	Altamaha Formation and Hawthorne Group	
Piedmont	18 (16 sampled in 1991)	New Georgia Group, Sandy Springs Group, Laura Lake Mafic Complex, Austell Gneiss, Sand Hill Gneiss, Mulberry Rock Gneiss, Atlanta Group and Lithonia Gneiss	Predominately Paleozoic and Precambrian
Blue Ridge	4 (4 sampled in 1991)	Corbin Gneiss Complex, Snowbird Group, Walden Creek Group, Great Smokey Group and Murphy Marble Belt Group	Predominately Paleozoic and Precambrian
Valley and Ridge	9 (9 sampled in 1991)	Shady Dolomite, Knox group, and Chickamauga group	Paleozoic, mostly Cambrian and Ordovician

Table 2-2a. - The significance of parameters of a basic water quality analysis, cations (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 attack 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 parts per million 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
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 parts per billion 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 favor growth of iron bacteria but do not endanger health.

*Major alkali metals present in most ground waters.

Table 2-2b - The significance of parameters of a basic water quality analysis, anions (Wait, 1960)

PARAMETER(S)	**SIGNIFICANCE**
Chloride	Chloride salts in excess of 100 parts per million give a salty taste to water. Large quantities make the water corrosive. Water that contains excessive amounts of chlorine is not suitable for irrigation. It is recommended that chloride content should not exceed 250 parts per million.
Nitrate/Nitrite	Concentrations much greater than the local average may suggest pollution. Excessive amounts of nitrogen in drinking or formula water of infants may cause a type of methemoglobinemia ("blue babies"). Nitrate/nitrite in concentrations greater than 10 parts per million (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 parts per million have a laxative effect, but 500 parts per million is considered safe.

3.0 GROUND-WATER QUALITY IN GEORGIA - 1991

3.1 OVERVIEW

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

The Coastal Plain Province is comprised of seven major aquifers that are restricted to specific regions and depths within the Coastal Plain because of their aquifer geometry (Figure 3-1). These major aquifer systems, in many cases, incorporate smaller aquifers that are locally confined. Monitoring wells in the Coastal Plain aquifers are generally located in three settings:

1. Recharge (or outcrop) areas, which 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, which 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.

The two major hydrogeologic provinces of north Georgia, the Piedmont/Blue Ridge Province and the Valley and Ridge Province, are characterized by smaller-scale and localized ground-water flow patterns. Deeper regional flow systems are unknown in northern Georgia. Ground-water flow in the Piedmont/Blue Ridge Province is generally controlled by geologic discontinuities (such as fractures) and compositional changes within the aquifer. Local physiographic features, such as hills and valleys, influence local ground-water flow patterns. Many of the factors controlling ground-water flow in the Piedmont/Blue Ridge Province are also present in the Valley and Ridge Province. Furthermore,

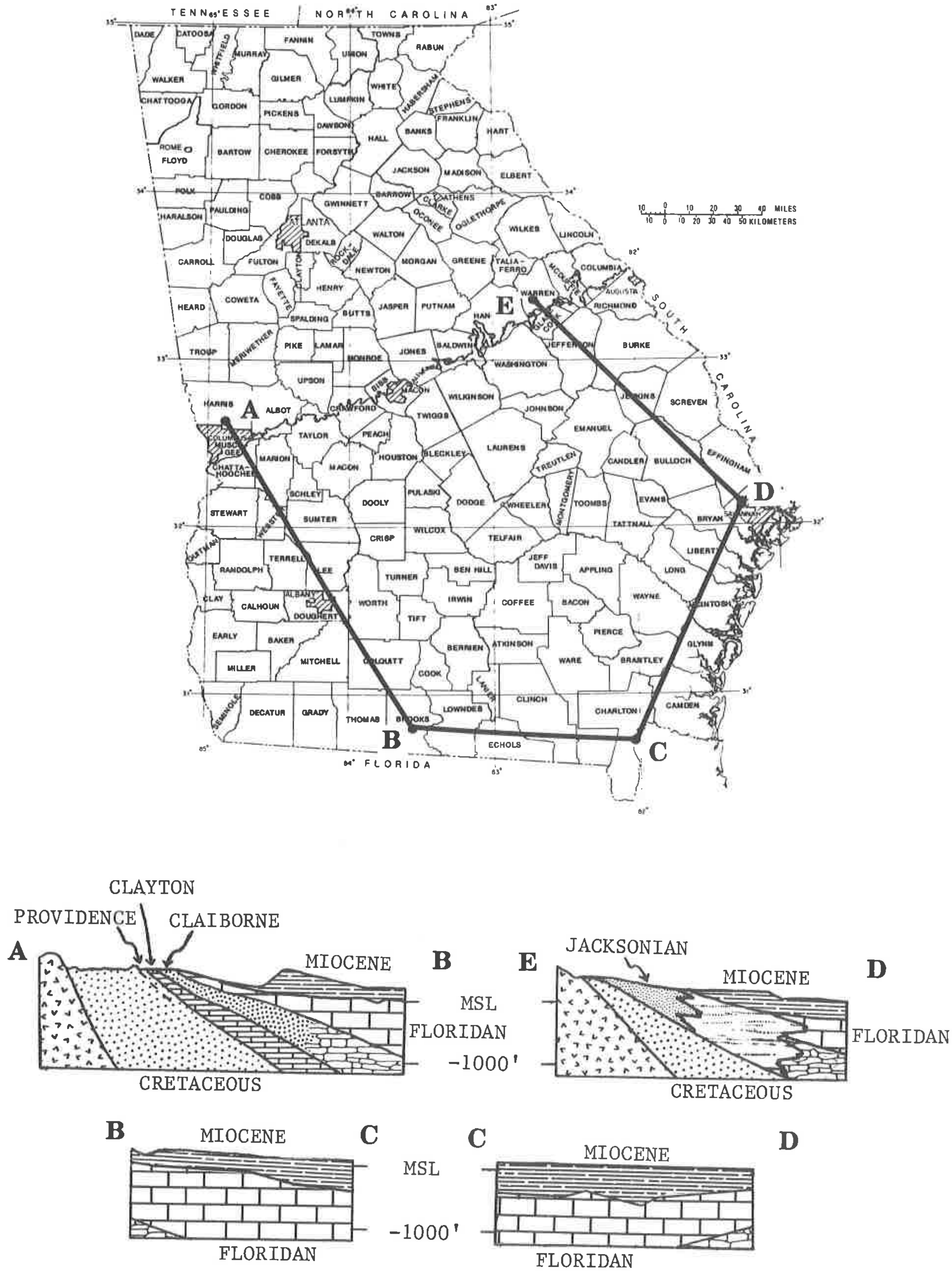


Figure 3-1. - The seven major aquifer systems of the Coastal Plain Province

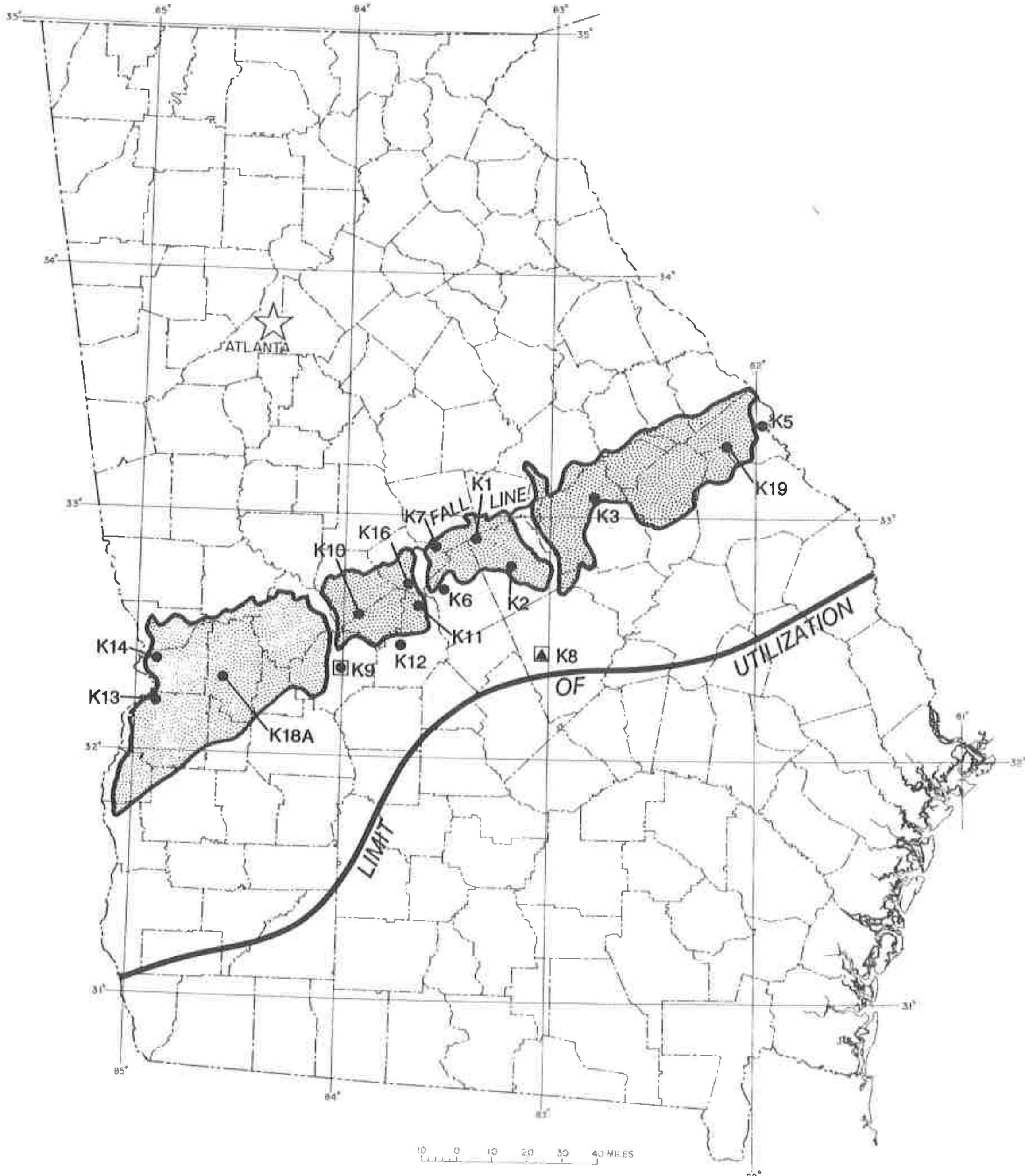
widespread development of karst features may significantly enhance porosity and permeability in localized areas, and exert a strong influence on local ground-water flow patterns.

3.2 CRETACEOUS AQUIFER SYSTEM

The Cretaceous aquifer system is a complexly interconnected group of aquifer subsystems consisting of 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 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 east (Clarke, et al., 1985). Aquifer sands thicken southward from the Fall Line, 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. Leakage from adjacent members of the aquifer system provides significant recharge in down-dip areas.

Water quality of the Cretaceous aquifer system, excluding the Providence aquifer system (discussed separately in this report),was monitored in 16 wells. All of these wells are located in up-dip areas in or adjacent to outcrop and surface recharge areas for the Cretaceous aquifer system.

Water from the wells in the up-dip area was typically acidic, to the point of being corrosive, and soft. Iron and manganese concentrations were generally low, although one well in Macon County yielded water containing 1,400 parts per billion iron and one well in Laurens County yielded water containing 3,000 parts per billion. The State Secondary Maximum Contaminant Level (MCL) for iron is 300 parts per billion. Figures 3-3 and 3-4 show trends in iron and manganese concentrations for wells that have historically yielded water with high levels of these metals. Concentrations of major alkali metals (calcium, magnesium, potassium and sodium) were generally either low or below



□ Iron concentrations exceed drinking-water limits
▲ Moderately hard water
● Soft water
General recharge area (from Davis, et al., 1988)

Figure 3-2. - Water quality of the Cretaceous aquifer system.

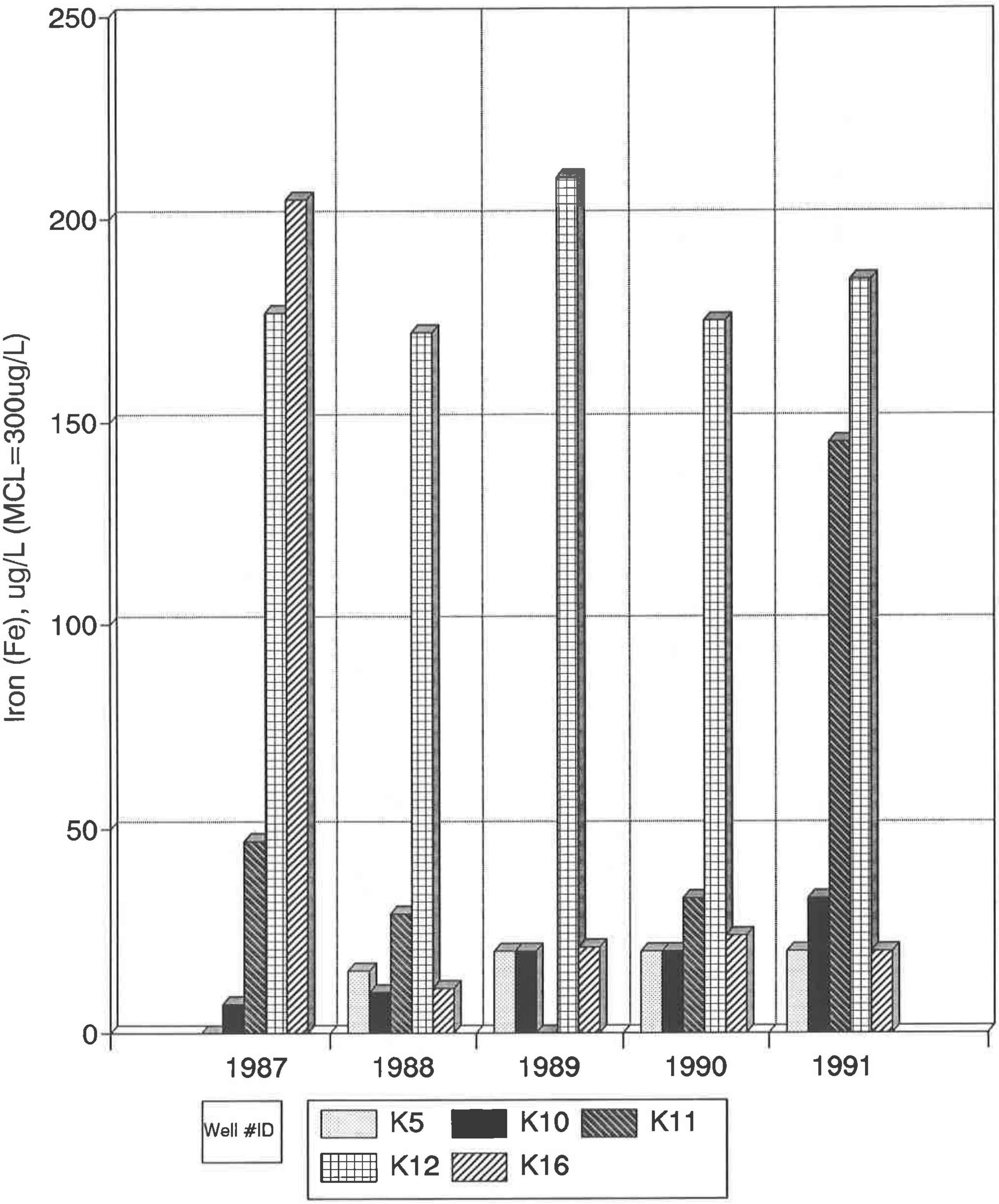


Figure 3-3. - Iron Concentrations in Selected Wells in the Cretaceous Aquifer System.

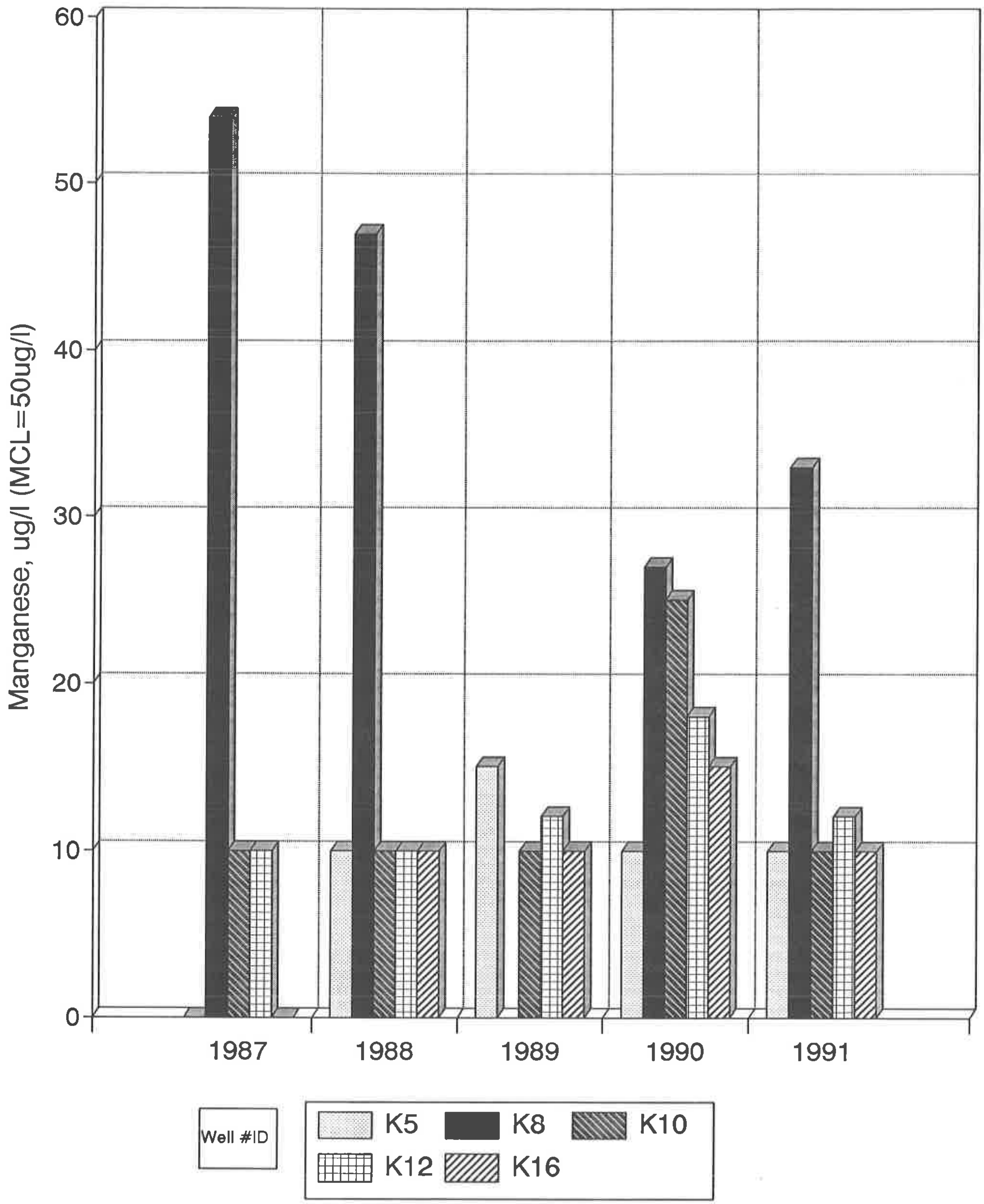


Figure 3-4. - Manganese Concentrations in Selected Wells in the Cretaceous Aquifer System.

detection limits. Other trace metals (aluminum, strontium and zinc) were present in minor amounts. Chloride and sulfate levels were low (less than 9.4 parts per million chloride and 7.0 parts per million sulfate) in all of the samples collected.

Water samples from six of the wells contained detectable levels of nitrite/nitrate. The highest value, 3.4 parts per million, was measured in a sample from one well (GWN-K10) in Peach County in 1990 and 1991. Figure 3-5 shows trends in levels of combined nitrite/nitrate (reported as parts per million nitrogen) for wells that have historically yielded water with detectable nitrate/nitrite levels.

3.3 PROVIDENCE AQUIFER SYSTEM

Sand and coquinoid limestone 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. In 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. Areas where the thickness of the Providence exceeds 300 feet are known in Pulaski County, and similar thicknesses have been projected in the vicinity of Baker, Calhoun and Early Counties (Clarke, et al., 1983).

The permeable Providence-Clayton Formation interval forms a single aquifer 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.

Water samples were taken from 3 wells in the Providence aquifer system in 1991 (Figure 3-6). Iron concentrations exceeded the secondary

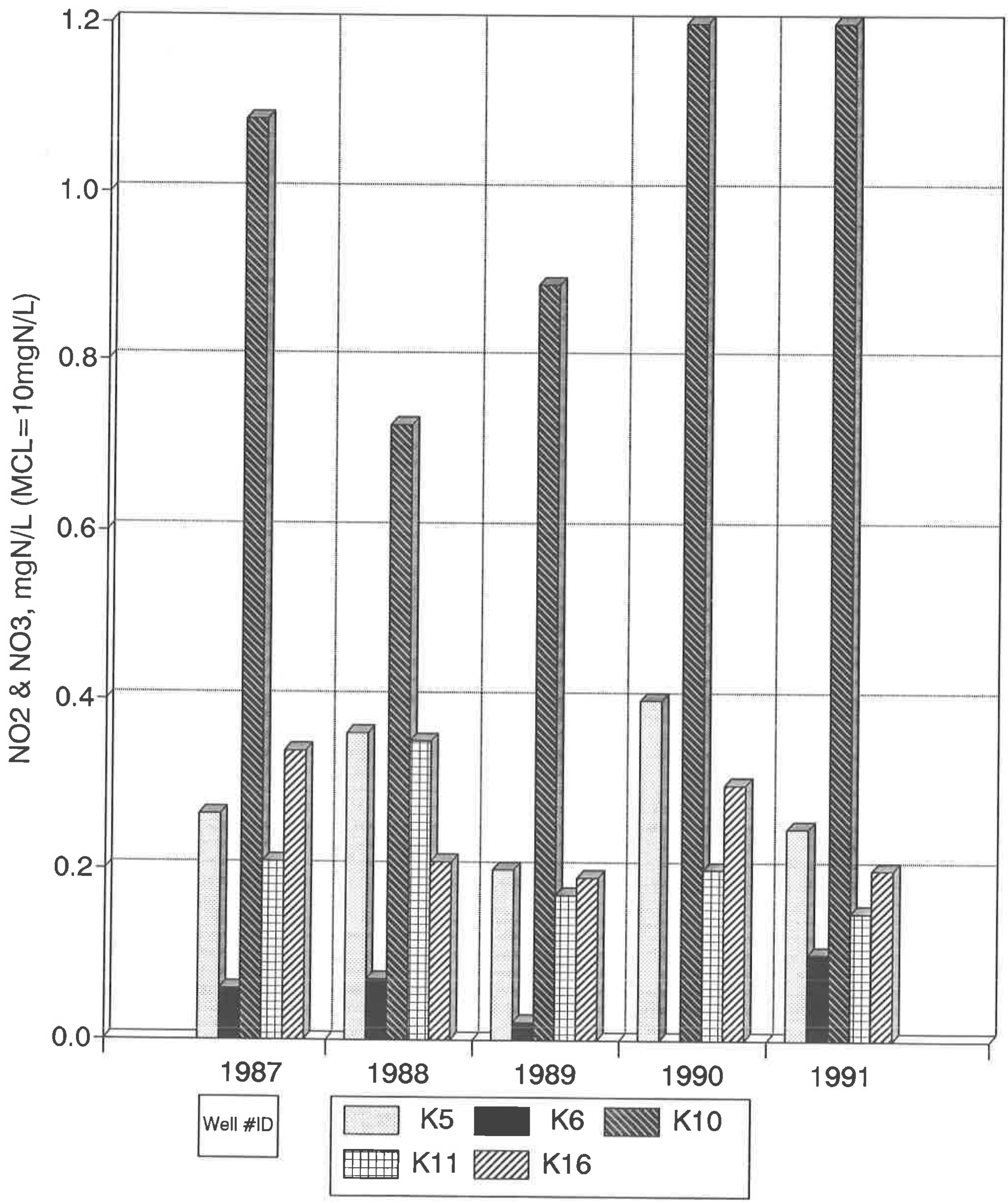
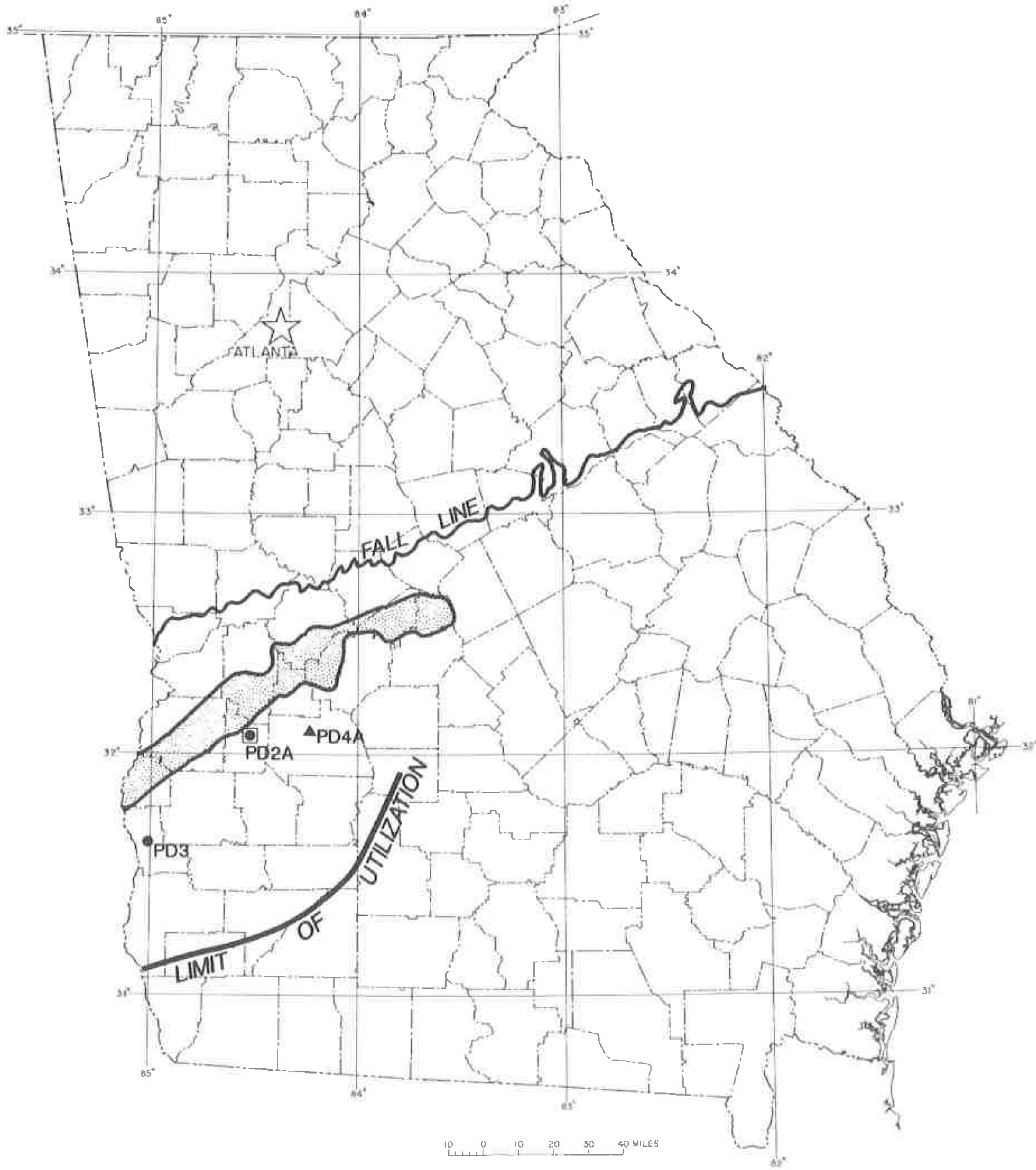


Figure 3-5. - Nitrite/Nitrate Concentrations in Selected Wells in the Cretaceous Aquifer System.



□ Iron concentrations exceed drinking-water limits
▲ Moderately hard water
● Soft water
General recharge area (from Davis, et al., 1988)

Figure 3-6. - Water quality of the Providence aquifer system.

MCL of 300 parts per billion for well GWN-PD2A in Webster County with a level of 350 parts per billion. Alkali and trace metals were generally low or below detection limits, with flourine present in minor amounts.

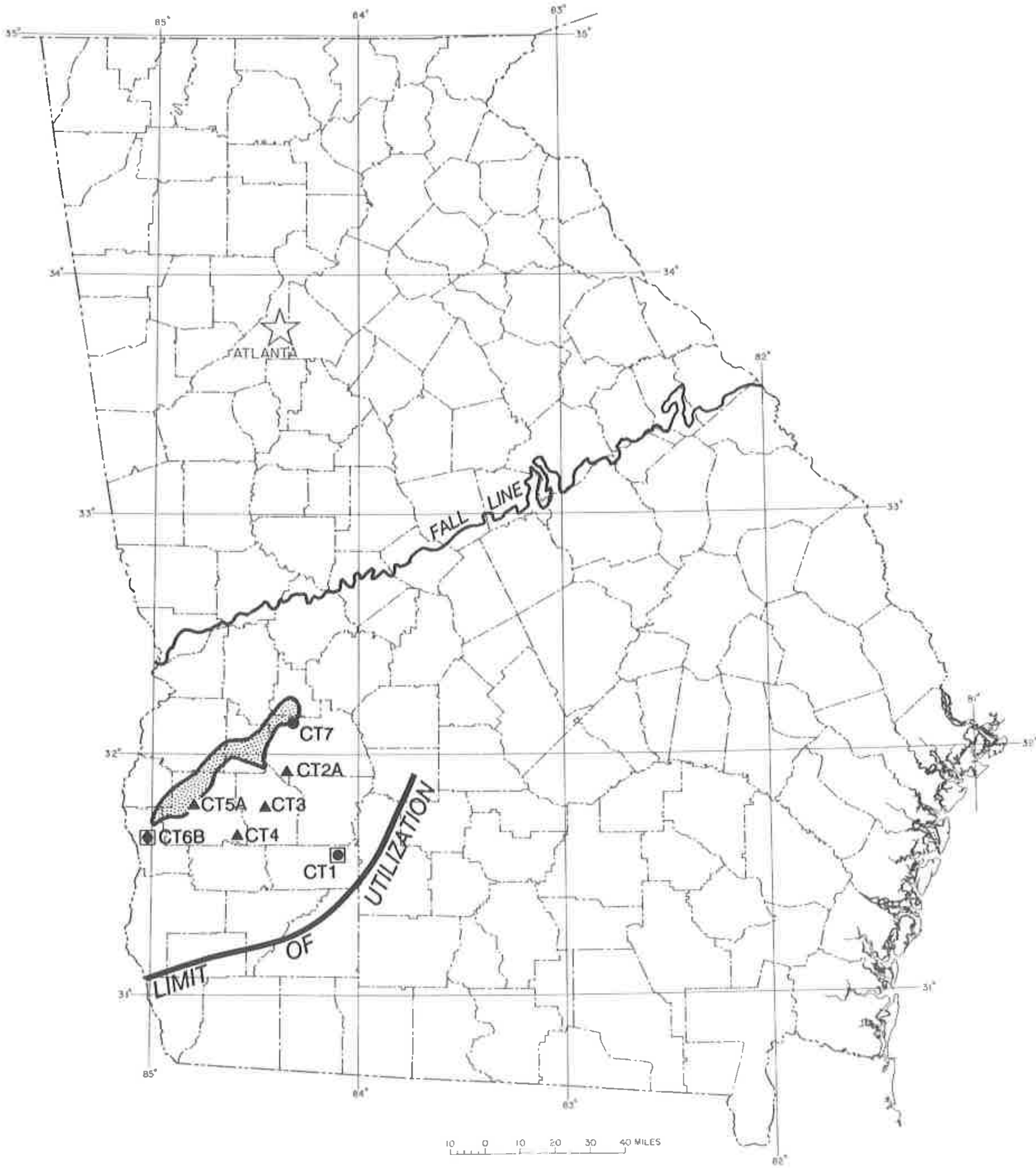
Water quality analysis for the Providence Aquifer System is reported in the Appendix.

3.4 CLAYTON AQUIFER SYSTEM

The Clayton aquifer system of southwestern Georgia is developed 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 3-7). Aquifer thickness varies irregularly, 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 the overlying Wilcox confining zone is significant in down-dip areas (Clarke, et al., 1984). The Clayton Formation and Providence Formation merge to form a single aquifer unit in up-dip areas (Long, 1989). In areas east of the Ocmulgee River, the combination of these two aquifers is referred to as the Dublin aquifer system (Clarke, et al., 1985).

Six out of seven wells in the Clayton aquifer system were used to monitor water quality in 1991. These sample stations were located in confined, up-dip areas of the Clayton aquifer.

All of the water samples were slightly basic and non-corrosive. The water samples analyzed were moderately hard to hard with the pH levels ranging from 7.0 to 7.9. Iron concentrations (Figure 3-8) were typically below secondary Maximum Contaminant Levels, with the exception of GWN-CT1, which measured 700 parts per billion, and GWN-CT6B, which measured 1,400 parts per billion. Manganese levels in the western most well (GWN-CT6B) have decreased since 1987, with a very slight increase in 1991 (Figure 3-9). Trace amounts of aluminum, barium, bismuth,



□ Iron concentrations exceed drinking-water limits
▢ Iron and manganese concentrations exceed drinking-water limits
• Soft water
▲ Moderately hard water
■ Hard water
♦ Very hard water
General recharge area (from Davis, et al., 1988)

Figure 3-7. - Water quality of the Clayton aquifer system.

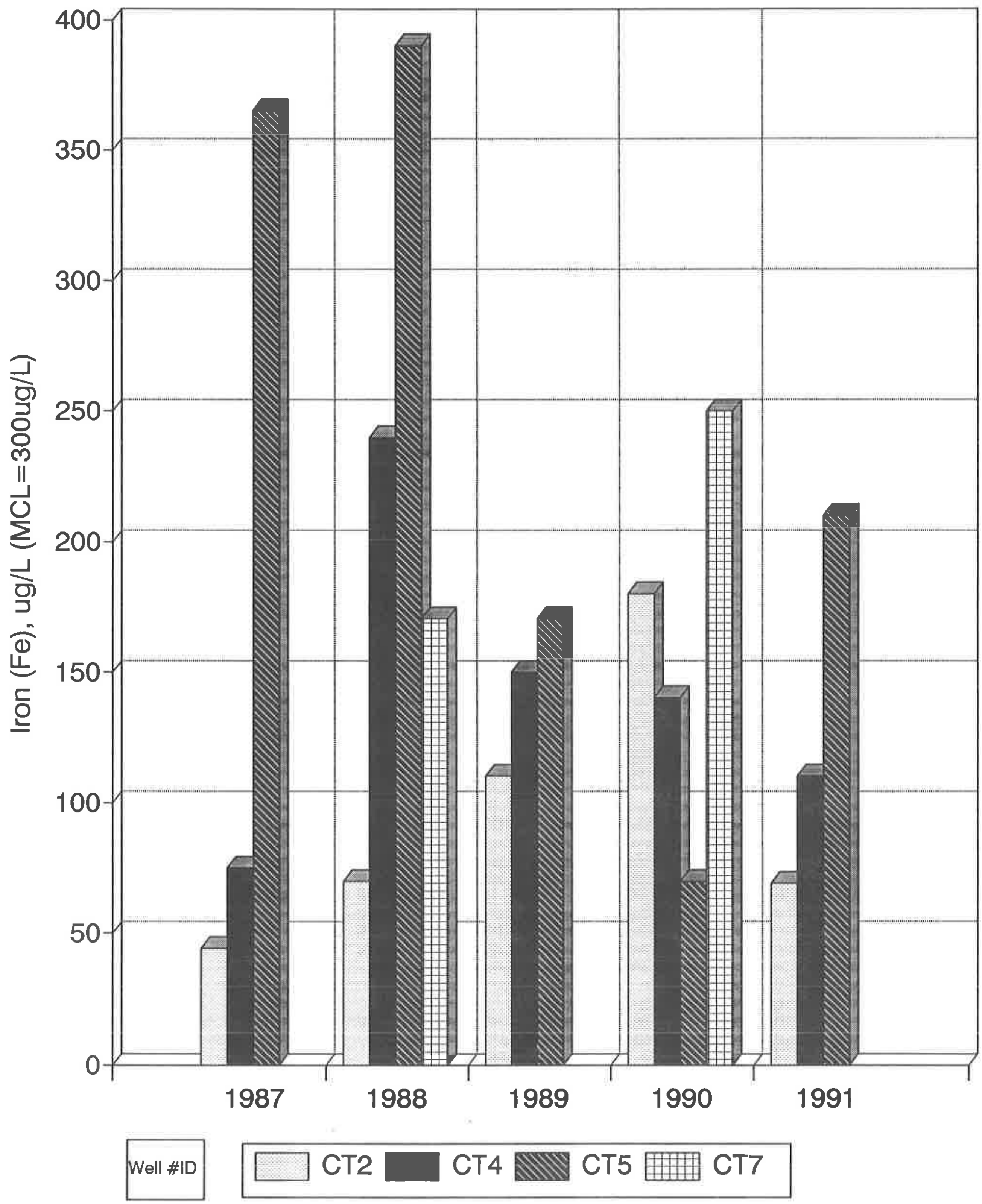


Figure 3-8. - Iron Concentrations in Selected Wells in the Clayton Aquifer System.

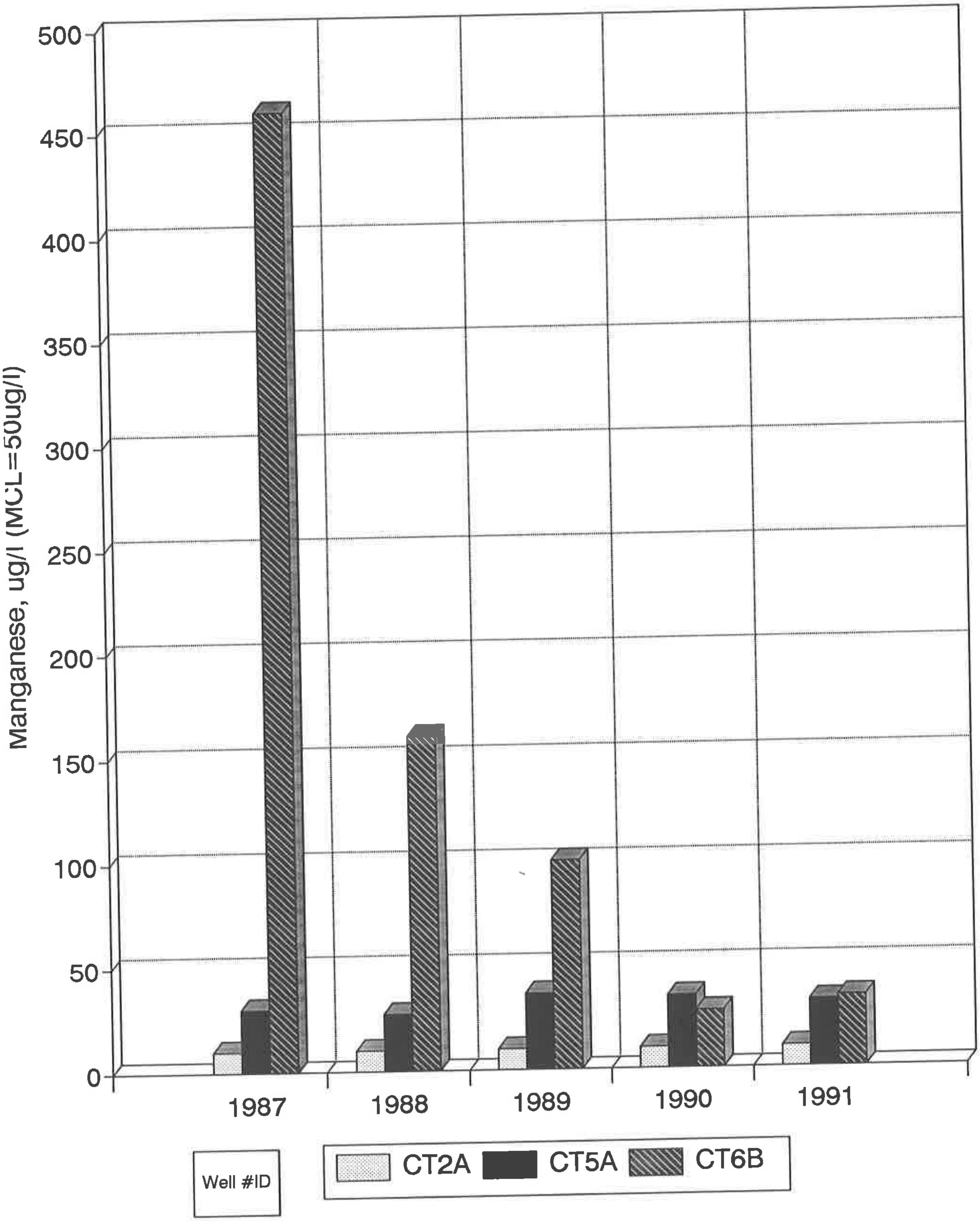


Figure 3-9. - Manganese Concentrations in Selected Wells in the Clayton Aquifer System.

copper, fluorine, strontium, and zinc were detected along with the major alkali metals.

Chloride content was uniformly low, less than 7.0 parts per million, in all samples. Sulfate levels were less than 16.9 parts per million in the water from all sample stations except for the western most well GWN-CT6B, which measured 56.8 parts per million, adjacent to the Chattahoochee River. All six samples analyzed for nitrite/nitrate in 1991 ranged within a typical detection limit of 0.02 milligrams of nitrogen per liter (mgN/L) to a maximum detection limit of 0.10 mgN/L (Figure 3-10). The northeastern most well GWN-CT7, which showed a nitrate/nitrite concentration of 6.3 parts per million in 1990, was not sampled in 1991.

3.5 CLAIBORNE AQUIFER SYSTEM

Sands of the Middle Eocene Claiborne Group are the primary members of the Claiborne aquifer system of southwestern Georgia (Figure 3-11). Claiborne Group sands crop out in a belt extending from northern Early County through western Dooly County. Limited recharge may be derived down-dip in the vicinity of Albany in Dougherty County by leakage from the overlying Floridan aquifer system (Hicks, et al., 1981). Discharge boundaries of the aquifer system are the Ocmulgee River, to the east, and the Chattahoochee River, to the west.

The aquifer generally thickens from the outcrop area towards the southeast, attaining a thickness of almost 300 feet in eastern Dougherty County. In down-dip areas where the Claiborne Group can be divided into the Lisbon Formation above and the Tallahatta Formation below, the Claiborne aquifer system is generally restricted to the Tallahatta Formation, and the Lisbon Formation acts as a confining unit that separates the Claiborne aquifer from the overlying Floridan aquifer (McFadden and Perriello, 1983; Long, 1989). The permeable Tallahatta unit is included in the Gordon aquifer system east of the Ocmulgee River (Brooks, et al., 1985).

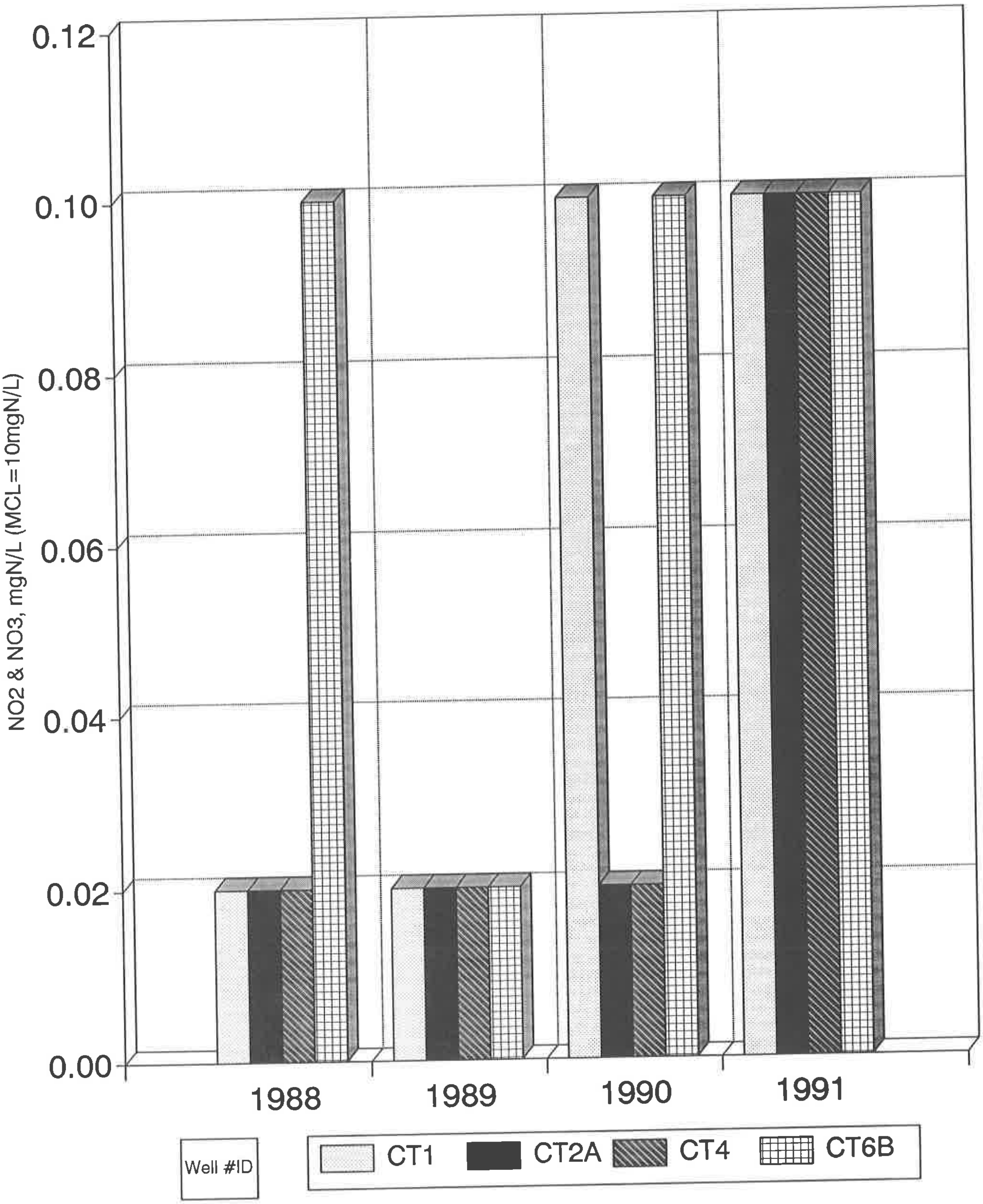
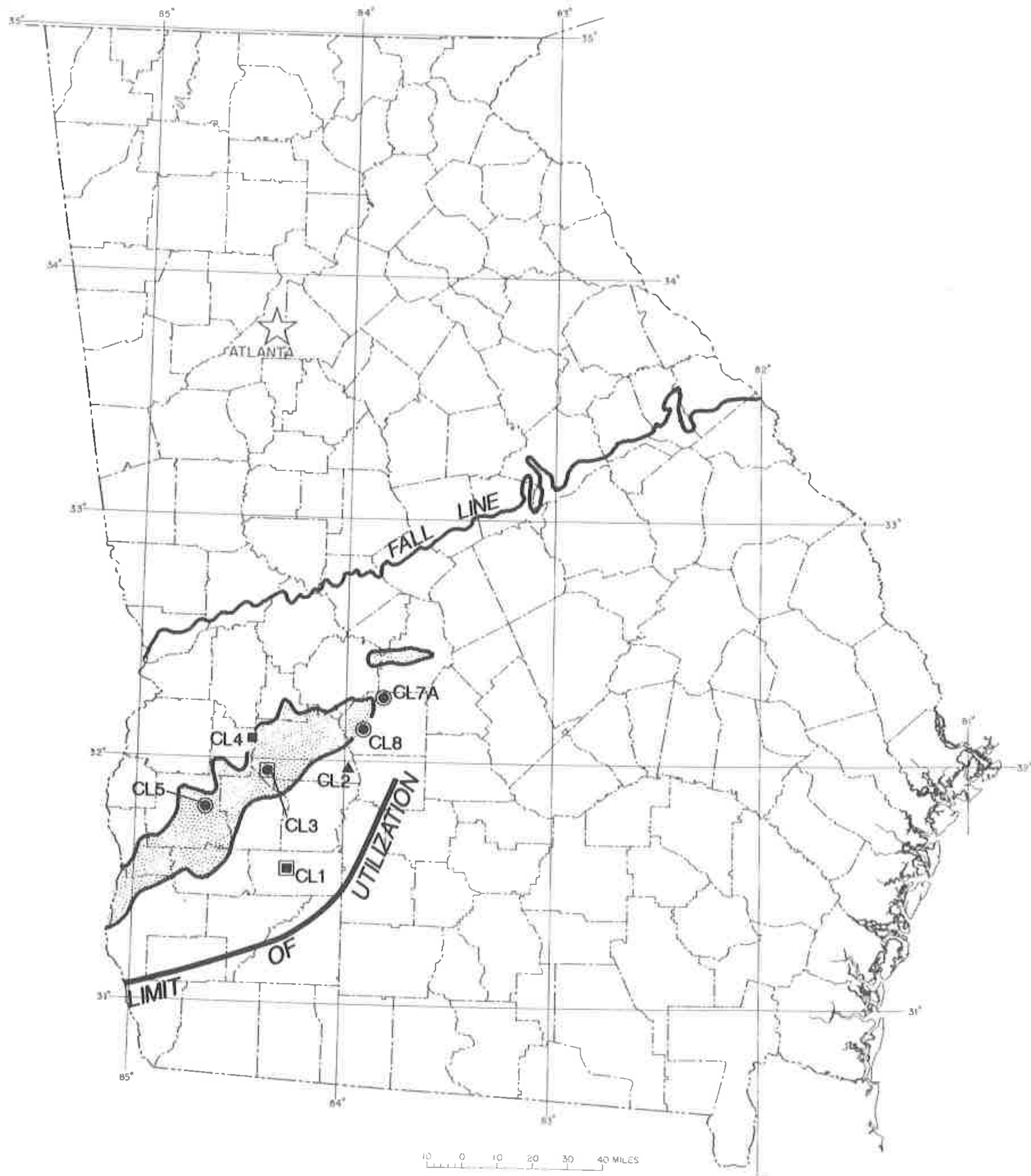


Figure 3-10. - Nitrite/Nitrate Concentrations in Selected Wells in the Clayton Aquifer System.



□ Iron concentrations exceed drinking-water limits
○ Manganese concentrations exceed drinking-water limits
● Soft water
▲ Moderately hard water
■ Hard water
General recharge area (from Davis, et al., 1988)

Figure 3-11. - Water quality of the Claiborne aquifer system.

Ph levels measured from acidic, 4.2 in Randolph County, to basic, 7.6 in Sumter County. Two wells yielded a high level of iron exceeding the secondary MCL's: GWN-CL1 in Dougherty County with a level of 380 parts per billion, and GWN-CL3 in Lee County contained 960 parts per billion. All other wells were within Primary and Secondary Maximum Contaminant Levels. Manganese levels from wells GWN-CL5 in Randolph County, GWN-CL7A in Crisp County, and GWN-CL8 in Dooly County all contained concentrations exceeding the secondary Maximum Contaminant Level, while the remainder measured wells below acceptable limits.

Nitrate concentrations in all six wells analyzed were below the MCL of 10 mgN/L. Chloride and sulfate levels were typically low, less than 9.0 parts per million, with the exception of GWN-CL5 in Dooly County, which registered 10.7 parts per million chloride. Traces of volatile organic compounds benzene and M and P xylenes were detected in Sumter County well GWN-CL4, with GWN-CL5 in Randolph County showing traces of aluminum, cobalt, yttrium, and flourine. GWN-CL7A in Crisp County contained minimal levels of yttrium, flourine, copper and zinc, while GWN-CL8 in Dooly County showed trace levels of aluminum, yttrium, flourine and zinc.

Concentration levels for iron, manganese and nitrate/nitrite for selected wells in the Claiborne Aquifer system are illustrated in Figures 3-12, 3-13, and 3-14, respectively.

3.6 JACKSONIAN AQUIFER SYSTEM

The Jacksonian aquifer system of central and east-central Georgia is developed in sands of the Eocene Barnwell Group. Outcrops of sand and clay of the Barnwell Group extend from Macon and Peach Counties eastward to Burke and Richmond Counties (Figure 3-15). Aquifer sands form a northern clastic facies of the Barnwell Group and grade southward into less permeable silts and clays of a transition facies (Vincent, 1982). The water-bearing sands are relatively thin, generally ranging from ten to fifty feet in thickness. Limestones equivalent to the Barnwell Group

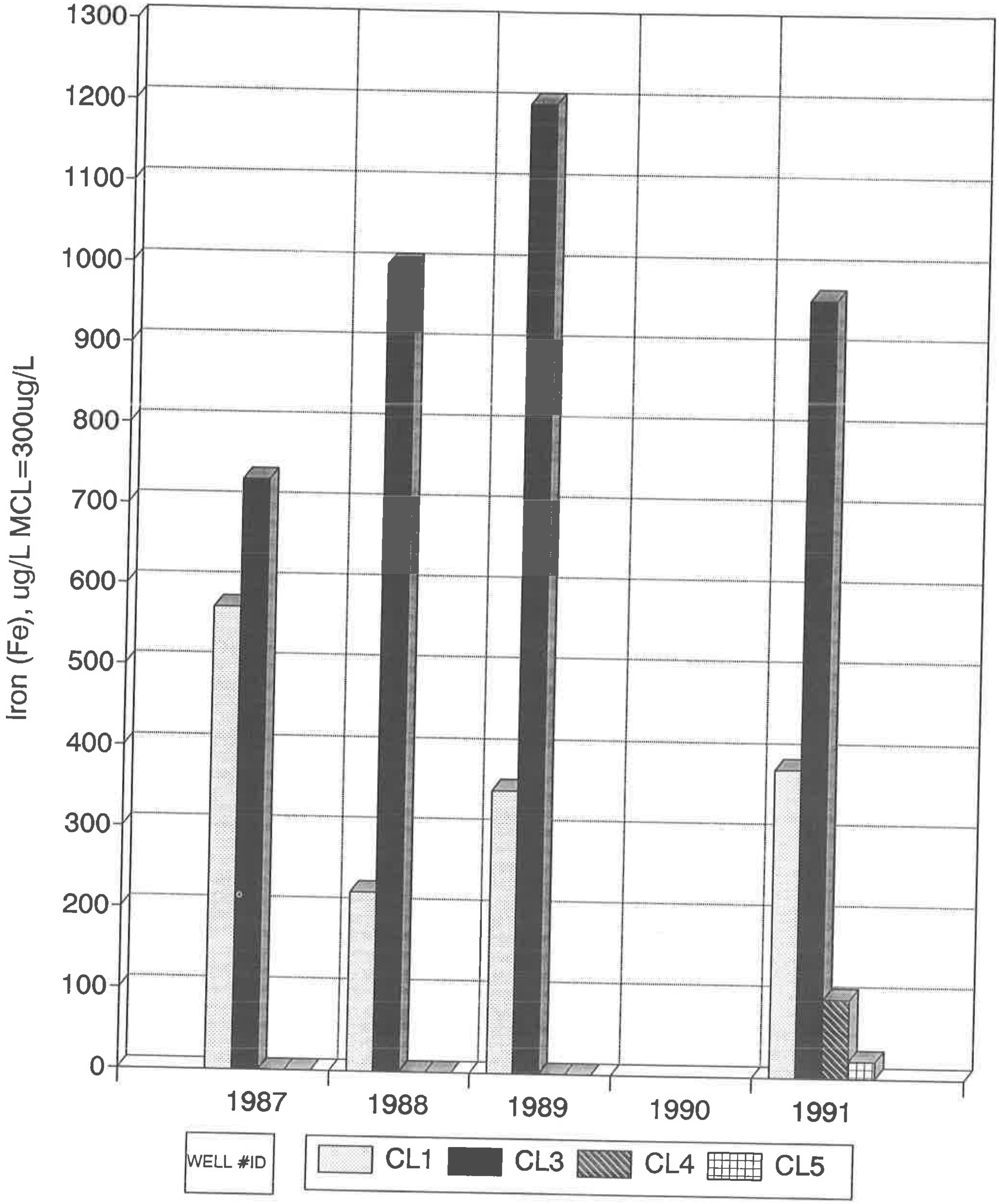


Figure 3-12. - Iron Concentrations in Selected Wells in the Claiborne Aquifer System.

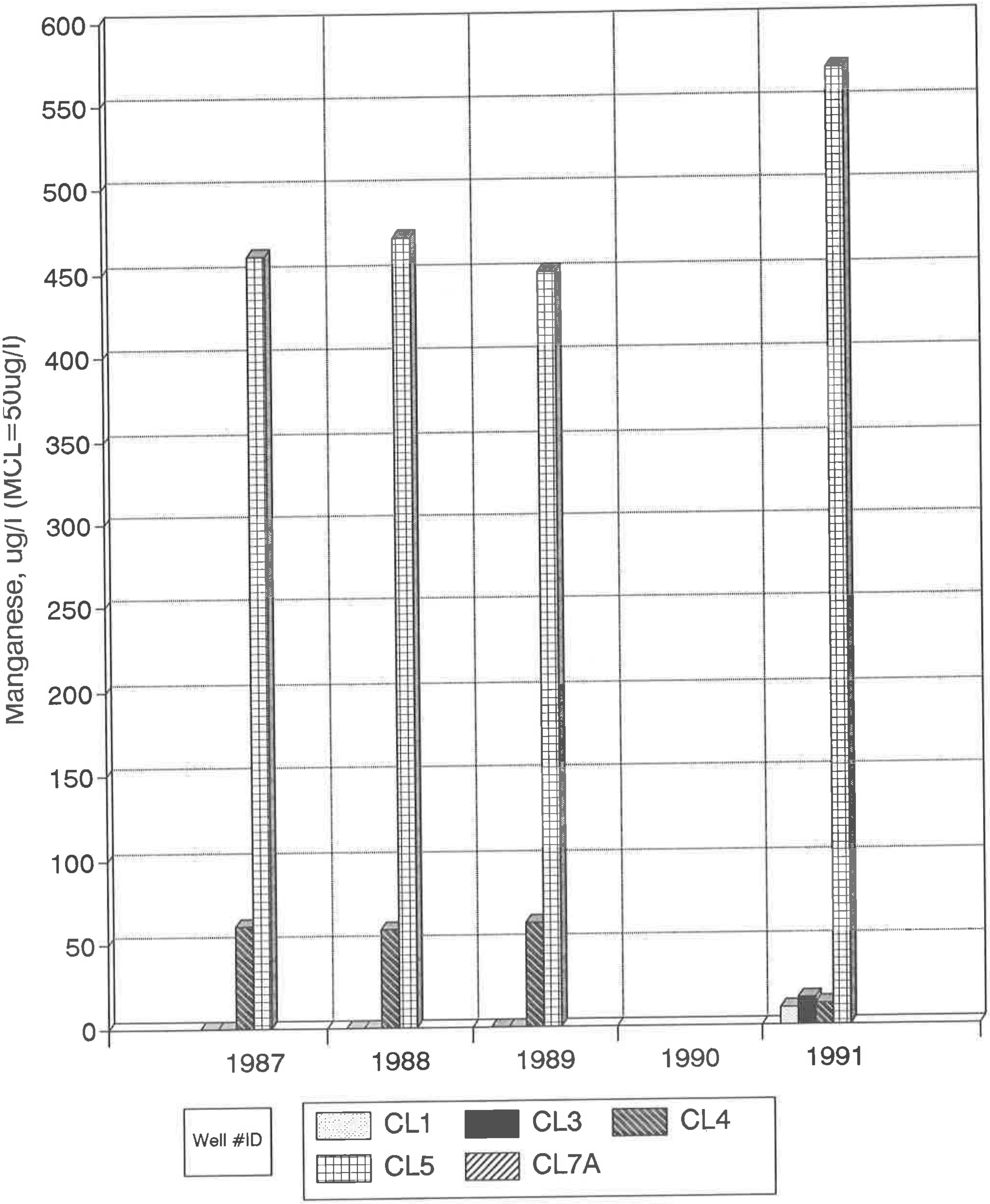


Figure 3-13. - Manganese Concentrations in Selected Wells in the Claiborne Aquifer System.

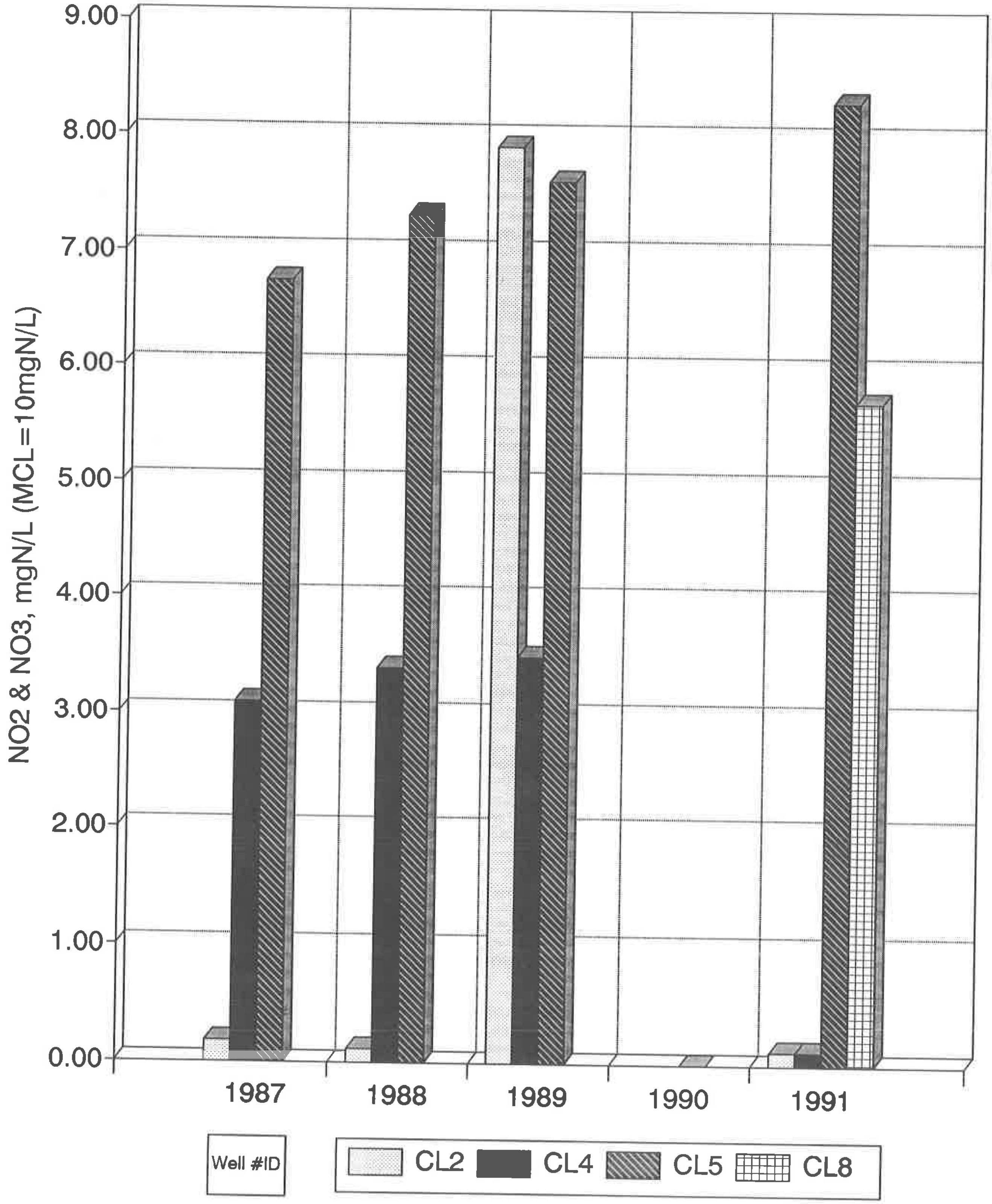
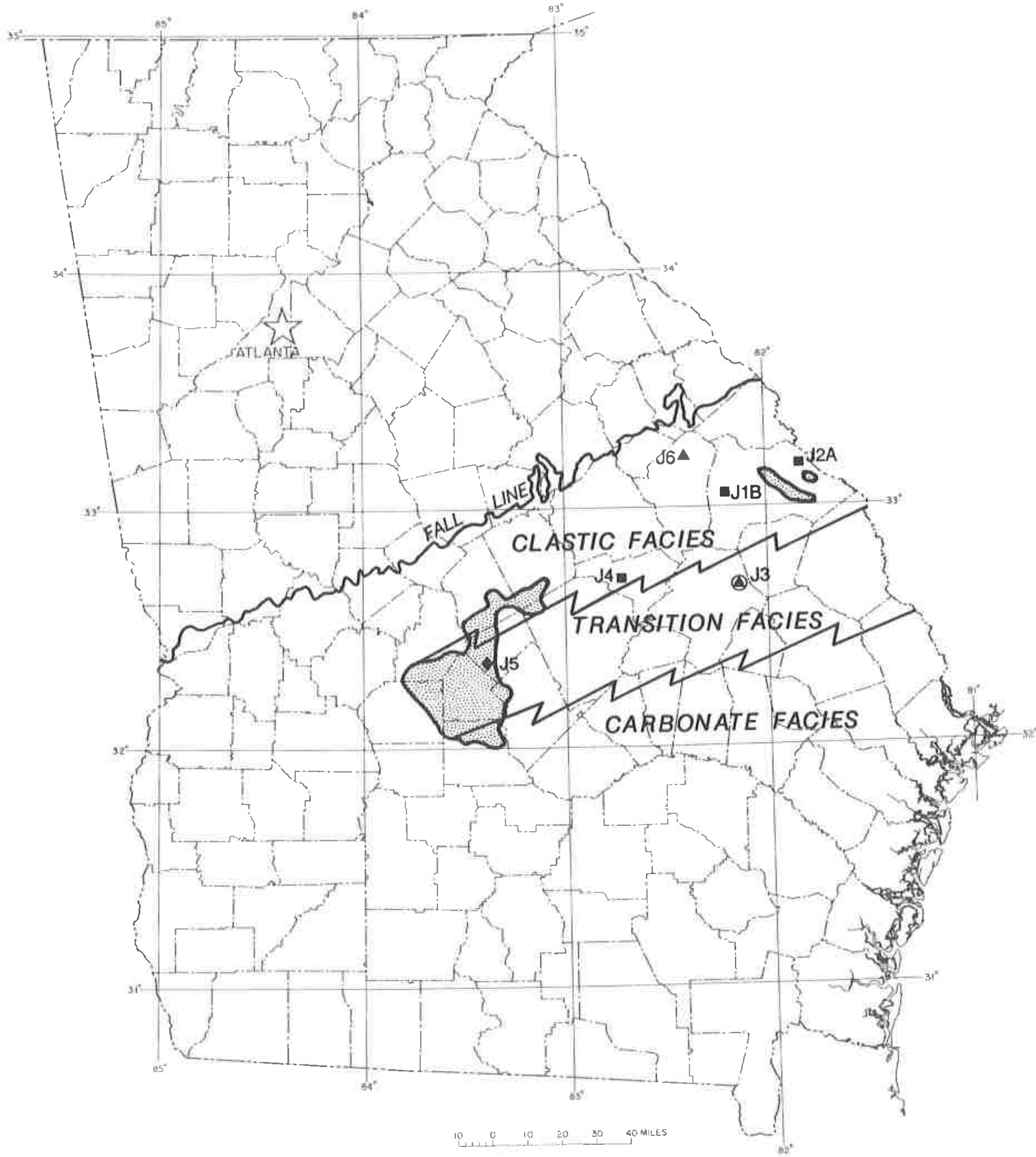


Figure 3-14. - Nitrite/Nitrate Concentrations in Selected Wells in the Claiborne Aquifer System.



○ Manganese concentrations exceed drinking-water limits
● Soft water
▲ Moderately hard water
■ Hard water
♦ Very hard water
General recharge area (from Davis, et al., 1988)
Facies boundary (from Vincent, 1982)

Figure 3-15. - Water quality of the Jacksonian aquifer system.

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.

Water quality in the Jacksonian aquifer system was monitored in four wells in the clastic facies and two wells in the transition facies. Ph levels changed very slightly, ranging from 6.7 to 7.7. Iron levels were within secondary Maximum Contaminant Levels for drinking water in all wells in both transition facies and clastic facies. Manganese exceeded drinking water limits in water from one well, GWN-J3 in Emanuel County. Figures 3-16 and 3-17 shows trends in concentration for wells that have historically yielded water high in iron and manganese. The major alkali metals and aluminum, bismuth, and zinc were the other common cations.

Chloride and sulfate levels were 13 parts per million or less in all samples. Nitrite/nitrate concentrations ranged from below detection limits up to 1.6 parts per million in one clastic-facies well in Burke County (GWN-J1B). These concentrations are within the range of previous measurements from wells in the same area. Figure 3-18 summarizes trends in nitrite/nitrate levels for the Jacksonian aquifer.

3.7 FLORIDAN AQUIFER SYSTEM

The Floridan aquifer system, formerly known as the Principal Artisan aquifer system, consists of Eocene and Oligocene limestones and dolostones that underlie most of the Coastal Plain Province (Figure 3-19). Other units are included locally in the aquifer. 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.

Floridan aquifer system carbonates form a single permeable zone in up-dip areas and two permeable zones in down-dip areas (Miller, 1986).The upper water-bearing units of the Floridan are the Eocene Ocala Group and the Oligocene Suwannee Limestone (Crews and Huddlestun, 1984). These limestones crop out in the Dougherty Plain (a karstic area in

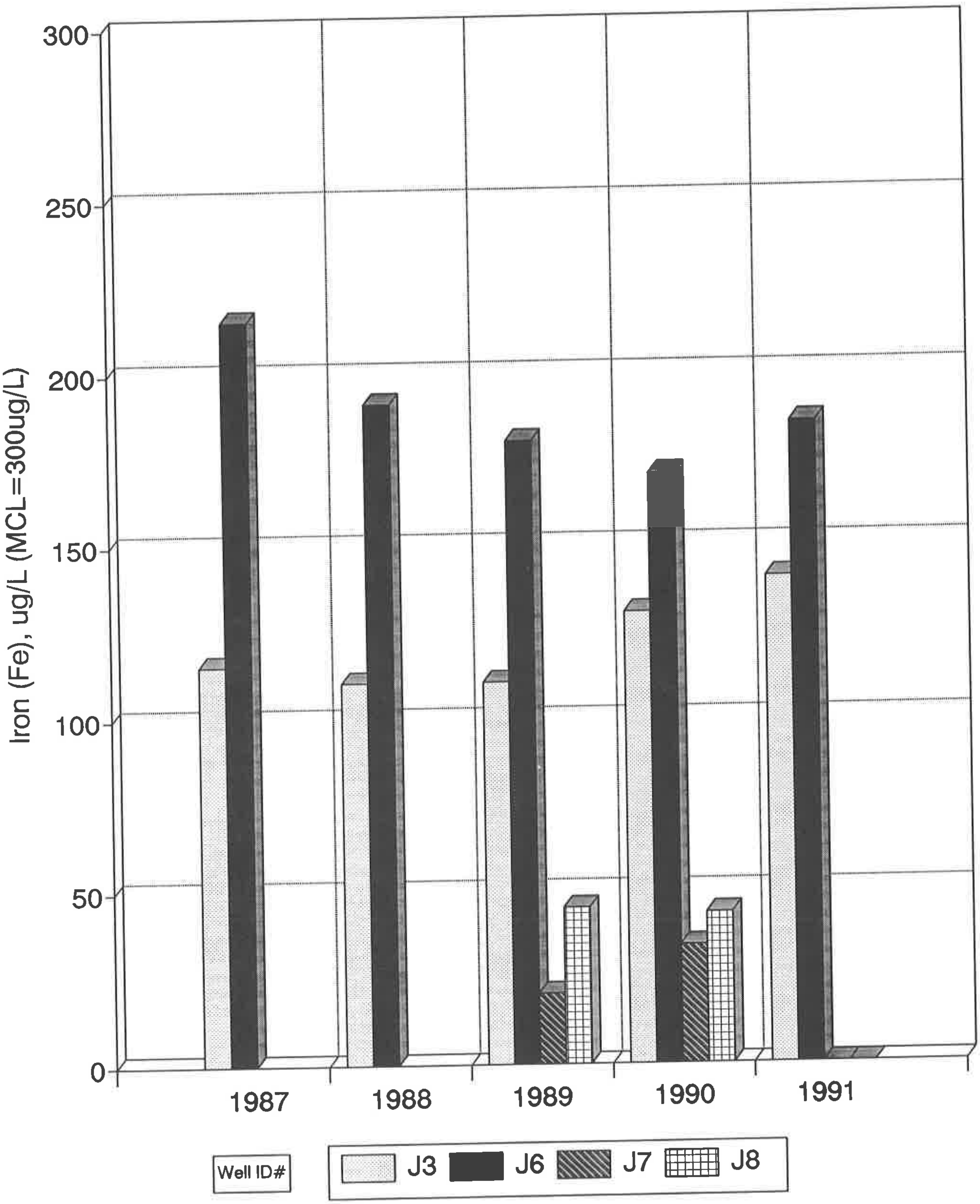


Figure 3-16. - Iron Concentrations in Selected Wells in the Jacksonian Aquifer System.

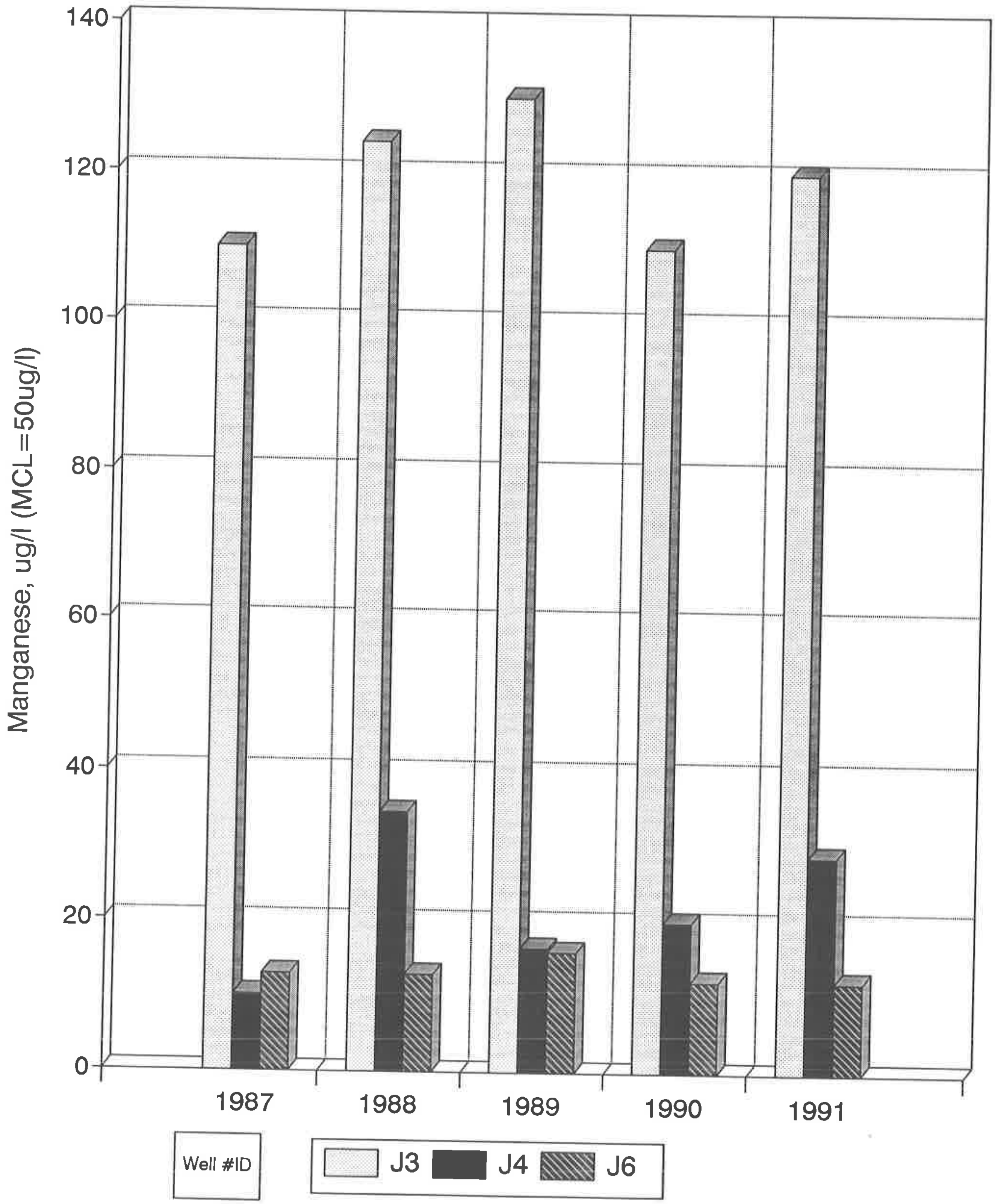


Figure 3-17. - Manganese Concentrations in Selected Wells in the Jacksonian Aquifer System.

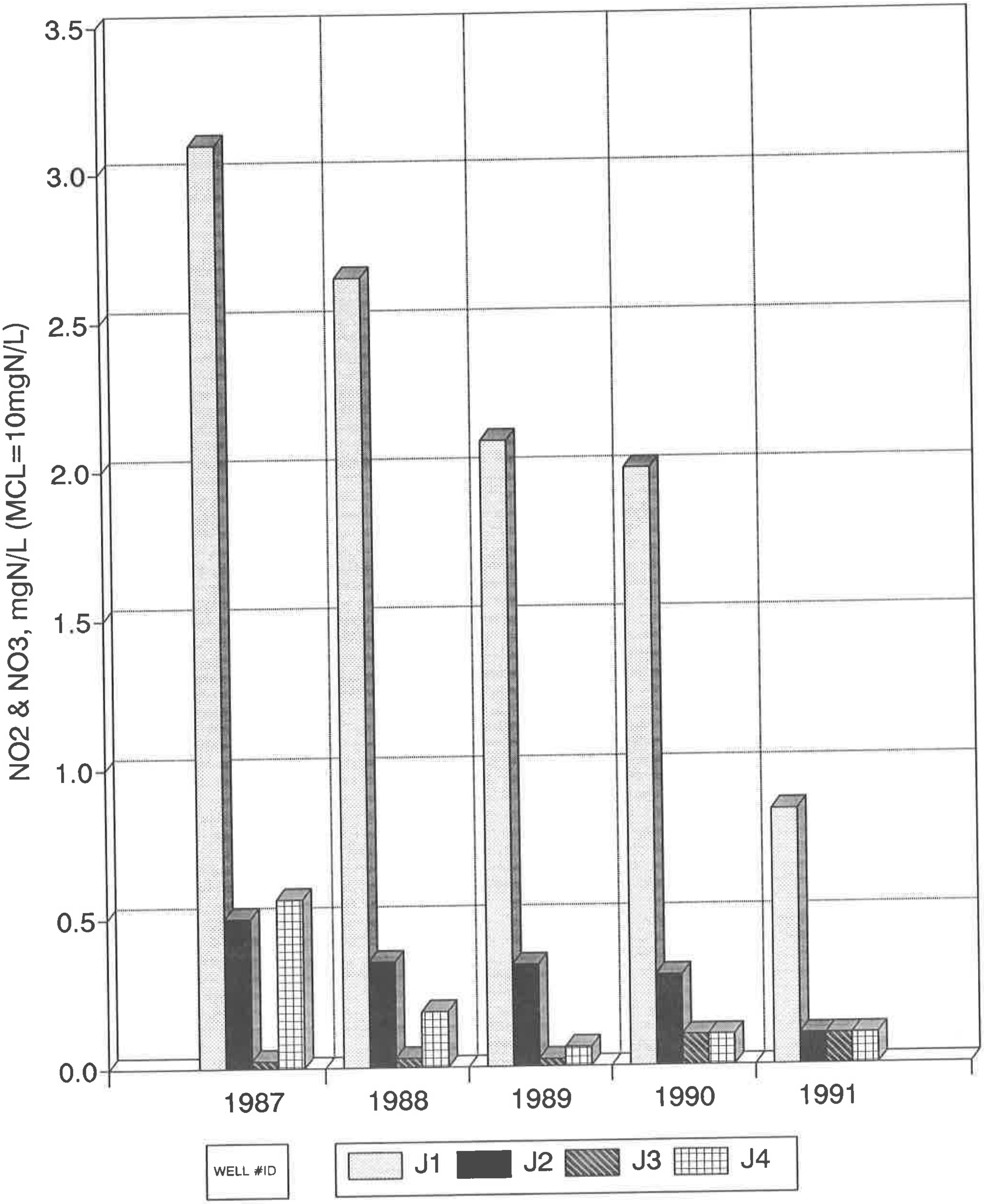
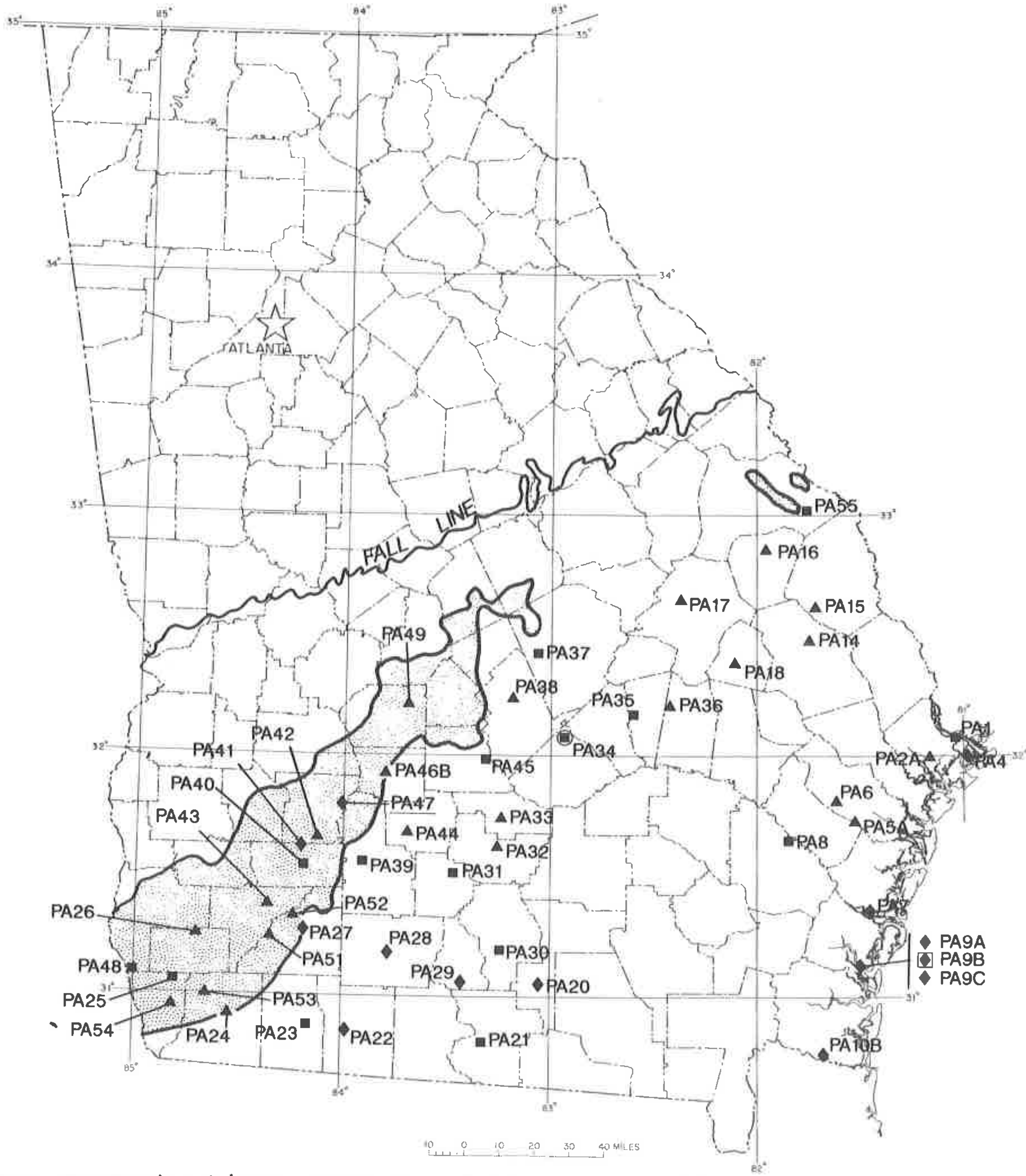


Figure 3-18. - Nitrite/Nitrate Concentrations in Selected Wells in the Jacksonian Aquifer System.



□ Iron concentrations exceed drinking-water limits
○ Manganese concentrations exceed drinking-water limits
PA47 Nitrite/nitrate concentrations exceed 0.45 parts per million
▲ Moderately hard water
■ Hard water
♦ Very hard water
General recharge area (from Davis, et al., 1988)

Figure 3-19. - Water quality of the Floridan aquifer system.

southwestern Georgia) and in adjacent areas along 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, which consists of dolomitic limestone of middle and lower Eocene age and pelletal, vuggy, dolomitic limestone of Paleocene age, 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 Gulf Trough is a linear depositional feature in the Ocala Group that extends from southwestern Decatur County through central Bulloch County.

A ground-water divide separates a southwestward flow system in the Floridan aquifer in the Dougherty Plain from the Floridan aquifer system's major southeastward flow system in the remainder of Georgia. Rainfall infiltration in outcrop areas and leakage from extensive surficial aquifers provides recharge to 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 Brooks-Echols-Lowndes Counties area where the Withlacoochee River and numerous sinkholes breach upper confining beds (Krause, 1979).

Ground-water samples were collected from 52 wells completed in the Floridan aquifer system. All of the water samples were neutral to basic and moderately hard to hard. Iron exceeded drinking-water limits in water in one well, GWN-PA9B in Glynn County, while manganese exceeded secondary MCL from only one well, GWN-PA34 in Telfair County. Trends in iron and manganese levels in selected wells screened in the Floridan aquifer are shown in Figures 3-20 and 3-21. Aluminum, barium, bismuth, strontium, and zinc were other common trace metals, with molybdenum, copper, tin and titanium occurring less frequently. Barium levels in

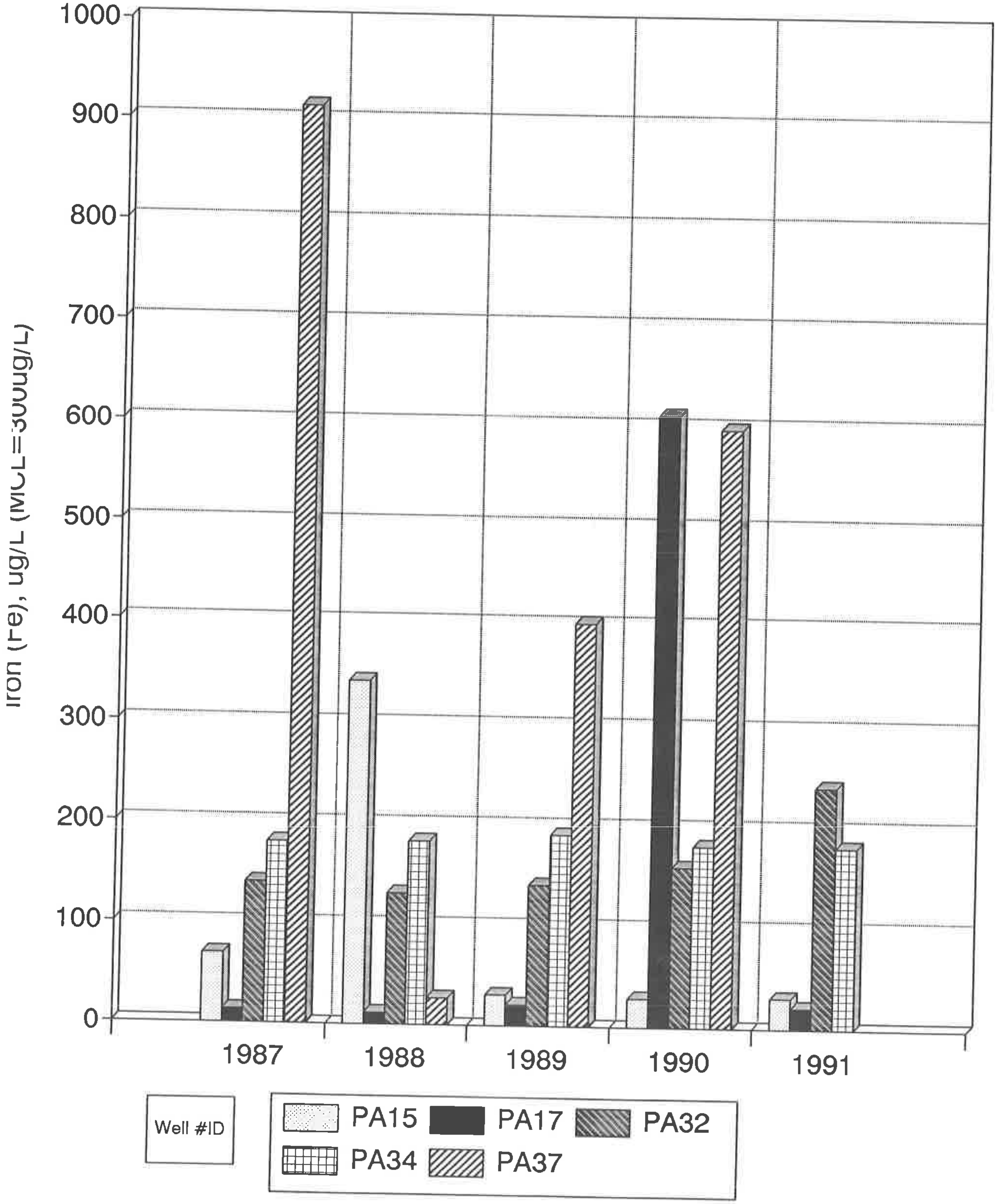


Figure 3-20. - Iron Concentrations in Selected Wells in the Floridan Aquifer System.

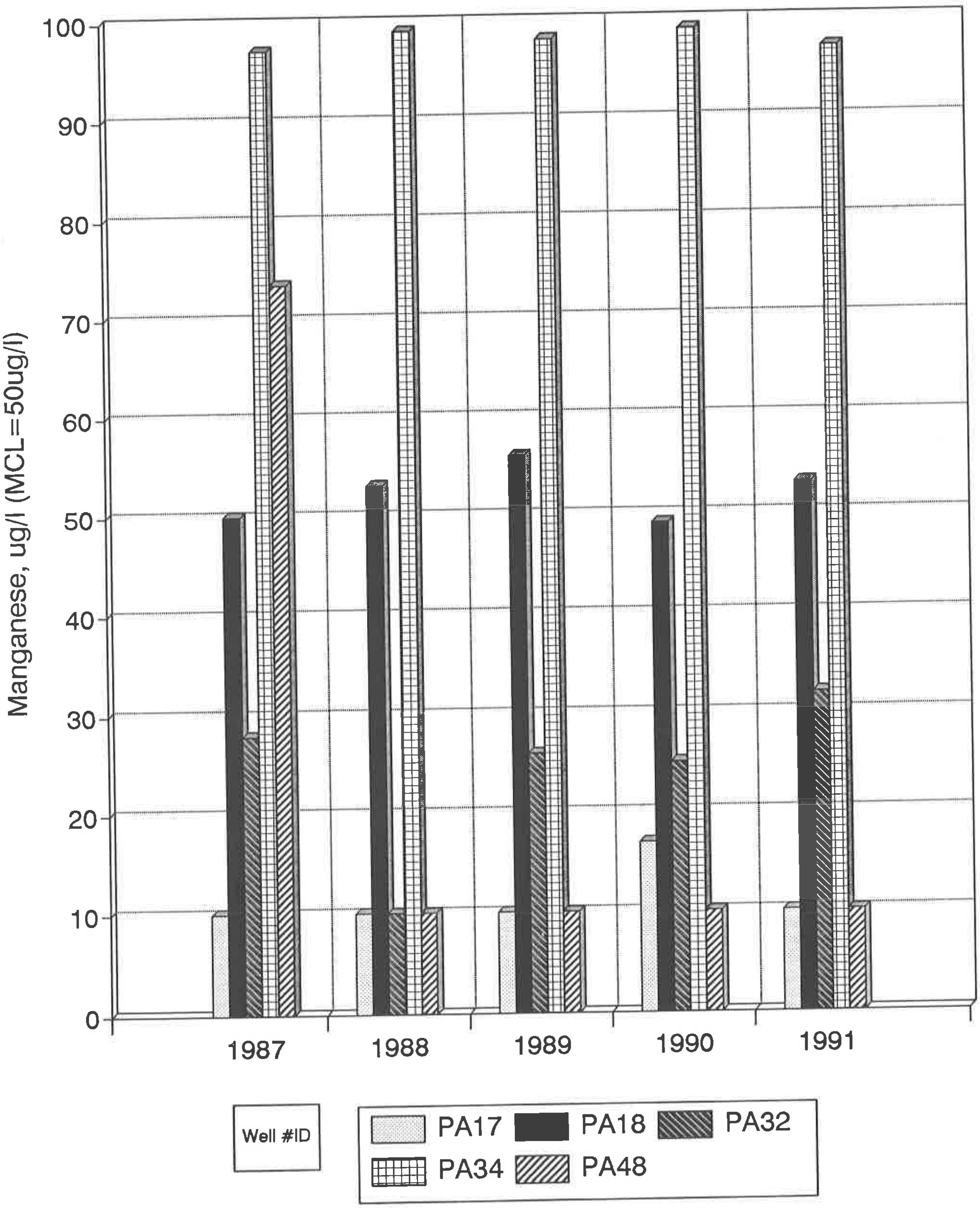


Figure 3-21. - Manganese Concentrations in Selected Wells in the Floridan Aquifer System.

water samples from a well in Fitzgerald, Ben Hill County, GWN-PA33 exceeded the drinking-water maximum.

Chloride and sulfate levels were highest (192 and 273 parts per million, respectively) in water from Glynn County monitoring well GWN-PA9B. Most of the water samples collected from the recharge area of the Floridan aquifer contained detectable amounts of nitrite/nitrate. Levels of nitrite/nitrate in this area ranged from 0.10 to 4.7 parts per million. Most of the wells in the confined portion of the Floridan aquifer did not contain detectable levels of nitrite/nitrate, although one well, GWN-PA47 in Lee County, measured 10.8 parts per million. Trends in nitrite/nitrate levels in selected wells in the Floridan Aquifer are presented in Figure 3-22.

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 along 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). Two principal aquifer units are present in the coastal area (Joiner, et al., 1988). Clarke (and others, 1990) use the names upper and lower Brunswick aquifers to refer to these two sandy aquifer units.

Water quality of the Miocene aquifer system was monitored in eight wells (Figure 3-23). Water samples varied from slightly acidic to slightly basic, with pH values ranging between 4.5 to 7.9 (standard pH units). Most of the water samples were soft to moderately hard, but wells in Cook and Glynn Counties yielded hard water. Water samples from three wells in Screven, Bulloch, and Cook Counties contained iron at

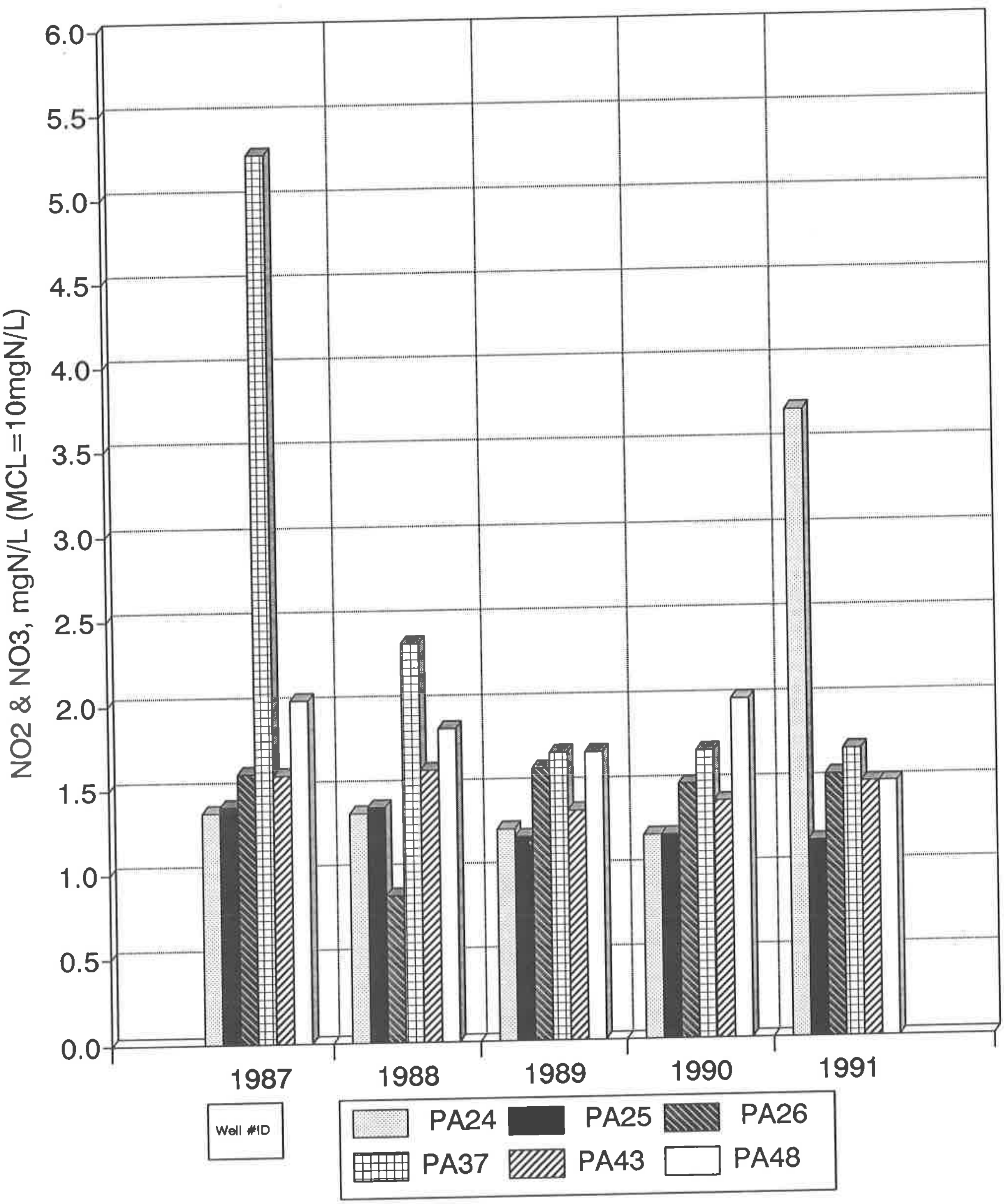
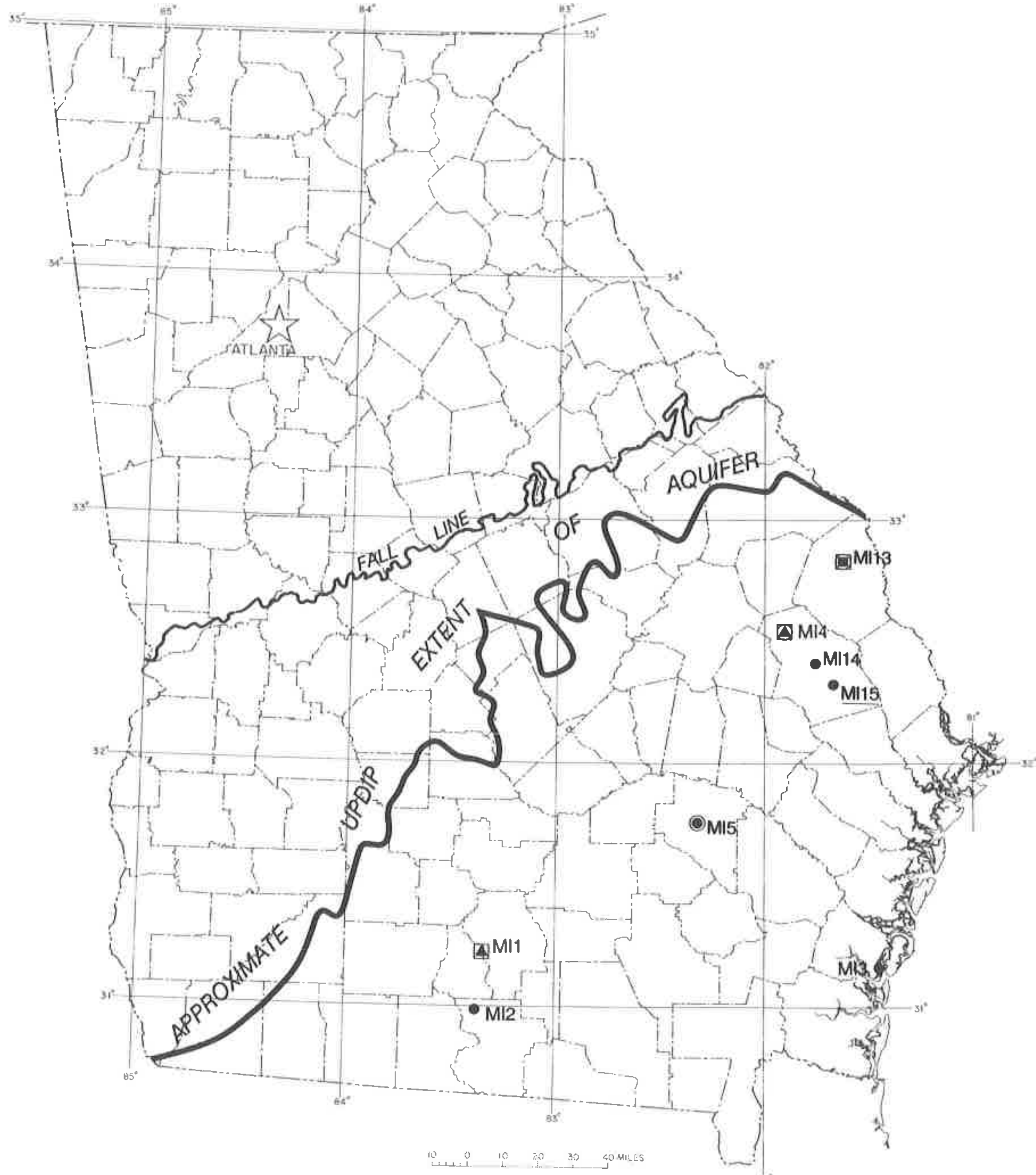


Figure 3-22. - Nitrite/Nitrate Concentrations in Selected Wells in the Floridan Aquifer System.



□ Iron concentrations exceed drinking-water limits
○ Manganese concentrations exceed drinking-water limits
▢ Iron and manganese concentrations exceed drinking-water limits
MI15 Nitrate/nitrite concentration exceeds drinking-water limits
● Soft water
▲ Moderately hard water
■ Hard water

Figure 3-23. - Water quality of the Miocene aquifer system.

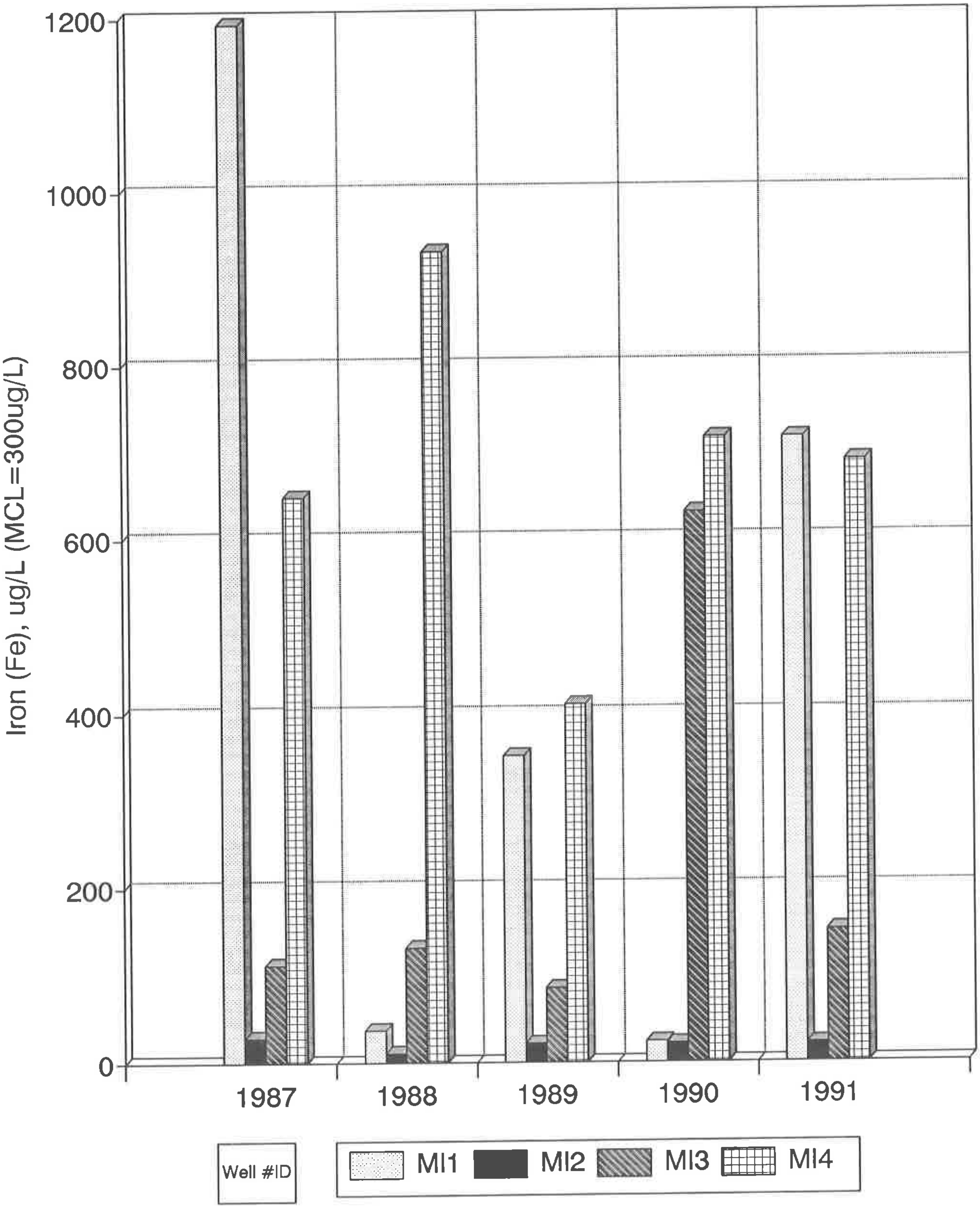


Figure 3-24. - Iron Concentrations in Selected Wells in the Miocene Aquifer System.

concentrations in excess of acceptable drinking water limits (Figure 3-24). Manganese was detected above Secondary Maximum Contaminant Levels in water from three wells in Bulloch, Appling, and Screven Counties (Figure 3-25). Aluminum, barium, bismuth, strontium, titanium, zinc and the major alkali metals were other commonly detected cations in the Miocene aquifer system water samples. Antimony and copper were less commonly detected trace metals.

Chloride levels were less than 16.2 parts per million in all of the samples analyzed. Flourine was present in minor amounts, while sulfate was undetectable in a majority of the samples. Levels were highest (30 parts per million) in Glynn County well GWN-MI3, and 9.5 in well GWN-MI15 in Bulloch County, but were 3.7 parts per million or less in all of the other wells. Detectable levels of nitrite/nitrate, ranging from 0.1 to 11.6 parts per million, were found in the eight wells sampled. Concentrations of nitrate/nitrite for selected wells are illustrated in Figure 3-26.

3.9 PIEDMONT/BLUE RIDGE UNCONFINED AQUIFERS

Georgia's Piedmont and Blue Ridge Physiographic Provinces are developed on metamorphic and igneous rocks that are predominately Precambrian and Paleozoic in age. 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 flow of water into wells completed in crystalline rocks. The permeability and thickness of soils and shallow saprolite horizons determine the amount of discharge that can be sustained.

Ground-water samples were collected from fourteen wells and two springs in the Piedmont Province and four wells in the Blue Ridge Province. Figure 3-27 shows the locations of the monitoring stations. Water from wells in the crystalline-rock aquifers was generally slightly acidic and soft to moderately hard. Iron and manganese levels exceeded drinking-water limits in water samples from seven of the Piedmont wells and in one of the Blue Ridge wells. Figures 3-28, 3-29, 3-30, and 3-31

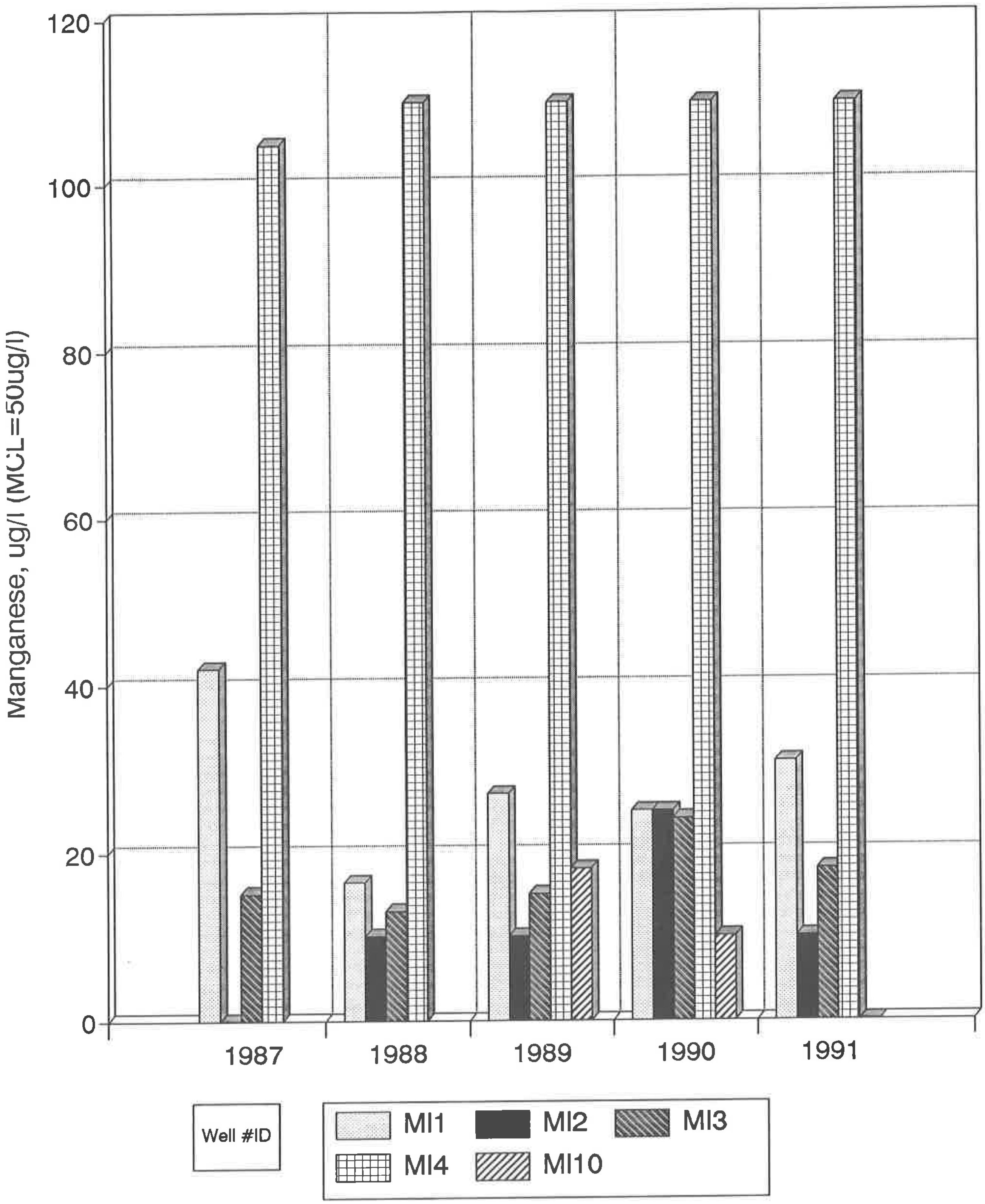


Figure 3-25. - Manganese Concentrations in Selected Wells in the Miocene Aquifer System.

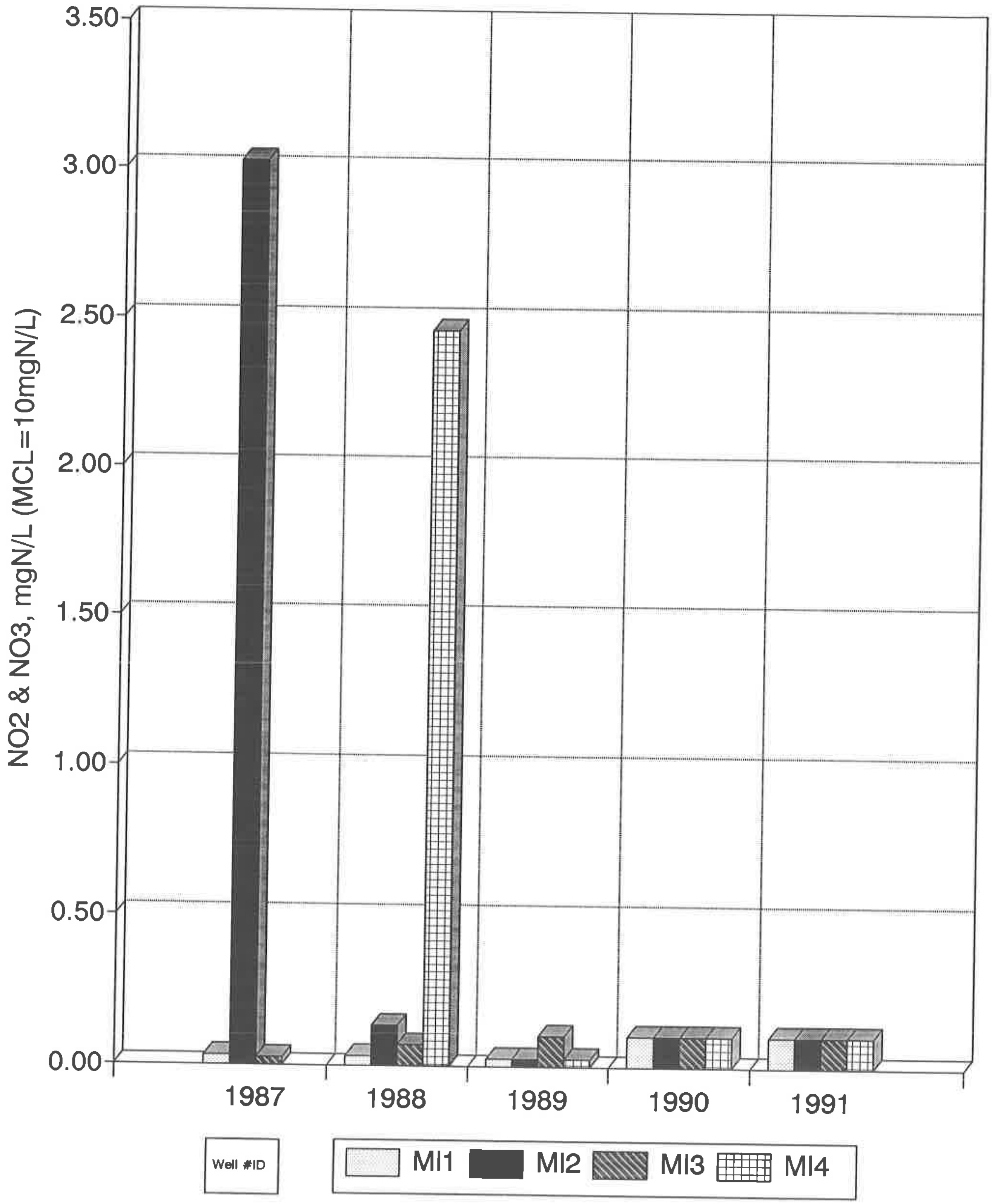
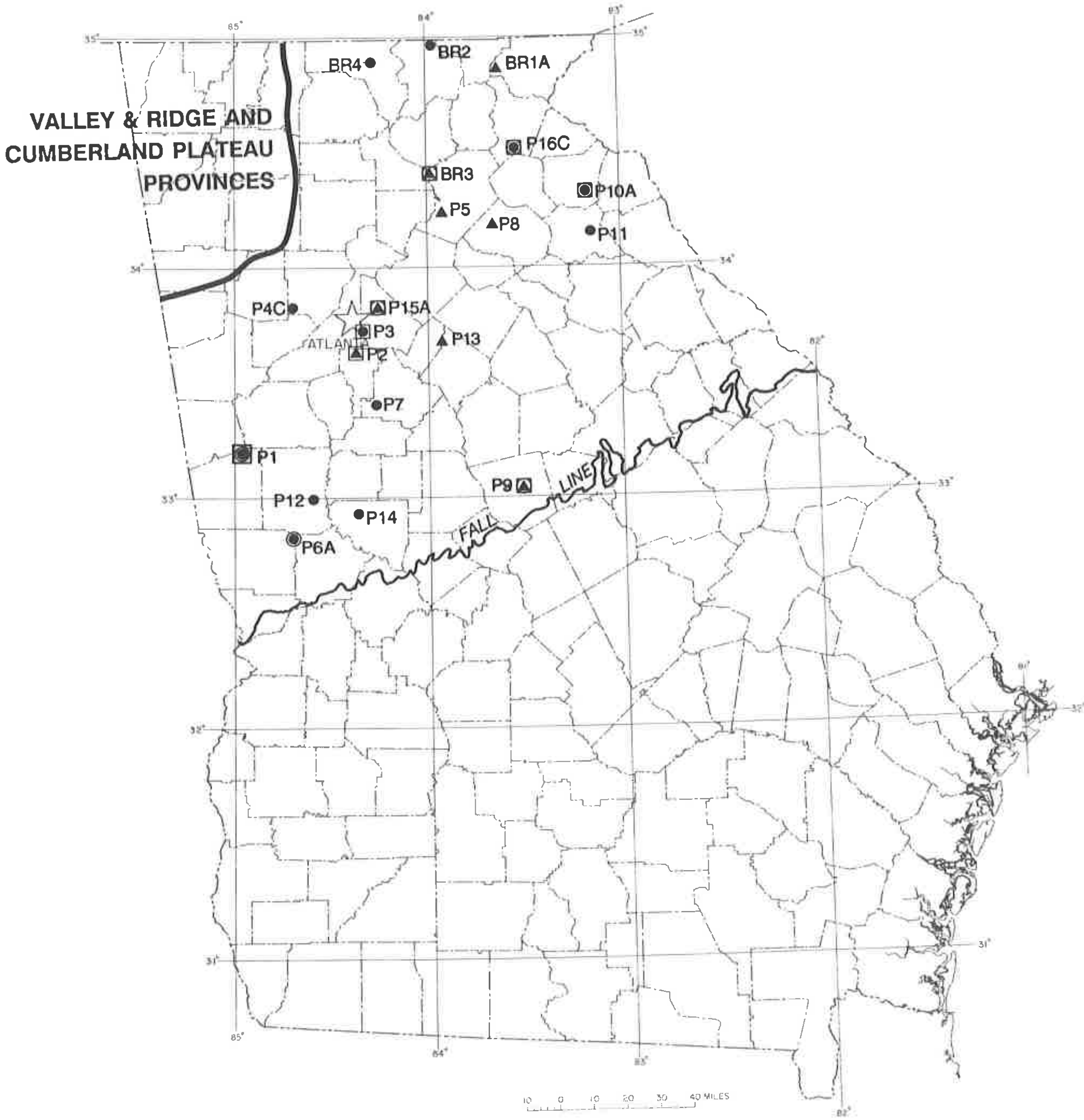


Figure 3-26. - Nitrite/Nitrate Concentrations in Selected Wells in the Miocene Aquifer System.



□ Iron concentrations exceed drinking-water limits
○ Manganese concentrations exceed drinking-water limits
◘ Iron and manganese concentrations exceed drinking-water limits
● Soft water
▲ Moderately hard water
■ Hard water

Figure 3-27. - Water quality of the Piedmont/Blue Ridge unconfined aquifers.

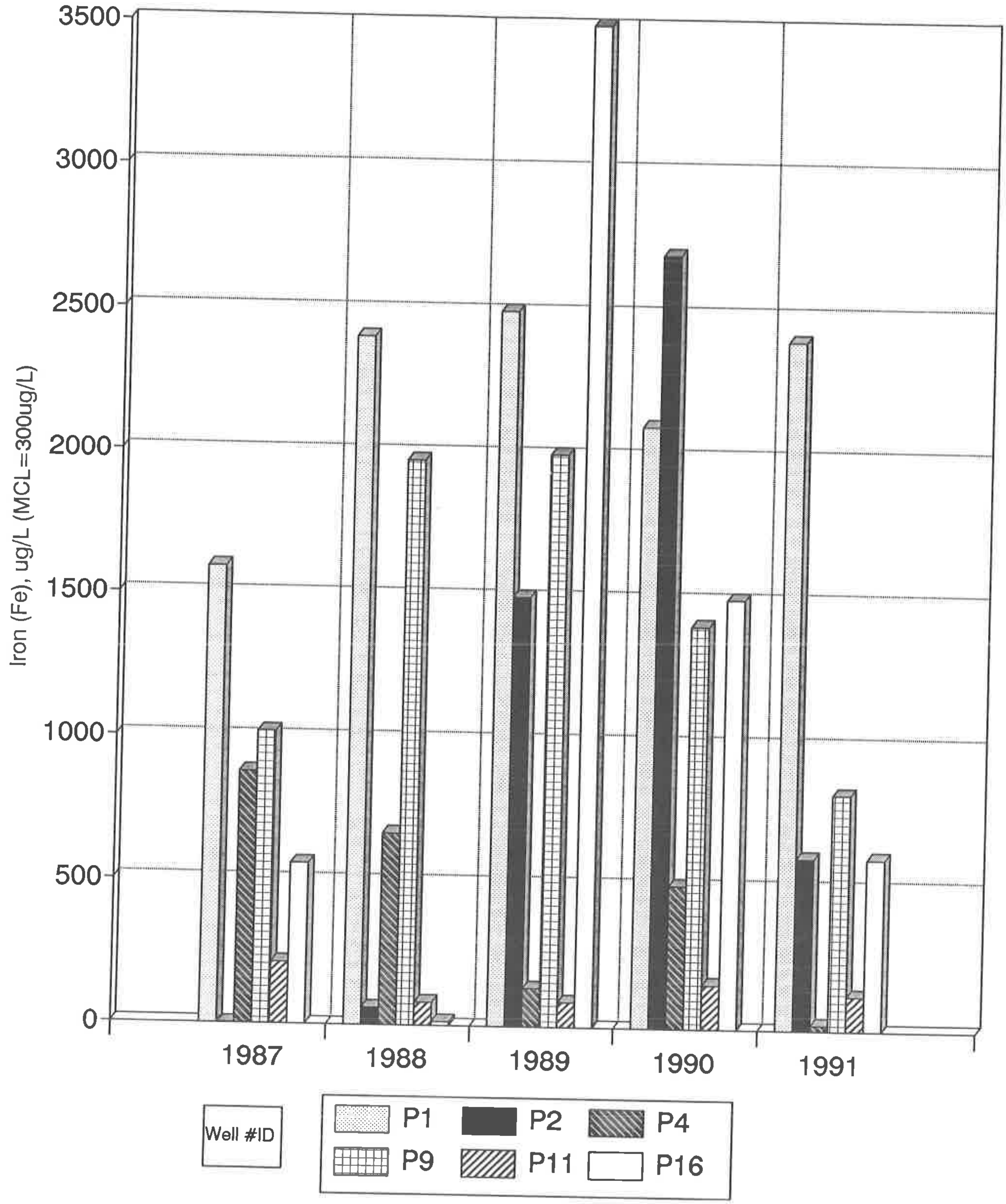


Figure 3-28. - Iron Concentrations in Selected Wells in the Piedmont Aquifer System.

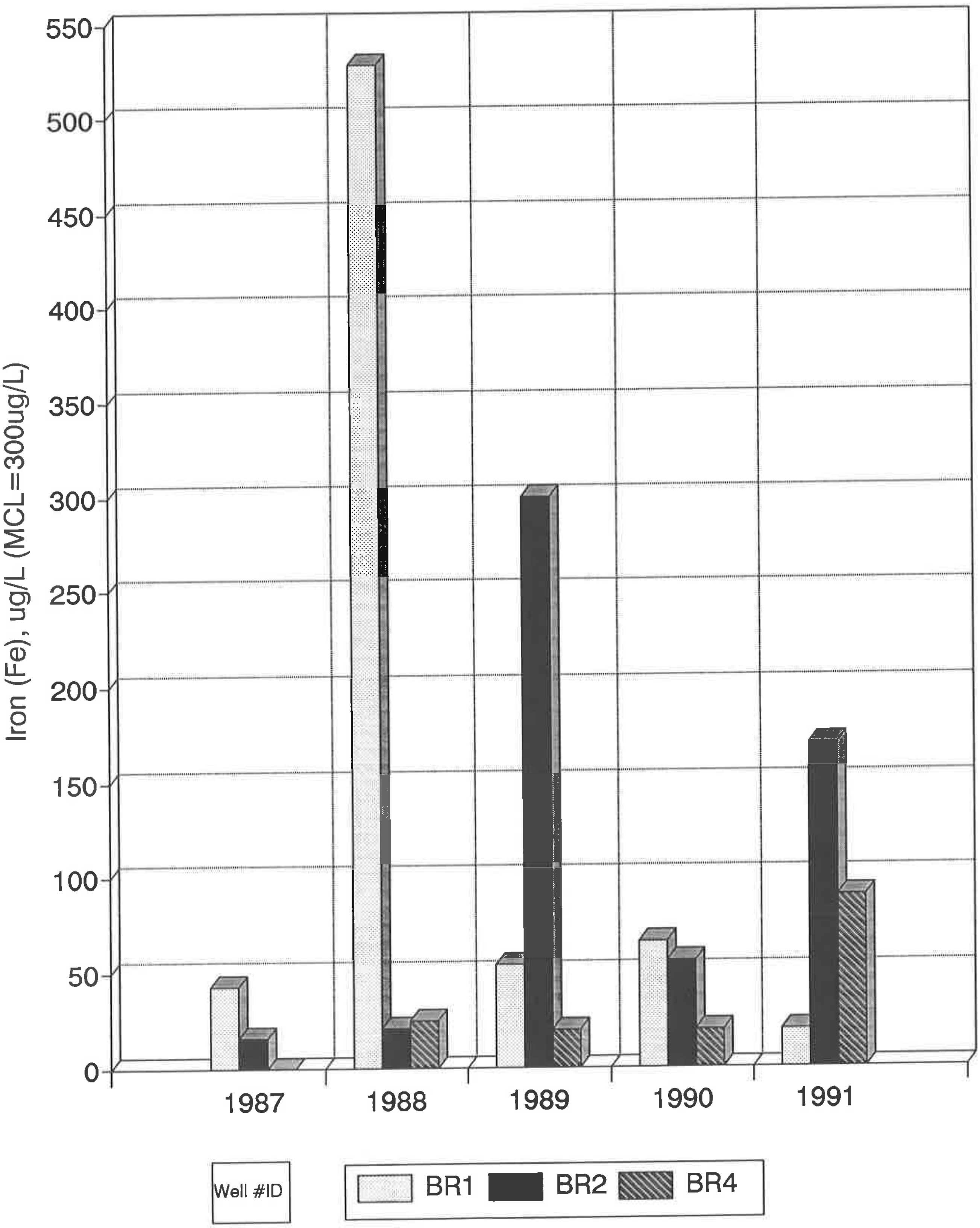


Figure 3-29. - Iron Concentrations in Selected Wells in the Blue Ridge Aquifer System.

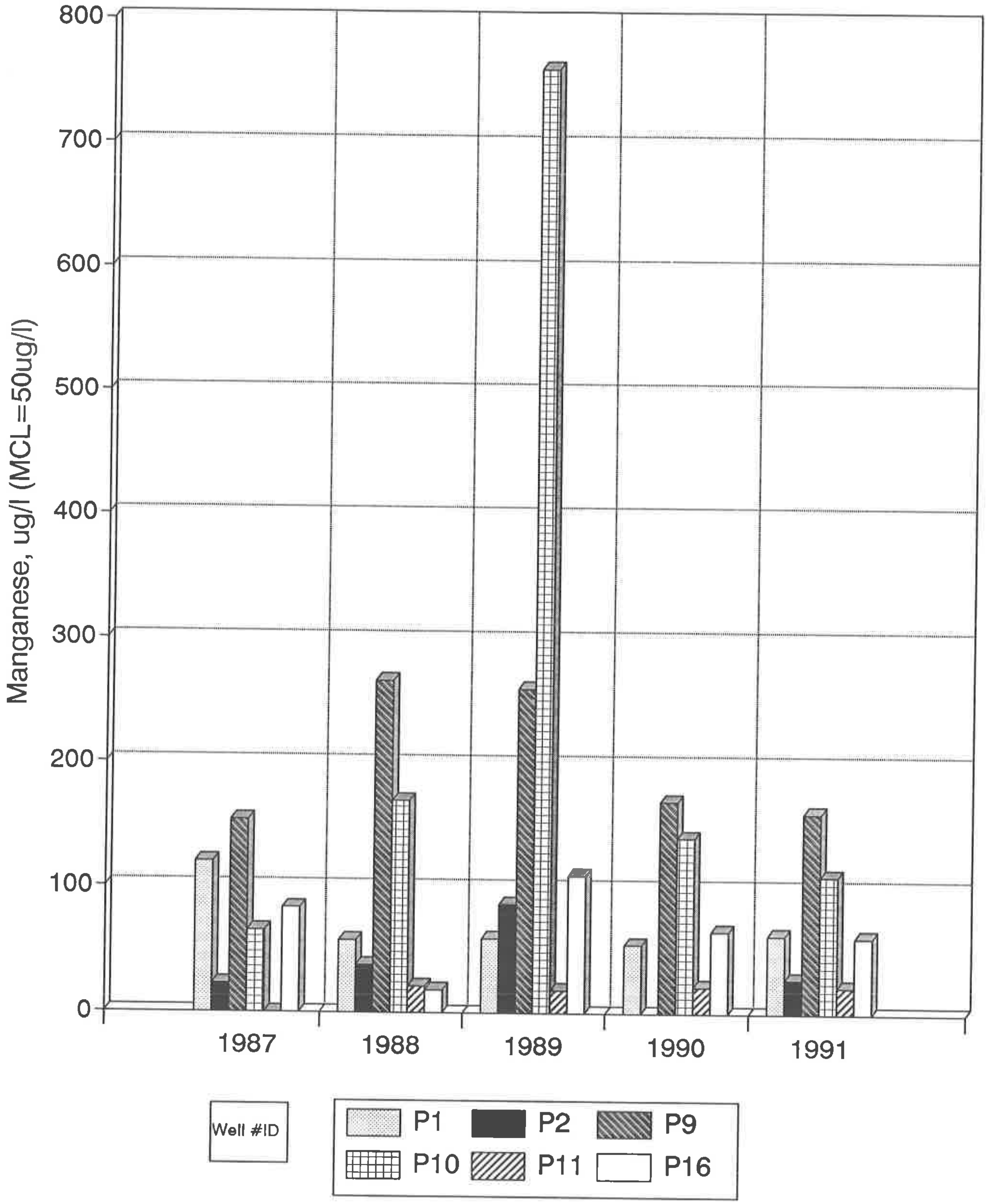


Figure 3-30. - Manganese Concentrations in Selected Wells in the Piedmont Aquifer System.

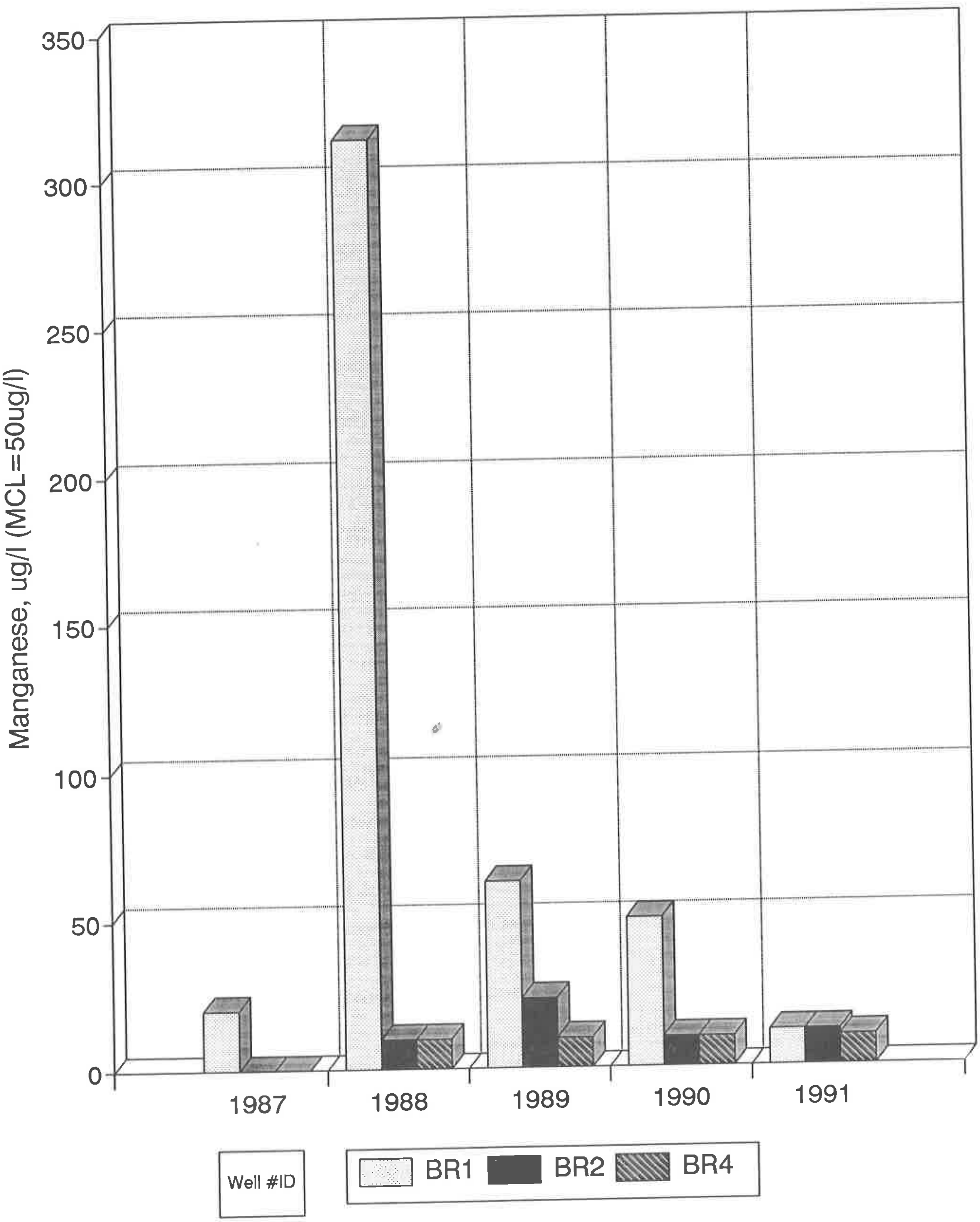


Figure 3-31. - Manganese Concentrations in Selected Wells in the Blue Ridge Aquifer System.

show trends in iron and manganese concentrations for wells that have historically yielded water with high levels of these metals. Aluminum, barium, bismuth cadmium, strontium, and zinc were common trace metal constituents.

Chloride and sulfate concentrations in the water samples were typically below 20 parts per million. Nitrite/nitrate was present in water from twelve wells, all of which yielded water with nitrite/nitrate levels less than 1.9 parts per million. Figures 3-32 and 3-33 show nitrite/nitrate concentrations from the Piedmont and Blue Ridge aquifers.

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 bottom outcrops of 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.

Water quality in the Valley and Ridge unconfined aquifers was monitored in six wells and three springs located across the Province (Figure 3-34). Three of these wells and all three springs produced water from Knox Group carbonates. The other wells represent water quality in the Ordovician Chickamauga Group of Walker County and the Cambrian Shady Dolomite of Bartow County. Water from the Valley and Ridge monitoring stations was typically basic and moderately hard to very hard. Iron and manganese concentrations (Figures 3-35 and 3-36) exceeded drinking-water limits in one of the water samples analyzed (GWN-VR2). Aluminum, barium, bismuth, and strontium were the most common trace metal constituents. Less commonly detected trace metals included copper and zinc.

Chloride ranged in concentration from 1.0 to 20 parts per million and was typically less than one part per million. Sulfate concentrations ranged from 2.0 to 55.7 parts per million. Detectable levels of nitrite/nitrate were present in all but one of the water samples.

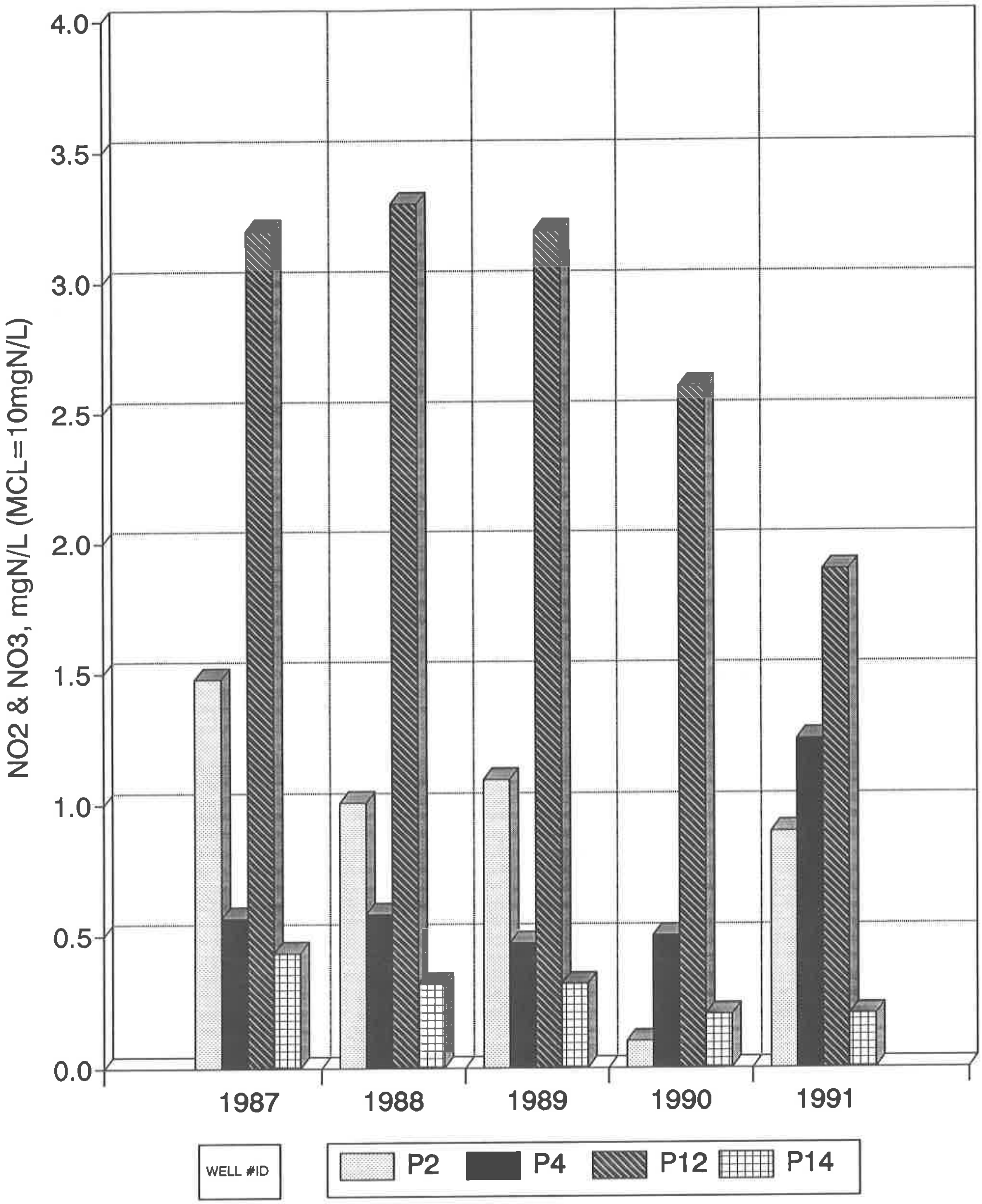


Figure 3-32. - Nitrite/Nitrate Concentrations in Selected Wells in the Piedmont Aquifer System.

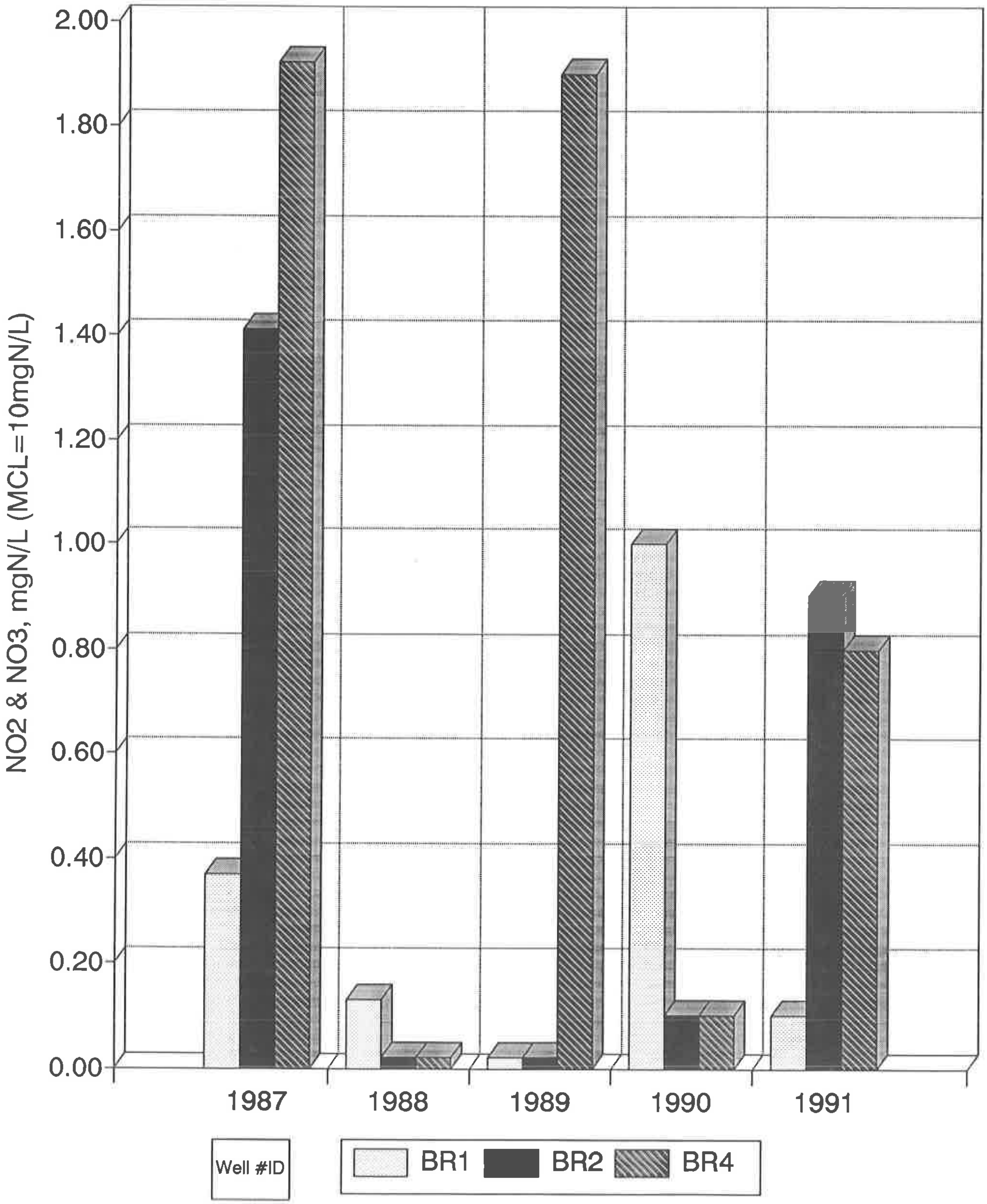
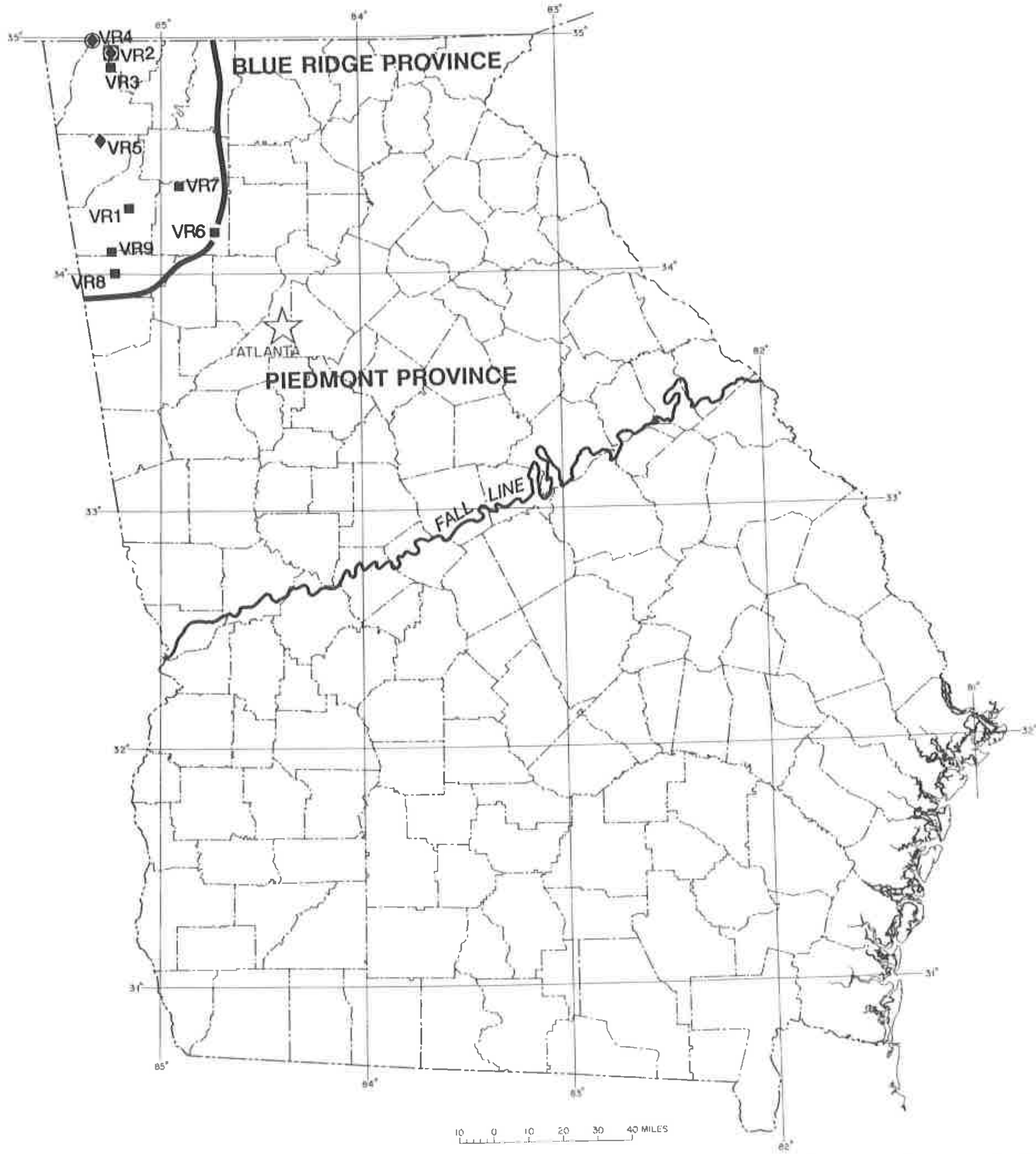


Figure 3-33. - Nitrite/Nitrate Concentrations in Selected Wells in the Blue Ridge Aquifer System.



□ Iron and manganese concentrations exceed drinking-water limits
▲ Moderately hard water
■ Hard water
♦ Very hard water

Figure 3-34. - Water quality of the Valley and Ridge unconfined aquifers.

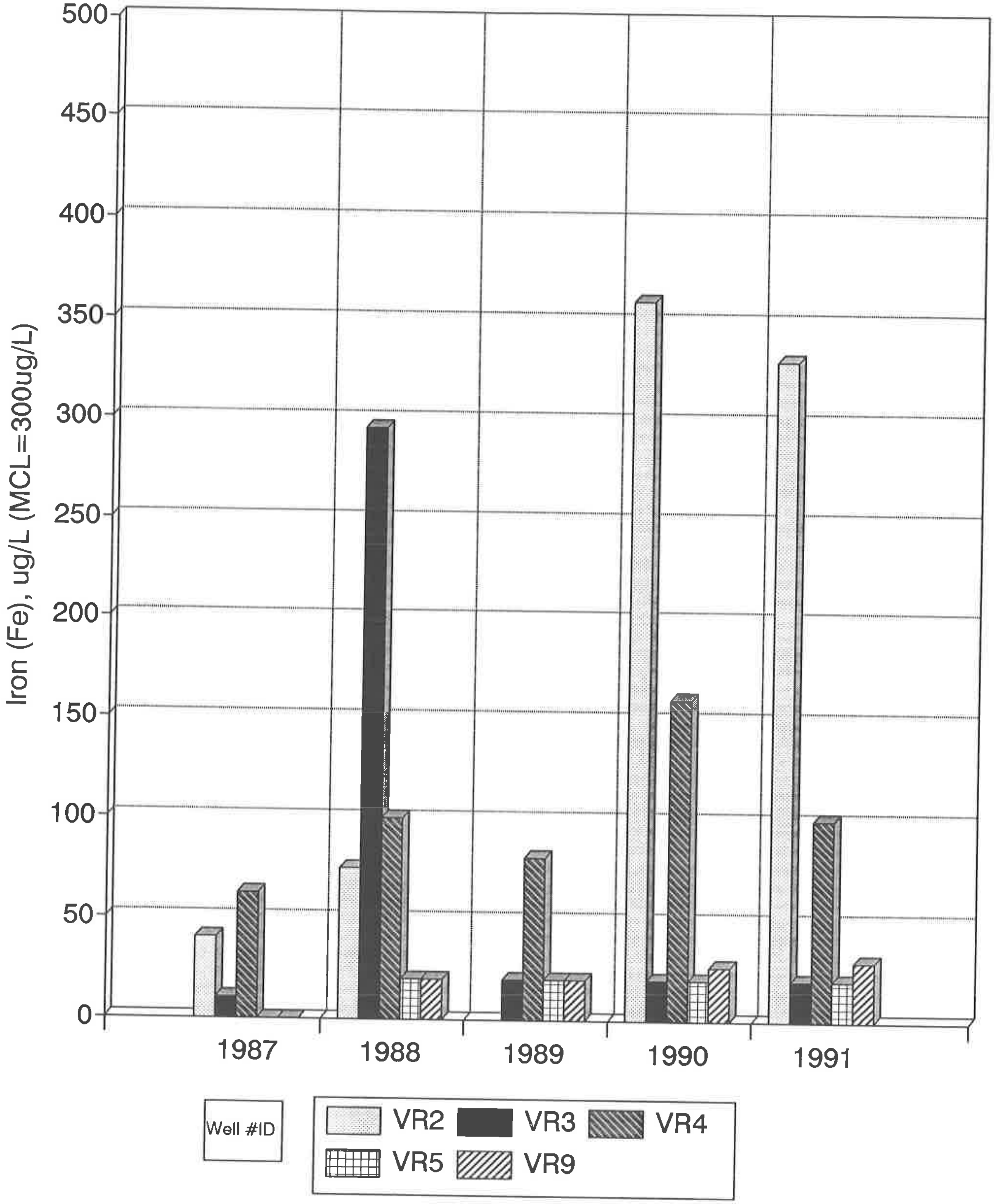


Figure 3-35. - Iron Concentrations in Selected Wells in the Valley & Ridge Aquifers.

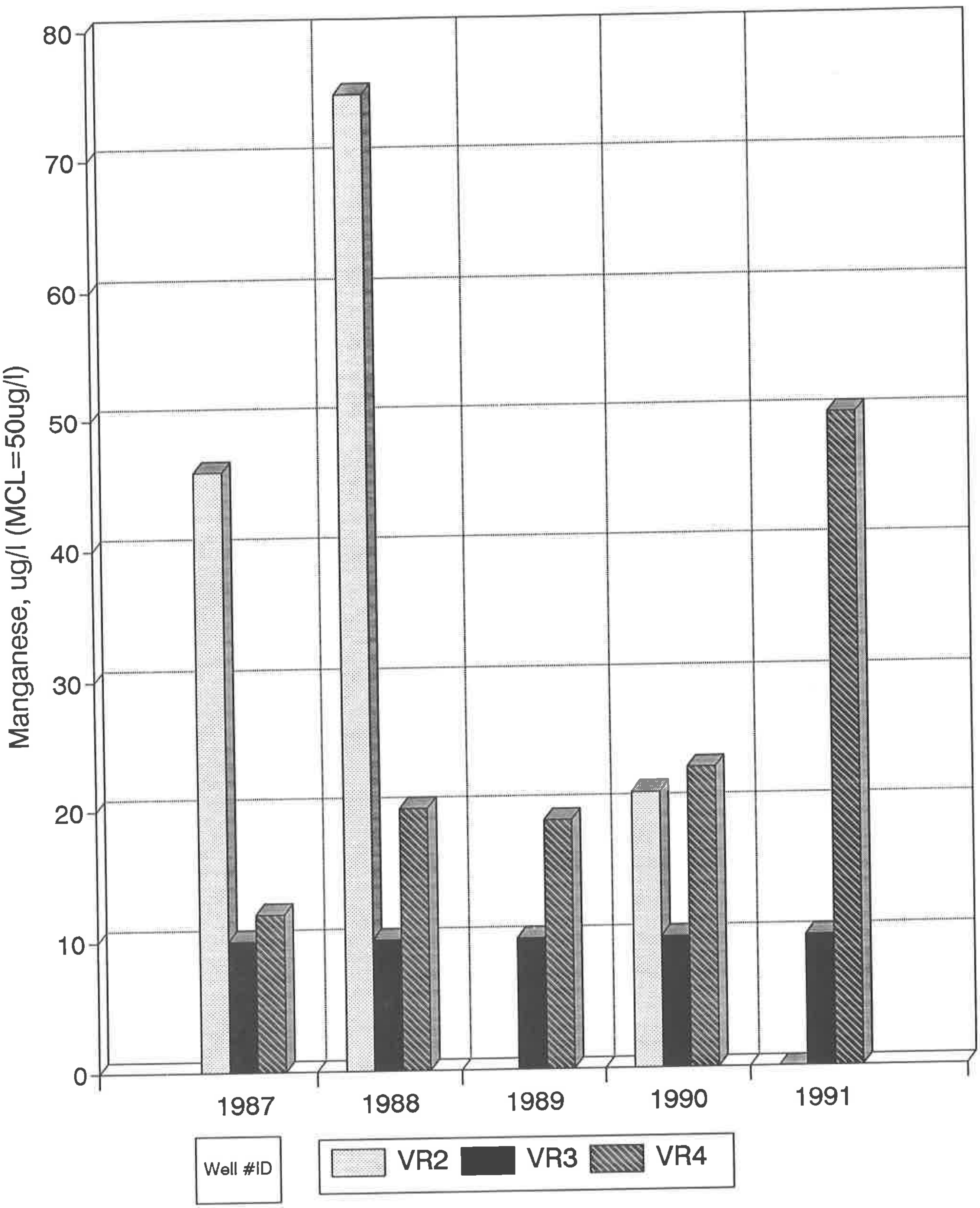


Figure 3-36. - Manganese Concentrations in Selected Wells in the Valley & Ridge Aquifers.

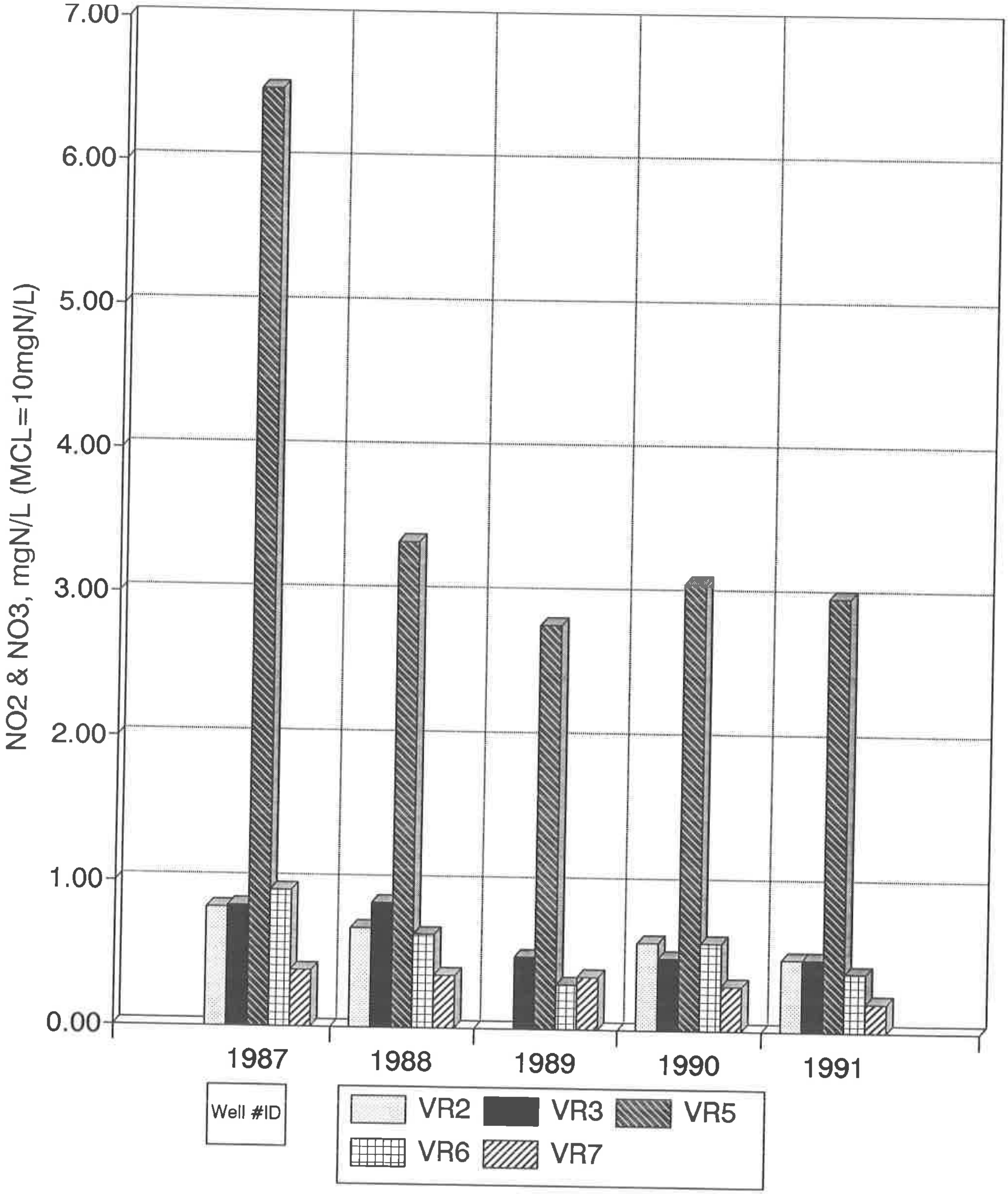


Figure 3-37. - Nitrite/Nitrate Concentrations in Selected Wells in the Valley & Ridge Aquifers.

Concentrations ranged from .10 to 3.0 parts per million in water from eight of the wells and springs. Figure 3-37 shows nitrite/nitrate levels measured in 1991 were generally within previously established ranges for water from these monitoring stations.

Several volatile organics were found in GWN-VR2 when it was sampled July, 1991 (Appendix, 1991 Groundwater Quality Analysis of the Valley and Ridge Unconfined Aquifer System). It should be noted that the water from this well is used only for cooling water and is not being used as a drinking water source.

4.0 SUMMARY AND CONCLUSIONS

Hydrogeologists collected 154 water samples for analysis from 122 wells and five springs for the Ground-Water Monitoring Network in 1991. These wells and springs represent eight major aquifer systems:

Cretaceous aquifer system,
Clayton aquifer system,
Jacksonian aquifer system,
Floridan aquifer system,
Miocene aquifer system,
Piedmont unconfined aquifer,
Blue Ridge unconfined aquifer and
Valley and Ridge unconfined aquifers.

Analyses of water samples collected in 1991 were compared 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 that were detected at stations of the Ground-Water Monitoring Network during 1991. Although isolated ground-water quality problems were documented during 1991 at specific localities, the quality of water from the majority of the Ground-Water Monitoring Network stations remains excellent.

Only two wells, a domestic well in the Miocene aquifer and a USGS monitoring well in Lee County, yielded water samples in 1991 with nitrite/nitrate concentrations exceeding the Primary Maximum Contaminant Level of 10 parts per million Nitrogen. Samples from Coastal Plain aquifers with the highest nitrite/nitrate levels were, in most cases, from wells in outcrop areas.

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. Some nitrite/nitrate may come from natural sources, and some may be man-made. The most common sources of man-made dissolved nitrogen in Georgia usually are derived from septic systems, agricultural wastes, and storage or application of fertilizers (Robertson, et. al, 1993). Dissolved nitrogen is also present in rainwater, derived from terrestrial vegetation and volatilization of fertilizers (Drever, 1988). The conversion of other nitrogen species to nitrate occurs in aerobic environments (i.e. recharge areas). Anaerobic conditions, as are commonly developed along the flow path of ground water, foster the dentrification process. However, this process is inhibited by the lack of dentrifying bacteria in ground water (Freeze and Cherry, 1979).

Iron and manganese were the most commonly detected metals in the samples analyzed. Although minor increases or decreases in levels of iron and manganese were noted for some stations, no long-term trends in concentrations of these metals were documented for the majority of the wells and springs sampled.

The presence of organic compounds was again documented in water from a few of the wells sampled. Because of the sporadic nature of the occurrence of organic compounds in most of these wells, spatial and temporal trends in levels of organic pollutants cannot be defined at this time.

Table 4-1: Contaminants and Pollutants detected exceeding MCL during 1991 in stations of the Ground-Water Monitoring Network, by aquifer

Aquifer	Well #ID	Parameter & Detected Level
Cretaceous	GWN-K8	Iron = 3,000 ug/L
	GWN-K9	Iron = 1,400 ug/L
Providence	GWN-PD2A	Iron = 350 ug/L
Clayton	GWN-CT1	Iron = 700 ug/L
	GWN-CT6B	Iron = 1,400 ug/L
Claiborne	GWN-CL1	Iron = 380 ug/L
	GWN-CL3	Iron = 960 ug/L
	GWN-CL5	Manganese = 570 ug/L
	GWN-CL7A	Manganese = 61 ug/L
	GWN-CL8	Manganese = 100 ug/L
Jacksonian	GWN-J3	Manganese = 120 ug/L
Floridan	GWN-PA9B	Iron = 400 ug/L
	GWN-PA18	Manganese = 53 ug/L
	GWN-PA33	Barium = 2,000 ug/L
	GWN-PA34	Manganese = 97 ug/L
	GWN-PA41	Manganese = 120 ug/L
Miocene	GWN-MI1*	Iron = 970 ug/L
		Iron = 460 ug/L
	GWN-MI4	Iron = 690 ug/L
		Manganese = 110 ug/L
	GWN-MI5	Manganese = 110 ug/L
	GWN-MI13	Iron = 2,000 ug/L
		Manganese = 190 ug/L

* Two values indicate two sampling dates

(CONTINUED ON NEXT PAGE)

Table 4-1: Contaminants and Pollutants detected exceeding MCL during 1991 in stations of the Ground-Water Monitoring Network, by aquifer (Continued)

Aquifer	Well #ID	Parameter & Detected Level
Piedmont	GWN-P1	Iron = 2,400 ug/L
		Manganese = 62 ug/L
	GWN-P2	Iron = 1,100 ug/L
	GWN-P3*	Iron = 1,300 ug/L
		Iron = 660 ug/L
	GWN-P6A	Manganese = 79 ug/L
	GWN-P9	Iron = 820 ug/L
		Manganese = 160 ug/L
	GWN-P10A	Iron = 11,000 ug/L
		Manganese = 110 ug/L
	GWN-P15A*	Iron = 660 ug/L
		Manganese = 110 ug/L
		Iron = 480 ug/L
		Manganese = 100 ug/L
	GWN-P16C	Iron = 600 ug/L
		Manganese = 61 ug/L
Blue Ridge	GWN-BR3	Iron = 530 ug/L
		Manganese = 130 ug/L
Valley & Ridge	GWN-VR2	Iron = 330 ug/L
		Manganese = 580 ug/L
	GWN-VR4	Manganese = 90 ug/L

* Two values indicate two sampling dates

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APPENDIX A

APPENDIX: ANALYSES OF SAMPLES COLLECTED DURING 1991 FOR THE GEORGIA GROUND-WATER MONITORING NETWORK

All water quality samples that are collected for the Georgia Ground-Water Monitoring Network are subjected to a Standard Analysis which includes tests for five 'indicator' parameters, twelve common pesticides and industrial chemicals and thirty metals. Analyses for additional parameters may be included for samples that are collected from an area where a possibility of ground-water pollution exists due to regional activities. These optional screens include tests for agricultural chemicals, coal-tar creosote, phenols and anilines and volatile organic compounds (Tables A-1 through A-4). Because parameters other than the five 'indicators' and eight of the metals of the Standard Analysis were detected very rarely, other parameters are listed in the appendix only when they were detected.

For this appendix, the following abbreviations are used:

SU	= standard units
mg/L	= milligrams per liter (parts per million)
mgN/L	= milligrams per liter (parts per million), as nitrogen
ug/L	= micrograms per liter (parts per billion) and
umho/cm	= micromhos per centimeter
U	= less than (below detection limit). Where this abbreviation is used for a figure that is a calculated average, the average is below the typical detection limit for the parameter
D	= for minimum values reported for a parameter, indicates that the parameter was detected below the usual detection limit (usually used when the minimum would otherwise be below the detection limit)

Underlined values listed for a parameter in the water quality data summaries indicates that the parameter was detected at levels above the Maximum Contaminant Level (MCL) listed in the Rules for Safe Drinking Water. Values that are both underlined and enclosed in parentheses indicate detected pollutants for which no MCL has been established.

Table A-1. - Standard water-quality analysis: indicator parameters, Organic Screens #2 and #4 and ICP metal screen

Parameter	Typical Detection Limit / MCL *	Units
pH	(NA)	SU
Spec. Cond.	1.0 / NA	umho/cm
Chloride	0.1 / 250	mg/L [2]
Sulfate	2.0 / 250	mg/L [2]
Nitrite/ nitrate	0.02 / 10	mgN/L [1]
ORGANIC SCREEN #2		
(Chlorinated Pesticides)		
Dicofol	0.10 / NA	ug/L
Endrin	0.03 / 0.2	ug/L [1]
Lindane	0.008 / 4.0	ug/L [1]
Methoxychlor	0.30 / 100	ug/L [1]
PCB's	0.60 / NA	ug/L
Permethrin	0.30 / NA	ug/L
Toxaphene	1.20 / 5.0	ug/L [1]
ORGANIC SCREEN #4		
(Phenoxy Herbicides)		
2,4-D	5.2 / 100	ug/L [1]
Acifluorfen	0.2 / NA	ug/L
Chloramben	0.2 / NA	ug/L
Silvex	0.1 / 10	ug/L [1]
Trichlorfon	2.0 / NA	ug/L
ICP METAL SCREEN		
Calcium	1.0 / NA	mg/L
Magnesium	1.0 / NA	mg/L
Sodium	1.0 / NA	mg/L
Potassium	5.0 / NA	mg/L

Parameter	Typical Detection Limit / MCL *	Units
ICP SCREEN, Cont.		
Silver	30 / 50	ug/L [1]
Aluminum	50 / NA	ug/L
Arsenic **	10 / 50	ug/L [1]
Gold	10 / NA	ug/L
Barium	10 / 1000	ug/L [1]
Beryllium	10 / NA	ug/L
Bismuth	30 / NA	ug/L
Cadmium	5.0 / 10	ug/L [1]
Cobalt	10 / NA	ug/L
Chromium	10 / 50	ug/L [1]
Copper	20 / 1000	ug/L [2]
Iron	10 / 300	ug/L [2]
Manganese	10 / 50	ug/L [2]
Molybdenum	10 / NA	ug/L
Nickel	20 / NA	ug/L
Lead	25 / 50	ug/L [1]
Antimony	40	ug/L
Selenium **	5 / 10	ug/L [1]
Tin	20 / NA	ug/L
Strontium	10 / NA	ug/L
Titanium	10 / NA	ug/L
Thallium	40 / NA	ug/L
Vanadium	10 / NA	ug/L
Yttrium	10 / NA	ug/L
Zinc	20 / 5000	ug/L [2]
Zirconium	10 / NA	ug/L

** Analyzed by atomic absorption graphite furnace

* MCL = Maximum Contaminant Level from the Georgia Rules for Safe Drinking Water, 1989 ([1] = Primary, [2] = Secondary, NA = no MCL established)

Table A-2. - Additional water-quality analyses: cyanide, mercury and Organic Screens #1, #3, #5 and #7

Parameter		Typical Detection Limit	Parameter		Typical Detection Limit
Cyanide		0.05 ug/L	Mercury		0.2 / 2.0 ug/L *

ORGANIC SCREEN #1

(Herbicides (H)/Insecticides (I))

Atrazine	H	0.30 ug/L	Malathion	I	1.40 ug/L
Azodrin	I	1.00 ug/L	Metolachlor	H	1.00 ug/L
Chlorpyrifos	I	0.80 ug/L	Metribuzin	H	0.90 ug/L
Dasanit	I	0.60 ug/L	Mevinphos	H	1.40 ug/L
DCPA	H	0.01 ug/L	Parathion (E)	I	0.08 ug/L
Demeton	I	1.00 ug/L	Parathion (M)	I	0.10 ug/L
Diazinon	I	1.00 ug/L	Pebulate	H	0.60 ug/L
Dimethoate	I	0.50 ug/L	Pendimethalin	H	0.80 ug/L
Di-Syston	I	1.00 ug/L	Phorate	I	1.00 ug/L
Eptam	H	0.50 ug/L	Profluralin	H	0.90 ug/L
Ethoprop	I	0.50 ug/L	Simazine	H	0.90 ug/L
Fonophos	I	0.50 ug/L	Sutan	H	0.70 ug/L
Guthion	I	2.00 ug/L	Trifluralin	H	1.00 ug/L
Isopropalin	H	1.00 ug/L	Vernam	H	0.50 ug/L

ORGANIC SCREEN #3

Dinoseb 0.10 ug/L (Herbicide)

ORGANIC SCREEN #5

(Herbicides (H)/Insecticides (I))

Carbaryl	I	10.0 ug/L	Linuron	H	1.0 ug/L
Carbofuran	I	2.0 ug/L	Methomyl	I	3.0 ug/L
Diuron	H	1.0 ug/L	Monuron	H	1.0 ug/L
Fluometuron	H	1.0 ug/L			

ORGANIC SCREEN #7

EDB 1.0 ug/L (fumigant, gasoline additive)

* Primary Maximum Contaminant Level for Mercury.

Table A-3. - Additional water-quality analyses: Organic Screens #8 and #9

ORGANIC SCREEN #8
(Extractable Organics: Coal-tar Creosote)

Parameter	Typical Detection Limit
Naphthalene	10 ug/L
2-Chloronaphthalene	10 ug/L
Acenaphthylene	10 ug/L
Acenaphthene	10 ug/L
Fluorene	10 ug/L
Phenanthrene	10 ug/L
Anthracene	10 ug/L
Fluoranthene	10 ug/L
Pyrene	10 ug/L
Benzo(A)Anthracene	10 ug/L
Benzo(B)Fluoranthene	10 ug/L
Benzo(K)Fluoranthene	10 ug/L
Benzo-A-Pyrene	10 ug/L
Indeno(1,2,3-CD)Pyrene	10 ug/L
Benzo(GHI)Perylene	10 ug/L

ORGANIC SCREEN #9
(Extractable Organics: Phenols and Aniline)

Parameter	Typical Detection Limit
Aniline	10 ug/L
2-Chlorophenol	10 ug/L
2-Nitrophenol	10 ug/L
Phenol	10 ug/L
2,4-Dimethylphenol	10 ug/L
2,4-Dichlorophenol	10 ug/L
2,4,6-Trichlorophenol	10 ug/L
Parachlorometa Cresol	10 ug/L
2,4-Dinitrophenol	50 ug/L
4,6-Dinitro-O-Cresol	50 ug/L
Pentachlorophenol	20 ug/L
4-Nitrophenol	50 ug/L

Table A-4. - Additional water-quality analyses: Organic Screen #10

ORGANIC SCREEN #10
(Volatile Organics)

Parameter		Typical Detection Limit / Primary MCL
Methylene chloride		5 ug/L / NA
Trichlorofluoromethane		1 ug/L / NA
1,1-Dichloroethylene		1 ug/L / 7 ug/L
1,1-Dichloroethane		1 ug/L / 5 ug/L
1,2-Trans-dichloroethylene		1 ug/L / NA
Chloroform *	(* Indicates a tri-	1 ug/L / *
Dichlorobromomethane *	halomethane compound;	1 ug/L / *
Chlorodibromomethane *	MCL for total trihalo-	1 ug/L / *
Bromoform *	methanes = 100 ug/L)	1 ug/L / *
1,2-Dichloroethane		1 ug/L / NA
1,1,1-Trichloroethane		1 ug/L / 200 ug/L
Carbon tetrachloride		1 ug/L / 5 ug/L
1,2-Dichloropropane		1 ug/L / NA
Trans-1,3-dichloropropene		1 ug/L / NA
Trichloroethylene		1 ug/L / 5 ug/L
Benzene		1 ug/L / 5 ug/L
1,1,2-Trichloroethane		1 ug/L / NA
Cis-1,3-dichloropropene		1 ug/L / NA
1,1,2,2-Tetrachloroethane		1 ug/L / NA
Tetrachloroethylene		1 ug/L / NA
Toluene		1 ug/L / NA
Chlorobenzene		1 ug/L / NA
Ethylbenzene		1 ug/L / NA
Acetone		10 ug/L / NA
Methyl ethyl ketone		10 ug/L / NA
Carbon disulfide		1 ug/L / NA
Vinyl chloride		10 ug/L / 2 ug/L
Isopropyl acetate		1 ug/L / NA
2-Hexanone		1 ug/L / NA
Methyl isobutyl ketone		1 ug/L / NA
Styrene		1 ug/L / NA
Xylene (Total of o, m, and p-xylenes)		1 ug/L / NA

1991 Groundwater Quality Analyses of the Cretaceous Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected ug/L	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
GWN-K1	4.8	1 U	1 U	1.5	0.5 U	20	10 U	2.0	2.7	0.1 U	10 U	10 U	23		10
Well Name: Englehard Kaolin Company #2, Gordon County: Wilkinson Date Sampled: 1991/04/28															
GWN-K2	4.6	1.3	1 U	1.7	0.5 U	41	10 U	2.0	3.0	0.1 U	10 U	10 U	26	Al = 85	10
Well Name: Irwinton #2 County: Wilkinson Date Sampled: 1991/04/25															
GWN-K3	5.9	1.4	1.2	2.0	0.5 U	290	27	2.8	7.4	0.1 U	21	49	94		1,5,10
Well Name: Sandersville #7B County: Washington Date Sampled: 1991/04/25															
GWN-K5	5.1	1 U	1 U	1.4	5 U	20 U	10 U	1.5	0.3	0.4	10 U	10 U	16		1,8,9
Well Name: Richmond County #101, Augusta County: Richmond Date Sampled: 1991/06/27															
GWN-K5	5.9	1 U	1 U	1.3	5 U	20 U	10 U	1 U	2 U	0.1	10 U	10 U	14	Hg = 0.2	Hg,10
Well Name: Richmond County #101, Augusta County: Richmond Date Sampled: 1991/12/17															
GWN-K6	5.6	3.7	1 U	3.0	5 U	43	10 U	2.7	3.8	1 U	13	47	50	Zn = 23	
Well Name: J.M. Huber Corporation County: Twiggs Date Sampled: 1991/04/24															
GWN-K7	5.3	1.7	1 U	1.5	5 U	20 U	10 U	2.2	2 U	0.1 U	13	11	20		
Well Name: Jones County #4, Macon County: Jones Date Sampled: 1991/04/24															

1991 Groundwater Quality Analyses of the Cretaceous Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-K8 Well Name: Mohasco Corp, Laurens Park Mill #3, East Dublin County: Laurens Date Sampled: 1991/11/25	6.7	44	1.7	2.8	5 U	<u>3,000</u>	33	2.2	12.4	0.1 U	81	180	155		10
GWN-K9 4.1 Well Name: Marshallville #1 County: Macon Date Sampled: 1991/04/22	1 U	1 U	1 U	5 U	1,400	34	1.5	6.8	0.1 U	10 U	10 U	44			
GWN-K10 Well Name: Fort Valley #1 County: Peach Date Sampled: 1991/01/24	4.8	1.4	1 U	3.6	5 U	29	10 U	0.7	2 U	1.3	10 U	10 U	42		10
GWN-K10 Well Name: Fort Valley #1 County: Peach Date Sampled: 1991/11/26	5	2.7	1 U	8.9	0.5 U	37	10 U	2.0	5.9	3.4	11 U	13 U	63	Al = 57	
GWN-K11 Well Name: Warner Robins #1A County: Houston Date Sampled: 1991/05/30	5	1 U	1 U	1.6	5 U	20 U	10 U	1.3	2 U	0.2	10 U	10 U	15	Al = 52	10
GWN-K11 Well Name: Warner Robins #1A County: Houston Date Sampled: 1991/11/26	4.8	1 U	1 U	1.2	5 U	270	10 U	1.4	0.9	0.1	10 U	10 U	11		10

1991 Groundwater Quality Analyses of the Cretaceous Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-K12 Well Name: Perry, Holiday Inn Well County: Houston Date Sampled: 1991/05/30	4.2	1.7	1 U	1.8	5 U	180	12	1.8	2 U	0.2	10 U	10 U	40	Al = 410 Zn = 42 Cd = 5	1, 5, 10
GWN-K12 Well Name: Perry, Holiday Inn Well County: Houston Date Sampled: 1991/11/26	3.9	1 U	1 U	1.1	5	190	12	2.2	7.5	0.1 U	10 U	10 U	34	Al = 400 Zn = 38 Ni = 200	1, 5, 10
GWN-K13 Well Name: Omaha #1 County: Stewart Date Sampled: 1991/04/23	9.0	2.1	1 U	48	5 U	20 U	10 U	9.4	7.0	0.1 U	10 U	10 U	194	F = 0.3mg/L	
GWN-K14 Well Name: Ft. Benning TW County: Muscogee Date Sampled: 1991/04/23	7.9	12	1 U	25	5 U	100	10 U	7.4	6.3	0.1 U	15	200	165	F = 0.2mg/L	
GWN-K16 Well Name: Packaging Corporation of America, North Well County: Bibb Date Sampled: 1991/05/30	5.4	1 U	1 U	4.9	5 U	20 U	10 U	2.2	2 U	0.2	10 U	10 U	25	Zn = 24	10
GWN-K16 Well Name: Packaging Corporation of America, North Well County: Bibb Date Sampled: 1991/11/26	5.3	1 U	1 U	5.2	5 U	20 U	10 U	2.4	2.0	0.2	10 U	10 U	21	Zn = 26	10

1991 Groundwater Quality Analyses of the Cretaceous Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
WELL ID#															
GWN-K18A	5.3	2.0	1 U	1.1	5 U	80	10 U	1.5	3.2	0.1 U	10 U	10 U	26	F = 0.2mg/L	10
Well Name: Buena Vista #6															
County: Marion															
Date Sampled: 1991/04/23															
GWN-K19	5.0	1 U	1 U	1.3	5 U	85	10 U	2.0	1.0	0.1 U	10 U	10 U	18		10
Well Name: Hephzibah, Murphy Street Well (#3)															
County: Richmond															
Date Sampled: 1991/06/27															
Average:	5.4	3.8	1.0	5.4	4.2	258.5	13	2.5	3.7	0.4	14.1	29.6	48.3		
Maximum:	9.0	44.0	1.7	48.0	5.0	3,000	34	9.4	12.4	3.4	81.0	200	194.0		
Minimum:	3.9	1.0	1.0	1.0	0.5	20	10	0.7	0.3	0.1	10.0	10	11.0		
Standard Deviation:	1.1	8.9	0.1	10.3	1.7	648.8	7.2	1.9	2.9	0.7	14.5	49.8	50.2		

1991 Groundwater Quality Analyses of the Providence Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PD2A	7.0	9.4	1 U	2.0	5 U	350	44	2.2	2.0	0.1 U	19	30	61	F = 0.8mg/L	
Well Name: Preston #2															
County: Webster															
Date Sampled: 1991/09/16															
GWN-PD3	7.9	6.3	1.1	85	5 U	20 U	10 U	11.2	10.3	0.1 U	10 U	100	360	F = 0.7mg/L	
Well Name: Ft. Gaines #2															
County: Clay															
Date Sampled: 1991/08/22															
GWN-PD4	7.3	37	2.3	2.8	5 U	110	15	1.5	12.2	0.1 U	10 U	200	198	F = 0.1mg/L	
Well Name: Americus #3															
County: Sumter															
Date Sampled: 1991/08/19															
Average:	7.4	17.6	1.5	29.9	5.0	160.0	23.0	5.0	8.2	0.1	13.0	110.0	206.3		
Maximum:	7.9	37.0	2.3	85.0	5.0	350.0	44.0	11.2	12.2	0.1	19.0	200.0	360.0		
Minimum:	7.0	6.3	1.0	2.0	5.0	20.0	10.0	1.5	2.0	0.1	10.0	30.0	61.0		
Standard Deviation:	0.4	13.8	0.6	38.9	0.0	139.3	15.0	4.4	4.4	0.0	4.2	69.8	122.2		

1991 Groundwater Quality Analyses of the Clayton Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-CT1 Well Name: Turner City Monitoring Well County: Dougherty Date Sampled: 1991/12/10	7.9	11	4.9	43	5 U	<u>700</u>	19	2.0	10.3	0.1 U	10 U	270	255	Al = 65 F = 0.2mg/L	10
GWN-CT2A Well Name: Burton Thomas Residence Well County: Sumter Date Sampled: 1991/10/29	7.8	38	2.7	5.5	5 U	69	10 U	1.5	16.9	0.1 U	10 U	250	240	Al = 73 Zn = 21	1, 3, 5
GWN-CT3 Well Name: Dawson, Crawford Street Well County: Terrell Date Sampled: 1991/10/30	7.6	37	3.9	6.6	5 U	20 U	10 U	1.8	11.9	0.1 U	10 U	390	249	Al = 87 F = 0.1mg/L	
GWN-CT4 Well Name: C. T. Martin TW 2 County: Randolph Date Sampled: 1991/10/29	7.7	41	3.0	4.7	5 U	110	10 U	1.7	8.5	0.1 U	10 U	250	253	Al = 84	
GWN-CT5A Well Name: Cuthbert #3 County: Randolph Date Sampled: 1991/10/28	7.7	43	3.6	1.6	5 U	210	31	1.8	10.3	0.1 U	13	150	252	Al = 98	1, 3, 5, 10
GWN-CT6B Well Name: Fort Gaines Test Well County: Clay Date Sampled: 1991/12/11	7.0	130	3.4	7.8	5 U	<u>1,400</u>	33	6.7	56.8	0.1 U	34	170	544	Al = 56 Ti = 10 Zn = 220	10

1991 Groundwater Quality Analyses of the Clayton Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
Average:	7.6	50.0	3.6	11.5	5.0	418.2	18.8	2.6	19.1	0.2	14.5	246.7	298.8		
Maximum:	7.9	130.0	4.9	43.0	5.0	1,400.0	33.0	6.7	56.8	0.5	34.0	390.0	544.0		
Minimum:	7.0	11.0	2.7	1.6	5.0	20.0	10.0	1.5	8.5	0.1	10.0	150.0	240.0		
Standard Deviation:	0.3	37.3	0.7	14.2	5.0	493.7	9.9	1.8	17.1	0.1	8.8	77.8	109.7		

1991 Groundwater Quality Analysis of the Claiborne Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-CL1 Well Name: Albany TW#5 County: Dougherty Date Sampled: 1991/08/21	7.5	54	8.8	9.0	5 U	380	10 U	3.8	2.7	0.1 U	10 U	370	330	Al = 79 F = 0.2mg/L	
GWN-CL2 Well Name: Unadilla #3 County: Dooly Date Sampled: 1991/08/20	7.5	43	1 U	1.5	5 U	20 U	10 U	1.7	7.4	0.1	12	110	199	F = <0.1mg/L	3
GWN-CL3 Well Name: Pete Long TW#2 County: Lee Date Sampled: 1991/08/21	5.3	1.4	1 U	1.5	5 U	960	15	2.1	0.6	0.1 U	10 U	12	20	F = 0.1mg/L	1, 3, 5
GWN-CL4 Well Name: Plains #3 County: Sumter Date Sampled: 1991/08/19	7.6	61	2.1	2.9	5 U	96	12	2.9	5.8	0.1 U	10 U	190	292	Benzene = <2.75mg/L M Xylene = 1.1 P Xylene = 1.1	1, 3, 5, 10
GWN-CL5 Well Name: Shellman #2 County: Randolph Date Sampled: 1991/08/19	4.2	5.6	2.9	2.9	5 U	20 U	570	10.7	0.5	8.3	62	39	118	Al = 310 Co = 26 Y = 71 F = 0.2mg/L	

1991 Groundwater Quality Analyses of the Claiborne Aquifer System

PARAMETER	Ph	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-CL7A	4.9	2.4	1.5	5.7	5 U	20 U	61	8.3	3.4	0.1 U	21	17	64	Cu = 88 Y = Zn = 70 F = 0.1mg/L	10
Well Name: Veterans Memorial State Park #2 County: Crisp Date Sampled: 1991/08/20															
GWN-CL8	5.2	4.6	2.8	3.1	5 U	92	100	6.3	2 U	5.7	99	43	77	Al = 88 Y = 11 Zn = 29 F = <0.1mg/L	1, 5
Well Name: Flint River Nursery Office County: Dooly Date Sampled: 1991/08/20															
Average:	6.0	24.6	2.9	3.8	5.0	226.9	111.1	5.1	3.2	2.1	32.0	111.6	157.1		
Maximum:	7.6	61.0	8.8	9.0	5.0	960.0	570.0	10.7	7.4	8.3	99.0	370.6	330.0		
Minimum:	4.2	1.4	1.0	1.5	5.0	20.0	10.0	1.7	0.5	0.1	10.0	12.0	20.0		
Standard Deviation:	1.3	24.8	2.5	2.5	0.0	321.7	190.0	3.2	2.4	5.2	32.4	120.6	110.4		

1991 Groundwater Quality Analyses of the Jacksonian Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-J1B Well Name: M. Horton Residence Well County: Burke Date Sampled: 1991/06/26	7.3	54	1 U	4.1	5 U	20 U	10 U	8.9	0.3	1.6	22	26	275	Al = 120 Zn = 35	1, 3, 5
GWN-J1B Well Name: K. Hudlow Residence Well County: Burke Date Sampled: 1991/12/16	7.4	56	1 U	4.2	5 U	20 U	10 U	7.6	2 U	0.1	21	26	273	Al = 98 F = 0.2mg/L	1, 3, 5
GWN-J2A Well Name: Oakwood Village MHP #2 County: Burke Date Sampled: 1991/06/26	7.4	53	1 U	1.7	5 U	20 U	10 U	1.9	0.6	0.1 U	66	64	236	Al = 100 Zn = 54 F = 0.1mg/L	1, 3, 5, 10
GWN-J2A Well Name: Oakwood Village MHP #2 County: Burke Date Sampled: 1991/12/17	7.6	51	1 U	1.9	5 U	20 U	10 U	1.8	2 U	0.1 U	62	61	242	Al = 110 F = 0.1mg/L	1, 3, 5, 10
GWN-J3 Well Name: J. W. Black Residence Well, Canoochee County: Emanuel Date Sampled: 1990/01/24	7.7	36	6.1	11	5 U	140	120	7.9	1.2	0.1 U	710	290	256	Al = 65 Bi = 48 Zn = 37	1, 5, 10
GWN-J4 Well Name: Wrightsville #4, North Myrtle Street Well County: Johnson Date Sampled: 1991/06/24	7.6	48	2.4	3.6	5 U	41 U	39	2.5	6.0	0.1 U	10	180	248	Al = 100 Bi = 25 F = 0.2mg/L	1, 5
GWN-J4 Well Name: Wrightsville #4, North Myrtle Street Well County: Johnson Date Sampled: 1991/12/19	7.7	49	2.3	4.2	5 U	20 U	18	3.5	12.2	0.1 U	10 U	190	254	Al = 98	10

1991 Groundwater Quality Analyses of the Jacksonian Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-J5	7.4	68	2.5	3.2	5 U	20 U	29	2.3	10.6	0.1 U	10 U	220	341	Al = 150 Bi = 35	1, 3, 5, 10
Well Name: Cochran #3 County: Bleckley Date Sampled: 1991/06/24															
GWN-J6	6.7	28	1.0	1.9	5 U	200	13	1.9	7.2	0.1 U	13	95	15	Al = 64 Bi = 33	5, 10
Well Name: Wrens #4 County: Jefferson Date Sampled: 1991/06/27															
GWN-J6	6.9	28	1 U	1.8	5 U	170	12	1.9	6.6	0.1	13	95	147	Al = 46	1, 5, 10
Well Name: Wrens #4 County: Jefferson Date Sampled: 1991/12/17															
Average:	7.4	46.3	2.0	3.7	5.0	72.3	29.0	3.5	5.4	0.1	101.7	135.7	223.6		
Maximum:	7.7	68.0	6.1	11.0	5.0	200.0	120.0	7.9	12.2	0.1	710.0	290.0	341.0		
Minimum:	6.7	28.0	1.0	1.7	5.0	20.0	10.0	1.8	0.6	0.1	10.0	26.0	15.0		
Standard Deviation:	0.3	12.6	1.6	2.8	0.0	70.8	33.5	2.3	4.0	0.0	216.1	82.9	87.3		

1991 Groundwater Quality Analyses of the Floridan Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PA1 Well Name: Thunderbolt #1 County: Chatham Date Sampled: 1991/06/26	7.7	28	15	61	5 U	20 U	10 U	109.9	17.4	0.1 U	11	390	547	Bi = 94 F = 0.4mg/L	
GWN-PA2A Well Name: Savannah #6 County: Chatham Date Sampled: 1991/06/25	7.9	24	8.2	12	5 U	20 U	10 U	4.1	0.1 U	4.7	12	290	226	Al = 62 F = 0.4mg/L	
GWN-PA4 Well Name: Tybee Island #1 County: Chatham Date Sampled: 1991/06/25	7.7	35	26	56	5 U	20 U	10 U	45.9	108	0.1 U	10 U	1300	593	Al = 80 Bi = 140 Cd = 7	
GWN-PA5A Well Name: Interstate Paper Co. #2-Riceboro County: Bryan Date Sampled: 1991/10/23	7.8	25	14	16	5 U	20 U	10 U	5.9	36.9	0.1 U	25	410	315	Al = 54 Bi = 80 F = 0.7mg/L	10
GWN-PA6 Well Name: Hinesville #5 County: Bryan Date Sampled: 1991/10/23	7.8	23	11	14	5 U	20 U	10 U	5.0	23.7	0.1 U	19	350	269	Al = 46 Bi = 70 F = 0.7mg/L	10
GWN-PA7 Well Name: Darien New Well County: McIntosh Date Sampled: 1991/10/23	7.6	44	26	24	5 U	120	10 U	20.4	90.4	0.1 U	44	690	539	Al = 100 Bi = 150 Cd = 7 Zr = 10 F = 0.7mg/L	10

1991 Groundwater Quality Analysis of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PA8 Well Name: ITT Rayonier #4D-Doctortown County: Wayne Date Sampled: 1991/10/23	7.8	34	17	17	5 U	20 U	10 U	7.7	0.1 U	0.1 U	64	530	377	Al = 77 Bi = 100 Cd = 5 F = 0.7mg/L	10
GWN-PA9A Well Name: Brunswick Pulp & Paper Co. #2 County: Glynn Date Sampled: 1991/01/08	7.6	43	25	14	5 U	44	10 U	13.7	95	0.1 U	44	410	467	Al = 60 Bi = 110 Cd = 5 Zn = 34 F = 0.6mg/L	
GWN-PA9B Well Name: Brunswick Pulp & Paper #1 County: Glynn Date Sampled: 1991/01/08	7.6	92	57	140	5 U	400	10 U	192	273	0.1 U	93	1,100	1,592	Al = 130 Bi = 280 Cd = 15 Pb = 35 F = 0.6mg/L	
GWN-PA9C Well Name: Miller Ball Park TW #25 County: Glynn Date Sampled: 1991/01/30	7.7	40	26	19	5 U	97	14	20.5	86.0	0.1 U	36	670	465	Al = 78 Bi = 130 Cd = 7 Zn = 100 Zr = 20 F = 0.6mg/L	
GWN-PA10B Well Name: Gilman Paper Co. #1 County: Camden Date Sampled: 1991/01/09	7.4	73	40	58	5 U	20 U	10 U	111	164	0.1 U	36	740	895	Al = 140 Bi = 170 Cd = 7 F = 0.6mg/L	
GWN-PA14 Well Name: Statesboro #7 County: Bulloch Date Sampled: 1991/01/17	7.7	31	4.5	6.0	5 U	20 U	10 U	2.3	4.2	0.1 U	28	170	225	Al = 34 F = 0.4mg/L	

1991 Groundwater Quality Analysis of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PA15	7.7	25	7.9	7.9	5 U	29	10 U	1.9	5.1	0.1 U	10 U	370	233	Al = 35 F = 0.4mg/L	
Well Name: King Finishing Company, Fire Pump Well, Dover County: Screven Date Sampled: 1991/01/16															
GWN-PA16	7.6	42	2.8	4.4	5 U	29	32	4.6	5.3	0.1 U	10 U	170	261	Al = 67 F = 0.2mg/L	
Well Name: Millen #1 County: Jenkins Date Sampled: 1991/01/17															
GWN-PA17	7.6	43	1.4	2.9	5 U	20 U	10 U	2.4	2 U	0.1 U	140	120	246	Al = 71 F = 0.2mg/L	
Well Name: Swainsboro #7 County: Emanuel Date Sampled: 1991/01/17															
GWN-PA18	7.8	28	3.1	9.5	5 U	20 U	53	3.0	2.3	0.1 U	22	220	217	Al = 33 F = 0.3mg/L	
Well Name: Metter #2 County: Candler Date Sampled: 1991/01/17															
GWN-PA20	7.7	48	17	5.8	5 U	20 U	10	3.4	59	0.1 U	28	200	351	Al = 120 Bi = 96 F = 0.4mg/L	
Well Name: Lakeland #2 County: Lanier Date Sampled: 1991/08/28															
GWN-PA21	7.8	46	4.5	3.4	5 U	20 U	10 U	4.0	56.6	0.1 U	53	66	272	Al = 84 Zr = 11 F = 0.2mg/L	
Well Name: Valdosta #1 County: Lowndes Date Sampled: 1991/02/13															

1991 Groundwater Quality Analysis of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PA21 Well Name: Valdosta #1 County: Lowndes Date Sampled: 1991/08/29	7.6	36	4.5	4.3	5 U	20 U	10 U	4.7	34.2	0.2	44	55	215	Al = 79 F = 0.2mg/L	
GWN-PA22 Well Name: Thomasville #6 County: Thomas Date Sampled: 1991/02/13	7.6	45	20	7.2	5 U	20 U	10 U	6.4	62.4	0.1 U	22	320	378		
GWN-PA23 Well Name: Cairo #8 County: Grady Date Sampled: 1991/02/13	7.7	34	16	11	5 U	20 U	10 U	5.3	30.5	0.1 U	130	320	333	Al = 72 Bi = 55 Mo = 37 F = 0.5mg/L	
GWN-PA24 Well Name: Bainbridge #1 County: Decatur Date Sampled: 1991/03/20	7.5	38	3.2	1.8	0.5 U	20 U	10 U	6.2	0.3	3.7	10 U	36	217	Al = 72	7, 10
GWN-PA25 Well Name: Donalsonville, East 7th Street Well County: Seminole Date Sampled: 1991/03/20	7.5	55	1 U	3.8	0.5 U	20 U	10 U	3.1	0.7	1.1	10 U	24	276	Al = 110	Cn, 10
GWN-PA25 Well Name: Donalsonville, East 7th Street Well County: Seminole Date Sampled: 1991/09/17	7.8	58	1 U	4.0	5 U	20 U	10 U	5.0	0.5	1.2	10 U	26	270	Al = 120	Cn, 1, 3, 5, 7, 10

1991 Groundwater Quality Analysis of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PA26 Well Name: Colquitt #3 County: Miller Date Sampled: 1991/03/20	7.5	44	1 U	2.1	0.5 U	20 U	10 U	3.7	0.3	1.7	10 U	20	216	Al = 94 Zn = 26	10
GWN-PA26 Well Name: Colquitt #3 County: Miller Date Sampled: 1991/09/18	7.6	47	1 U	2.4	5 U	20 U	10 U	3.5	0.4	1.4	10 U	20	217	Al =110 F = 0.2mg/L	1, 3, 5, 10
GWN-PA27 Well Name: Camilla New Well (#4) County: Mitchell Date Sampled: 1991/03/28	7.7	45	1.2	2.4	5 U	20 U	10 U	2.5	0.3	0.2	11	36	230		8, 9, 10
GWN-PA27 Well Name: Camilla New Well (#4) County: Mitchell Date Sampled: 1991/09/25	7.5	46	1.2	2.1	5 U	20 U	10 U	0.4	2U	0.1	10	38	212	Al = 91 F = 0.1mg/L	1, 3, 5, 8, 9, 10
GWN-PA28 Well Name: Moultrie #1 County: Colquitt Date Sampled: 1991/02/13	7.8	39	21	28	5 U	20 U	10 U	10	85.2	0.1 U	90	2,100	479	Al = 65 Bi = 90 Cd = 6 F = 0.7mg/L	
GWN-PA29 Well Name: Adel #6 County: Cook Date Sampled: 1991/02/12	7.7	54	19	4.0	5 U	72	30	3.6	69.9	0.1 U	15	360	402	Al = 110 Bi = 87 F = 0.3mg/L	

1991 Groundwater Quality Analyses of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PA29 Well Name: Adel #6 County: Cook Date Sampled: 1991/08/29	7.8	53	19	4.7	5 U	81	34	4	65	0.1 U	15	360	372	Al = 120 Bl = 110 Cd = 6 F = 0.3mg/L	
GWN-PA30 Well Name: Nashville Mills #2, Amoco Fabrics Company County: Berrien Date Sampled: 1991/02/13	7.7	43	16	5.0	5 U	21	10 U	4.2	60.2	0.1 U	53	230	352	Al = 79 Bl = 80 F = 0.4mg/L	
GWN-PA30 Well Name: Nashville Mills #2, Amoco Fabrics Company County: Berrien Date Sampled: 1991/08/28	7.8	44	17	6.0	5 U	52	10 U	4.6	59	0.1 U	55	250	341	Al = 110 Bl = 97	
GWN-PA31 Well Name: Tifton #6 County: Tift Date Sampled: 1991/02/12	7.7	43	8.2	2.5	5 U	20 U	10 U	2.2	2 U	0.1 U	67	270	258	Al = 82 F = 0.2mg/L	
GWN-PA32 Well Name: Ocilla #3 County: Irwin Date Sampled: 1991/02/12	7.7	34	4.3	2.3	5 U	240	32	2.5	2 U	0.1 U	73	140	210	Al = 63 F = 0.1mg/L	
GWN-PA33 Well Name: Fitzgerald Well C County: Ben Hill Date Sampled: 1991/02/12	8.2	22	8.0	3.0	5 U	20 U	14 U	2.1	2 U	0.1 U	2,000	250	188	Al = 46 F = 0.2mg/L	10
GWN-PA34 Well Name: McRae #1 County: Telfair Date Sampled: 1991/12/18	7.6	52	9.6	5.6	5 U	180	97	5.8	3.1	0.1 U	260	720	311	Al = 92 F = 0.3mg/L	10

1991 Groundwater Quality Analyses of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
WELL ID#															
GWN-PA35	7.8	30	12	6.5	5 U	60	29	3.1	6.0	0.1 U	89	480	259	Al = 56 Bi = 51 F = 0.4mg/L	10
Well Name: Mount Vernon New Well County: Montgomery Date Sampled: 1991/12/18															
GWN-PA36	8.0	29	4.9	12	5 U	24	34	3.5	2.6	0.1 U	140	350	222	Al = 75 F = 0.5mg/L	
Well Name: Vidalia #1 (Sixth Street Well) County: Toombs Date Sampled: 1991/12/18															
GWN-PA37	7.7	48	1 U	2.2	5 U	200	10 U	3.8	2 U	1.7	14	24	222	Al = 110 F = 0.2mg/L	
Well Name: Hogan Monitoring Well County: Laurens Date Sampled: 1991/12/19															
GWN-PA38	7.7	47	1.3	2.4	5 U	20 U	10 U	2.4	2 U	0.1 U	110	93	226	Al = 96 F = 0.2mg/L	
Well Name: Eastman #4 County: Dodge Date Sampled: 1991/12/18															
GWN-PA39A	7.5	48	6.8	4.3	5 U	20 U	10 U	7.1	0.4	3.0	200	360	287	Al = 120 F = 0.2mg/L	
Well Name: Sylvester #2 County: Worth Date Sampled: 1991/03/27															
GWN-PA39A	7.5	51	7.0	3.9	5 U	20 U	10 U	2.7	2 U	0.1 U	210	380	275	Al = 110 F = 0.2mg/L	
Well Name: Sylvester #2 County: Worth Date Sampled: 1991/09/23															

1991 Groundwater Quality Analysis of the Floridan Aquifer System (Continued)

PARAMETER UNITS WELL #ID	pH SU	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Fe ug/L	Mn ug/L	Cl MG/L	SO4 mg/L	NO2 &NO3 mgN/L	Ba ug/L	Sr ug/L	Spec. Cond. umho/cm	Other Parameters Detected ug/L	Other Screens Tested
GWN-PA40 Well Name: Merck Chemical Co. #8 County: Dougherty Date Sampled: 1991/03/27	7.5	55	1.0	2.5	5 U	20 U	10 U	3.8	0.5	1.2	16	47	280	Al = 130 F = 0.1mg/L Cn = <0.025mg/L	Cn
GWN-PA40 Well Name: Merck Chemical Co. #8 County: Dougherty Date Sampled: 1991/09/25	7.4	61	1.1	2.5	5 U	20 U	10 U	0.3	2 U	1.3	17	52	280	Al = 140 F = 0.1mg/L Cn = <0.025mg/L	Cn
GWN-PA41 Well Name: Albany TW #13. County: Dougherty Date Sampled: 1991/03/19	7.0	110	2.7	19	0.5 U	130	120	3.6	0.3	0.9	47	79	576	Al = 260 F = 0.1mg/L Cn = <0.025mg/L	1, 3, 5, 10 Cn
GWN-PA41 Well Name: Albany TW #13 County: Dougherty Date Sampled: 1991/09/26	7.0	110	2.8	21	5 U	24	10	17.4	28.9	1.8	47	78	566	Al = 220 F = 0.1mg/L Cn = <0.025mg/L	1, 3, 5, 10 Cn
GWN-PA42 Well Name: USGS Garrett Ob. Well County: Lee Date Sampled: 1991/03/28	7.2	30	1 U	3.0	5 U	74	10 U	3.6	0.5	1.2	10 U	14	171	Al = 67 F = 0.1mg/L Cn = <0.025mg/L	Cn
GWN-PA42 Well Name: USGS Garrett Ob. Well County: Lee Date Sampled: 1991/09/24	6.9	35	1 U	3.0	5 U	150	10 U	0.4	2 U	4.8	10 U	16	180	F = 0.1mg/L Cn = <0.025mg/L	1, 5, Cn

1991 Groundwater Quality Analyses of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PA43 Well Name: Newton #1 County: Baker Date Sampled: 1991/03/28	7.7	45	1 U	2.8	5 U	20 U	10 U	3.4	0.6	1.4	10 U	38	235	Al = 96 F = 0.1mg/L	10
GWN-PA43 Well Name: Newton #1 County: Baker Date Sampled: 1991/09/26	7.6	47	1.0	3.1	5 U	20 U	10 U	3.7	2 U	1.6	10 U	44	232	Al = 110 F = 0.1mg/L	1, 3, 5, 10
GWN-PA44 Well Name: Sycamore #2 County: Turner Date Sampled: 1991/02/12	7.8	33	4.3	2.3	5 U	20 U	10 U	1.8	2 U	0.1 U	140	290	211	Al = 64 F = 0.2mg/L	
GWN-PA45 Well Name: Abbeville #2 County: Wilcox Date Sampled: 1991/02/12	7.5	49	3.3	2.2	5 U	27	10 U	2.6	3.2	0.1 U	17	190	298	Al = 96	
GWN-PA46B Well Name: Wenona MHP County: Crisp Date Samped: 1991/02/26	7.5	46	1 U	2.8	5 U	20 U	10 U	19.1	37.2	0.1 U	37	29	227	Al = 89 F = 0.1mg/L	
GWN-PA47 Well Name: USGS Haley Farms TW #19 County: Lee Date Sampled: 1991/03/18	7.5	58	1 U	1.8	5 U	20 U	10 U	14.5	20.6	1.6	11	50	293	Al = 98 F = 0.1mg/L	1, 3, 5, 10*

* Sample was contaminated before analysis could be run*

1991 Groundwater Quality Analysis of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-PA47 Well Name: USGS Haley Farms TW #19 County: Lee Date Sampled: 1991/09/24	7.3	89	1.5	4.3	5 U	20 U	10 U	17.4	2 U	10.8	17	60	422	Al = 180 F = 0.1mg/L	1, 3, 5, 10
GWN-PA48 Well Name: Doug Harvey TW #1 County: Early Date Sampled: 1991/03/20	7.5	47	1 U	1.9	5 U	20 U	10 U	4.8	0.4	1.0	10	22	240	Al = 65 F = 0.1mg/L Cn = <0.025mg/L	1, 3, 5, 7, 10, Cn
GWN-PA48 Well Name: Doug Harvey TW #1 County: Early Date Sampled: 1991/09/17	7.5	51	1 U	2.5	5 U	20 U	10 U	4.1	0.3	2.0	10 U	25	237	Al = 130 F = 0.1mg/L Cn = <0.025mg/L	1, 3, 5, 10 Cn
GWN-PA49 Well Name: Harmony Baptist Church County: Dooly Date Sampled: 1991/02/11	7.6	38	1 U	1.6	5 U	20 U	10 U	2.5	2 U	1.0	17	24	207	Al = 76 F = 0.1mg/L	3
GWN-PA51 Well Name: J. Adams Residence Well County: Mitchell Date Sampled: 1991/03/28	7.6	46	1 U	2.8	5 U	20 U	10 U	2.5	1.2	0.1 U	10 U	21	230	Al = 140 Zn = 38 F = 0.1mg/L	1, 5
GWN-PA52 Well Name: J. Simmons Residence Well County: Mitchell Date Sampled: 1991/03/28	*	37	1 U	2.8	5 U	20 U	10 U	*	*	*	10 U	23	*	Al = 80 Zn = 29	1, 5

* Analyses of these parameters were not recorded in 1991*

1991 Groundwater Quality Analysis of the Floridan Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
WELL #ID															
GWN-PA53	7.5	41	1.1	2.8	5 U	20 U	10 U	5.6	2 U	3.9	14	28	207	Al = 80 Zn = 55 F = 0.2mg/L	1
Well Name: E. Cato Residence County: Decatur Date Sampled: 1991/09/17															
GWN-PA54	7.7	36	1 U	1.8	5 U	20 U	10 U	2.4	2 U	0.1 U	10 U	17	170	Al = 78 Zn = 34	8
Well Name: W. Field Residence County: Seminole Date Sampled: 1991/09/17															
GWN-PA55	7.6	51	2.5	3.5	5 U	20 U	10 U	2.4	3.9	0.1 U	170	240	255	Al = 100 Zn = 32 F = 0.1mg/L	1, 5
Well Name: W. Holland Residence County: Burke Date Sampled: 1991/06/26															
Average:	7.5	45.7	8.5	10.9	4.7	45.8	15.9	12.1	25.6	0.9	77.9	263.2	321.5		
Maximum:	8.2	110.0	57.0	140.0	5.0	400.0	120.0	192.0	273.0	10.8	2,000	2,100	1,592		
Minimum:	0.0	22.0	1.0	1.6	0.5	20.0	10.0	0.0	0.0	0.0	10.0	14.0	0.0		
Standard Deviation:	1.0	17.4	10.6	20.5	1.1	64.4	18.6	29.9	46.3	1.7	248.4	347.0	206.7		

1991 Groundwater Quality Analyses of the Miocene Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-MI1 Well Name: McMillan Residence Well County: Cook Date Sampled: 1991/08/29	7.9	25	15	7.9	5 U	970	34 U	3.0	3.7	0.1 U	21	130	233	Bi = 94 Zn = 35 F = 0.5mg/L Cn = <0.025mg/L	1, 10, Cn
GWN-MI1 Well Name: McMillan Residence Well County: Cook Date Sampled: 1991/10/31	7.8	22	12	6.3	5 U	460	28	2.9	3.6	0.1 U	16	110	239	Bi = 81 Zn = 21 F = 0.5mg/L Cn = <0.025mg/L	1, 5, 10, Cn
GWN-MI2 Well Name: Boutwell Residence Well County: Lowndes Date Sampled: 1991/04/24	5.7	2.8	1 U	2.6	5 U	20 U	10 U	2.6	2 U	0.1 U	10 U	10 U	39	F = 0.5mg/L	1, 5, 8, 9, 10
GWN-MI2 Well Name: Boutwell Residence Well County: Lowndes Date Sampled: 1991/10/31	5.5	2.7	1 U	2.4	5 U	20 U	10 U	2.8	2 U	0.1 U	10 U	10 U	46	F = 0.6mg/L	1, 5, 8, 9, 10
GWN-MI3 Well Name: Coffin Park TW 3 County: Glynn Date Sampled: 1991/01/09	7.5	69	11	20	5 U	150	18	16.2	30.2	0.1 U	11	440	467	Al = 110 Tl = 160 F = 0.4mg/L	10
GWN-MI4 Well Name: Hopeulikit TW 2 County: Bulloch Date Sampled: 1991/01/10	7.4	17	5.0	6.0	5 U	690	110	2.8	3.6	0.1 U	79	93	145	Al = 70 Tl = 92 F = 0.5mg/L	

1991 Groundwater Quality Analyses of the Miocene Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-MI5 Well Name: Carter Residence County: Appling Date Sampled: 1991/01/07	5.3	5.0	2.1	4.0	5 U	20 U	110	10.0	2 U	4.6	83	32	92	Al = 160 Tl = 52 F = 0.1mg/L	
GWN-MI13 Well Name: Meeks Rental House County: Screven Date Sampled: 1991/01/17	7.3	48	1 U	1.8	5 U	2,000	190	0.3	2 U	0.1 U	22	44	243	Al = 53 Tl = 23 F = 0.2mg/L	1
GWN-MI14 Well Name: Thomas Residence County: Bulloch Date Sampled: 1991/01/16	4.8	2.0	1.0	5.4	5 U	34	10 U	7.6	2 U	1.9	16	13	67	Al = 160 Zn = 24 F = 0.1mg/L	1, 5
GWN-MI15 Well Name: Aldrich Residence County: Bulloch Date Sampled: 1991/01/17	4.5	9.2	7.5	1.4	5 U	81	13	7.9	9.5	11.6	54	89	160	Al = 240 Tl = 69 F = 0.1mg/L	
Average:	6.2	19.7	4.6	5.5	5.0	386.1	55.4	5.9	6.3	2.1	33.4	93.4	166.4		
Maximum:	7.8	69.0	12.0	20.0	5.0	2,000	190.0	16.2	30.2	11.6	83.0	440.0	467.0		
Minimum:	4.5	2.0	1.0	1.4	5.0	20.0	10.0	0.3	2.0	0.1	10.0	10.0	39.0		
Standard Deviation:	1.2	22.3	4.2	5.4	5.0	612.6	61.7	4.7	8.7	3.7	28.5	127.8	128.3		

1991 Groundwater Quality Analyses of the Piedmont Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected ug/L	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm		
GWN-P1 Well Name: Luthersville New Well County: Meriwether Date Sampled: 1991/05/28	5.0	8.3	2.6	11	5 U	2,400	62	5.7	16.2	0.1 U	10 U	100	111	Al = 27 F = 0.1mg/L	
GWN-P2 Well Name: Riverdale, Delta Drive Well County: Clayton Date Sampled: 1991/05/23	6.4	13	1.5	12	5 U	98	27	2.8	2 U	0.9	28	82	116	Al = 46 Zn = 53 F = 0.2mg/L	
GWN-P2 Welll Name: Riverdale, Delta Drive Well County: Clayton Date Sampled: 1991/12/02	6.6	16	1.8	11	5 U	1,100	28	2.7	2.0	0.7	31	97	131	Al = 47 Zn = 62 F = 0.2mg/L	10
GWN-P3 Well Name: USGS Ft. McPherson County: Fulton Date Sampled: 1991/03/07	7.1	9.6	2.4	10	5 U	1,300	45	1.3	6.0	0.1 U	14	72	107	Al = 150 Ti = 14 F = 0.2mg/L Dichloropropane = 1.1ug/L	8, 9, 10
GWN-P3 Well Name: USGS Ft. McPherson County: Fulton Date Sampled: 1991/10/03	6.7	9.6	2.4	9.3	5 U	660	47	1.4	6.3	0.1 U	12	78	102	Al = 45 F = 0.2mg/L Dichloropropane = 1.7ug/L	10
GWN-P4C Well Name: Barton Brands, Inc. #3 County: Fulton Date Sampled: 1991/05/20	6.2	6.4	1.0	8.9	5 U	20 U	10 U	1.37	2 U	1.07	24	67	78	Zn = 28 F = 0.4mg/L	

1991 Groundwater Quality Analyses of the Piedmont Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-P4C	6.2	6.7	1.0	8.7	5 U	20 U	10 U	1.5	2 U	1.4	20	69	75	Al = 39 F = 0.4mg/L	
Well Name: Barton Brands, Inc. #3 County: Fulton Date Sampled: 1991/11/21															
GWN-P5	6.8	25	3.9	2.0	5 U	20 U	10 U	1.1	1.3	0.3	30	90	115	Al = 69	10
Well Name: Flowery Branch #1 County: Hall Date Sampled: 1991/11/27															
GWN-P6A	7.3	15	2.2	8.3	5 U	74	79	2.2	4.9	0.1 U	10 U	42	136	Al = 71 F = 0.3mg/L	
Well Name: Shiloh #1 County: Harris Date Sampled: 1991/04/22															
GWN-P7	5.6	11	4.6	8.7	5 U	20 U	10 U	2.4	2.3	0.2	58	73	114	Al = 33 F = 0.1mg/L	
Well Name: Hampton #6 County: Henry Date Sampled: 1991/05/21															
GWN-P8	6.9	30	8.8	9.8	5 U	20 U	10 U	8.4	6.9	0.1 U	10 U	83	237	Al = 47 F = 0.3mg/L	10
Well Name: Wayne Poultry Company #4, Pendergrass County: Jackson Date Sampled: 1991/01/09															
GWN-P9	6.2	16	7.9	14	5 U	820	160	9.5	7.0	0.1 U	32	120	228	F = 0.2mg/L	
Well Name: Gray #4 County: Jones Date Sampled: 1991/04/24															

1991 Groundwater Quality Analyses of the Piedmont Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-P10A	5.9	5.0	3.3	6.5	5 U	11,000	110	2.6	17.0	0.1 U	15	58	91	Al = 31 Cd = 5 F = 0.2mg/L	10
Well Name: Franklin Springs #4 County: Franklin Date Sampled: 1991/11/22															
GWN-P11	6.5	12	5.2	7.4	5 U	120	20	2.3	4.8	0.2	10	33	124	Al = 47 F = 0.2mg/L	
Well Name: Danielsville #2 County: Madison Date Sampled: 1991/11/22															
GWN-P12	6.2	11	2.4	15	5 U	110	35	13.2	5.2	1.9	36	70	142	Al = 40 Zn = 190 F = 0.1mg/L	
Well Name: Nabisco Plant #1, Woodbury County: Meriwether Date Sampled: 1991/05/29															
GWN-P13	5.6	5.0	1.3	7.0	5 U	20 U	10 U	8.8	2 U	0.74	34	42	72	Al = 34 F = 0.1mg/L	10
Well Name: Covington Academy Spring County: Newton Date Sampled: 1991/05/21															
GWN-P14	6.2	1 U	1 U	1.8	5 U	55	10 U	1.8	2 U	0.2	30	10 U	17	F = 0.1mg/L	
Well Name: Sunset Village #1 County: Upson Date Sampled: 1991/05/29															
GWN-P15A	7.1	21	4.8	8.9	5 U	660	110	7.5	6.0	0.1 U	67	100	179	Al = 43 Bi = 61 Zn = 280 F = 0.3mg/L	
Well Name: Bolton Garden Well County: DeKalb Date Sampled: 1991/05/20															

1991 Groundwater Quality Analysis of the Piedmont Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS WELL #ID	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-P15A	7.2	21	4.7	9.0	5 U	480	100	8.0	6.6	0.1 U	66	100	179	Al = 64 Zn = 42 F = 0.3mg/L	10
Well Name: Bolton Garden Well County: DeKalb Date Sampled: 1991/11/21															
GWN-P16C	6.4	8.0	1.6	3.0	5 U	600	61	0.8	6.2	0.1 U	10 U	50	68	Al = 40 F = 0.2mg/L	10
Well Name: Mt. Airy #4, Chase Road Well County: Habersham Date Sampled: 1991/11/22															
Average:	6.4	12.5	3.2	8.6	5.0	979.9	47.7	4.3	5.4	0.4	27.4	71.8	121.1		
Maximum;	7.3	30.0	8.8	15.0	5.0	11,000	160.0	13.2	17.0	1.9	67.0	120.0	237.0		
Minimum:	5.0	1.0	1.0	1.8	5.0	20.0	10.0	0.8	1.3	0.1	10.0	10.0	17.0		
Standard Deviation:	0.6	7.1	2.2	3.4	5.0	2,373.2	42.5	3.5	4.2	0.5	17.8	26.2	52.0		

1991 Groundwater Quality Analyses of the Blue Ridge Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-BR1A	7.2	22	1.5	5.4	5 U	20 U	12	1.3	3.1	0.1 U	19	150	135	Zn = 57 F = 0.2mg/L	
Well Name: Hiawassee #7 County: Towns Date Sampled: 1991/07/16															
GWN-BR2	5.8	3.2	1.4	3.6	5 U	170	12	1 U	2 U	0.9	45	38	46	Al = 91 F = 0.2mg/L	
Well Name: Notla Water Authority #3 County: Union Date Sampled: 1991/07/16															
GWN-BR3	8.0	24	2.3	14	5 U	530	130	1.6	12.4	0.1 U	12	220	180	F = 0.1mg/L	
Well Name: Dawsonville Shoal Hole Park Well County: Dawson Date Samped: 1991/07/16															
GWN-BR4	6.9	9.8	2.2	8.0	5 U	90	10 U	2.2	2 U	0.8	10 U	90	94	Zn = 43 F = 0.2mg/L	
Well Name: Morganton Old Well County: Fannin Date Sampled: 1991/07/16															
Average:	7.0	14.8	1.9	7.8	5.0	202.5	41.0	1.5	4.9	0.5	21.5	124.5	113.8		
Maximum:	8.0	24.0	2.3	14.0	5.0	530.0	130.0	2.2	12.4	0.9	45.0	220.0	180.0		
Minimum:	5.8	3.2	1.4	3.6	5.0	20.0	10.0	1.0	2.0	0.1	10.0	38.0	46.0		
Standard Deviation:	0.8	8.6	0.4	3.9	5.0	196.4	51.4	0.4	4.4	0.4	14.0	67.9	49.5		

1991 Groundwater Quality Analyses of the Valley and Ridge Unconfined Aquifer System

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-VR1 Well Name: Kingston Road Well, Rome County: Floyd Date Sampled: 1991/07/24	7.6	27	15	1.8	5 U	20 U	10 U	1 U	2 U	0.3	10 U	17	221	Al = 82 Bi = 65 F = 0.1mg/L	
GWN-VR2 Well Name: Tri-County Hospital Well - Ft. Oglethorpe County: Catoosa Date Sampled: 1991/07/23	6.9	70	23	15	5 U	330	580	20.0	13.8	0.5	33	78	515	Al = 180 Bi = 130 F = 0.2mg/L Benzene = 140 Toluene = 290 Ethylbenzene = 36 O-xylene = 75 M-xylene = 100	10
GWN-VR3 Well Name: Chickamauga, Crawfish Springs County: Walker Date Sampled: 1991/07/23	7.3	31	14	1.9	5 U	20 U	10 U	1 U	2.0	0.5	81	27	234	Al = 89 Bi = 57 F = 0.1mg/L	10
GWN-VR4 Well Name: American Thread Company #4 County: Walker Date Sampled: 1991/07/23	7.3	82	20	17	5 U	100	90	12.6	55.7	0.1 U	130	740	544	Al = 420 Bi = 99 F = 0.3mg/L	10
GWN-VR5 Well Name: Chatooga County #4 County: Chattooga Date Sampled: 1991/07/24	7.1	77	3.9	6.2	5 U	20 U	10 U	9.7	3.0	3.0	110	180	368	Al = 170 F = 0.1mg/L	10
GWN-VR6 Well Name: Chemical Products Corporation, East Well County: Bartow Date Sampled: 1991/08/02	7.4	28	16	5.3	5 U	20 U	10 U	1 U	3.9	0.4	570	130	246	Bi = 77 Tetrachloroethylene = 2.1	10

1991 Groundwater Quality Analyses of the Valley and Ridge Unconfined Aquifer System (Continued)

PARAMETER	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
UNITS / WELL ID#	SU	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	mg/L	mgN/L	ug/L	ug/L	umho/cm	ug/L	
GWN-VR7	7.4	29	15	1.1	5 U	20 U	10 U	1 U	2 U	0.2	32	24	238	Al = 110 Bi = 84 F = 0.2mg/L	10
Well Name: Adairsville, Lewis Spring County: Bartow Date Sampled: 1991/07/24															
GWN-VR8	7.5	34	15	1.4	5 U	20 U	10 U	1 U	2 U	0.4	13	22	252	Bi = 86 F = 0.2mg/L	
Well Name: Cedartown Spring County: Polk Date Sampled: 1991/07/25															
GWN-VR9	7.7	38	13	1.5	5 U	20 U	10 U	2.7	2 U	0.4	12	26	230	Bi = 73 F = 0.2mg/L	10
Well Name: Polk County #2 County: Polk Date Sampled: 1991/07/31															
Average:	7.4	46.2	15.0	5.7	5.0	63.3	82.2	5.6	9.6	0.6	110.1	138.2	316.4		
Maximum:	7.7	82.0	23.0	17.0	5.0	330.0	580.0	20.0	55.7	3.0	570.0	740.0	544.0		
Minimum:	6.9	27.0	3.9	1.1	5.0	20.0	10.0	1.0	2.0	0.1	10.0	17.0	221.0		
Standard Deviation:	0.2	21.7	4.9	5.8	5.0	97.5	177.7	6.6	16.7	0.8	168.0	219.5	121.3		

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Editor: Melynda Lewis