GROUND-WATER QUALITY IN GEORGIA FOR 1989

by

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GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
GEORGIA GEOLOGIC SURVEY

CIRCULAR 12F

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GROUND-WATER MANAGEMENT PROGRAM

The preparation of this report was financed in part through a grant from the U.S. Environmental Protection Agency under the provisions of Section 106 of the Federal Water Pollution Control Act of 1972, as amended.

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ATLANTA
1991

CIRCULAR 12F

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INTRODUCTION

PURPOSE AND SCOPE

This report is the sixth 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. Four 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 in the farm belt (currently being conducted by the Geologic Survey Branch in cooperation with Georgia Southern University) is an example of this type of study.

4. Sampling of ground water at environmental facilities such as municipal solid waste landfills, RCRA facilities, sludge disposal facilities, etc. EPD's Land Protection and Water Protection Branches have the primary responsibility for monitoring these facilities.

Analyses of water samples collected for the Georgia Ground-Water Monitoring Network during calendar year 1989 and from previous years are

the data base for this summary. Representative water samples were collected from 140 wells and springs in 1989. A review of the 1989 data, and comparison of these data with analyses of samples collected as early as 1984, indicates that ground-water quality at most of the 140 sampling sites generally has changed little and remains excellent.

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 and 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 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.

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.

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.

The Coastal Plain contains the State's major confined (artesian) 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.

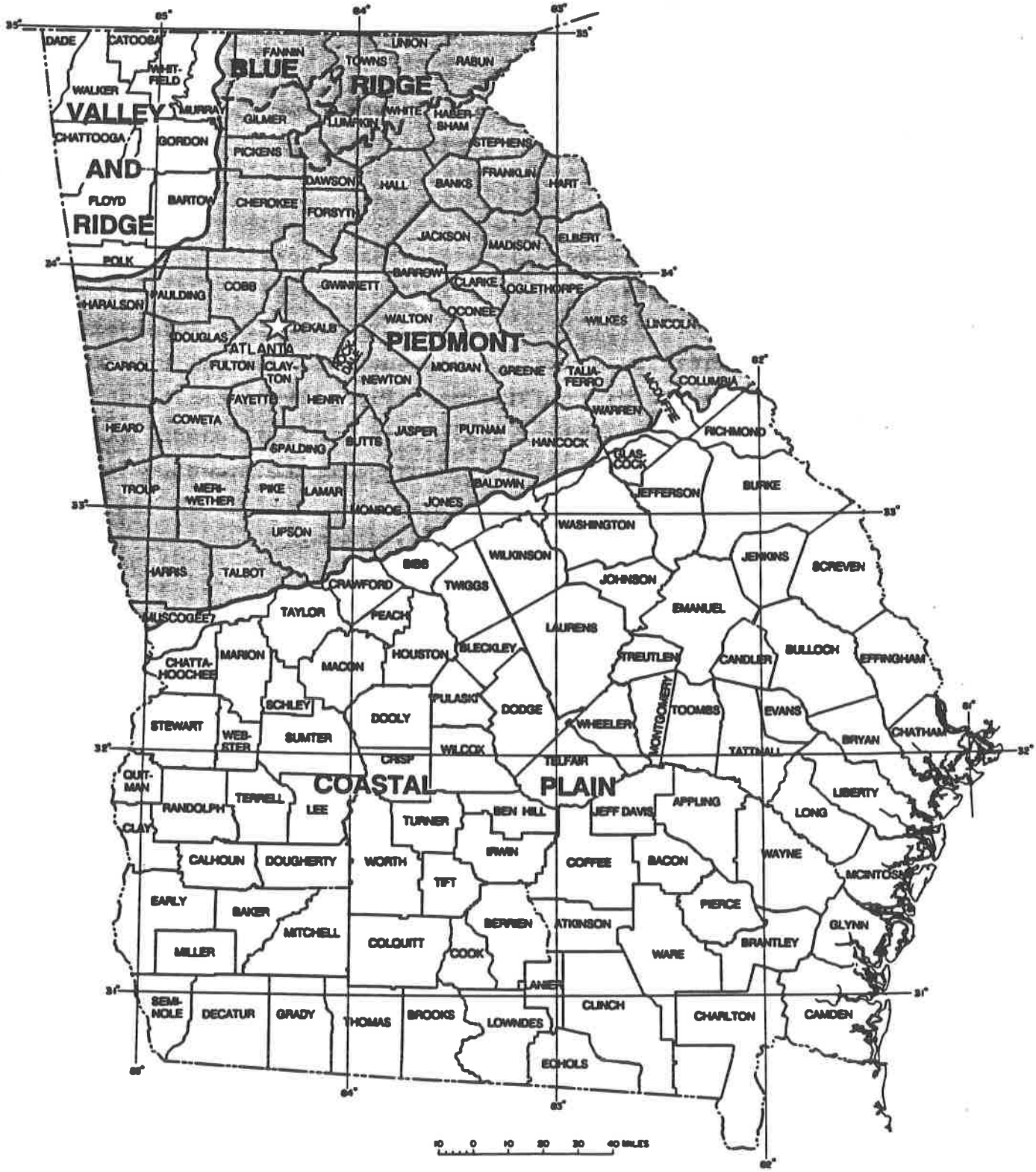


Figure 1-1. - The three hydrogeologic provinces of Georgia.

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.

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.

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.

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, but do not pose a health risk.

Only a few occurrences of polluted or contaminated ground waters are known from north Georgia. 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 karstic areas of both southwestern and northwestern Georgia are 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 are common 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.

GEORGIA GROUND-WATER MONITORING NETWORK

MONITORING STATIONS

Stations of the Ground-Water Monitoring Network include all seven 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. other areas of potential pollution related to regional activities (agricultural and industrial areas) and
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 water 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 Georgia Geologic Survey and the U.S. Geological Survey.

EPD's concern over pesticides in ground water warranted the addition of 22 shallow wells as monitoring stations and an expanded pesticides analysis program for samples from two other Monitoring Network wells during 1988 and 1989. Three of the recently added wells were sampled during 1988. Nineteen shallow wells located in agricultural areas of the Coastal Plain Province were sampled for the first time in 1989. Most of the wells are the source of domestic drinking-water supplies. Two of the new wells are screened in the Jacksonian Aquifer System (J7,J8), six are screened in the Floridan Aquifer System (PA50 - PA55), and eleven are screened in the Miocene Aquifer System (MI5 - MI15). The increased number of monitoring stations necessitated a

reduction in the frequency of sample collection from some of the other Monitoring Network wells, especially those located in confined aquifers of south-central and coastal Georgia.

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 are representative of water quality in only limited areas of the State. Monitoring water quality at 140 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 stations 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 areally extensive aquifers of the Coastal Plain Province. The Monitoring Network allows for some definition of the chemical processes occurring

in large confined aquifers. Unconfined aquifers in northern Georgia and the surface recharge areas of southern Georgia are 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 stations. In contrast, ground water from monitoring stations 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 stations 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.

ANALYSES

Analyses are available for 167 water samples collected during 1989 from 137 wells and three springs. Annual analyses of water samples from 28 of the wells span six years with the addition of the 1989 data. For 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. Water samples were collected state-wide from 84 wells and three springs in 1985, 25 wells and three springs in 1986, 123 wells and three springs in 1987, and 112 wells and three springs in 1988.

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, chlorinated pesticides (Organics Screen #2), phenoxy herbicides (Organics Screen #4) 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 are tested. These additional chemical

screens are listed in the Appendix (Tables 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 established 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 Tables A-1, A-2 and A-4 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 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 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. EPD laboratories in Atlanta perform all analyses except for organic chemical screens 1, 2, 3, 4, 5, and 7 (Appendix, Tables A-1 and A-2). The Agricultural Services Laboratory of the Cooperative Extension Service at the University of Georgia in Athens performs these organic screens.

Table 2-1. - Georgia Ground-Water Monitoring Network, 1989

AQUIFER SYSTEM	NUMBER OF MONITORING STATIONS	PRIMARY STRATIGRAPHIC EQUIVALENTS	AGE OF AQUIFER FORMATIONS
Cretaceous	20 (16 sampled in 1989)	Ripley Formation, Cusseta Sand, Blufftown Formation, Eutaw Formation, and Tuscaloosa Formation	Late Cretaceous
Providence	4	Providence Sand	Late Cretaceous
Clayton	7 (6 sampled in 1989)	Clayton Formation	Paleocene
Claiborne	9 (7 sampled in 1989)	Tallahatta Formation	Middle Eocene
Jacksonian	10 (9 sampled in 1989)	Barnwell Group	Late Eocene
Floridan	58 (54 sampled in 1989)	Suwannee Limestone, Ocala Group, Bridgeboro Limestone and Claibornian Carbonates	Middle Eocene to Oligocene
Miocene	15	Altamaha Formation and Hawthorne Group	Miocene
Piedmont	18 (17 sampled in 1989)	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	Corbin Gneiss Complex, Snowbird Group, Walden Creek Group, Great Smoky Group and Murphy Marble Belt Group	Predominately Paleozoic and Precambrian
Valley and Ridge	9	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 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 chloride is not suitable for irrigation. It is recommended that chloride content should not exceed 250 parts per million.
Nitrite/nitrate	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"). Nitrite/nitrate 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.

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 stations 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 more localized ground-water flow patterns in aquifers that are typically unconfined. Deeper regional flow systems are less developed in northern Georgia than in the Coastal Plain Province because of the discontinuous nature of permeable features in the north Georgia aquifers. 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, may 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. In addition, widespread development of karst features (for example, caves, springs and solution-enlarged voids) may significantly enhance porosity and permeability in localized areas, and exert a strong influence on local ground-water flow patterns.

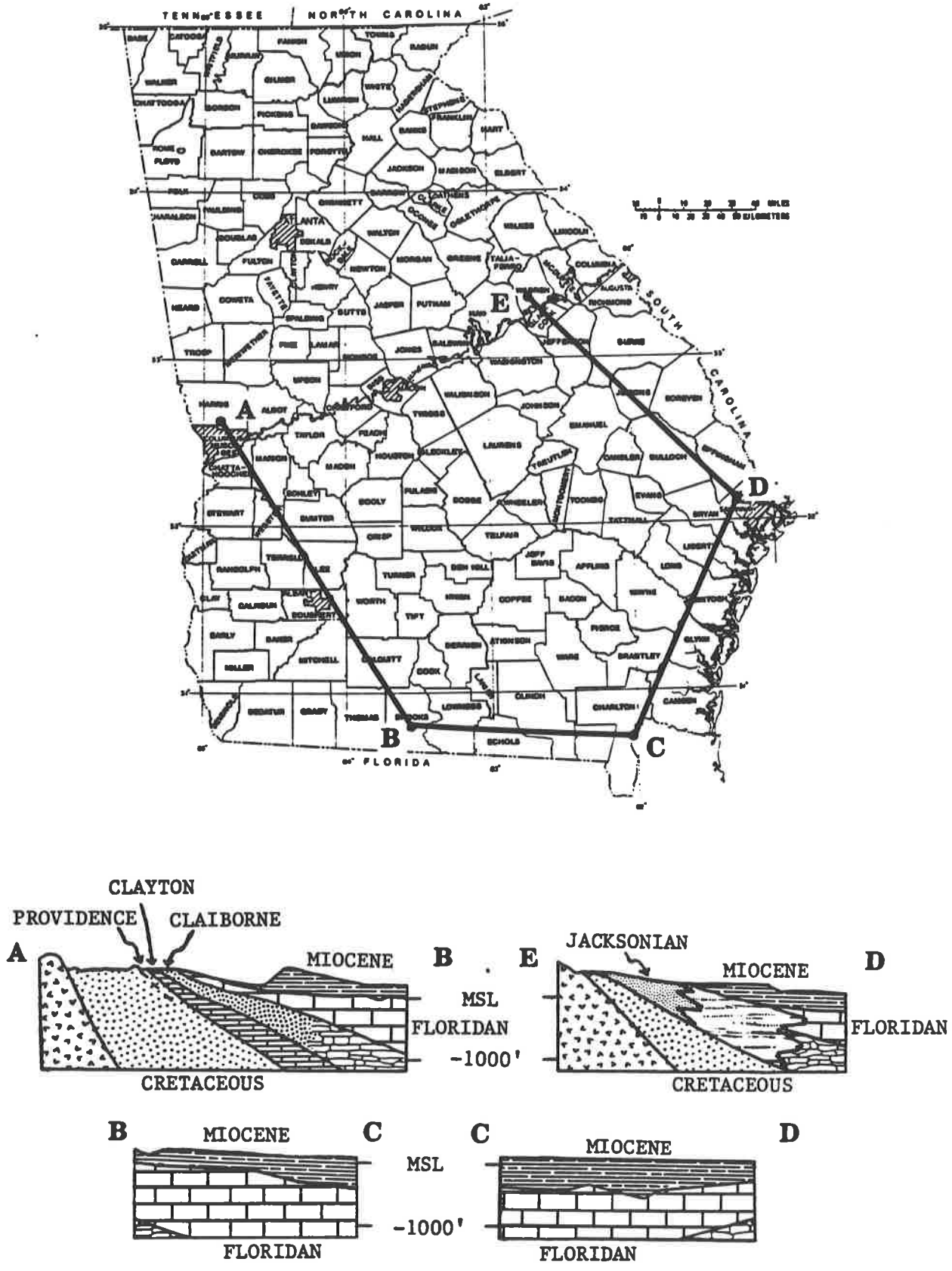


Figure 3-1. - The seven major aquifer systems of the Coastal Plain Province.

CRETACEOUS AQUIFER SYSTEM

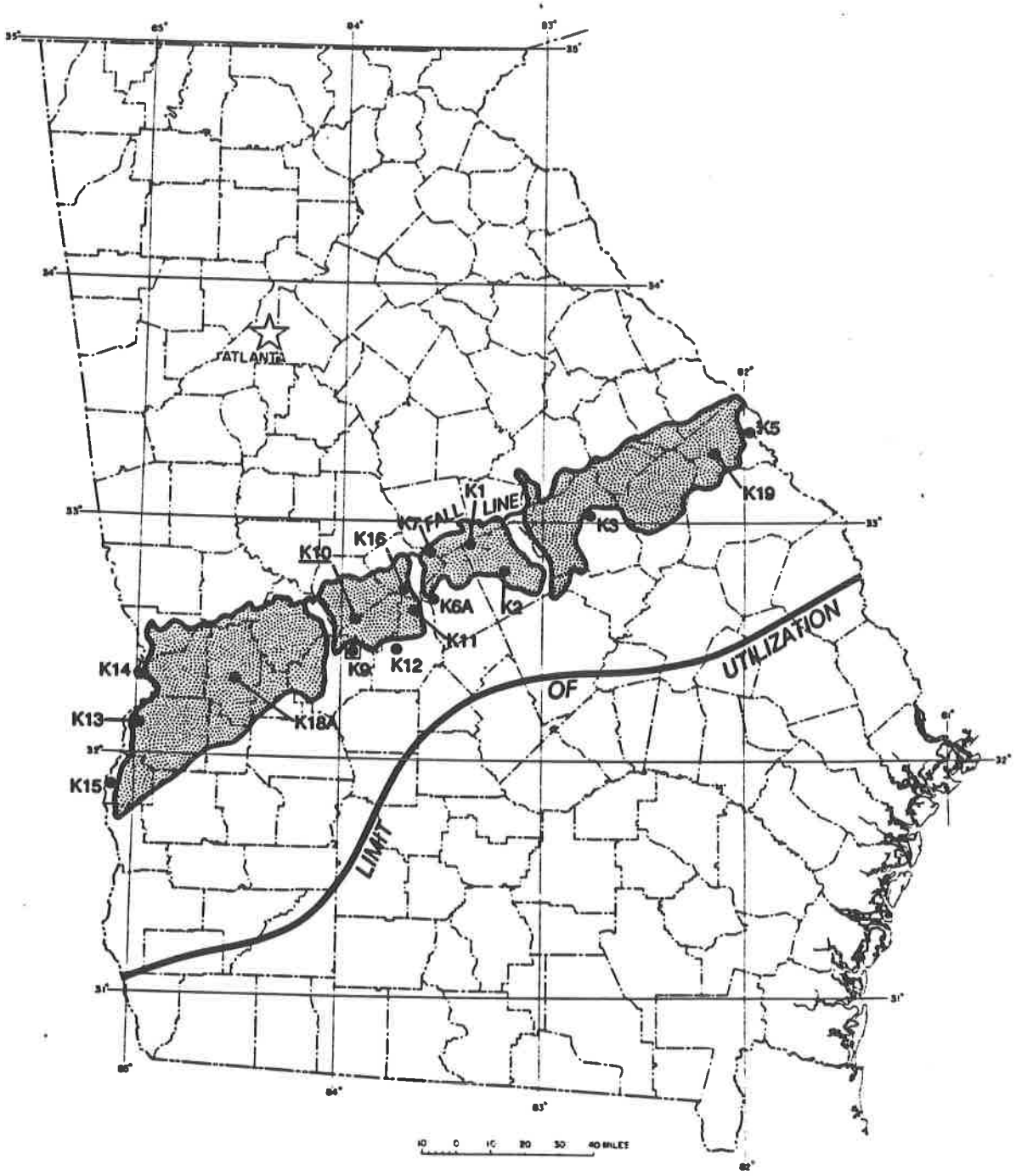
The Cretaceous aquifer system is a complexly interconnected group of aquifer subsystems consisting of the Late Cretaceous sands of the Coastal Plain Province. These sands crop out in an extensive recharge area immediately south of the Fall Line in west and central Georgia (Figure 3-2). Overlying sediments 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. No down-dip wells were sampled during 1989.

Water from the wells in the up-dip area was typically acidic, to the point of being corrosive, and soft. Three wells in outcrop areas adjacent to the Chattahoochee River yielded basic water. Iron and manganese concentrations were generally low, although one well in Macon County yielded water containing 740 parts per billion iron. 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 detection limits. Other trace metals (aluminum, copper, strontium and zinc) were commonly present in minor amounts.

Chloride and sulfate levels were low (less than 15 parts per

million chloride and 10 parts per million sulfate) in all of the samples collected. Water samples from eight of the wells in the up-dip area contained detectable levels of nitrite/nitrate. The highest values, 0.23 to 0.98 parts per million, were measured in samples from five wells in middle Georgia and in a Richmond County well. 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 high nitrite/nitrate levels. Most of these wells show an overall decrease in nitrite/nitrate levels when compared to previous years, although one up-dip well showed a slight increase.



□ Iron concentrations exceed drinking-water limits
K10 Nitrite/nitrate concentrations exceed 0.45 parts per million
• Soft water
General recharge area (from Davis, et al., 1988)

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

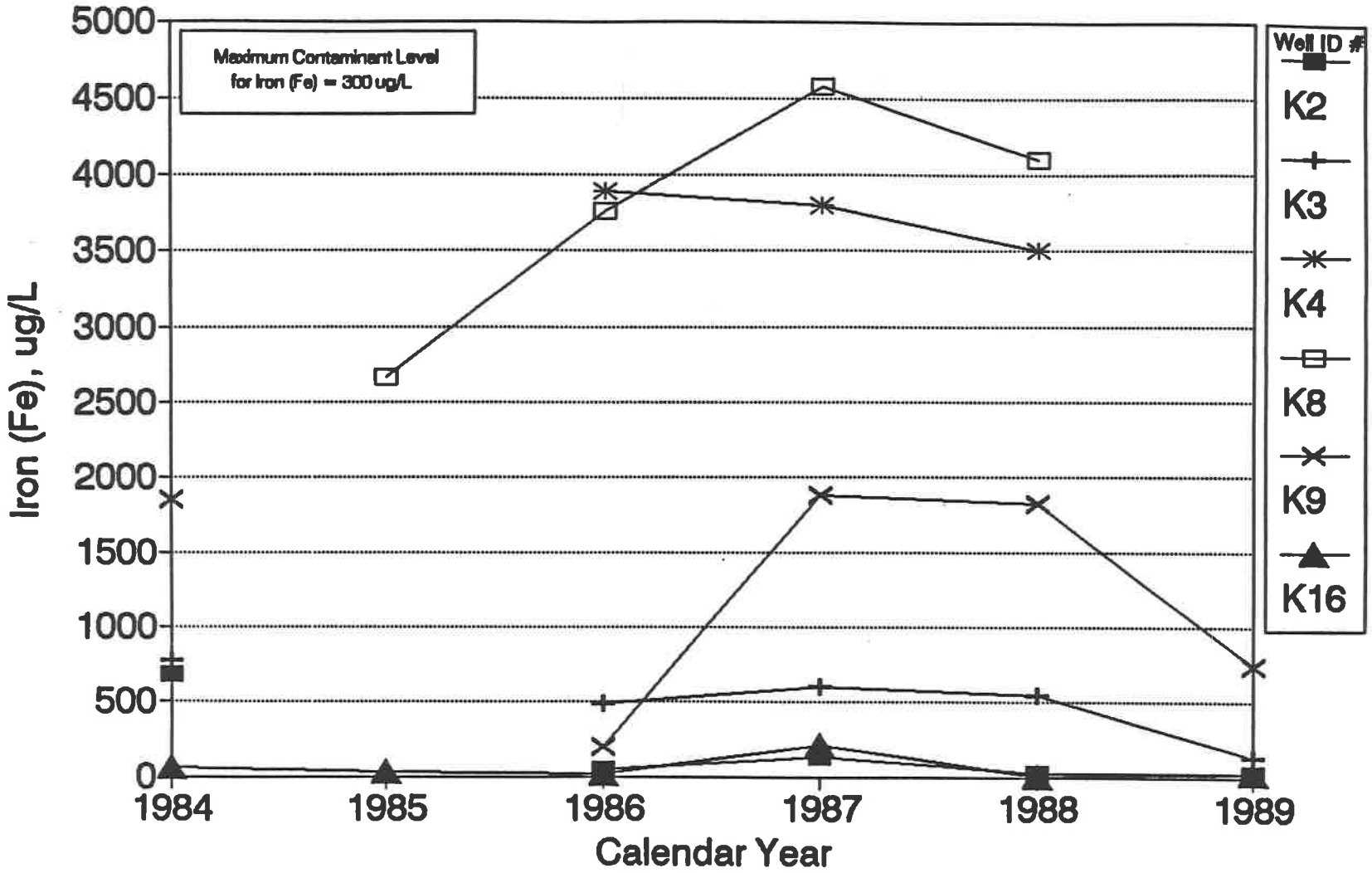


Figure 3-3. - Iron concentrations in selected wells in the Cretaceous aquifer.

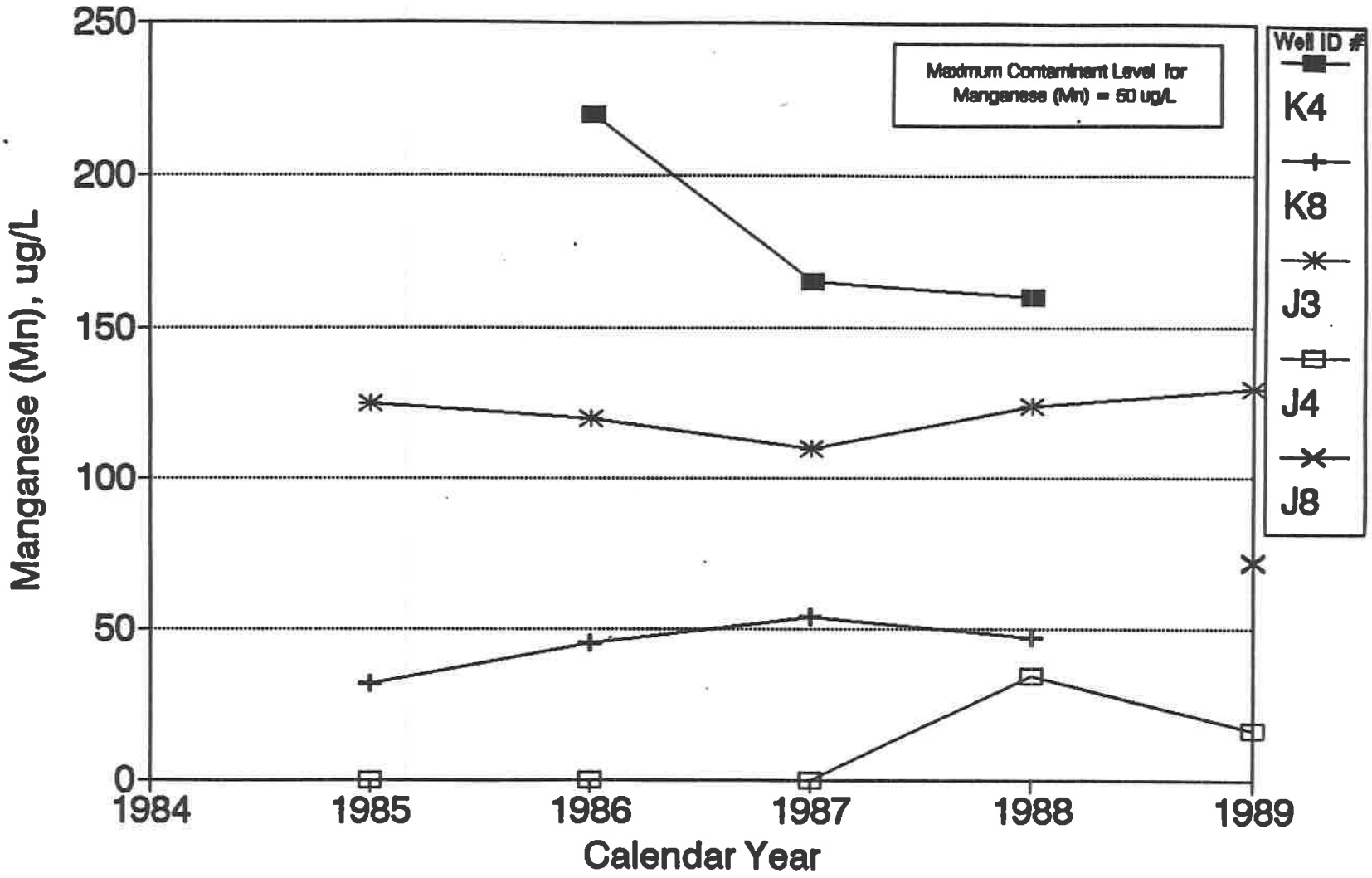


Figure 3-4. - Manganese concentrations in selected wells in the Cretaceous and Jacksonian aquifers.

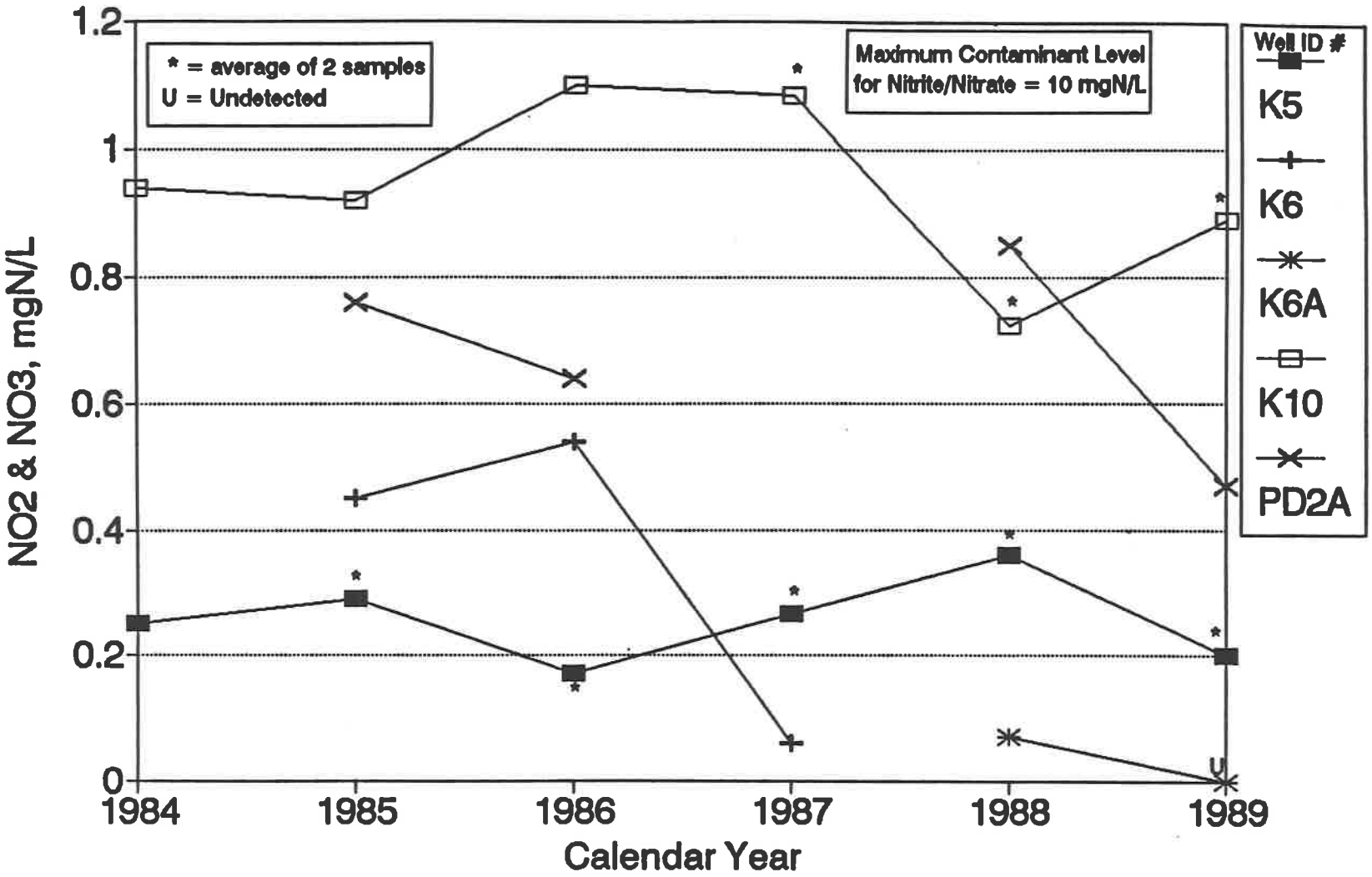


Figure 3-5. - Nitrite/nitrate concentrations in selected wells in the Cretaceous and Providence aquifers.

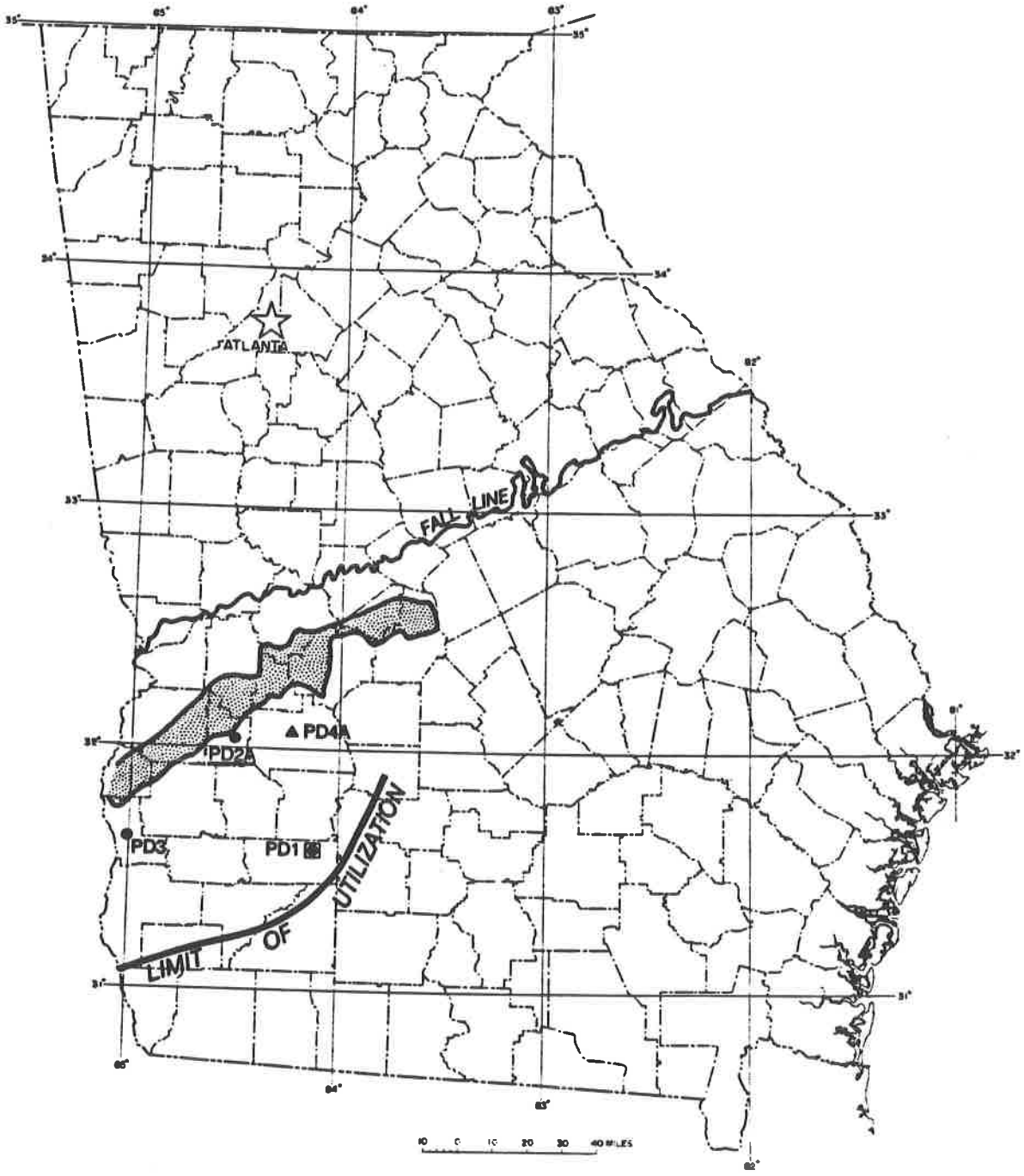
PROVIDENCE AQUIFER SYSTEM

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 (Figure 3-6). 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 Formation-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 quality in the Providence aquifer system was monitored in one outcrop-area well and in two up-dip and one down-dip wells where the system is confined. Water from the outcrop-area well was acidic and soft. The wells in the confined areas yielded water that was basic and soft to moderately hard. Manganese levels were below 15 parts per billion in the water samples from all four wells. Water from the down-dip well in the confined area of the aquifer contained 1,200 parts per billion of iron. Figure 3-7 shows trends in iron concentrations in this well. Calcium, magnesium, potassium, sodium and strontium were the only other cations that were commonly detected. Chloride and sulfate concentrations were low, less than 14 parts per million, in all samples. Minor nitrite/nitrate levels were present in the water samples from the one well located in the up-dip outcrop area. Figure 3-5 shows that nitrite/nitrate concentrations in this well have decreased since 1988.

One well in the up-dip, confined portion of the Providence aquifer yielded water containing 2 parts per billion of tetrachloroethylene when it was sampled during March (Figure 3-8). This well, located in Americus, Sumter County, was resampled in June, at which time no tetrachloroethylene was detected. Teterachloroethylene is a common industrial solvent used in dry cleaning and degreasing applications.



■ Iron concentrations exceed drinking-water limits
PD2A Nitrite/nitrate concentrations exceed 0.45 parts per million
● Soft water
▲ Moderately hard water
▒ General recharge area (from Davis, et al., 1988)

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

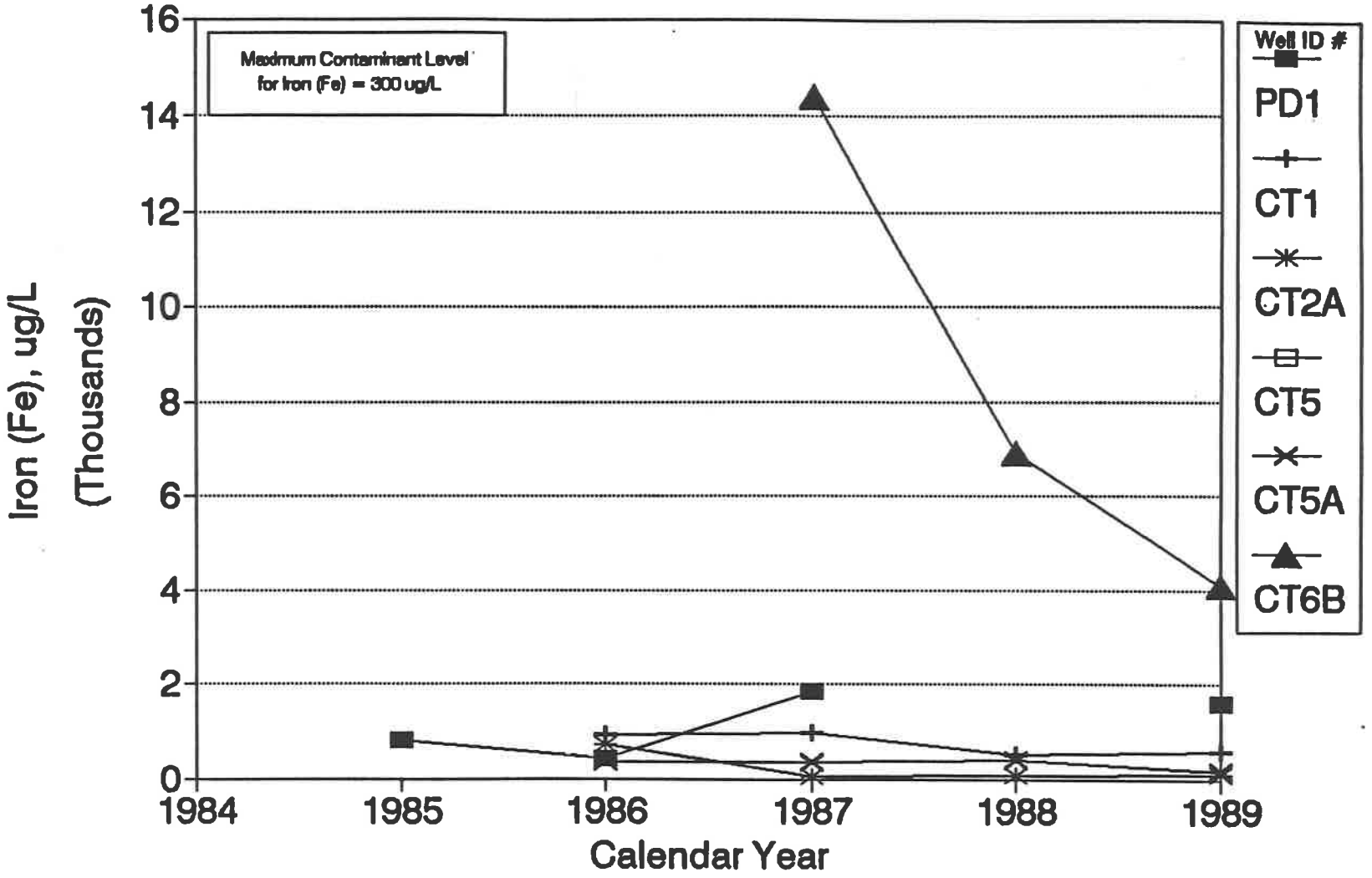


Figure 3-7. - Iron concentrations in selected wells in the Providence and Clayton aquifers.

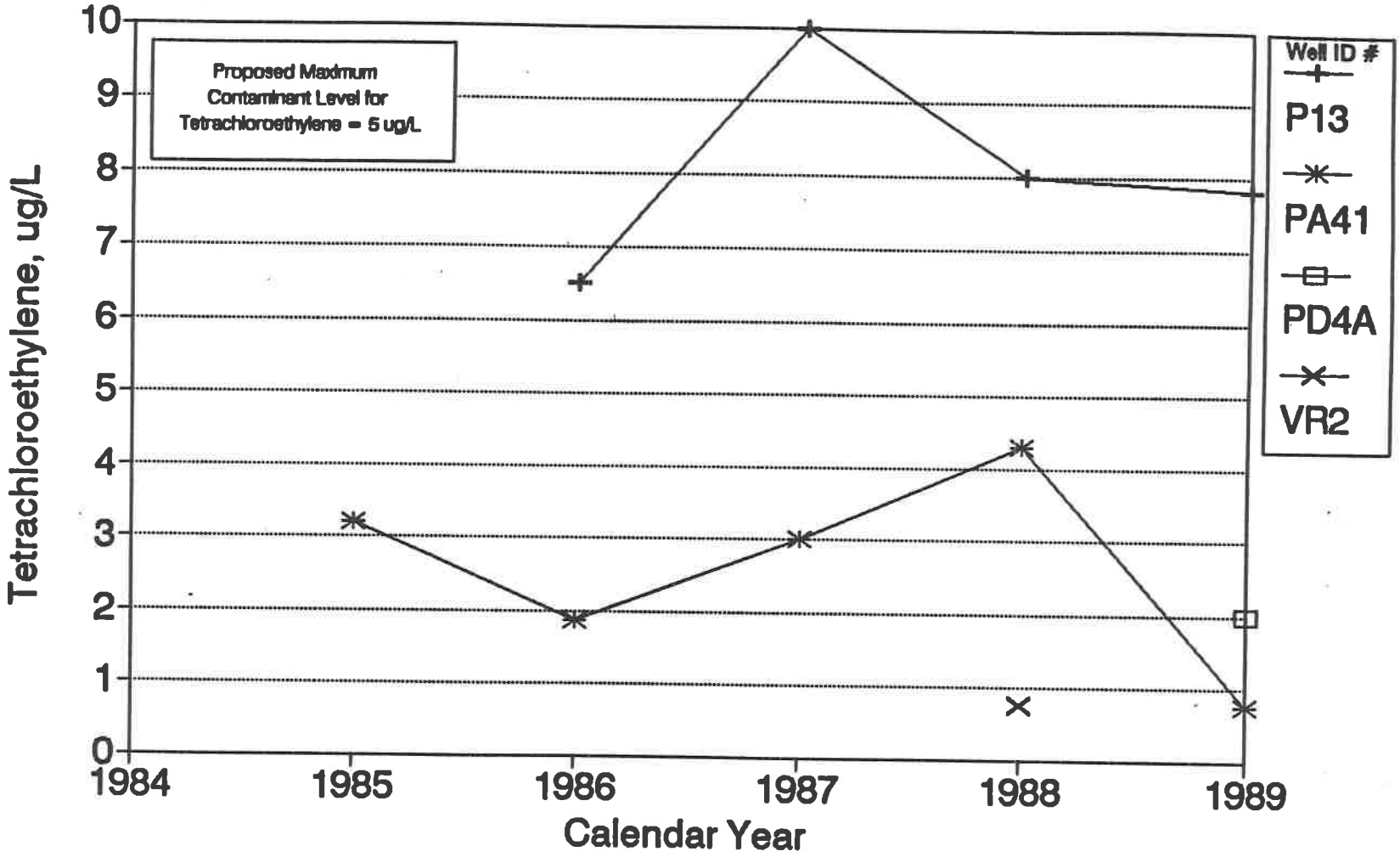


Figure 3-8. - Tetrachloroethylene concentration in selected wells.

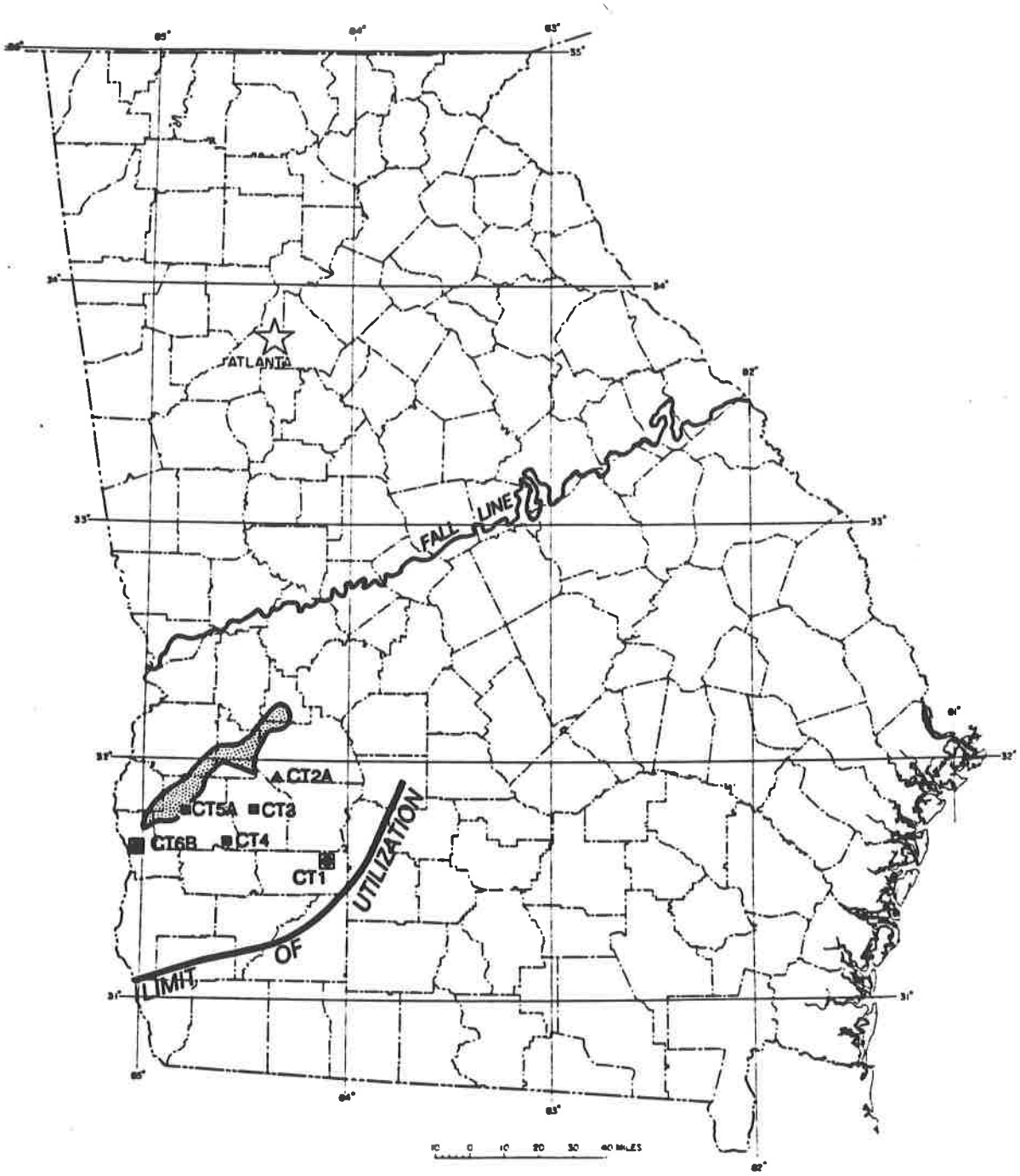
CLAYTON AQUIFER SYSTEM

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 3-9). 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 wells were used to monitor water quality of the Clayton aquifer system. These sample stations included five wells in confined, up-dip areas of the Clayton aquifer, and one well in the confined, down-dip area of the aquifer.

All water samples from the confined-area wells were slightly basic and non-corrosive. The water samples from wells in the up-dip area were hard to very hard. Iron and manganese concentrations exceeded drinking-water limits in samples from the western-most well. Manganese levels in this well have decreased over the last three years (Figure 3-10), but still exceed the Secondary Maximum Contaminant Level for public drinking water. Concentrations of iron in the same well for the same period have also decreased, but also remain above levels considered acceptable for public drinking water (Figure 3-7). Trace amounts of gold, barium, bismuth, cobalt, molybdenum, strontium, vanadium and zinc and the major alkali metals were the other common cations. The water sample from the one down-dip well was moderately hard, with iron levels that exceeded public drinking-water limits.

Chloride content was uniformly low, less than 10 parts per million, in all samples. Sulfate levels were less than 20 parts per million in the water from all sample stations except for a well adjacent to the Chattahoochee River. Nitrite/nitrate concentrations were below detection limits in all of the samples analyzed.



□ 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 3-9. - Water quality of the Clayton aquifer system.

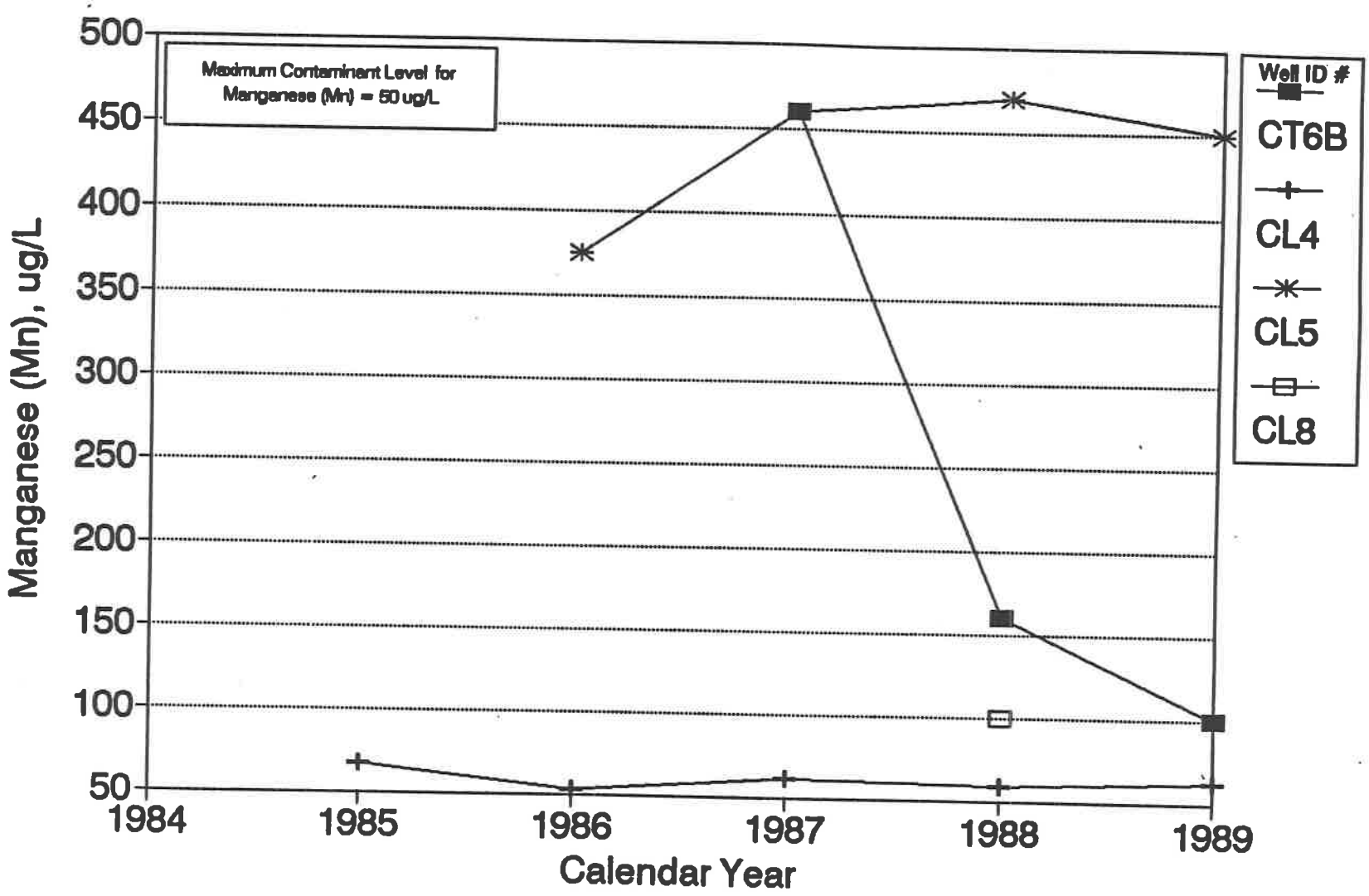


Figure 3-10. - Manganese concentrations in selected wells in the Clayton and Claiborne aquifers.

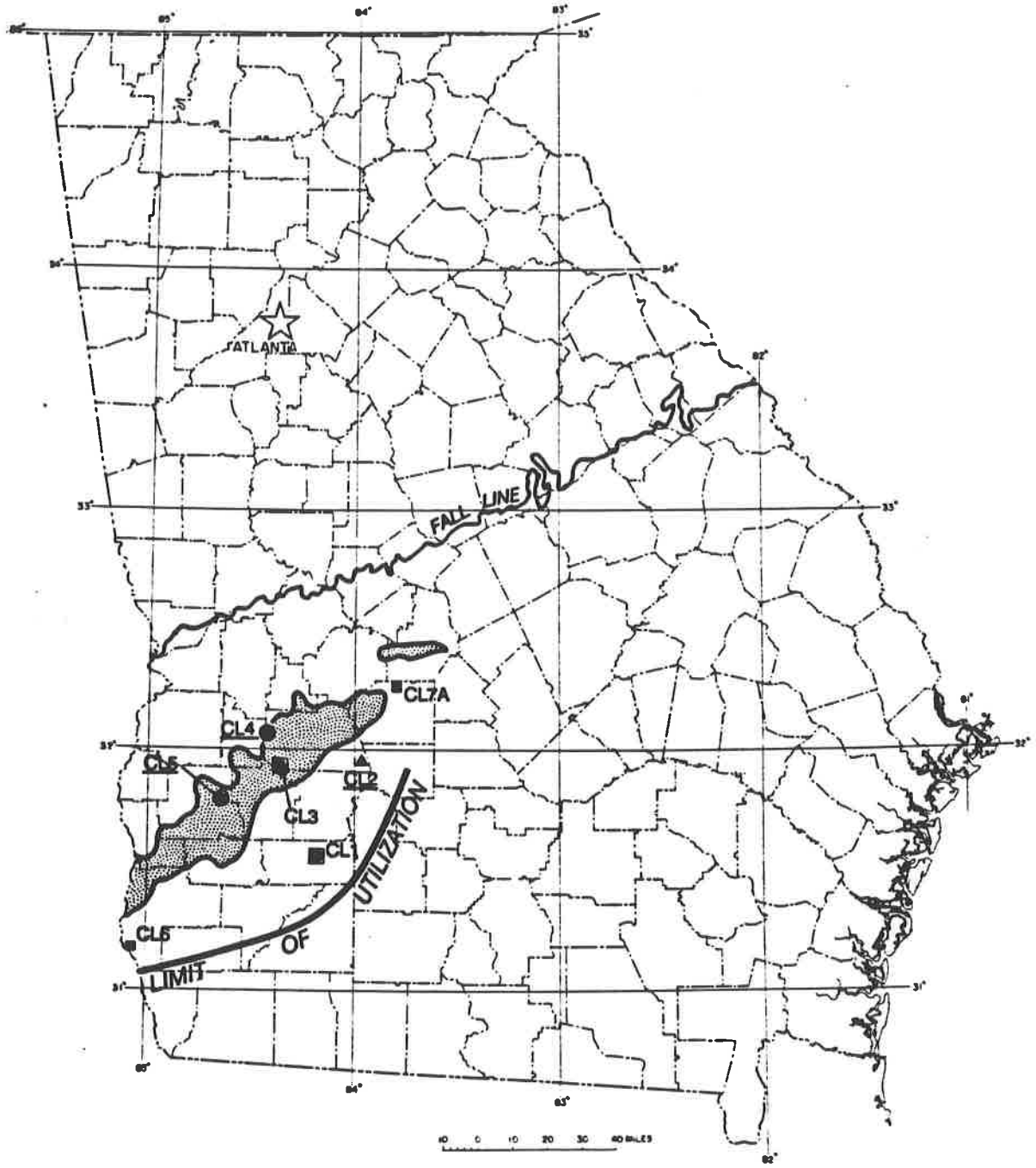
CLAIBORNE AQUIFER SYSTEM

Sands of the Middle Eocene Claiborne Group are the primary members of the Claiborne aquifer system of southwestern Georgia. Claiborne Group sands crop out in a belt extending from northern Early County through western Dooly County (Figure 3-11). 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).

Ground-water samples of the Claiborne aquifer system were collected from three outcrop-area wells and from four wells in down-dip areas where the aquifer is confined. Water samples from wells in the outcrop areas were acidic, to the point of being corrosive, and soft. Iron concentrations exceeded drinking-water limits in one outcrop-area well in Lee County, and water from two wells in Sumter and Randolph Counties exceeded acceptable limits for manganese. Wells in the down-dip areas yielded water that was basic and moderately hard to very hard. Water from one down-dip well in Dougherty County exceeded the Secondary Maximum Contaminant Level for iron, but the remainder of the wells in the down-dip area yielded water with acceptable iron and manganese levels. Figures 3-12 and 3-10 show trends in iron and manganese concentrations for wells that have historically yielded water with high levels of these metals. Aluminum, barium, bismuth, cobalt, copper, gold, molybdenum, strontium, vanadium, yttrium and zinc were also detected.

Chloride and sulfate concentrations in the water samples were uniformly low. Further down dip, in Thomas County, water in the Claiborne aquifer system is highly mineralized (Sever, 1966). Nitrite/nitrate levels of 3.5 and 7.6 parts per million nitrogen were measured in water samples from two of the three outcrop-area wells. Concentrations have increased from 6.33 (average of two analyses) to 7.6 parts per million in the water samples collected from a Shellman, Randolph County, well since sampling began in 1986 (Figure 3-13). A well in Sumter County has shown an increase from 1.15 to 3.5 parts per million nitrite/ nitrate since 1985. One well in Unadilla, Dooly County, located in the confined portion of the aquifer, yielded water containing 7.9 parts per million nitrite/nitrate. In previous years, nitrite/nitrate levels in this well had never exceeded 0.2 parts per million. The same Dooly County well contained 0.45 parts per billion of the herbicide Dinoseb. Nitrite/nitrate levels were below detection limits in water samples from other wells in the confined portion of the Claiborne aquifer.



□ Iron concentrations exceed drinking-water limits
○ Manganese concentrations exceed drinking-water limits
CL2 Nitrite/nitrate concentrations exceed 0.45 parts per million
• 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.

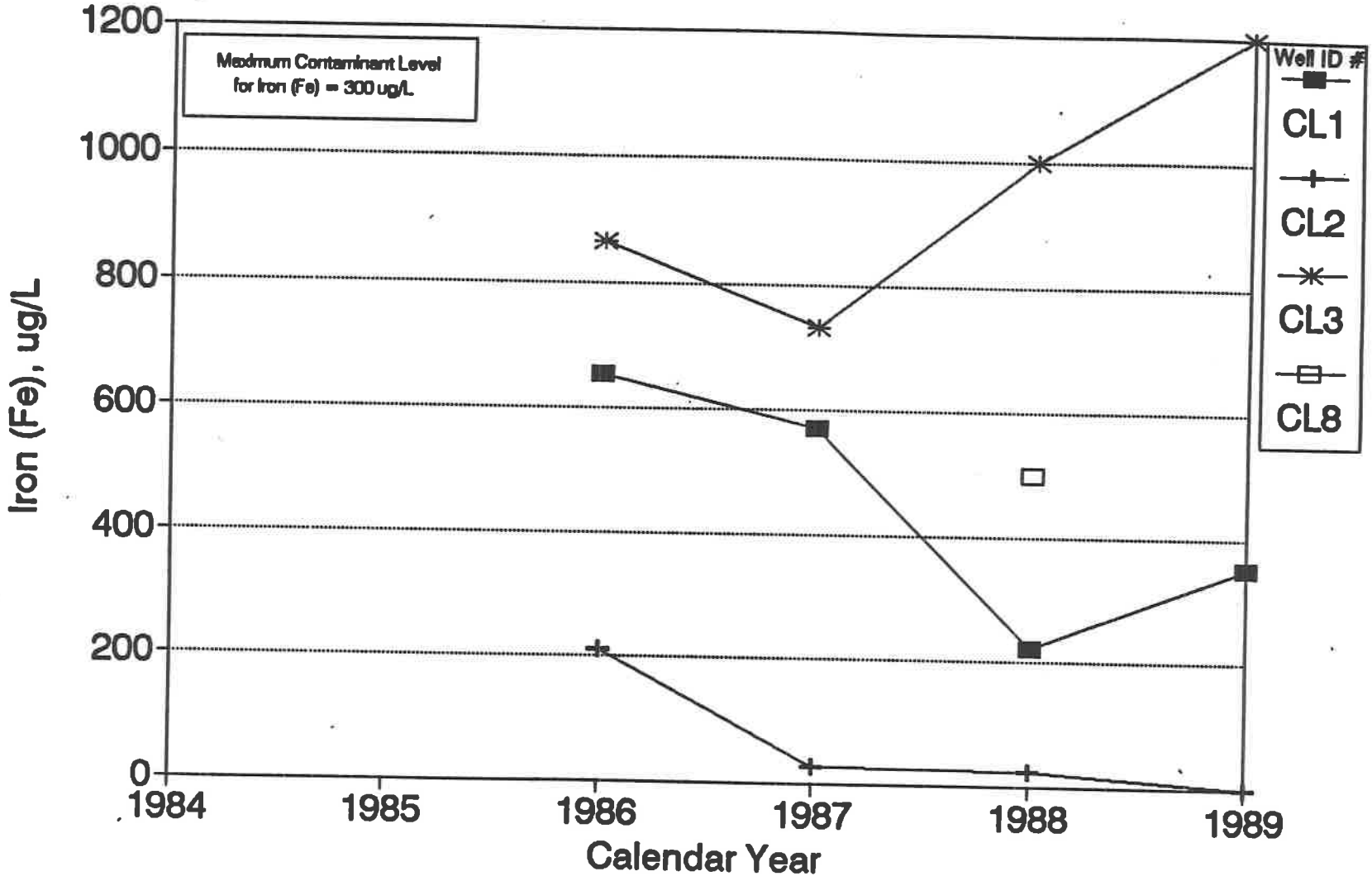


Figure 3-12. - Iron concentrations in selected wells in the Claiborne aquifer.

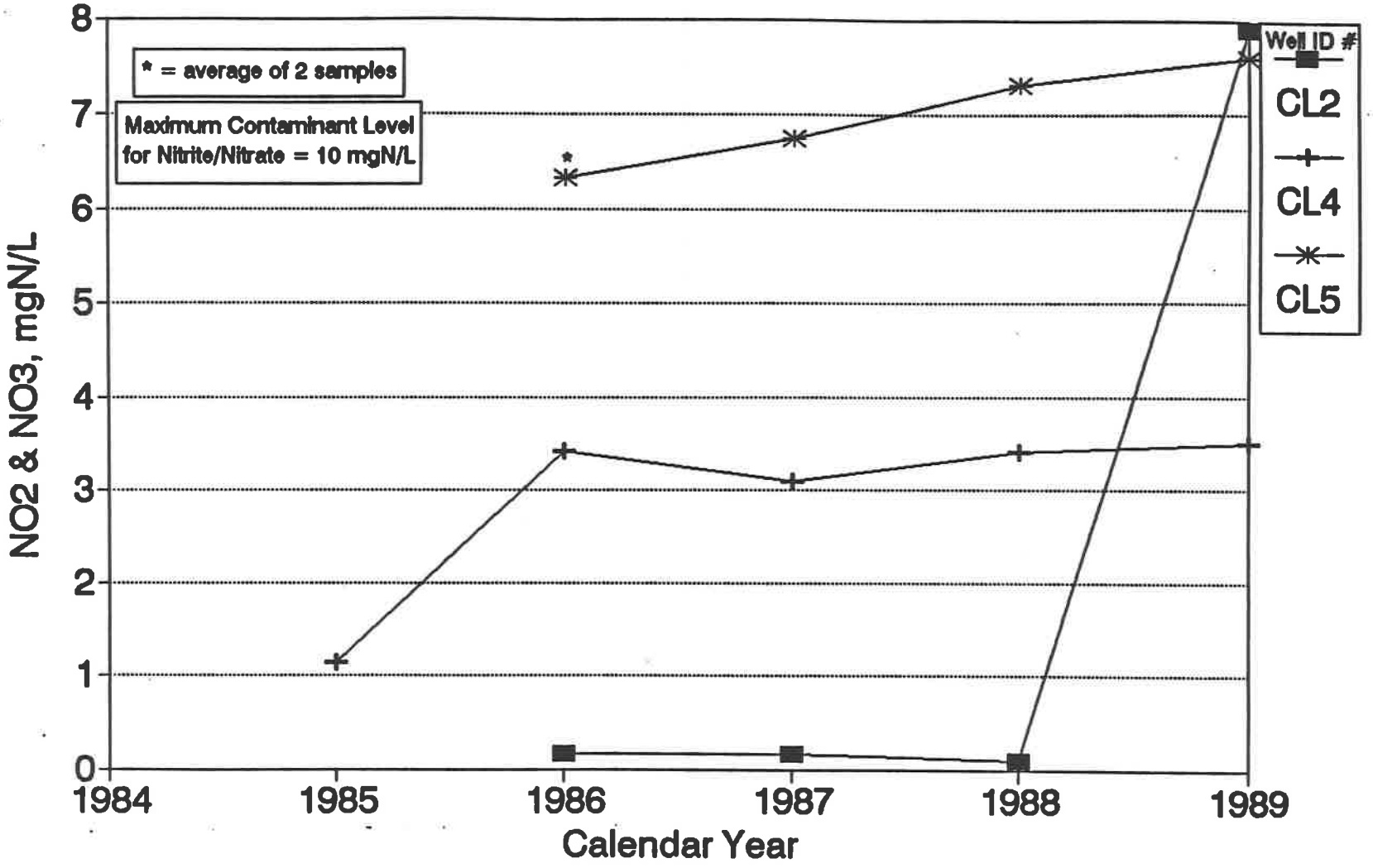


Figure 3-13. - Nitrite/nitrate concentrations in selected wells in the Claiborne aquifer.

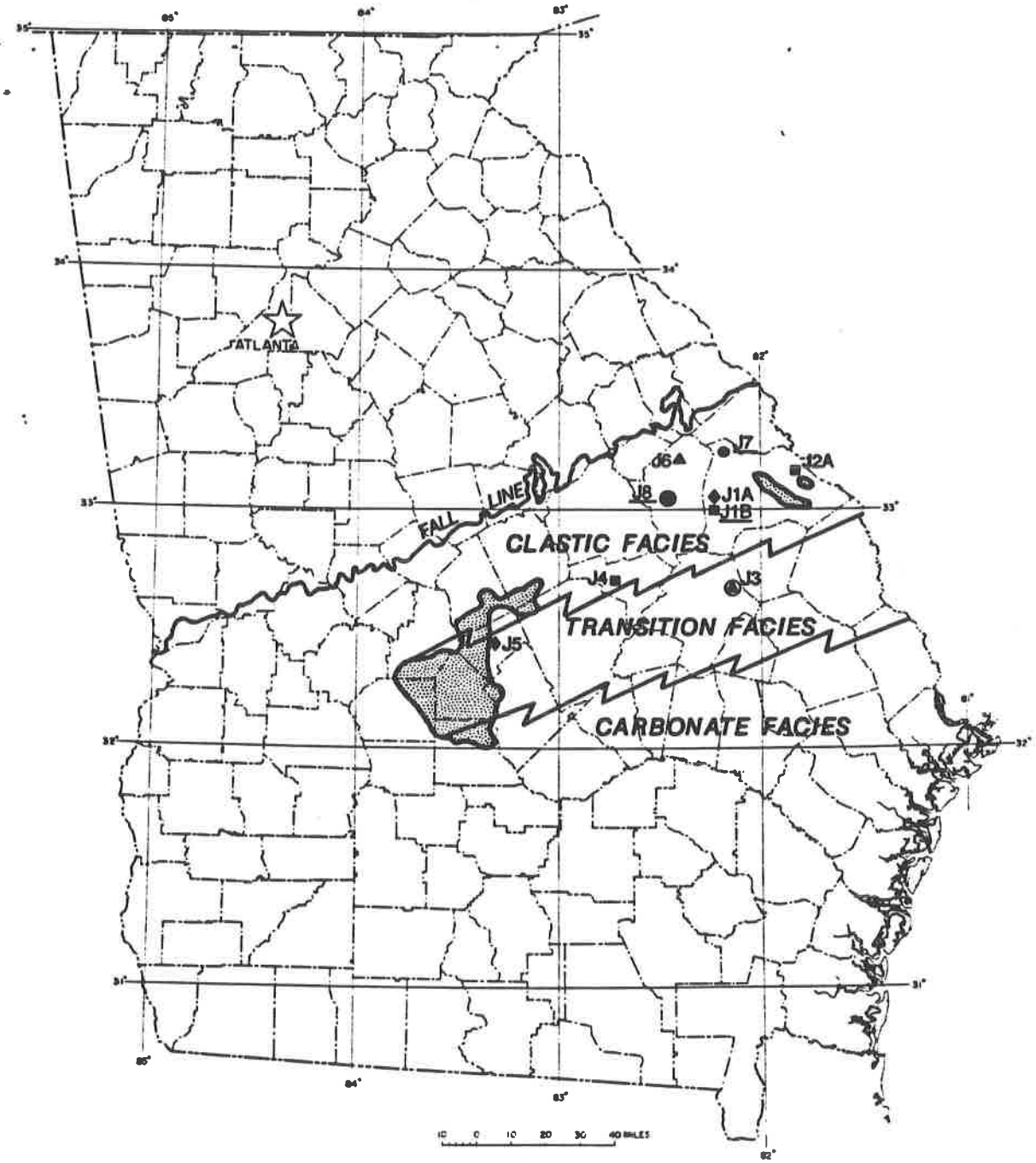
JACKSONIAN AQUIFER SYSTEM

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 3-14). 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 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 seven wells in the clastic facies and two wells in the transition facies. Two of the clastic facies wells, located in Burke and Jefferson Counties, were sampled for the first time in 1989. Water from the aquifer system was generally basic and varied from soft to very hard. Iron levels in all samples were below the Secondary Maximum Contaminant Level for drinking water. Manganese exceeded drinking water limits in water from one transition-facies well in Emanuel County and one clastic-facies well in Jefferson County. Figure 3-4 shows trends in concentration for wells that have historically yielded water high in manganese. Water from one well in Jefferson County exceeded Primary Maximum Contaminant Levels for silver. High levels of silver can lead to a condition known as argyria, with symptoms including discoloration of the skin and mucous membranes. The major alkali metals and aluminum, antimony, barium, bismuth, cobalt, copper, gold, molybdenum, strontium, tin, vanadium and zinc were the other common cations.

Chloride and sulfate levels were 11 parts per million or less in all samples. Nitrite/nitrate concentrations ranged from below detection limits up to 0.34 parts per million in the water samples from six of the wells. Two clastic-facies wells in Burke County contained 2.1 and 2.3 parts per million nitrite/nitrate. These concentrations are within the

range of previous measurements from wells in the same area. The new monitoring station in Jefferson County yielded water containing 7.1 parts per million nitrite/nitrate, the highest level yet measured from a Monitoring Network station in the Jacksonian aquifer. Figure 3-15 summarizes trends in nitrite/nitrate levels for the Jacksonian aquifer.



- Manganese concentrations exceed drinking-water limits
- Nitrite/nitrate concentrations exceed 0.45 parts per million
- Soft water
- Moderately hard water
- Hard water
- Very hard
- General recharge area (from Davis, et al., 1988)
- Facies boundary (from Vincent, 1982)

Figure 3-14. - Water quality of the Jacksonian aquifer system.

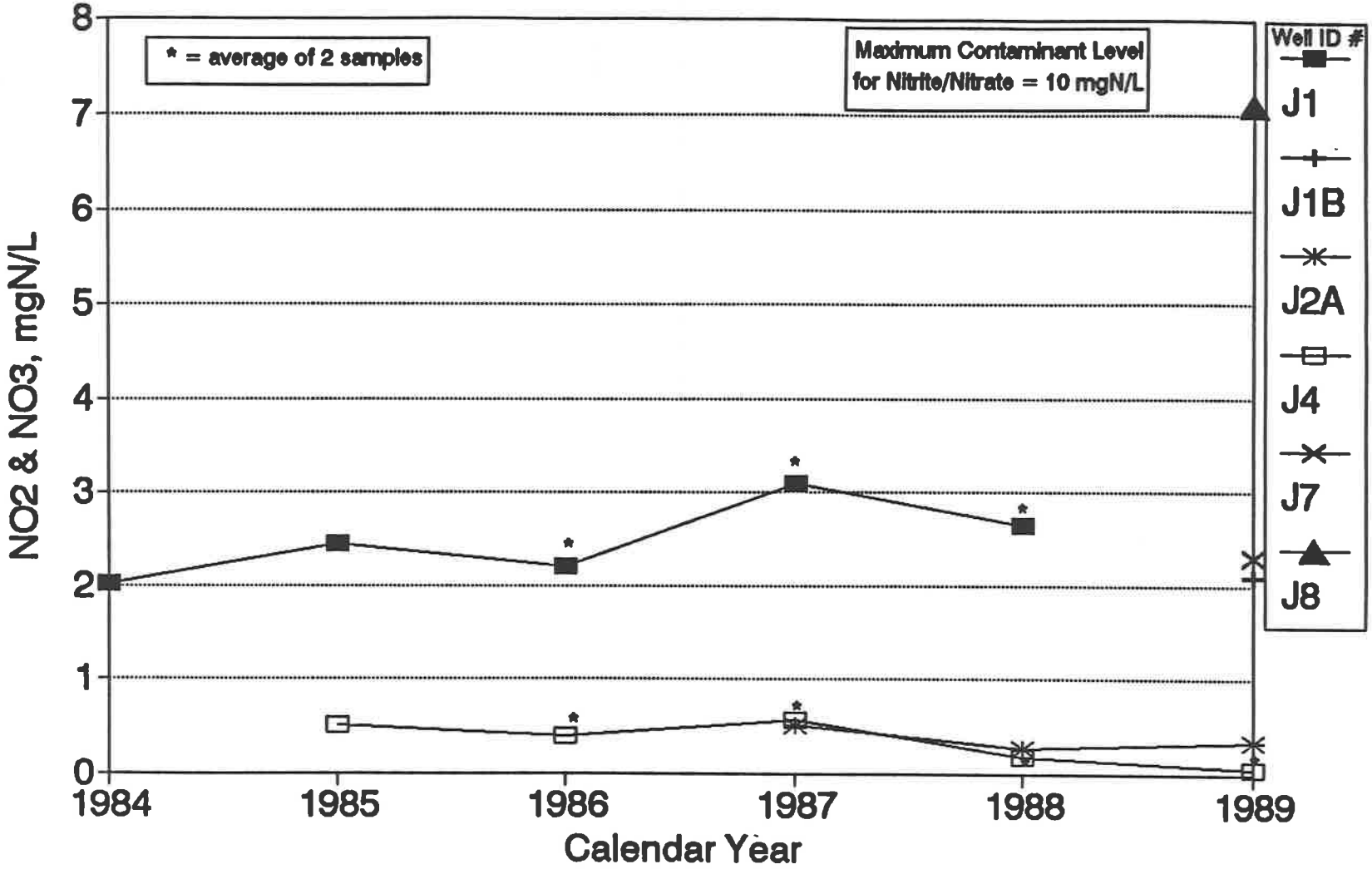


Figure 3-15. - Nitrite/nitrate concentrations in selected wells in the Jacksonian aquifer.

FLORIDAN AQUIFER SYSTEM

The Floridan aquifer system, formerly known as the Principal Artesian aquifer system, consists of Eocene and Oligocene limestones and dolostones that underlie most of the Coastal Plain Province (Figure 3-1). 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. There are 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 southwestern Georgia) and in adjacent areas along strike to the northeast (Figure 3-16). 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).

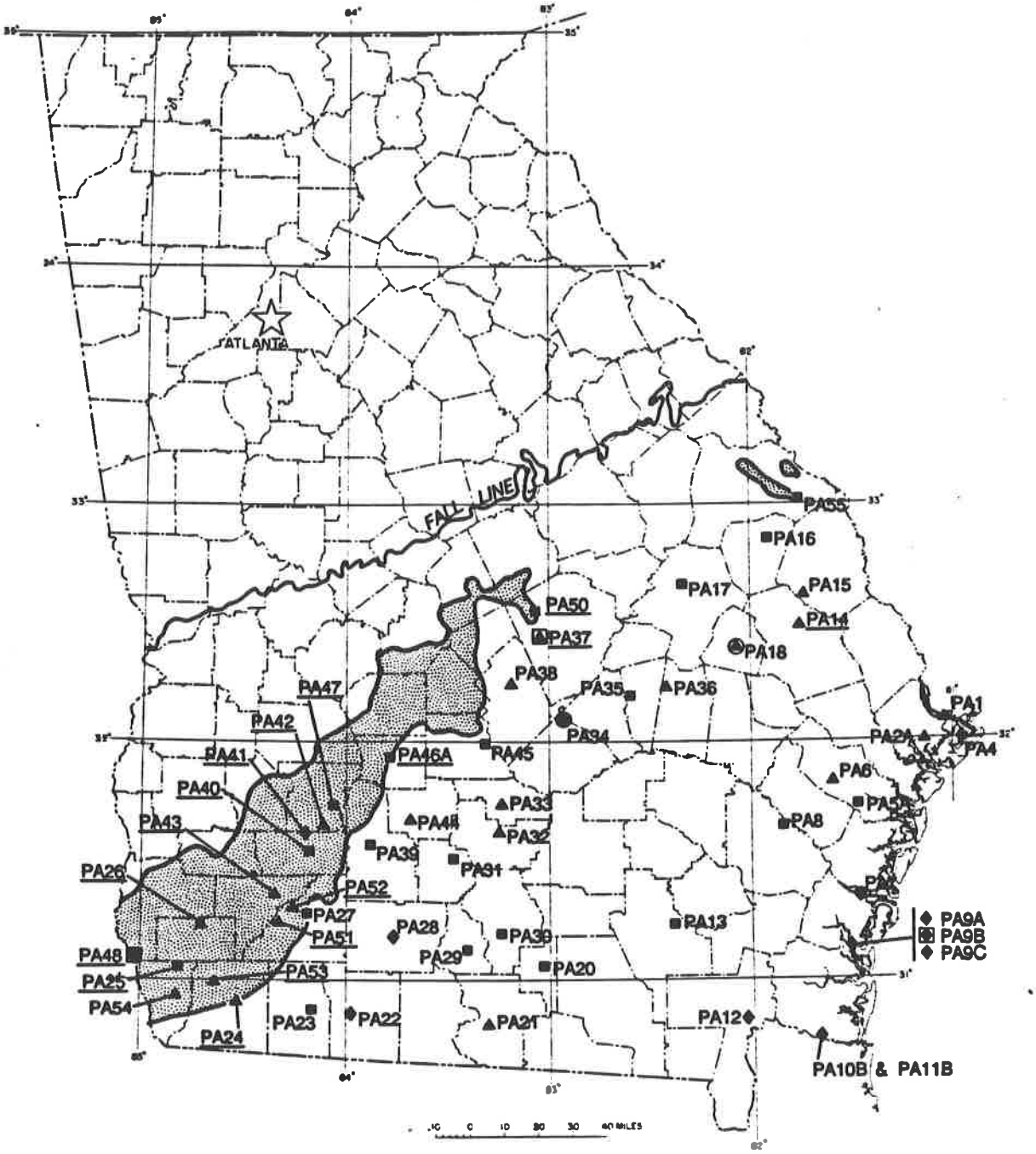
Ground-water samples were collected from 54 wells completed in the Floridan aquifer system. Six wells that are located in recharge areas of the Floridan were sampled for the first time in 1989. All of the water samples were neutral to basic and moderately hard to very hard. Iron and manganese exceeded drinking-water limits in water from only six wells. Trends in iron and manganese levels in selected wells screened in the Floridan aquifer are shown in Figures 3-17 and 3-18. Aluminum, barium, bismuth, cobalt, gold, molybdenum, strontium, tin, vanadium and zinc were other common trace metals, with copper, silver and titanium occurring less frequently. Barium levels in water samples from a well in Fitzgerald, Ben Hill County, exceeded the drinking-water maximum. Silver was detected above the Primary Maximum Contaminant Level in an outcrop-area well in Burke County.

Chloride and sulfate concentrations in the water samples commonly were below 10 parts per million. Chloride and sulfate levels were highest (90.2 and 168.1 parts per million, respectively) in water from a Brunswick, Glynn County monitoring well. Concentrations of sulfate were highest (49 to 168.1 parts per million) in water samples from the Glynn County well and in fourteen wells located within and south of the Gulf Trough.

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 0.08 to 6.06 parts per million. Nitrite/nitrate was also detected in two wells located in the up-dip, confined portion of the aquifer. One of these wells, located in Bulloch County, yielded water containing 6.0 parts per million nitrite/nitrate. When previously sampled in 1988, water from this well contained only 0.03 parts per million nitrite/nitrate. Most of the wells in the down-dip, confined portion of the Floridan aquifer did not contain detectable levels of nitrite/nitrate. Trends in nitrite/nitrate

levels in selected wells in the Floridan Aquifer are presented in Figures 3-19a and b.

Organic compounds were detected in water samples from three wells screened in the Floridan Aquifer. Bis (2-ethylhexyl) phthalate was detected in two wells located in Chatham and Lowndes Counties. Samples from these wells contained 127 and 38.6 parts per billion bis (2-ethylhexyl) phthalate, respectively. This compound is a common component of lubricating oils, frequently used in pumps. It is possible that this contamination may be coming from the lubricants used on the pump, and therefore may not actually be present in the aquifer itself. Water from a shallow monitoring well in Albany, Dougherty County, continued to contain traces of volatile organic compounds. Tetrachloroethylene was detected in a sample from this well at a level of 1.5 parts per billion (Figure 3-8).



□ Iron concentrations exceed drinking-water limits
○ Manganese concentrations exceed drinking-water limits
PA25 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 3-16. - Water quality of the Floridan aquifer system.

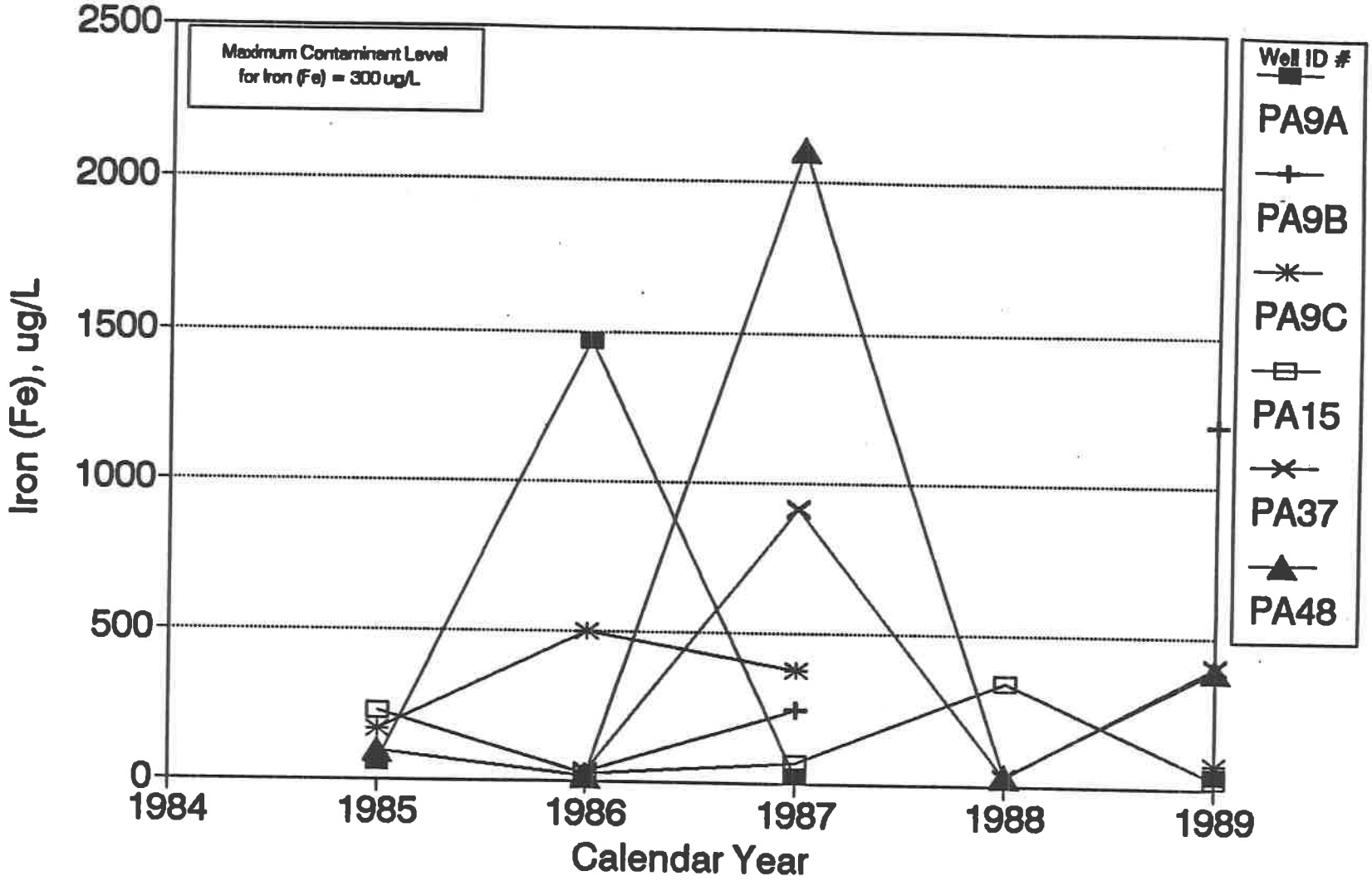


Figure 3-17. - Iron concentrations in selected wells by the Fl

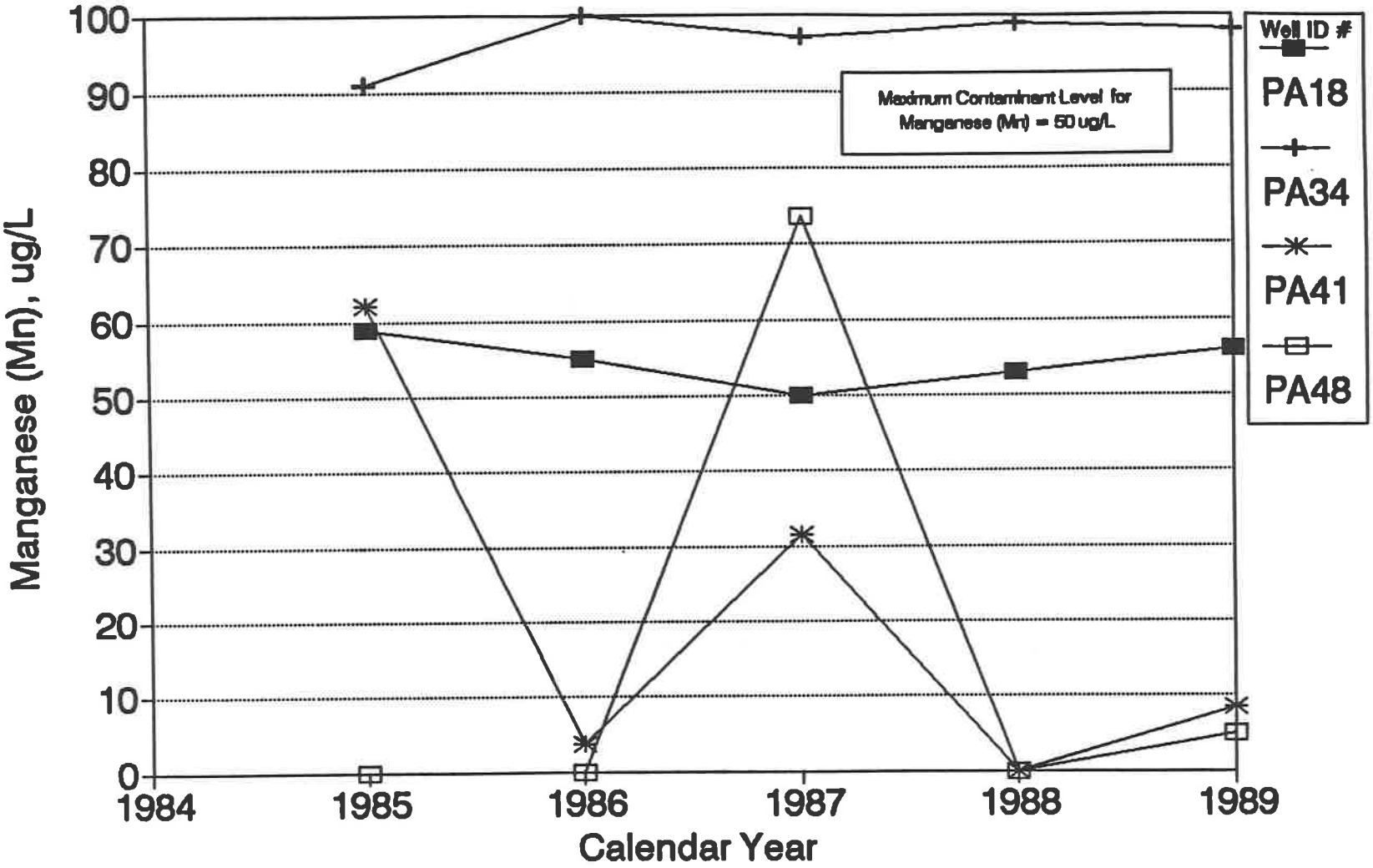


Figure 3-18. - Manganese concentrations in selected wells in the Floridan aquifer.

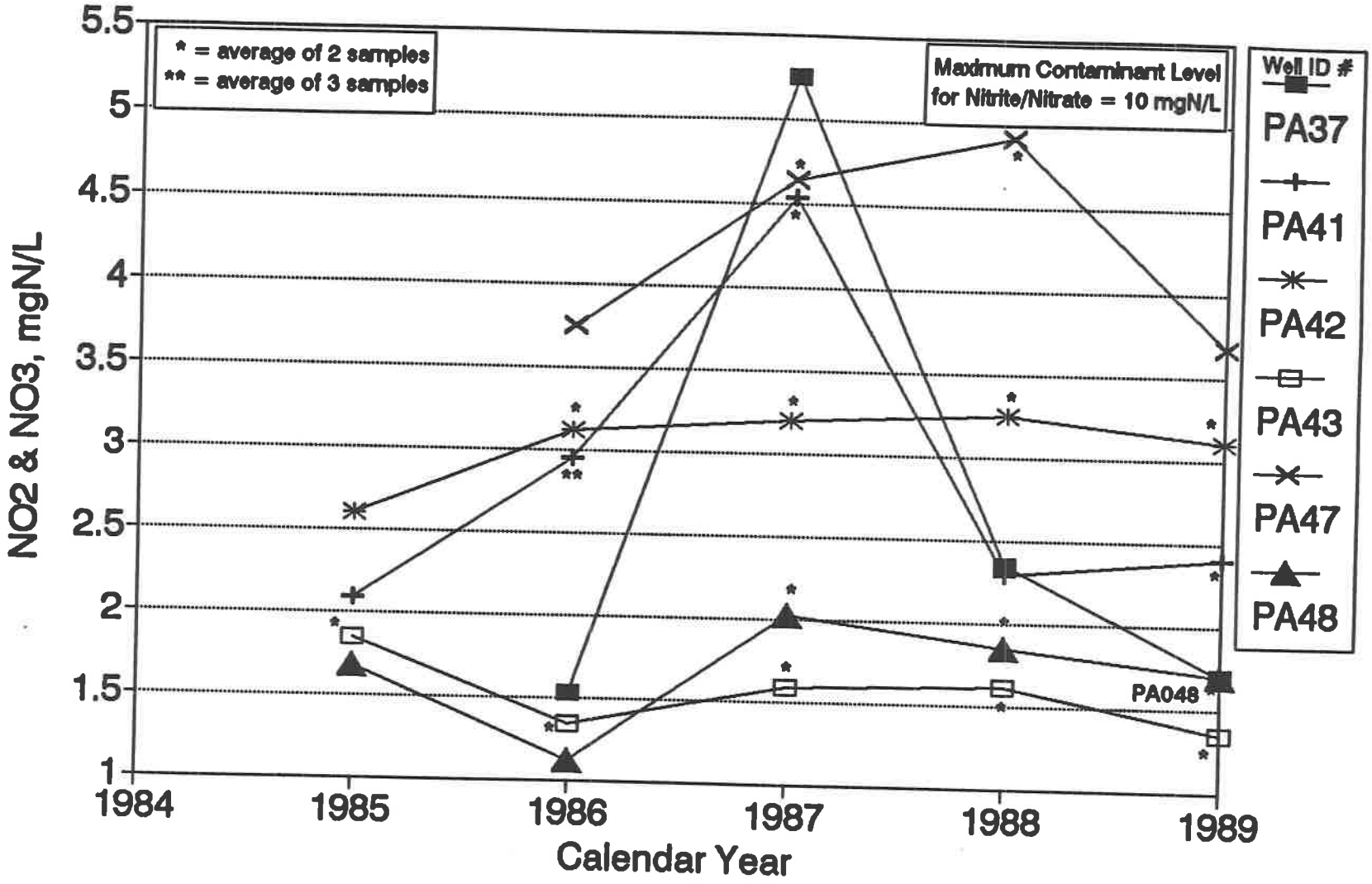


Figure 3-19a. - Nitrite/nitrate concentrations in selected wells in the Floridan aquifer.

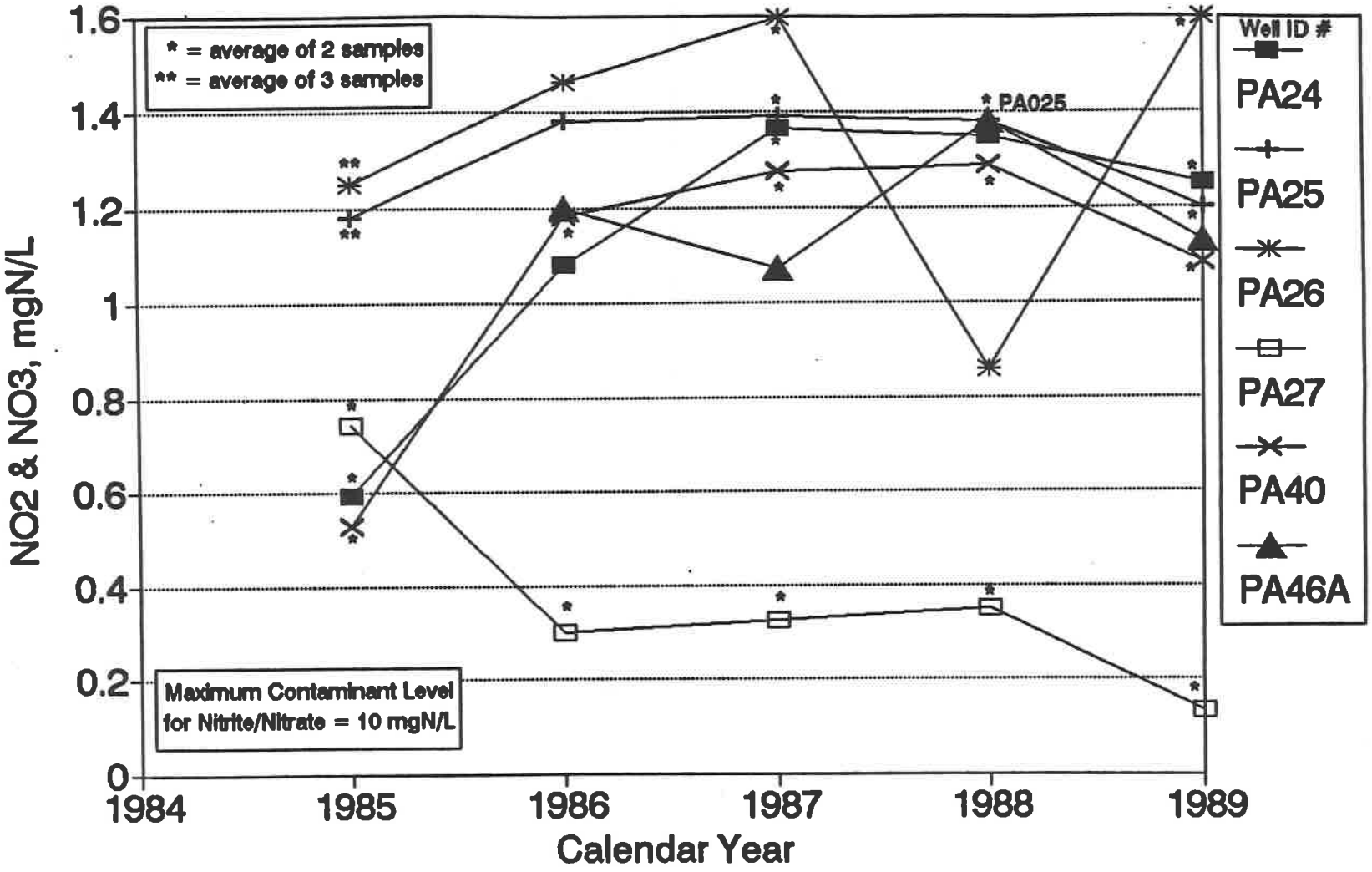


Figure 3-19b. - Nitrite/nitrate concentrations in selected wells in the Floridan aquifer (continued).

MIOCENE AQUIFER SYSTEM

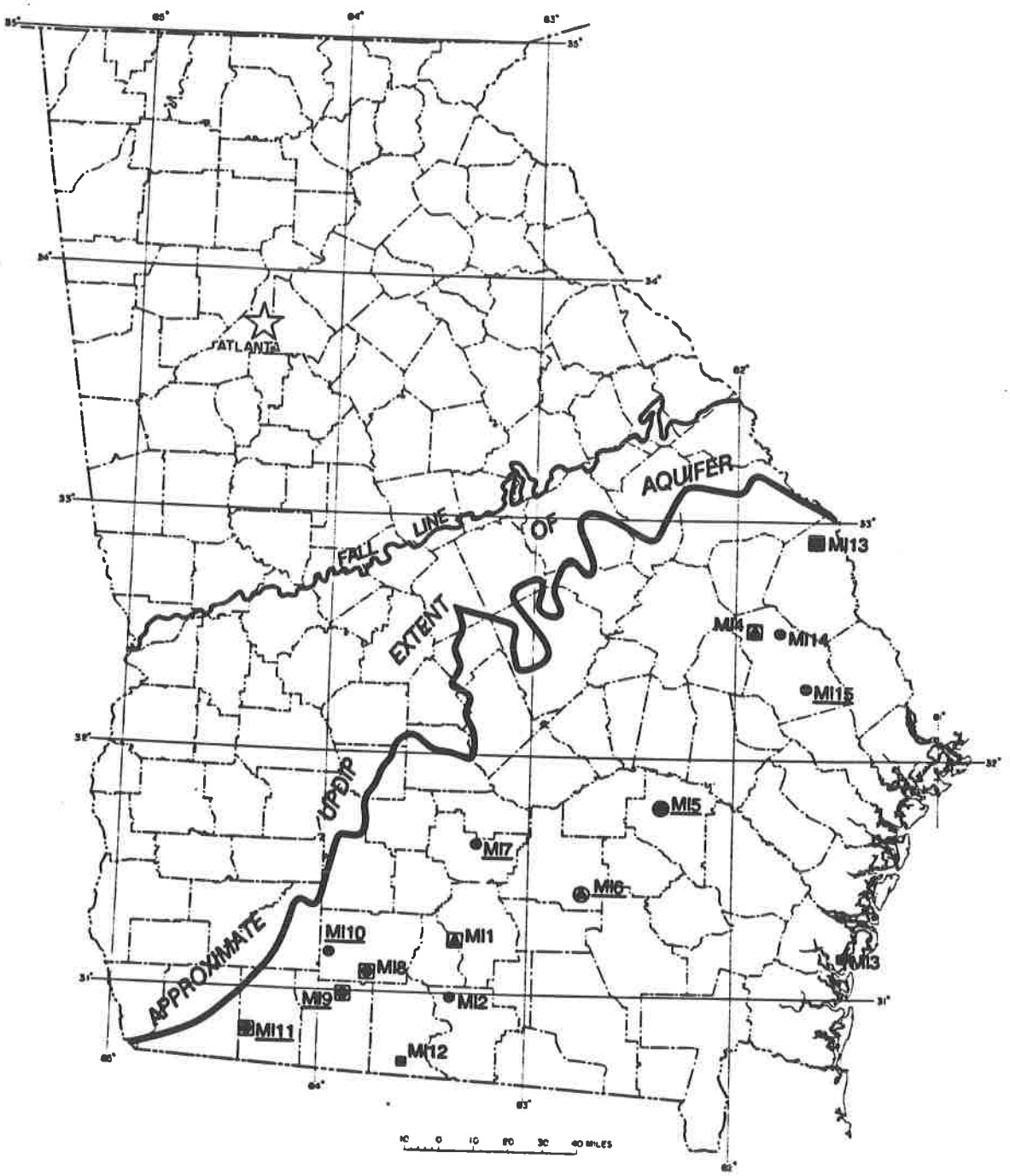
Much of south-central and southeastern Georgia lies within outcrop areas of the Miocene Altamaha Formation and Hawthorne Group (Figure 3-8). Discontinuous lens-shaped bodies of sand, 50 to 80 feet thick, are the main permeable units. Miocene clays and sandy clays are thickest, more than 500 feet, in Wayne County (Watson, 1982).

Areas of confinement exist along the coast and locally in Grady, Thomas, Brooks and Lowndes 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 et al. (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 fifteen wells, eleven of which were first sampled in 1989. Water samples varied from acidic to basic, with pH values ranging between 4.3 to 8.1 (standard pH units). Most of the water samples were soft to moderately hard, but wells in Brooks, Glynn and Screven Counties yielded hard water. Water samples from six wells in Bulloch, Colquitt, Cook, Screven and Thomas Counties contained iron at concentrations in excess of acceptable drinking water limits (Figure 3-21). Manganese was detected above Secondary Maximum Contaminant Levels in water from four wells in Appling, Bulloch, Coffee and Screven Counties (Figure 3-22). Aluminum, barium, strontium, titanium, zinc and the major alkali metals were other commonly detected cations in the Miocene aquifer system water samples. Bismuth, Copper, and tin were less commonly detected trace metals.

Chloride levels were less than 25 parts per million in all of the samples analyzed. The highest chloride levels (over 20 parts per million) were recorded from stations in Colquitt, Glynn and Thomas Counties. Sulfate levels were highest (38.9 parts per million) in a Glynn County well, but were 4 parts per million or less in all of the other wells. Detectable levels of nitrite/nitrate, ranging from 0.05 to

14.70 parts per million, were found in eight of the fifteen wells sampled. All eight of these wells were sampled for the first time in 1989. A residential well in Bulloch County contained 14.7 parts per million of nitrite/nitrate. This is the first Monitoring Network well to exceed drinking water limits for nitrite/ nitrate (Figure 3-23).



□ Iron concentrations exceed drinking-water limits
○ Manganese concentrations exceed drinking-water limits
□ Iron and manganese concentrations exceed drinking-water limits
MI7 Nitrite/nitrate concentrations exceed 0.45 parts per million
● Soft water
▲ Moderately hard water
■ Hard water

Figure 3-20. - Water quality of the Miocene aquifer system.

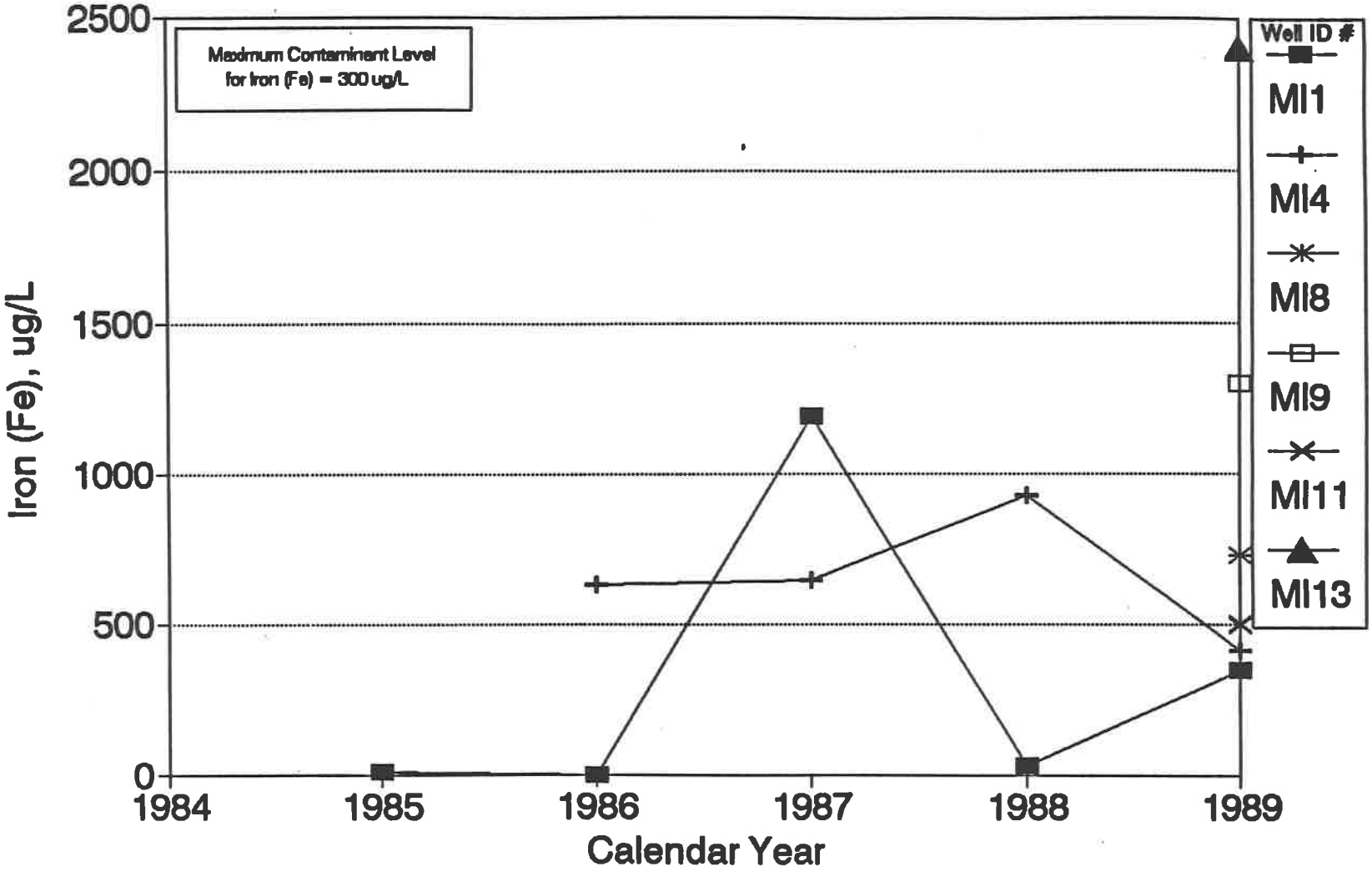


Figure 3-21. - Iron concentrations in selected wells in the Miocene aquifer.

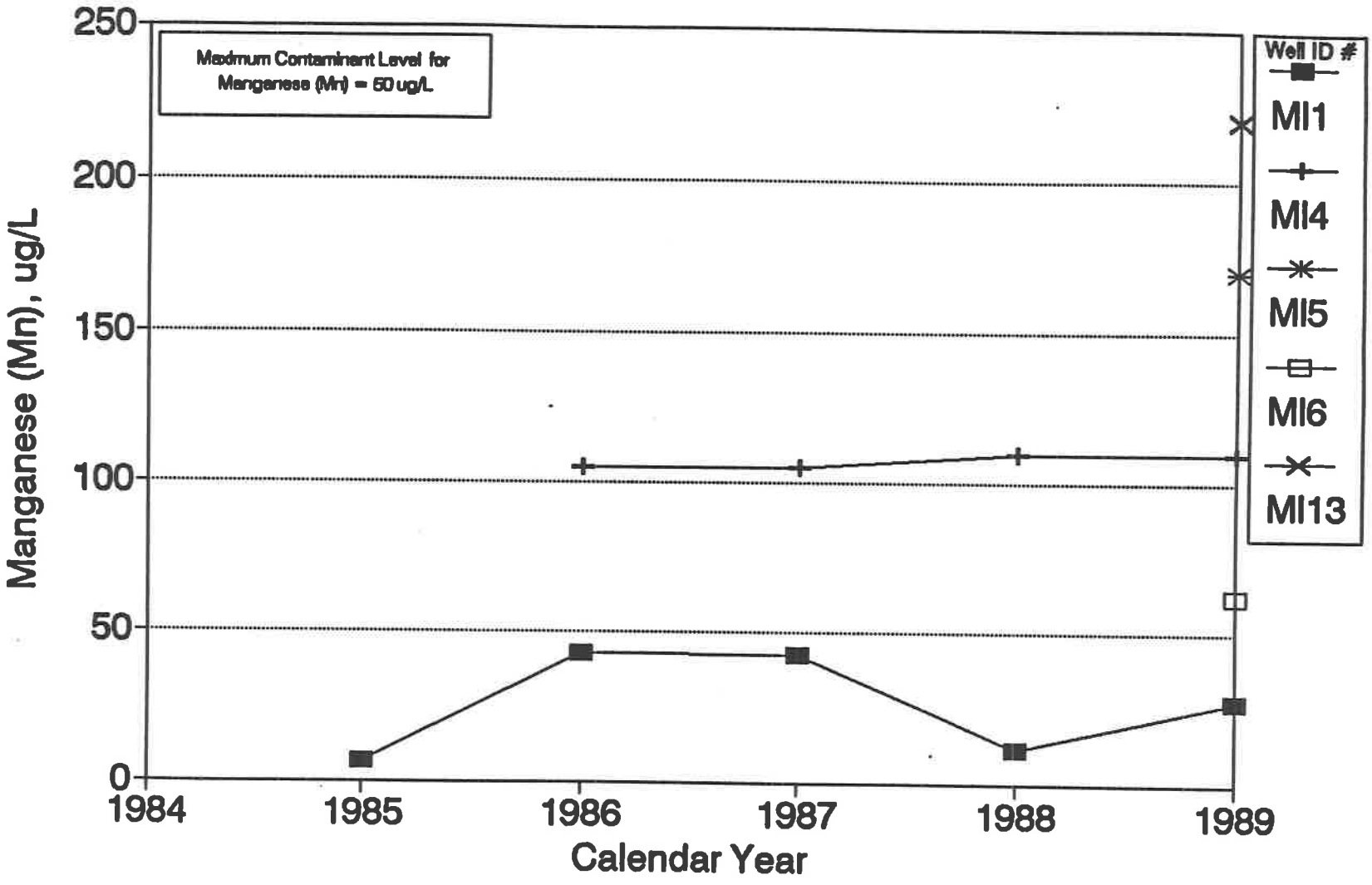


Figure 3-22. - Manganese concentrations in selected wells in the Miocene aquifer.

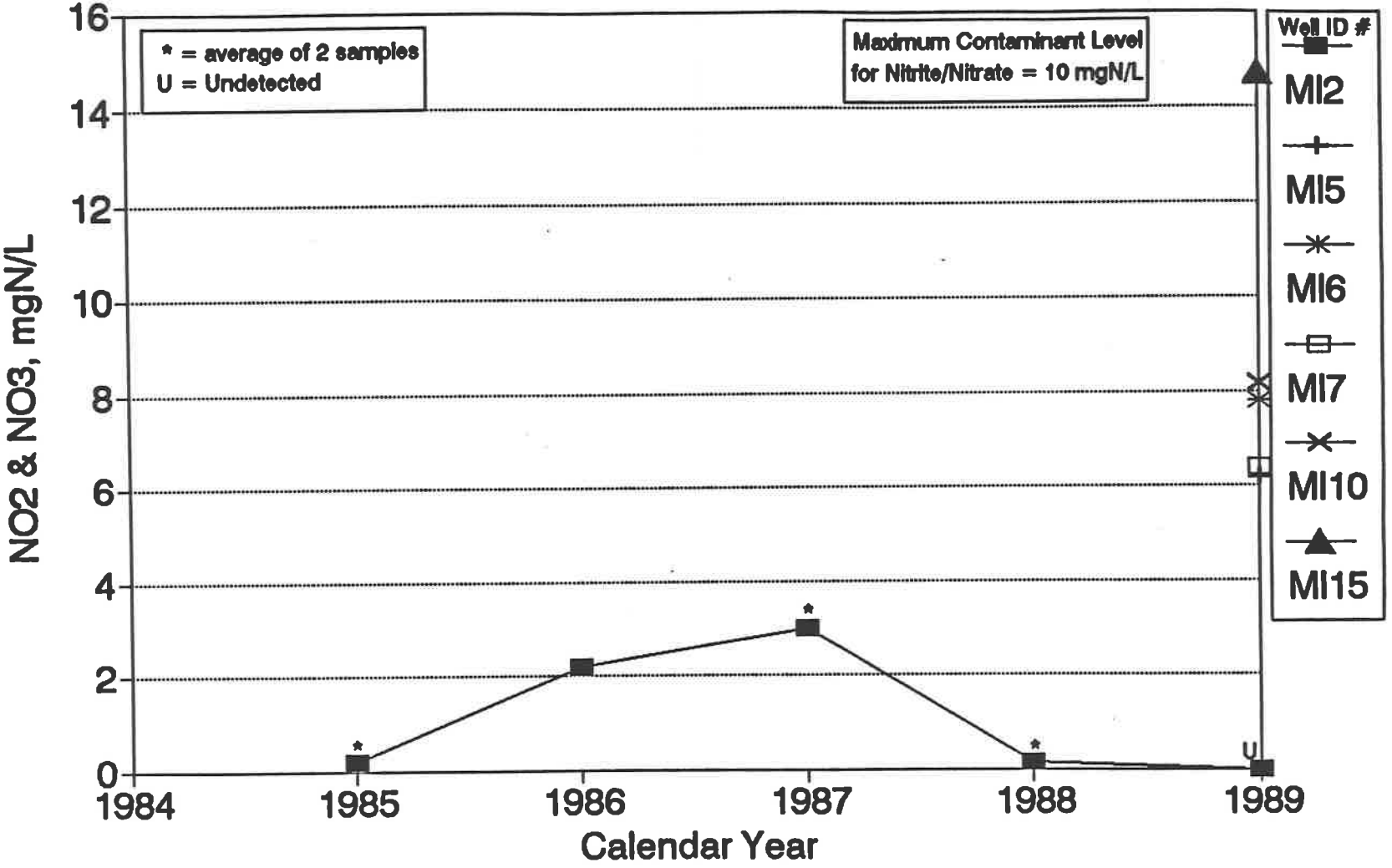


Figure 3-23. - Nitrite/nitrate concentrations in selected wells in the Miocene aquifer.

PIEDMONT/BLUE RIDGE UNCONFINED AQUIFERS

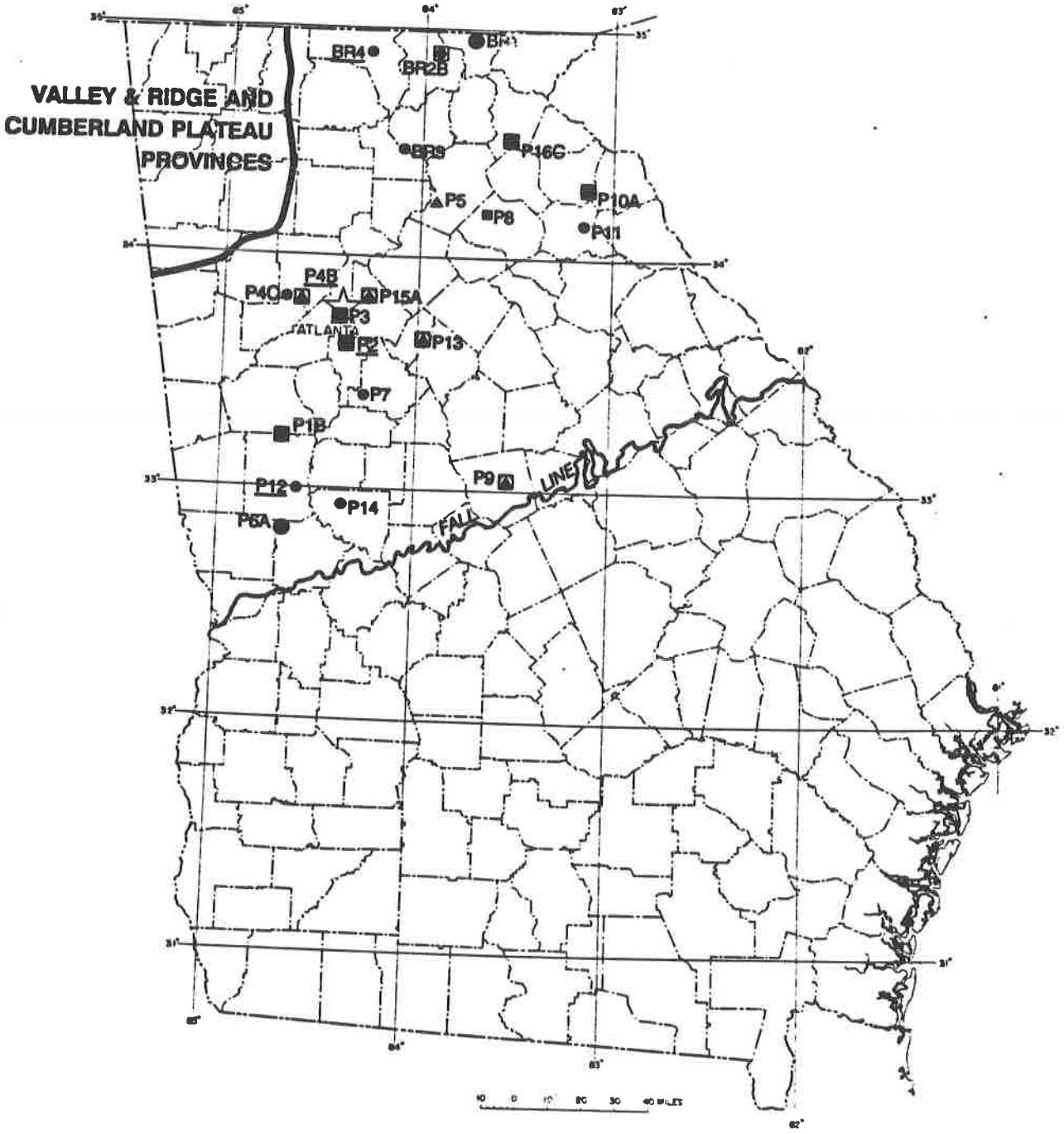
Georgia's Piedmont and Blue Ridge Physiographic Provinces are developed on metamorphic and igneous rocks that are predominately Precambrian and Paleozoic in age. Soil and saprolite horizons, compositional layers and openings along fractures and joints in the rocks are the major water-bearing features. 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 seventeen wells in the Piedmont Province and four wells in the Blue Ridge Province (Figure 3-9). Water from wells in the crystalline-rock aquifers was generally non-corrosive and soft to moderately hard, although one Piedmont well in Jackson County yielded hard water. Iron and manganese levels exceeded drinking-water limits in water samples from eleven of the Piedmont wells and two of the Blue Ridge wells (Figures 3-25a and b, 3-26a and b, 3-27 and 3-28). Aluminum, barium, bismuth, strontium and zinc were common trace metal constituents. Less commonly detected trace metals included antimony, cobalt, gold, molybdenum, nickel, silver, thallium, tin, titanium, vanadium and zirconium. A Piedmont well in Riverdale, Clayton County, exceeded Secondary Maximum Contaminant Levels for silver. Analysis of a water sample taken from a Franklin County (Piedmont) well detected thallium (a highly toxic metal) at a level of 94 parts per billion. The same sample also contained 30,000 parts per billion iron. Because excessive amounts of iron in a sample can result in spurious estimates of thallium content, this analysis for thallium may not be valid. Subsequent water samples collected from this well have not contained detectable levels of thallium.

Chloride and sulfate concentrations in the water samples were typically below 20 parts per million. Nitrite/nitrate was present in water from five of the wells (Figure 3-29). Four of these wells yielded water with nitrite/nitrate levels greater than 0.45 parts per million. The highest concentration measured was 3.2 parts per million. For most

monitoring stations, nitrite/nitrate concentrations monitored in 1989 were approximately the same as levels reported in samples collected during 1988 from the same wells. One Blue Ridge well showed an increase in nitrite/nitrate from below detection limits in 1988 to 1.9 parts per million in 1989.

Traces of volatile organic compounds continued to be detected in samples from wells in Fulton and Rockdale Counties. Water samples collected in April and October of 1989 from a monitoring well at Fort McPherson, Fulton County, contained ethylbenzene and P, M, and O xylenes. Other organic compounds, including trimethyl benzene, ethylmethyl benzene, 1,2 dichloropropane and toluene, were detected from the same well in October, but were not detected in April. An unused well in Conyers, Rockdale County, yielded water containing tetrachloroethylene at a concentration of 7.8 parts per billion (Figure 3-8) and 1.6 parts per billion trichloroethylene.



□ Iron concentrations exceed drinking-water limits
○ Manganese concentrations exceed drinking-water limits
□ Iron and manganese concentrations exceed drinking-water limits
P12 Nitrite/nitrate concentrations exceed 0.45 parts per million
• Soft water
▲ Moderately hard water
■ Hard water

Figure 3-24. - Water quality of the Piedmont/Blue Ridge unconfined aquifers.

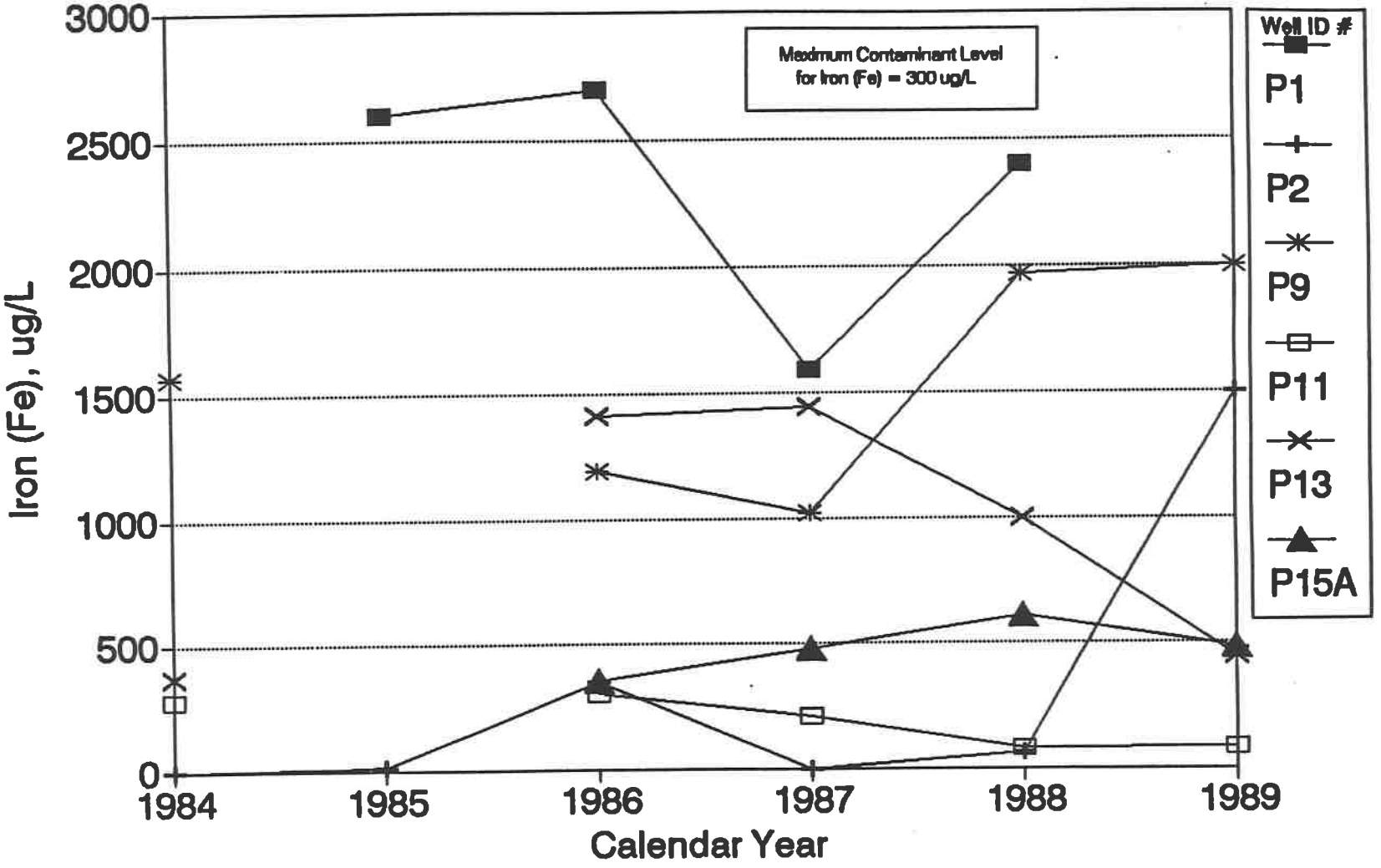


Figure 3-25a. - Iron concentrations in selected wells in the Piedmont aquifer.

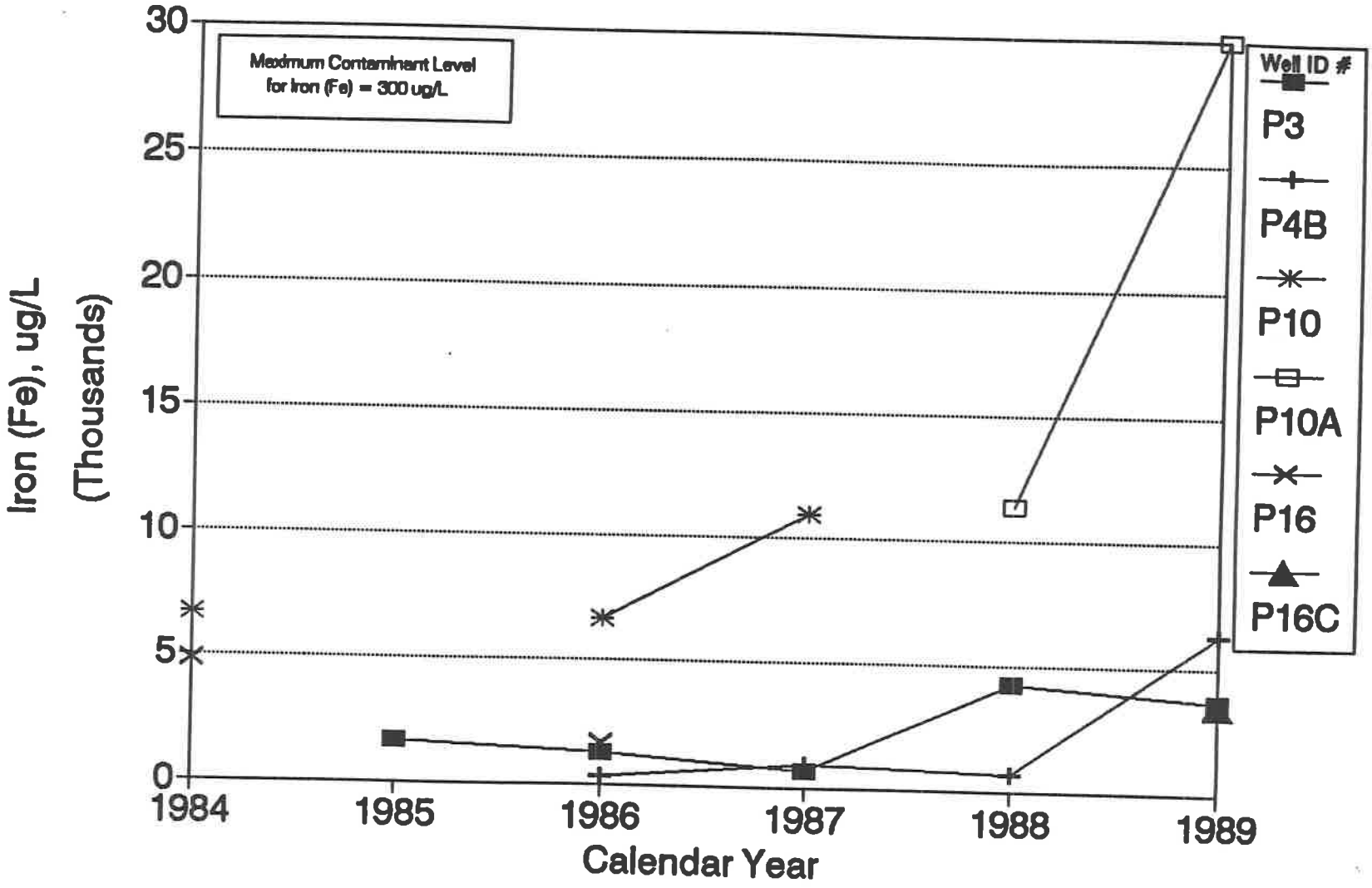


Figure 3-25b. - Iron concentrations in selected wells in the Piedmont aquifer (continued).

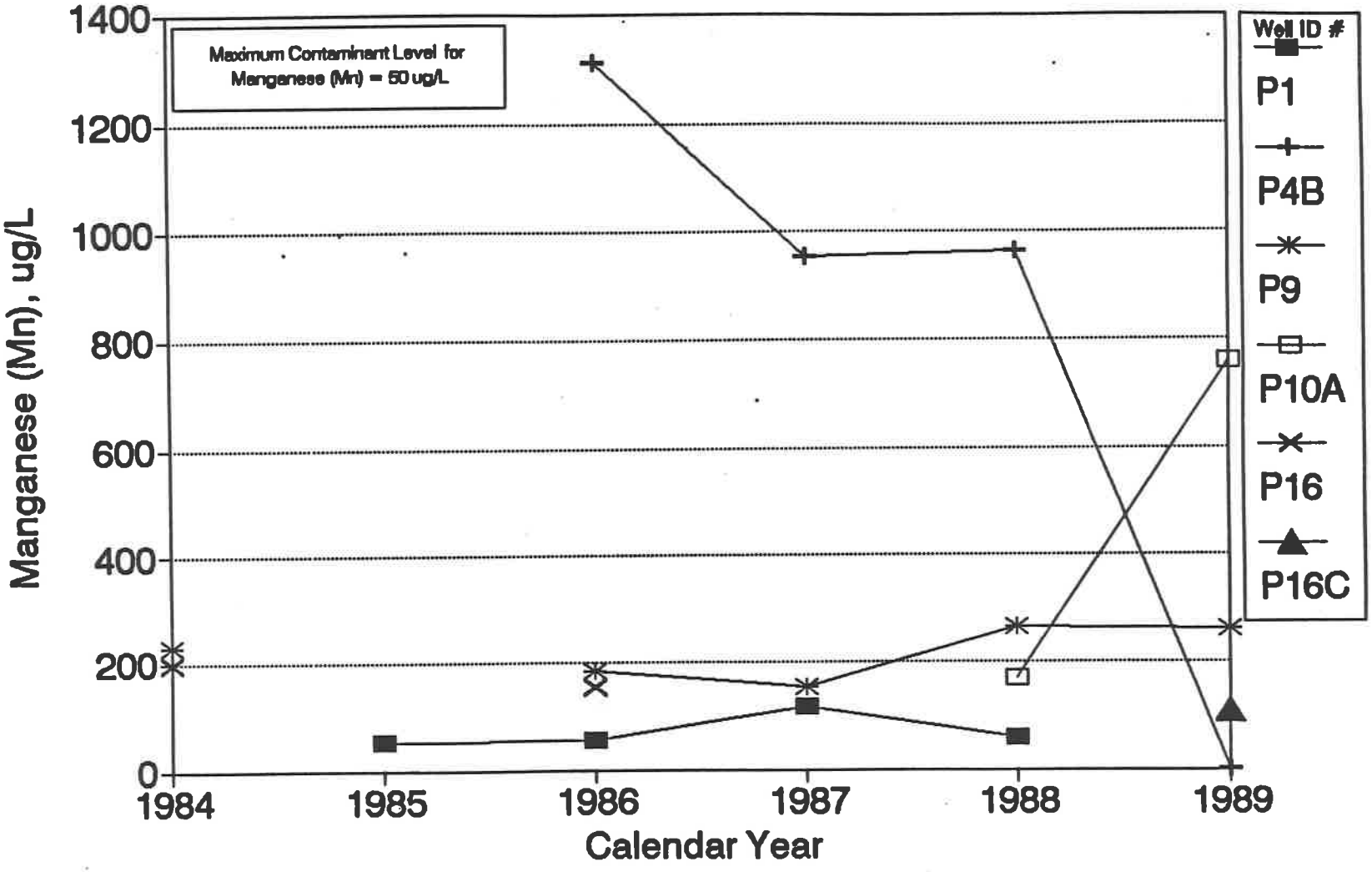


Figure 3-26a. - Manganese concentrations in selected wells in the Piedmont aquifer.

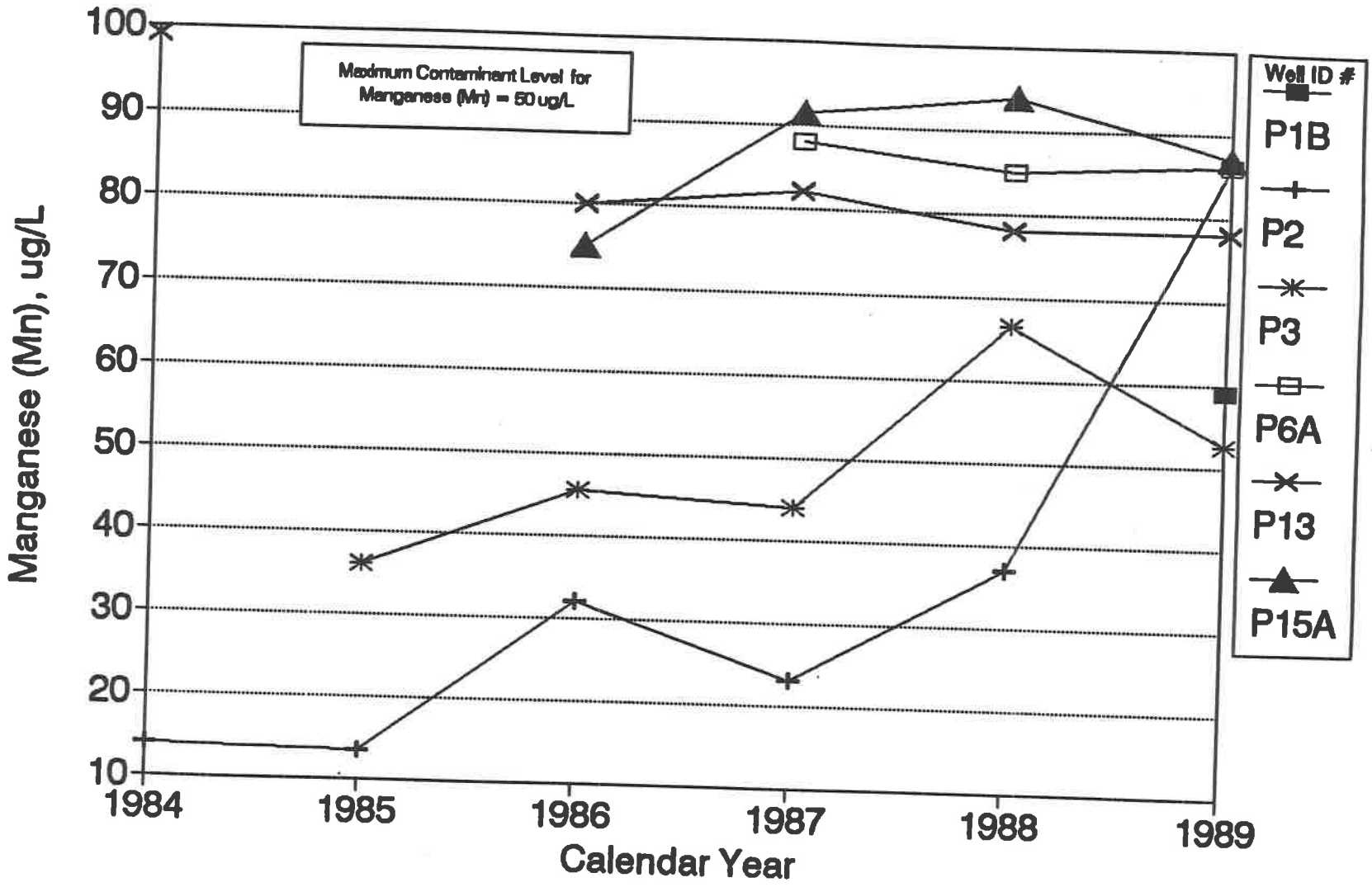


Figure 3-26b. - Manganese concentrations in selected wells in the Piedmont aquifer (continued).

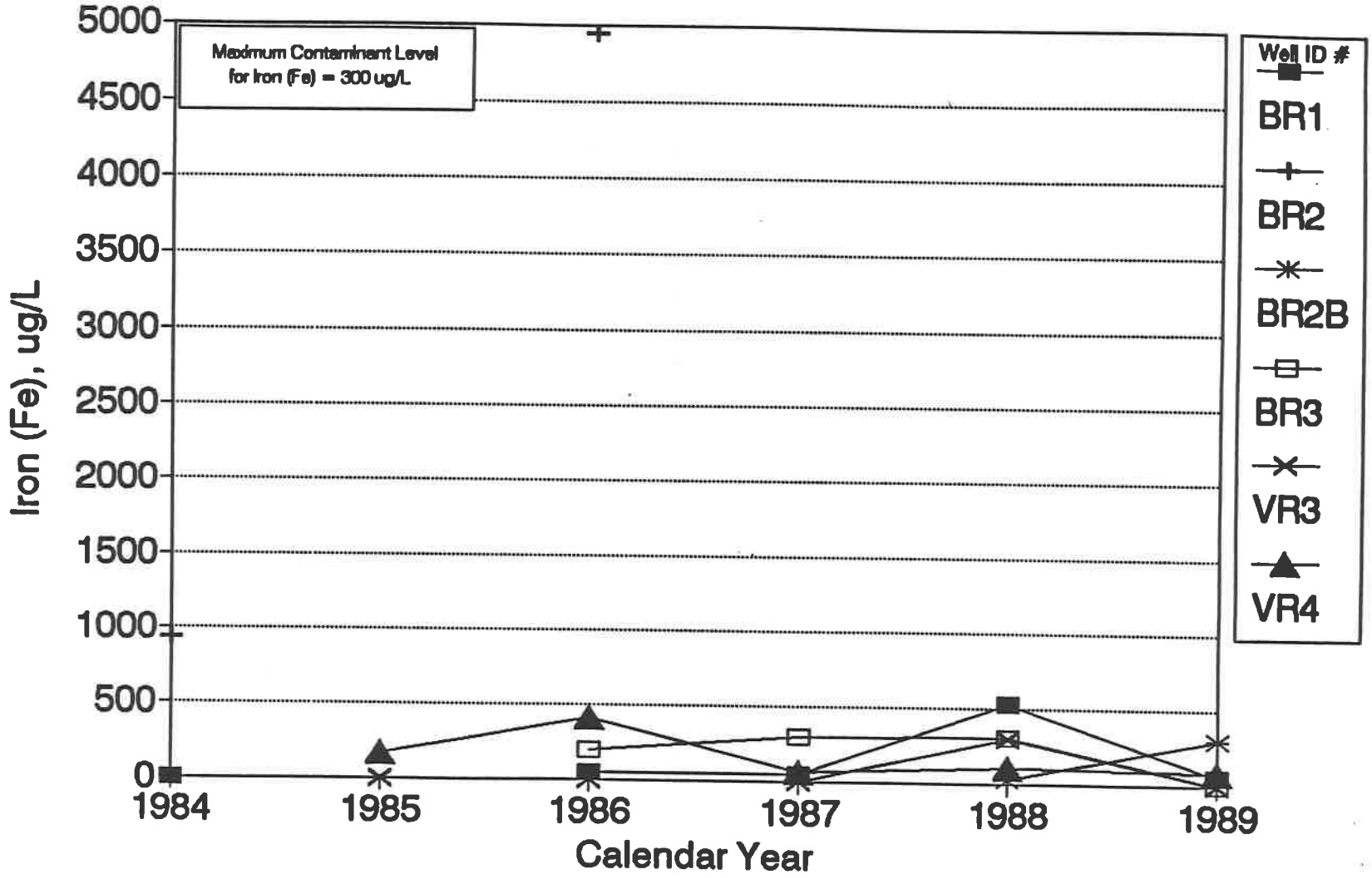


Figure 3-27. - Iron concentrations in selected wells and springs in the Blue Ridge and Valley & Ridge aquifers.

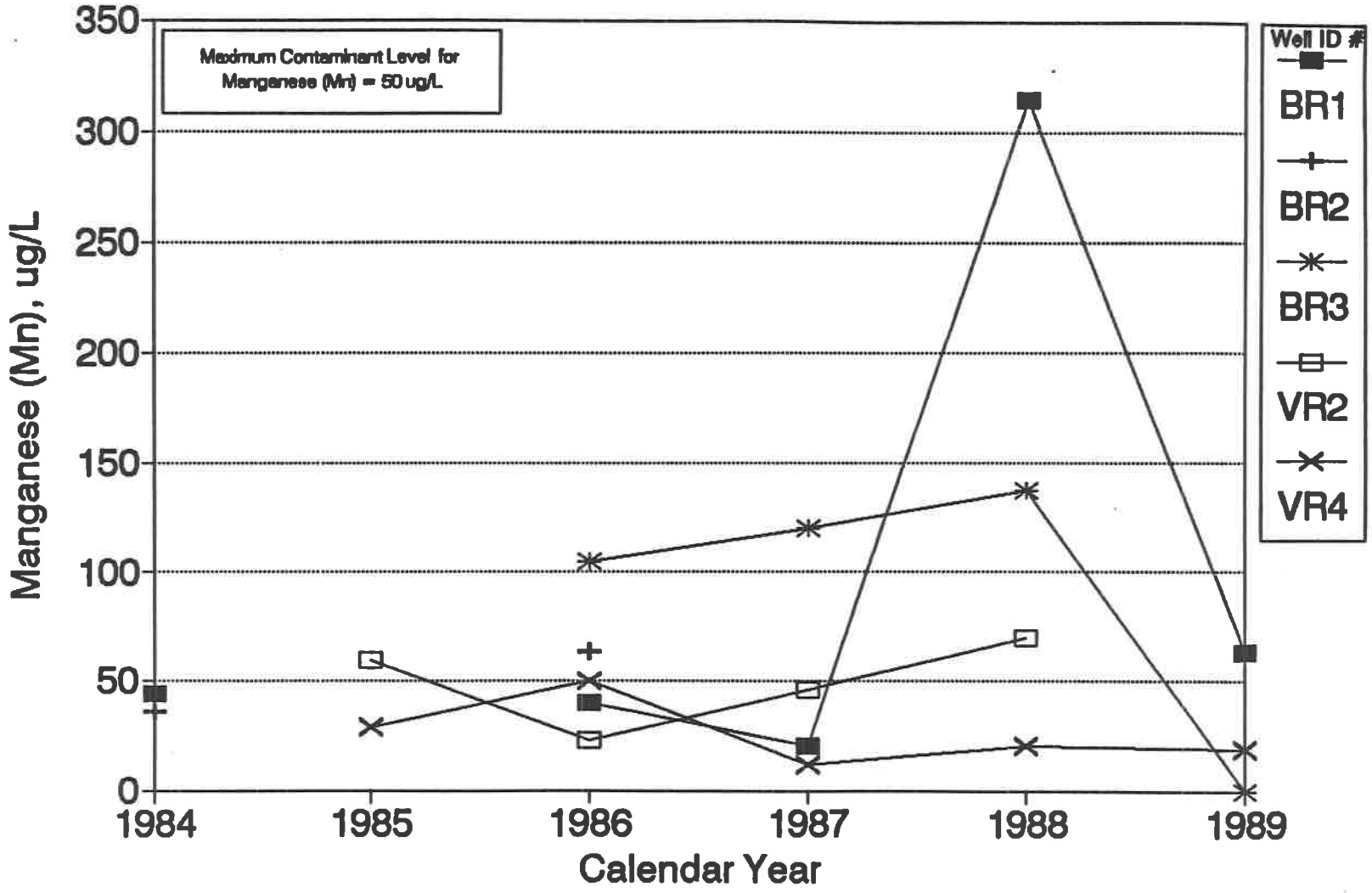


Figure 3-28. - Manganese concentrations in selected wells in the Blue Ridge and Valley & Ridge aquifers

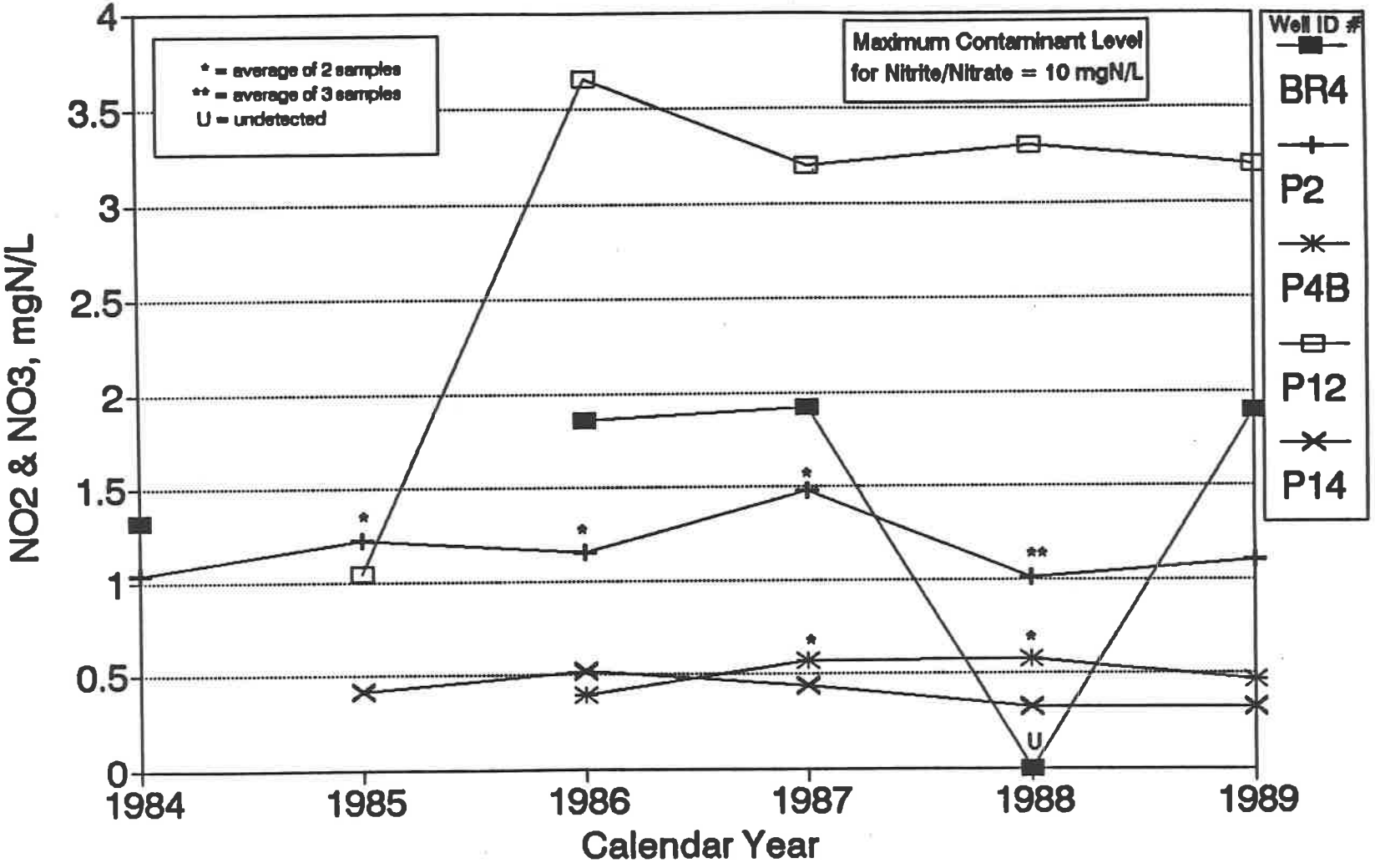


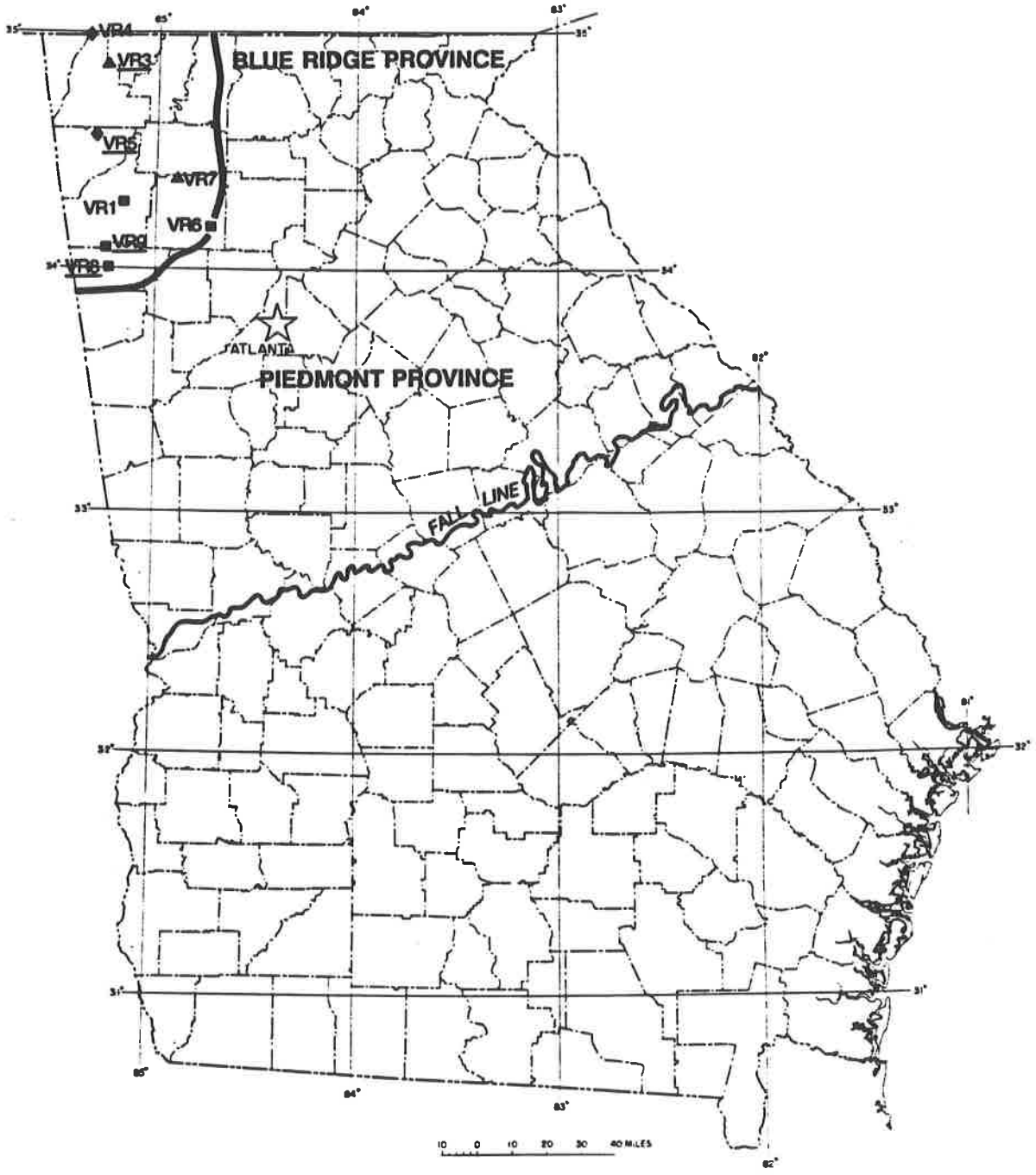
Figure 3-29. - Nitrite/nitrate concentrations in selected wells in the Piedmont and Blue Ridge aquifers.

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 five wells and three springs located across the Province (Figure 3-30). 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 were below drinking-water limits in all of the water samples analyzed. Barium, bismuth, strontium and tin were the most common trace metal constituents.

Chloride and sulfate concentrations were typically less than five parts per million. A water sample from a well in Walker County contained 12.2 parts per million chloride and 66 parts per million sulfate. Detectable levels of nitrite/nitrate were present in all but one of the water samples. Concentrations ranged from 0.30 to 2.80 parts per million in water from eight of the wells and springs. The nitrite/nitrate levels measured in 1989 were generally within previously established ranges for water from these monitoring stations. Four of the stations showed moderate decreases in nitrite/nitrate levels since 1988, while two stations showed slight to moderate increases over the same period.



VR3 Nitrite/nitrate concentrations exceed 0.45 parts per million
▲ Moderately hard water
■ Hard water
◆ Very hard water

Figure 3-30. - Water quality of the Valley and Ridge unconfined aquifer.

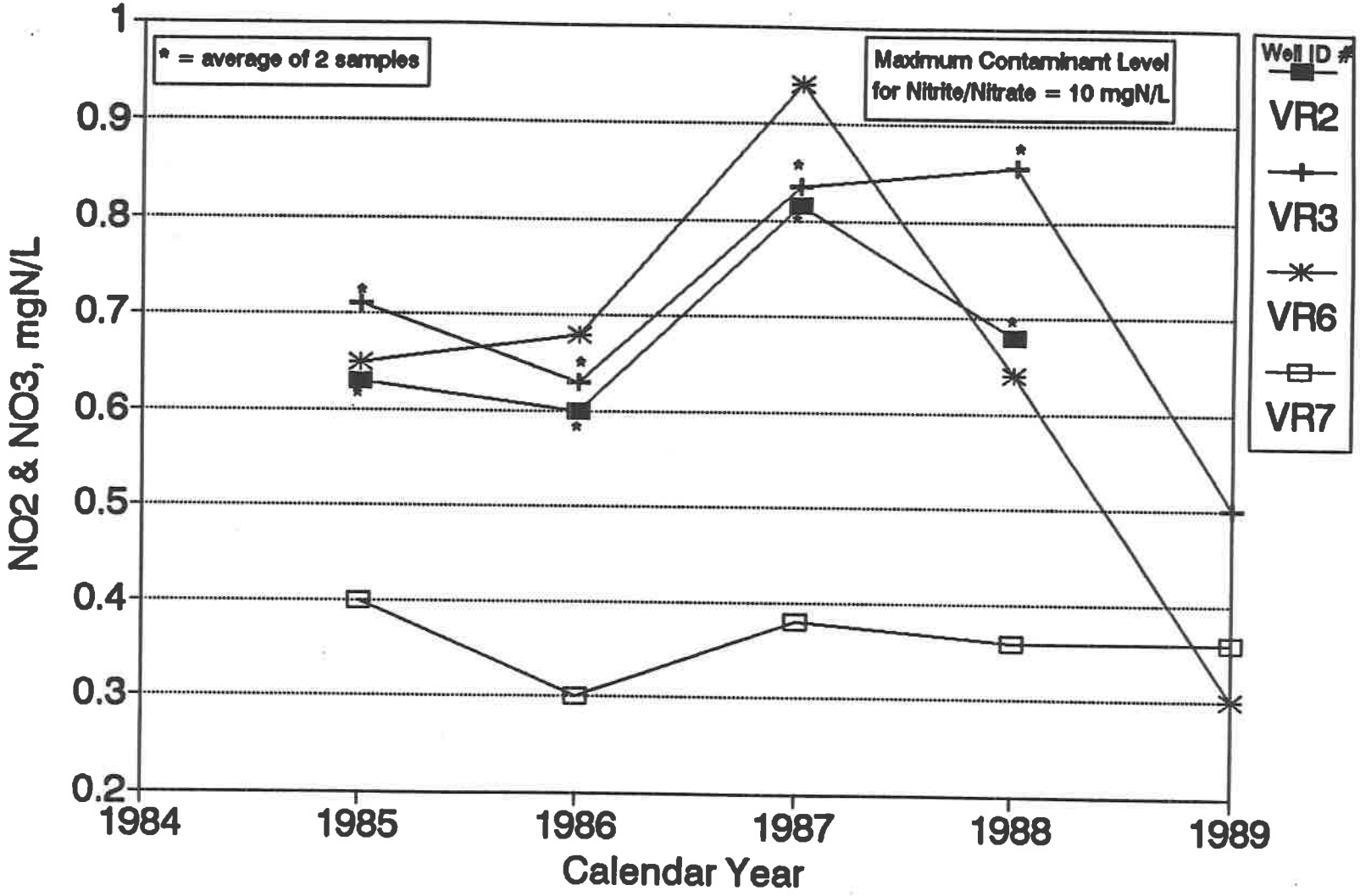


Figure 3-31a. - Nitrite/nitrate concentrations in selected wells and springs in the Valley and Ridge aquifer

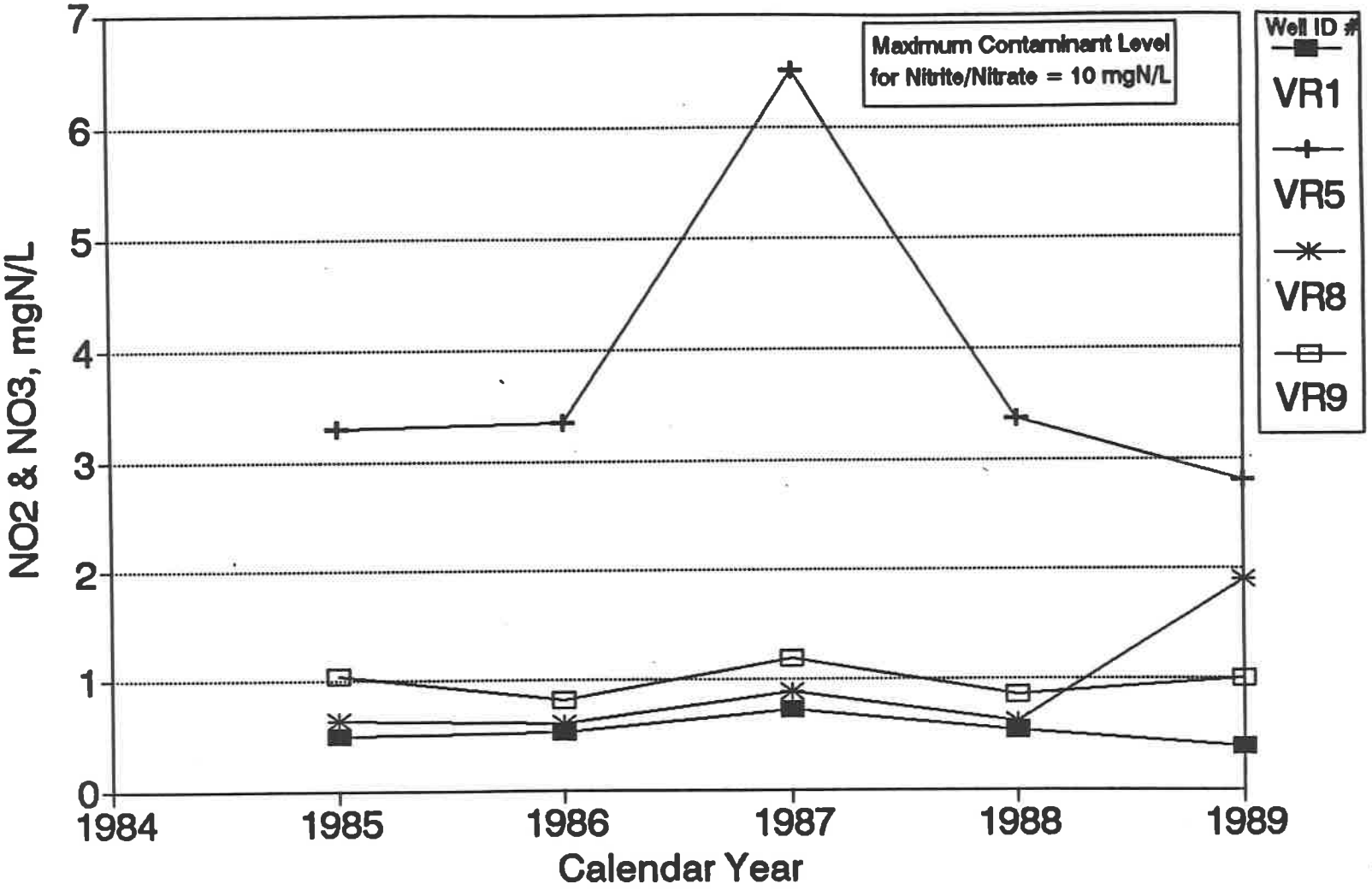


Figure 3-31b. - Nitrite/nitrate concentrations in selected wells in the Valley and Ridge aquifer (continued).

SUMMARY AND CONCLUSIONS

Hydrogeologists collected 167 water samples for analysis from 137 wells and three springs for the Ground-Water Monitoring Network in 1989. These wells and springs represent the ten major aquifer systems of the State:

Cretaceous aquifer system,
Providence aquifer system,
Clayton aquifer system,
Claiborne 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 1989 were compared with analyses for the Ground-Water Monitoring Network dating back to 1984, permitting the recognition of temporal trends. Tables 4-1a through 4-1c list the major contaminants and pollutants that were detected at stations of the Ground-Water Monitoring Network during 1989. Although isolated ground-water quality problems were documented during 1989 at specific localities, the quality of water from the majority of the Ground-Water Monitoring Network stations remains excellent.

An increasing occurrence of detectable levels of nitrite/nitrate in samples collected from some monitoring stations is the only apparent adverse trend in ground-water quality in Georgia. Few wells or springs yielded water samples in 1989 with nitrite/nitrate concentrations that exceeded previously established ranges. Samples from Coastal Plain aquifers with the highest nitrite/nitrate levels were, in most cases, from wells in outcrop areas. The first occurrence of nitrite/nitrate levels greater than the Primary Maximum Contaminant Level of 10 parts per million nitrogen was recorded from a domestic well in the Miocene aquifer. Because this well had not been sampled prior to 1989, it is not yet possible to determine if the nitrite/nitrate level is increasing or decreasing at this station.

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 are septic systems, agricultural wastes and fertilizers (Freeze and Cherry, 1979). 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 denitrification process. However, this process is inhibited by the lack of denitrifying 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 4-1a. - Contaminants and pollutants detected during 1989 in stations of the Ground-Water Monitoring Network, by aquifer

Aquifer	Well ID, parameter, and detected value *	
Cretaceous	GWN-K9	Iron = 740 ug/L
	GWN-K10	NO_2/NO_3 = 0.98 & 0.8 mgN/L
Providence	GWN-PD1	Iron = 1,600 ug/L
	GWN-PD2A	NO_2/NO_3 = 0.47 mgN/L
	GWN-PD4A	Tetrachloroethylene = 2.0 ug/L
Clayton	GWN-CT1	Iron = 590 ug/L
	GWN-CT6B	Iron = 4,100 ug/L
		Manganese = 100 ug/L
Claiborne	GWN-CL1	Iron = 350 ug/L
	GWN-CL2	NO_2/NO_3 = 7.9 mgN/L
		Dinoseb = 0.45 ug/L
	GWN-CL3	Iron = 1,200 ug/L
	GWN-CL4	Manganese = 62 ug/L
		NO_2/NO_3 = 3.5 mgN/L
	GWN-CL5	Manganese = 450 ug/L
		NO_2/NO_3 = 7.6 mgN/L
Jacksonian	GWN-J1B	NO_2/NO_3 = 2.1 mgN/L
	GWN-J3	Manganese = 130 ug/L
	GWN-J7	NO_2/NO_3 = 2.3 mgN/L
	GWN-J8	Manganese = 72 ug/L
		NO_2/NO_3 = 7.1 mgN/L
		Silver = 62 ug/L
Floridan (Principal Artesian)	GWN-PA2A	Bis (2-Ethylhexyl)-phthalate = 127
	GWN-PA9B	Iron = 1,200 ug/L
	GWN-PA14	NO_2/NO_3 = 6.0 mgN/L
	GWN-PA18	Manganese = 56 ug/L
	GWN-PA21	Bis (2-Ethylhexyl)-phthalate = 38.6
	GWN-PA24	NO_2/NO_3 = 1.2 & 1.3 mgN/L
	GWN-PA25	NO_2/NO_3 = 1.2 & 1.2 mgN/L
	GWN-PA26	NO_2/NO_3 = 1.8 & 1.4 mgN/L
	GWN-PA33	Barium = 2,500 ug/L
	GWN-PA37	Iron = 400 ug/L
		NO_2/NO_3 = 1.7 mgN/L
	GWN-PA40	NO_2/NO_3 = 0.9 & 1.27 mgN/L
	GWN-PA41	NO_2/NO_3 = 2.0 & 2.8 mgN/L
		Tetrachloroethylene = 1.5 ug/L
	GWN-PA42	NO_2/NO_3 = 2.71 & 3.5 mgN/L
	GWN-PA43	NO_2/NO_3 = 1.3 & 1.4 mgN/L

* Metals are reported only when detected at levels above the maximum contaminant level. Nitrite/nitrate (NO_2/NO_3) levels less than 0.45 mgN/L are not reported. Two values indicate two sampling dates.

Table 4-1b. - Contaminants and pollutants detected during 1989 in stations of the Ground-Water Monitoring Network, by aquifer (cont'd.)

Aquifer	Well ID, parameter, and detected value *	
Floridan (Principal Artesian), continued	GWN-PA46A	NO_2/NO_3 = 1.13 mgN/L
	GWN-PA47	NO_2/NO_3 = 1.29 & 6.06 mgN/L
	GWN-PA48	Iron = 680 ug/L
		NO_2/NO_3 = 1.49 & 1.9 mgN/L
	GWN-PA50	NO_2/NO_3 = 0.74 mgN/L
	GWN-PA51	NO_2/NO_3 = 1.7 mgN/L
	GWN-PA52	NO_2/NO_3 = 3.4 mgN/L
	GWN-PA53	NO_2/NO_3 = 3.7 mgN/L
	GWN-PA55	Silver = 64 ug/L
Miocene	GWN-MI1	Iron = 400 &300 ug/L
	GWN-MI4	Iron = 410 ug/L
		Manganese = 110 ug/L
	GWN-MI5	Manganese = 170 ug/L
		NO_2/NO_3 = 6.2 mgN/L
	GWN-MI6	Manganese = 62 ug/L
		NO_2/NO_3 = 7.8 mgN/L
	GWN-MI7	NO_2/NO_3 = 6.4 mgN/L
	GWN-MI8	Iron = 730 ug/L
	GWN-MI9	Iron = 1,300 ug/L
		NO_2/NO_3 = 2.8 mgN/L
	GWN-MI10	NO_2/NO_3 = 8.2 mgN/L
	GWN-MI11	Iron = 500 ug/L
		NO_2/NO_3 = 0.86 mgN/L
	GWN-MI13	Iron = 2,400 ug/L
		Manganese = 220 ug/L
	GWN-MI15	NO_2/NO_3 = 14.7 mgN/L (Over MCL)
Piedmont	GWN-P1B	Iron = 2,500 ug/L
		Manganese = 59 ug/L
	GWN-P2	Iron = 1,500 ug/L
		Manganese = 86 ug/L
		NO_2/NO_3 = 1.1 mgN/L
		Silver = 52 ug/L
	GWN-P3	Iron = 980 & 6,300 ug/L
		Manganese = 62 ug/L
		Ethylbenzene = 1 & 1.3 ug/L
		p, m & o Xylenes = 2 & 7.4 ug/L
		Trimethyl benzene = 2 ug/L
		Ethylmethyl benzene = 2 ug/L
		Toluene = 5.9 ug/L
		1,2 Dichloropropane = 1.7 ug/L

* Metals are reported only when detected at levels above the maximum contaminant level. Nitrite/nitrate (NO_2/NO_3) levels less than 0.45 mgN/L are not reported. Two values indicate two sampling dates.

Table 4-1c. - Contaminants and pollutants detected during 1989 in stations of the Ground-Water Monitoring Network, by aquifer (cont'd.)

Aquifer	Well ID, parameter, and detected value *	
Piedmont (continued)	GWN-P4B	Iron = 6,300 ug/L
		NO_2/NO_3 = 0.47 mgN/L
	GWN-P6A	Manganese = 86 ug/L
	GWN-P9	Iron = 2,000 ug/L
		Manganese = 260 ug/L
	GWN-P10A	Iron = 30,000 ug/L
		Manganese = 760 ug/L
		Thallium = 94 ug/L (No MCL established for thallium)
	GWN-P12	NO_2/NO_3 = 3.2 mgN/L
	GWN-P13	Iron = 440 ug/L
		Manganese = 78 ug/L
		Trichloroethylene = 1.6 ug/L
		Tetrachloroethylene = 7.8 ug/L
	GWN-P15A	Iron = 480 & 480 ug/L
		Manganese = 86 & 88 ug/L
	GWN-P16C	Iron = 3,500 ug/L
		Manganese = 110 ug/L
Blue Ridge	GWN-BR1	Manganese = 63 ug/L
	GWN-BR2B	Iron = 300 ug/L
	GWN-BR4	NO_2/NO_3 = 1.9 mgN/L
Valley and Ridge	GWN-VR3	NO_2/NO_3 = 0.5 mgN/L
	GWN-VR5	NO_2/NO_3 = 2.8 mgN/L
	GWN-VR8	NO_2/NO_3 = 1.9 mgN/L
	GWN-VR9	NO_2/NO_3 = 1.0 mgN/L

* Metals are reported only when detected at levels above the maximum contaminant level. Nitrite/nitrate (NO_2/NO_3) levels less than 0.45 mgN/L are not reported. Two values indicate two sampling dates.

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APPENDIX

APPENDIX: ANALYSES OF SAMPLES COLLECTED DURING 1989 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 *
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 mg/LN [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 *
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

Parameter	ORGANIC SCREEN #10 (Volatile Organics)	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

WATER QUALITY FOR THE CRETACEOUS AQUIFER SYSTEM

PARAMETER / UNITS / WELL ID#	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
	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-K1	4.8	1.0 U	1.0 U	1.8	5.0 U	100	10 U	2.2	2.0 U	0.40	10 U	10 U	24	Al = 29	
WELL NAME: Englehard Kaolin Company #2, Gordon COUNTY: Wilkinson DATE SAMPLED: 06/13/1989															
GWN-K2	4.5	1.3	1.0 U	1.7	5.0 U	29	10 U	1.8	3.5	0.17	10 U	10 U	27	Al = 56	10
WELL NAME: Irwinton #2 COUNTY: Wilkinson DATE SAMPLED: 06/13/1989															
GWN-K3	6.5	19.0	1.4	2.4	5.0 U	130	27	2.0	6.5	0.02 U	22	63	119		1, 5, 10
WELL NAME: Sandersville #7B COUNTY: Washington DATE SAMPLED: 04/20/1989															
GWN-K5	5.9	1.0 U	1.0 U	1.4	5.0 U	20 U	20 U	2.0 U	2.0 U	0.02 U	10 U	10 U	17		8, 9, Hg
WELL NAME: Richmond County #101, Augusta COUNTY: Richmond DATE SAMPLED: 04/19/1989															
GWN-K5	6.3	1.0 U	1.0 U	1.3	2.0 U	20 U	10 U	1.4	2.0 U	0.40	10 U	10 U	14		8, 9, Hg
WELL NAME: Richmond County #101, Augusta COUNTY: Richmond DATE SAMPLED: 09/12/1989															
GWN-K6A	5.8	4.2	1.0 U	3.4	5.0 U	20 U	10 U	2.6	4.2	0.02 U	15	56	53	Zn = 69	CN
WELL NAME: Huber Corporation #6 COUNTY: Twiggs DATE SAMPLED: 06/15/1989															

WATER QUALITY FOR THE CRETACEOUS 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	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-K7	5.4	1.8	1.0 U	1.5	5.0 U	20 U	10 U	2.0	2.0 U	0.02 U	13	11	31		
WELL NAME: Jones County #4, Macon COUNTY: Jones DATE SAMPLED: 06/15/1989															
GWN-K9	3.8	1.4	1.0 U	1.1	5.0 U	740	10 U	1.6	7.9	0.02 U	10 U	10 U	47	Al = 340	1, 5, 10
WELL NAME: Marshallville #1 COUNTY: Macon DATE SAMPLED: 06/13/1989															
GWN-K10	4.9	1.3	1.0 U	2.7	2.0 U	20 U	10 U	3.2	2.0 U	0.98	20 U	10 U	30		10
WELL NAME: Fort Valley #1 COUNTY: Peach DATE SAMPLED: 01/26/1989															
GWN-K10	4.9	1.3	1.0 U	2.9	5.0 U	20 U	10 U	2.8	2.0 U	0.80	10 U	10 U	30		10
WELL NAME: Fort Valley #1 COUNTY: Peach DATE SAMPLED: 06/13/1989															
GWN-K11	5.0	1.0 U	1.0 U	1.3	2.0 U	100	10 U	1.3	2.0 U	0.23	20 U	10 U	15		10
WELL NAME: Warner Robins #1A COUNTY: Houston DATE SAMPLED: 01/26/1989															
GWN-K11	5.1	1.0 U	1.0 U	1.1	5.0 U	20	10 U	1.0	2.0 U	0.12	10 U	10 U	14		10
WELL NAME: Warner Robins #1A COUNTY: Houston DATE SAMPLED: 06/13/1989															

WATER QUALITY FOR THE CRETACEOUS AQUIFER SYSTEM

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-K12 WELL NAME: Perry, Holiday Inn Well COUNTY: Houston DATE SAMPLED: 01/26/1989	4.0	1.0 U	1.0 U	1.2	2.0 U	240	12	1.9	5.1	0.02 U	20 U	10 U	46	Al = 390 Zn = 58	10
GWN-K12 WELL NAME: Perry, Holiday Inn Well COUNTY: Houston DATE SAMPLED: 06/14/1989	3.9	1.0 U	1.0 U	1.2	5.0 U	180	11	1.4	7.2	0.02 U	10 U	10 U	45	Al = 370 Zn = 42	5, 10
GWN-K13 WELL NAME: Omaha #1 COUNTY: Stewart DATE SAMPLED: 11/28/1989	8.5	2.3	1.0 U	45.0	2.0 U	20 U	10 U	11.5	8.5	0.02 U	10 U	45	167		3, 5
GWN-K14 WELL NAME: Fort Benning Test Well COUNTY: Chattahoochee DATE SAMPLED: 11/29/1989	7.8	13.0	1.0 U	24.0	2.4	100	10 U	7.7	7.1	0.02 U	17	220	159		
GWN-K15 WELL NAME: Georgetown #2 COUNTY: Quitman DATE SAMPLED: 11/28/1989	8.9	1.0 U	1.0 U	81.0	2.0 U	20 U	10 U	7.9	2.0 U	0.02 U	10 U	17	334		10
GWN-K16 WELL NAME: Packaging Corporation of America, North Well COUNTY: Bibb DATE SAMPLED: 01/26/1989	5.3	1.0 U	1.0 U	4.5	2.0 U	22	10 U	2.2	2.0 U	0.19	20 U	10 U	26	Zn = 31	10

WATER QUALITY FOR THE CRETACEOUS 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	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-K16	5.4	1.0 U	1.0 U	5.3	5.0 U	20	10 U	2.2	2.4	0.24	10 U	10 U	30		10
WELL NAME: Packaging Corporation of America, North Well COUNTY: Bibb DATE SAMPLED: 06/13/1989															
GWN-K18A	4.8	1.1	1.0 U	1.2	2.0 U	110	10 U	1.7	2.9	0.06	20 U	10 U	26	Al = 28	10
WELL NAME: Buena Vista #6 COUNTY: Marion DATE SAMPLED: 03/30/1989															
GWN-K19	5.0	1.0 U	1.0 U	1.3	2.0 U	27	10 U	1.7	2.0 U	0.02 U	10 U	10 U	15	Cu = 38	10
WELL NAME: Hephzibah, Murphy Street Well (#3) COUNTY: Richmond DATE SAMPLED: 09/12/1989															
Average:	5.55	2.22	0.07 U	8.92	0.1 U	86.57	2.38 U	2.86	2.63	0.17	3.19 U	19.62	60.43		
Maximum:	8.9	19.0	1.4	45.0	2.4	740	27	11.5	8.5	0.98	22	220	334		
Minimum:	3.8	1.0 U	1.0 U	1.1	2.0 U	20 U	10 U	2.0 U/ 1.0 D	2.0 U	0.02 U	10 U	10 U	14		

WATER QUALITY FOR THE PROVIDENCE AQUIFER SYSTEM

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-PD1 WELL NAME: TW 10 - Albany COUNTY: Dougherty DATE SAMPLED: 10/24/1989	8.9	6.5	1.0 U	88.0	2.0 U	1,600	10 U	1.0 U	7.1	0.02 U	10 U	77	350	Al = 3,000 Ti = 100	1, 5
GWN-PD2A WELL NAME: Preston #2 COUNTY: Webster DATE SAMPLED: 03/30/1989	5.9	10.0	1.0 U	1.6	2.0 U	20 U	10 U	2.0 U	2.0 U	0.47	20 U	14	52	Zn = 170	1, 5, 10
GWN-PD3 WELL NAME: Fort Gaines #2 COUNTY: Clay DATE SAMPLED: 11/28/1989	8.0	6.0	1.1	78.0	2.0 U	20 U	10 U	11.1	11.1	0.02 U	10 U	100	288		
GWN-PD4A WELL NAME: Americus #3 COUNTY: Sumter DATE SAMPLED: 03/30/1989	7.2	43.0	2.3	2.7	2.6	73	12	2.0 U	13.7	0.02 U	20 U	220	234	(Tetrachloro-ethylene = 2.0)	1, 3, 5, 10
GWN-PD4A WELL NAME: Americus #3 COUNTY: Sumter DATE SAMPLED: 06/14/1989	7.4	(No metal sample taken)						1.4	13.0	0.02 U	(No sample)		209		10
Average:	7.48	16.37	0.85 U	42.57	0.65 U	418.25	3.0 U	2.5	8.98	0.094	10 U	102.75	226.6		
Maximum:	8.9	43	2.3	88.0	2.6	1,600	12	11.1	13.7	0.47	10 U	220	350		
Minimum:	5.9	6.0	1.0 U	1.6	2.0 U	20 U	10 U	2.0 U	2.0 U	0.02 U	10 U	14	52		

WATER QUALITY FOR 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	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-CT1	7.6	9.6	4.8	37.0	2.6	590	11	1.0 U	11.2	0.02 U	10 U	240	250	Cu = 37	
WELL NAME: Turner City Well															
COUNTY: Dougherty															
DATE SAMPLED: 10/25/1989															
GWN-CT2A	7.5	43.0	3.0	6.3	2.0 U	110	10 U	0.1	17.8	0.02 U	10 U	280	217	Bi = 57	1, 3, 5
WELL NAME: Burton Thomas Well														Mo = 10	
COUNTY: Sumter														V = 10	
DATE SAMPLED: 10/16/1989														Zn = 33	
GWN-CT3	7.5	46.0	4.6	7.7	2.0 U	20 U	10 U	1.8	13.0	0.02 U	10 U	440	249	Bi = 48	1, 3, 5, 10
WELL NAME: Dawson, Crawford Street Well														Co = 11	
COUNTY: Terrell														Mo = 10	
DATE SAMPLED: 10/17/1989														V = 11	
GWN-CT4	7.5	47.0	3.4	5.4	2.0 U	150	10 U	2.1	9.6	0.02 U	11	280	250	Au = 37	1, 3, 5
WELL NAME: C. T. Martin TW 2														Bi = 92	
COUNTY: Randolph														Co = 16	
DATE SAMPLED: 10/23/1989														Mo = 17	
														V = 18	
GWN-CT5A	7.5	47.0	4.0	2.2	2.0 U	170	36	2.1	11.2	0.02 U	17	160	246	Bi = 70	1, 3, 5, 10
WELL NAME: Cuthbert #3														Co = 11	
COUNTY: Randolph														Mo = 11	
DATE SAMPLED: 10/17/1989														V = 12	

WATER QUALITY FOR 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	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-CT6B	7.3	110.0	3.2	7.1	3.2	4,100	100	7.6	60.0	0.02 U	36	160	530	Zn = 100	1, 3, 5
WELL NAME: Fort Gaines Test Well															
COUNTY: Clay															
DATE SAMPLED: 11/28/1989															
Average:	7.48	50.43	3.83	10.95	0.97 U	853.3	24.5	2.28	20.47	0.02 U	10.67	260	290.3		
Maximum:	7.6	110.0	4.8	37.0	3.2	4100	100	7.6	60.0	0.02 U	36	440	530		
Minimum:	7.3	9.6	3.0	2.2	2.0 U	20 U	10 U	1.0 U/ 0.1 D	9.6	0.02 U	10 U	160	217		

WATER QUALITY FOR THE CLAIBORNE AQUIFER SYSTEM

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-CL1	7.3	56.0	8.6	9.3	2.9	350	10 U	4.1	3.0	0.02 U	10 U	360	340	Au = 32 Bi = 84 Co = 14 Mo = 14 V = 15	
WELL NAME: TW 5 - Albany COUNTY: Dougherty DATE SAMPLED: 10/25/1989															
GWN-CL2	7.2	46.0	1.0 U	1.7	2.0 U	20 U	10 U	1.8	0.1	7.9	10	110	204	(Dinoseb = 0.45)	1, 3, 5
WELL NAME: Unadilla #3 COUNTY: Dooly DATE SAMPLED: 10/16/1989															
GWN-CL3	5.1	1.3	1.0 U	1.5	2.0 U	1,200	14	2.1	2.0 U	0.02 U	10 U	11	20	Al = 38	1, 3, 5
WELL NAME: Pete Long TW 2 COUNTY: Lee DATE SAMPLED: 10/16/1989															
GWN-CL4	4.6	2.4	1.5	4.8	2.0 U	20 U	62	7.2	2.0 U	3.50	20 U	17	65	Al = 45 Cu = 130 Y = 14 Zn = 29	1, 3, 5, 7, 10
WELL NAME: Plains #3 COUNTY: Sumter DATE SAMPLED: 03/30/1989															
GWN-CL5	4.3	4.7	2.4	3.0	3.1	20 U	450	10.9	2.0 U	7.60	56	34	102	Al = 210 Co = 27 Y = 55	
WELL NAME: Shellman #2 COUNTY: Randolph DATE SAMPLED: 10/17/1989															
GWN-CL6	7.7	36.0	8.1	19.0	3.8	71	10 U	4.1	3.2	0.02 U	10 U	430	225		1, 3, 5
WELL NAME: Georgia Tubing Company Well COUNTY: Early DATE SAMPLED: 11/28/1989															

WATER QUALITY FOR 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	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-CL7A	7.6	60.0	2.0	2.6	2.0 U	100	10 U	2.6	5.5	0.02 U	20 U	190	302		7
WELL NAME: Vet. Memorial State Park TW 2															
COUNTY: Crisp															
DATE SAMPLED: 03/27/1989															
Average:	6.26	29.49	3.23	5.99	1.4 U	245.86	75.14	4.68	1.69 U	2.71	9.43	164.57	179.7		
Maximum:	7.7	60	8.6	19.0	3.8	1,200	450	10.9	5.5	7.9	56	430	340		
Minimum:	4.3	1.3	1.0 U	1.55	2.0 U	20 U	10 U	1.8	2.0 U/ 0.1 D	0.02 U	10 U	11	20		

WATER QUALITY FOR 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	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-J1A	7.6	86.0	1.4	3.1	5.0 U	280	21	3.0	2.0 U	0.02 U	67	88	323	Al = 300 Cu = 46 Sb = 31 Zn = 100	1, 3, 5
WELL NAME: Vidette New Well COUNTY: Burke DATE SAMPLED: 04/19/1989															
GWN-J1B	7.2	56.0	1.0	4.2	2.0 U	55	10 U	9.6	2.0 U	2.10	23	27	255	Zn = 46	1, 3, 5
WELL NAME: Horton Residence Well COUNTY: Burke DATE SAMPLED: 09/13/1989															
GWN-J2A	8.0	50.0	1.0 U	1.4	5.0 U	20 U	20 U	2.0 U	2.0 U	0.34	44	57	261		1, 3, 5, 10
WELL NAME: Oakwood Village MHP #2 COUNTY: Burke DATE SAMPLED: 04/19/1989															
GWN-J3	7.7	36.0	6.0	10.0	2.0 U	110	130	8.0	2.0 U	0.02 U	720	300	250		1, 5, 10
WELL NAME: J. W. Black Well, Canoochee COUNTY: Emanuel DATE SAMPLED: 01/25/1989															
GWN-J4	7.6	48.0	2.3	3.4	2.0 U	20 U	10 U	2.7	4.7	0.12	20 U	180	245		
WELL NAME: Wrightsville #4, North Myrtle Street Well COUNTY: Johnson DATE SAMPLED: 01/25/1989															
GWN-J4	7.5	47.0	2.4	3.4	5.0 U	20 U	33	2.3	6.3	0.02 U	10 U	190	257		1, 5
WELL NAME: Wrightsville #4, North Myrtle Street Well COUNTY: Johnson DATE SAMPLED: 06/13/1989															

WATER QUALITY FOR THE JACKSONIAN AQUIFER SYSTEM

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-J5 WELL NAME: Cochran #3 COUNTY: Bleckley DATE SAMPLED: 06/14/1989	7.6	69.0	2.5	3.2	5.0 U	20 U	25	2.1	11.0	0.02 U	10 U	230	348	Sn = 33	1, 3, 5, 10
GWN-J6 WELL NAME: Wrens #4 COUNTY: Jefferson DATE SAMPLED: 04/20/1989	7.3	27.0	1.0 U	1.9	5.0 U	170	20 U	2.0 U	6.6	0.02	14	97	153		1, 5, 10
GWN-J6 WELL NAME: Wrens #4 COUNTY: Jefferson DATE SAMPLED: 09/13/1989	6.6	29.0	1.1	1.7	2.0 U	190	12	1.8	7.0	0.02 U	14	100	144		1, 5, 10
GWN-J7 WELL NAME: Templeton Livestock Well COUNTY: Burke DATE SAMPLED: 09/12/1989	4.9	2.6	1.4	4.1	2.0 U	20 U	10	7.6	2.0 U	2.30	23	17	48	Al = 29	1, 5
GWN-J8 WELL NAME: Kahn Residence Well COUNTY: Jefferson DATE SAMPLED: 09/13/1989	4.9	10.0	1.6	5.4	2.0 U	45	72	8.9	2.0 U	7.10	38	20	91	Ag = 62 Al = 43 Au = 82 Bi = 170 Co = 38 Mo = 34 V = 36 Zn = 26	1
Average:	6.99	41.87	1.79	3.8	2.0 U	77.27	27.54	4.18	3.24	1.09	85.73	118.73	215.9		
Maximum:	8.0	86.0	6.0	10.0	5.0 U	280	130	9.6	11.0	7.10	720	300	348		
Minimum:	4.9	2.6	1.0 U	1.4	2.0 U	20 U	10 U	2.0 U	2.0	0.02 U	10 U	17	48		

WATER QUALITY FOR 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	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-PA1	7.7	27.0	9.2	15.0	5.0 U	20 U	10 U	14.3	5.8	0.02 U	12	380	273	Bi = 23	
WELL NAME: Thunderbolt #1 COUNTY: Chatham DATE SAMPLED: 05\24\1989															
GWN-PA2A	7.7	25.0	8.1	11.0	5.0 U	20 U	10 U	4.1	4.9	0.02 U	14	300	225	(Bis (2-Ethylhexyl)-phthalate = 127) Bi = 20	8, 9
WELL NAME: Savannah #6 COUNTY: Chatham DATE SAMPLED: 05\23\1989															
GWN-PA4	7.7	35.0	25.0	49.0	5.0 U	20 U	10 U	25.0	98.0	0.02 U	10	1,200	590	Bi = 36	
WELL NAME: Tybee Island #1 COUNTY: Chatham DATE SAMPLED: 05\24\1989															
GWN-PA5A	7.7	27.0	15.0	16.0	2.9	53	10 U	5.7	35.5	0.10 U	30	440	302	Cu = 35	
WELL NAME: Interstate Paper Company #2, Riceboro COUNTY: Liberty DATE SAMPLED: 12\21\1989															
GWN-PA6	7.5	24.0	12.0	14.0	3.0	20 U	10 U	4.6	22.9	0.10 U	23	370	263		
WELL NAME: Hinesville #5 COUNTY: Liberty DATE SAMPLED: 12\21\1989															
GWN-PA7	7.6	48.0	28.0	24.0	2.0 U	130	10 U	23.1	121.0	0.10 U	52	760	531		
WELL NAME: Darien New Well COUNTY: McIntosh DATE SAMPLED: 12\21\1989															

WATER QUALITY FOR THE FLORIDAN AQUIFER SYSTEM

PARAMETER / UNITS / WELL ID#	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected	Other Screens Tested
	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	7.7	33.0	17.0	17.0	2.9	20 U	10 U	7.4	52.8	0.10 U	73	550	350		
WELL NAME: ITT/Rayonier #4d, Doctortown COUNTY: Wayne DATE SAMPLED: 12\18\1989															
GWN-PA9A	7.6	43.0	25.0	13.0	2.1	40	10 U	15.1	101.6	0.10 U	44	420	469		8, 9
WELL NAME: Brunswick Pulp and Paper Company South 2 COUNTY: Glynn DATE SAMPLED: 12\19\1989															
GWN-PA9B	7.8	67.0	53.0	110.0	3.6	1,200	11	90.2	168.1	0.10 U	89	1,000	1,380		8, 9
WELL NAME: Brunswick Pulp and Paper Company South 1 COUNTY: Glynn DATE SAMPLED: 12\19\1989															
GWN-PA9C	7.7	41.0	26.0	18.0	2.0 U	77	10 U	20.7	98.5	0.10 U	41	660	450		8, 9
WELL NAME: Miller Ball Park TW 25 COUNTY: Glynn DATE SAMPLED: 12\20\1989															
GWN-PA10B	7.2	78.0	41.0	54.0	2.8	20 U	10 U	60.4	146.0	0.10 U	39	780	919	Bi = 33	
WELL NAME: Gilman Paper Company #11, St. Marys COUNTY: Camden DATE SAMPLED: 12\20\1989															
GWN-PA11B	7.2	74.0	35.0	24.0	2.0 U	68	10 U	32.4	141.4	0.10 U	36	650	698		5
WELL NAME: St. Mary's Well #3 COUNTY: Camden DATE SAMPLED: 12\20\1989															

WATER QUALITY FOR 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	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-PA12	7.6	70.0	29.0	22.0	2.1	43	10 U	29.2	121.6	0.10 U	33	520	630		
WELL NAME: Folkston #3															
COUNTY: Charlton															
DATE SAMPLED: 12\20\1989															
GWN-PA13	7.6	42.0	17.0	15.0	2.0 U	22	10 U	14.2	58.4	0.10 U	71	350	385		8, 9
WELL NAME: Waycross #3															
COUNTY: Ware															
DATE SAMPLED: 12\20\1989															
GWN-PA14	7.8	35.0	5.1	7.0	2.0 U	20 U	10 U	6.3	28.0	6.00	33	200	223		
WELL NAME: Statesboro #7															
COUNTY: Bulloch															
DATE SAMPLED: 01\25\1989															
GWN-PA15	7.8	28.0	9.1	8.3	4.1	29	10 U	2.5	2.7	0.02 U	20 U	430	231		CN
WELL NAME: King Finishing Company, Fire Pump Well, Dover															
COUNTY: Screven															
DATE SAMPLED: 01\25\1989															
GWN-PA16	7.7	49.0	3.2	4.8	2.0 U	20 U	33	5.6	6.0	0.02 U	20 U	210	262		1, 5
WELL NAME: Millen #1															
COUNTY: Jenkins															
DATE SAMPLED: 01\25\1989															
GWN-PA17	7.6	49.0	2.0	3.4	2.0 U	20 U	10 U	2.9	2.0 U	0.02 U	170	170	254		
WELL NAME: Swainsboro #7															
COUNTY: Emanuel															
DATE SAMPLED: 01\25\1989															

WATER QUALITY FOR THE FLORIDAN AQUIFER SYSTEM

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-PA18 WELL NAME: Metter #2 COUNTY: Candler DATE SAMPLED: 01\25\1989	7.8	32.0	3.5	11.0	2.1	20 U	56	3.9	2.0 U	0.02 U	27	260	218		
GWN-PA20 WELL NAME: Lakeland #2 COUNTY: Lanier DATE SAMPLED: 02\07\1989	7.4	47.0	16.0	4.8	2.0 U	20 U	10 U	3.3	72.0	0.02 U	30	200	360		10
GWN-PA20 WELL NAME: Lakeland #2 COUNTY: Lanier DATE SAMPLED: 07\12\1989	7.6	44.0	16.0	4.6	5.0 U	20 U	10 U	3.2	70.0	0.02 U	28	190	362	B1 = 32	10
GWN-PA21 WELL NAME: Valdosta #1 COUNTY: Lowndes DATE SAMPLED: 02\07\1989	7.3	42.0	4.6	3.3	2.0 U	20 U	10 U	4.5	49.0	0.02 U	53	63	247		1, 5, 8, 9, 10
GWN-PA21 WELL NAME: Valdosta #1 COUNTY: Lowndes DATE SAMPLED: 07\12\1989	7.5	34.0	4.2	3.2	5.0 U	20 U	10 U	4.5	35.0	0.02 U	42	52	225	(Bis (2-ethylhexyl)-phthalate = 38.6)	1, 5, 8, 9, 10
GWN-PA22 WELL NAME: Thomasville #6 COUNTY: Thomas DATE SAMPLED: 02\22\1989	7.5	49.0	20.0	8.2	5.0 U	20 U	10 U	7.3	72.0	0.02 U	35	360	395		

WATER QUALITY FOR 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	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-PA23	7.6	39.0	16.0	12.0	5.0 U	20 U	10 U	6.4	34.0	0.02 U	190	360	332	Mo = 25	10
WELL NAME: Cairo #8															
COUNTY: Grady															
DATE SAMPLED: 02\22\1989															
GWN-PA24	7.7	38.0	3.2	2.2	5.0 U	20 U	10 U	3.3	2.0 U	1.20	20 U	38	216		3, 7, 10
WELL NAME: Bainbridge #1															
COUNTY: Decatur															
DATE SAMPLED: 02\22\1989															
GWN-PA24	7.8	37.0	3.3	1.8	5.0 U	20 U	10 U	3.1	2.0 U	1.30	10 U	36	223		1, 3, 5, 7, 10
WELL NAME: Bainbridge #1															
COUNTY: Decatur															
DATE SAMPLED: 07\11\1989															
GWN-PA25	7.4	56.0	1.0 U	4.2	5.0 U	20 U	10 U	4.7	2.0 U	1.20	20 U	26	274		3, 7, 10
WELL NAME: Donalsonville, East 7th Street Well															
COUNTY: Seminole															
DATE SAMPLED: 02\22\1989															
GWN-PA25	7.6	52.0	1.0 U	3.4	5.0 U	20 U	10 U	4.6	2.0 U	1.20	10 U	24	292	Sn = 26	1, 3, 5, 10, CN
WELL NAME: Donalsonville, East 7th Street Well															
COUNTY: Seminole															
DATE SAMPLED: 07\11\1989															
GWN-PA26	7.4	49.0	1.0 U	2.4	5.0 U	20 U	10 U	3.4	2.0 U	1.80	20 U	21	227		3, 10
WELL NAME: Colquitt #3															
COUNTY: Miller															
DATE SAMPLED: 02\23\1989															

WATER QUALITY FOR THE FLORIDAN AQUIFER SYSTEM

PARAMETER / UNITS / WELL ID#	pH	Ca	Mg	Na	K	Fe	Mn	Cl	SO4	NO2 &NO3	Ba	Sr	Spec. Cond.	Other Parameters Detected ug/L	Other Screens Tested
	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		
WN-PA26 WELL NAME: Colquitt #3 COUNTY: Miller DATE SAMPLED: 07\11\1989	7.7	44.0	1.0 U	1.9	5.0 U	22	10 U	3.3	2.0 U	1.40	10 U	19	228	Al = 69 Zn = 35	1, 3, 5, 10
GWN-PA27 WELL NAME: Camilla New Well (#4) COUNTY: Mitchell DATE SAMPLED: 02\21\1989	7.6	50.0	1.2	2.1	5.0 U	20 U	10 U	2.5	0.4	0.02 U	20 U	42	299		3, 8, 9, 10
GWN-PA27 WELL NAME: Camilla New Well (#4) COUNTY: Mitchell DATE SAMPLED: 07\10\1989	7.6	45.0	1.2	1.7	5.0 U	20 U	10 U	2.4	2.0 U	0.27	10	38	238	Sn = 30	1, 3, 5, 8, 9, 10
GWN-PA28 WELL NAME: Moultrie #1 COUNTY: Colquitt DATE SAMPLED: 02\21\1989	7.7	42.0	21.0	30.0	5.0 U	20 U	10 U	11.1	101.0	0.02 U	130	2,300	229		
GWN-PA29 WELL NAME: Adel #6 COUNTY: Cook DATE SAMPLED: 02\08\1989	7.6	47.0	16.0	3.8	2.0 U	68	34	2.0 U	2.0 U	0.02 U	20 U	310	350		10, CN
GWN-PA29 WELL NAME: Adel #6 COUNTY: Cook DATE SAMPLED: 07\13\1989	7.8	45.0	15.0	3.7	5.0 U	73	34	3.8	65.0	0.02 U	13	310	368	Sn = 23	1, 5, 10

WATER QUALITY FOR 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	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-PA30	7.8	43.0	16.0	4.9	2.0 U	20 U	10 U	2.0 U	2.0 U	0.02 U	60	240	341		
WELL NAME: Nashville Mills #2, Amoco Fabrics Company															
COUNTY: Berrien															
DATE SAMPLED: 02\07\1989															
GWN-PA30	8.0	41.0	16.0	4.7	5.0 U	20 U	10 U	4.7	61.0	0.02 U	56	230	351		
WELL NAME: Nashville Mills #2, Amoco Fabrics Company															
COUNTY: Berrien															
DATE SAMPLED: 07\13\1989															
GWN-PA31	7.7	44.0	8.3	2.6	2.0 U	25	10 U	2.0 U	2.0 U	0.02 U	75	270	266		
WELL NAME: Tifton #6															
COUNTY: Tift															
DATE SAMPLED: 02\08\1989															
GWN-PA32	7.8	35.0	4.9	2.5	2.0 U	140	26	2.0 U	2.0 U	0.02 U	88	160	203		
WELL NAME: Ocilla #3															
COUNTY: Irwin															
DATE SAMPLED: 02\07\1989															
GWN-PA33	7.9	23.0	8.4	3.1	2.0 U	20 U	13	2.0 U	2.0 U	0.02 U	2500	270	180		10
WELL NAME: Fitzgerald Well C															
COUNTY: Ben Hill															
DATE SAMPLED: 02\06\1989															
GWN-PA34	7.2	50.0	9.6	5.5	5.0 U	190	98	5.8	2.8	0.02 U	300	730	321	Sn = 35	
WELL NAME: McRae #1															
COUNTY: Telfair															
DATE SAMPLED: 06\14\1989															

WATER QUALITY FOR THE FLORIDAN AQUIFER SYSTEM

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-PA35 WELL NAME: Mount Vernon New Well COUNTY: Montgomery DATE SAMPLED: 06\14\1989	7.7	30.0	13.0	6.0	5.0 U	64	29	3.5	6.9	0.02 U	90	490	266		
GWN-PA36 WELL NAME: Vidalia #1 (Sixth Street Well) COUNTY: Toombs DATE SAMPLED: 06\14\1989	7.9	30.0	5.4	12.0	5.0 U	32	38	3.8	3.0	0.02 U	140	370	227	Zn = 35	CN
GWN-PA37 WELL NAME: Hogan Monitoring Well COUNTY: Laurens DATE SAMPLED: 01\26\1989	7.5	47.0	1.0 U	2.0	2.0 U	400	10 U	3.7	2.0 U	1.70	20 U	25	233	Zn = 65	
GWN-PA38 WELL NAME: Eastman #4 COUNTY: Dodge DATE SAMPLED: 06\13\1989	7.5	46.0	1.3	2.1	5.0 U	20 U	10 U	2.2	2.0 U	0.08	110	96	234		1, 3, 5, 10
GWN-PA39 WELL NAME: Sylvester #1 COUNTY: Worth DATE SAMPLED: 02\21\1989	7.5	42.0	7.4	3.8	5.0 U	20 U	10 U	2.7	1.8	0.02 U	220	410	231		3, 7, 10
GWN-PA39 WELL NAME: Sylvester #1 COUNTY: Worth DATE SAMPLED: 07\10\1989	7.5	48.0	6.7	3.4	5.0 U	20 U	10 U	2.5	2.0 U	0.02 U	210	360	294		1, 3, 5, 10

WATER QUALITY FOR THE FLORIDAN AQUIFER SYSTEM

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	7.6	58.0	1.1	2.1	2.0 U	21	10 U	3.4	2.0 U	0.90	20 U	51	285	Al = 25	CN
WELL NAME: Merck and Company #8 COUNTY: Dougherty DATE SAMPLED: 03\28\1989															
GWN-PA40	7.4	64.0	1.1	2.6	2.0 U	34	10 U	1.1	2.0 U	1.27	16	51	280	Au = 43 Bi = 91 Co = 19 Mo = 18 Sn = 37 V = 21	CN
WELL NAME: Merck and Company #8 COUNTY: Dougherty DATE SAMPLED: 10\25\1989															
GWN-PA41	7.3	110.0	3.1	22.0	3.1	21	10 U	14.1	28.8	2.00	44	89	637		1, 3, 5, 10
WELL NAME: TW 13 - Albany COUNTY: Dougherty DATE SAMPLED: 03\28\1989															
GWN-PA41	7.0	120.0	3.2	23.0	3.4	66	17	18.0	36.9	2.80	47	87	608	(Tetrachloro-ethylene = 1.5) Au = 31 Bi = 75 Co = 14 Mo = 16 Sn = 51 V = 17	1, 3, 5, 10, CN
WELL NAME: TW 13 - Albany COUNTY: Dougherty DATE SAMPLED: 10\18\1989															
GWN-PA42	7.5	37.0	1.0 U	2.5	2.0 U	20 U	10 U	5.4	2.0 U	2.71	20 U	16	197		7, CN
WELL NAME: Garrett OW #4 COUNTY: Lee DATE SAMPLED: 03\29\1989															
GWN-PA42	7.0	40.0	1.0 U	3.1	2.0 U	35	10 U	8.3	2.0 U	3.50	10 U	16	180	Au = 68 Bi = 140 Co = 31 Mo = 28 V = 31	CN
WELL NAME: Garrett OW #4 COUNTY: Lee DATE SAMPLED: 10\26\1989															

WATER QUALITY FOR THE FLORIDAN AQUIFER SYSTEM

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-PA43	7.7	47.0	1.0 U	3.0	5.0 U	20 U	10 U	5.7	2.0 U	1.30	20 U	41	476		3, 7, 10
WELL NAME: Newton #1 COUNTY: Baker DATE SAMPLED: 02\23\1989															
GWN-PA43	7.9	44.0	1.0 U	2.2	5.0 U	20 U	10 U	3.2	2.0 U	1.40	10 U	37	250	Sn = 32	1, 3, 5, 10
WELL NAME: Newton #1 COUNTY: Baker DATE SAMPLED: 07\12\1989															
GWN-PA44	7.8	32.0	4.1	2.2	2.0 U	20 U	10 U	1.7	2.0 U	0.25	160	280	187		1, 3, 5, 10
WELL NAME: Sycamore #2 COUNTY: Turner DATE SAMPLED: 02\08\1989															
GWN-PA45	7.7	52.0	3.5	2.1	2.0 U	23	10 U	2.6	2.0	0.02 U	20 U	210	270		1, 3, 5, 10
WELL NAME: Abbeville #2 COUNTY: Wilcox DATE SAMPLED: 02\06\1989															
GWN-PA46A	7.6	51.0	1.0 U	2.3	2.0 U	20 U	10 U	4.0	2.0 U	1.13	32	39	259	Zn = 71	1, 3, 5, 7, 10
WELL NAME: Tyson Residence Well COUNTY: Crisp DATE SAMPLED: 03\27\1989															
GWN-PA47	7.7	55.0	1.0 U	1.7	2.0 U	20 U	10 U	2.8	2.0 U	1.29	20 U	57	268		1, 3, 5, 7, 10
WELL NAME: Haley Farms TW 19 COUNTY: Lee DATE SAMPLED: 03\28\1989															

WATER QUALITY FOR 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	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-PA47	7.4	69.0	1.1	2.7	2.0 U	65	10 U	1.0	2.0 U	6.06	14	57	310	Au = 45 Bi = 95 Co = 20 Mo = 19 V = 23	1, 3, 5, 10
WELL NAME: Haley Farms TW 19 COUNTY: Lee DATE SAMPLED: 10\24\1989															
GWN-PA48	7.6	51.0	1.0 U	2.2	2.0 U	680	10 U	2.9	2.0 U	1.49	20 U	24	243	Al = 65	1, 3, 5, 7, 10
WELL NAME: Doug Harvey TW 1 COUNTY: Early DATE SAMPLED: 03\29\1989															
GWN-PA48	7.4	48.0	1.0 U	3.3	3.0 U	100	10	3.6	2.0 U	1.90	10 U	25	235	Al = 55 Ti = 78	1, 3, 5, 10, CN
WELL NAME: Doug Harvey TW 1 COUNTY: Early DATE SAMPLED: 11\27\1989															
GWN-PA50	7.3	61.0	1.4	2.8	5.0 U	72	10 U	4.4	4.5	0.74	39	180	302	Sn = 31	1, 5
WELL NAME: Reynolds Residence Well COUNTY: Laurens DATE SAMPLED: 06\15\1989															
GWN-PA51	7.6	40.0	1.0 U	2.6	5.0 U	20 U	10 U	3.0	2.0 U	1.70	10 U	17	222	Sn = 25 Zn = 22	1, 5, 7
WELL NAME: Adams Residence Well COUNTY: Mitchell DATE SAMPLED: 07\10\1989															
GWN-PA52	7.8	36.0	1.0 U	2.3	5.0 U	43	10 U	4.4	2.0 U	3.40	10 U	23	215	Sn = 23 Zn = 35	1, 5, 7
WELL NAME: Simmons Residence Well COUNTY: Mitchell DATE SAMPLED: 07\10\1989															

WATER QUALITY FOR THE FLORIDAN AQUIFER SYSTEM

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-PA53 WELL NAME: Cato Residence Well COUNTY: Decatur DATE SAMPLED: 07\11\1989	7.6	41.0	1.1	3.1	5.0 U	20 U	10 U	5.0	2.0 U	3.70	14	27	226	Al = 28 Zn = 120	1, 7
GWN-PA54 WELL NAME: Fields Residence Well COUNTY: Seminole DATE SAMPLED: 07\11\1989	7.7	35.0	1.0 U	1.6	5.0 U	120	10 U	2.1	2.0 U	0.06	10 U	16	185	Sn = 26 Zn = 39	7
GWN-PA55 WELL NAME: Holland Residence Well COUNTY: Burke DATE SAMPLED: 09\13\1989	7.5	61.0	2.8	3.6	2.0 U	70	10 U	2.7	4.0	0.02 U	150	250	255	Ag = 64 Au = 83 Bi = 180 Co = 38 Mo = 36 Sn = 46 V = 37	1, 5
Average:	7.59	46.64	8.99	9.79	0.46 U	58.35	5.8 U	8.22	27.0	0.49	82.65	279.46	329.78		
Maximum:	8.00	120	53	110	4.1	1,200	98	90.2	168.1	6.06	2,500	2300	1380		
Minimum:	7.00	23	1.0 U	1.6	2.0 U	20 U	10 U	2.0 U/ 0.1 D	2.0 U/ 0.4 D	.02 U	10 U	16	180		

WATER QUALITY FOR 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	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-MI1	7.8	24.0	14.0	6.9	2.0 U	400	31	2.9	4.0	0.02 U	21	120	231	Zn = 22	1, 5, 10, CN
WELL NAME: McMillan Residence Well COUNTY: Cook DATE SAMPLED: 02/08/1989															
GWN-MI1	8.1	22.0	13.0	6.5	5.0 U	300	23	2.8	4.0	0.02 U	20	120	245	Bi = 36 Sn = 26	1, 5, 10, CN
WELL NAME: McMillan Residence Well COUNTY: Cook DATE SAMPLED: 07/13/1989															
GWN-MI2	5.7	3.2	1.0 U	2.6	2.0 U	20 U	10 U	3.0	2.0 U	0.02 U	20 U	10 U	40		1, 5, 8, 9, 10
WELL NAME: Boutwell Residence Well COUNTY: Lowndes DATE SAMPLED: 02/07/1989															
GWN-MI2	5.6	3.0	1.0 U	2.3	5.0 U	20 U	10 U	2.7	2.0 U	0.02 U	10 U	10 U	49		1, 5, 8, 9, 10
WELL NAME: Boutwell Residence Well COUNTY: Lowndes DATE SAMPLED: 07/12/1989															
GWN-MI3	7.4	68.0	11.0	20.0	4.0	85	15	23.6	38.9	0.10 U	11	440	496		10
WELL NAME: Coffin Park TW 3 COUNTY: Glynn DATE SAMPLED: 12/20/1989															
GWN-MI4	7.1	16.0	5.1	5.8	2.0 U	410	110	3.0	2.0 U	0.02 U	78	89	140		
WELL NAME: Hopeulikit TW 2 COUNTY: Bulloch DATE SAMPLED: 01/24/1989															

WATER QUALITY FOR THE MIOCENE AQUIFER SYSTEM

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-MI5	5.0	6.2	2.8	5.1	2.9	20 U	170	10.9	2.0 U	6.20	140	40	104	Al = 140	
WELL NAME: Carter Residence Well COUNTY: Appling DATE SAMPLED: 08/28/1989															
GWN-MI6	6.0	14.0	6.7	7.8	2.0 U	210	62	13.7	3.0	7.80	120	110	179	Al = 960 Ti = 67	
WELL NAME: Williams Residence Well COUNTY: Coffee DATE SAMPLED: 08/28/1989															
GWN-MI7	4.3	3.5	3.3	4.4	2.0 U	20 U	10 U	9.4	2.0 U	6.40	64	36	96	Al = 410	
WELL NAME: Chaudoin Residence Well COUNTY: Irwin DATE SAMPLED: 08/29/1989															
GWN-MI8	5.5	1.7	1.0 U	1.7	2.0 U	730	10 U	2.5	2.0 U	0.05	10 U	12	25	Al = 1,000 Cu = 60 Ti = 55 Zn = 27	1, 5
WELL NAME: McCall Residence Well COUNTY: Colquitt DATE SAMPLED: 08/29/1989															
GWN-MI9	4.8	2.3	2.7	17.0	2.0 U	1,300	10	23.3	2.0 U	2.80	58	30	137	Al = 2,700 Ti = 86 Zn = 320	
WELL NAME: Neely Residence Well COUNTY: Thomas DATE SAMPLED: 08/29/1989															
GWN-MI10	5.0	4.7	5.2	22.0	3.9	35	18	24.6	2.0	8.20	260	63	207	Al = 130	1, 5
WELL NAME: Luke Residence Well COUNTY: Colquitt DATE SAMPLED: 08/30/1989															

WATER QUALITY FOR THE MIOCENE AQUIFER SYSTEM

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-MI11	5.3	2.5	1.1	3.9	2.0 U	500	11	5.7	2.0 U	0.86	35	16	45	Al = 1,100 Bi = 23 Ti = 37 Zn = 24	
WELL NAME: Harrison Residence Well COUNTY: Grady DATE SAMPLED: 08/30/1989															
GWN-MI12	7.4	49.0	1.4	2.8	2.0 U	130	15	3.9	2.0 U	0.02 U	13	39	252	Zn = 41	1, 5
WELL NAME: Herzog Greenhouse Well COUNTY: Brooks DATE SAMPLED: 08/30/1989															
GWN-MI13	7.4	56.0	1.0	2.3	2.0 U	2,400	220	2.7	2.0 U	0.02 U	27	52	249		1
WELL NAME: Meeks Rental House Well COUNTY: Screven DATE SAMPLED: 09/14/1989															
GWN-MI14		2.1	1.0 U	7.7	2.0 U	270	10 U	(No sample)			11	10 U	(No sample)	Al = 150 Zn = 22	1, 5
WELL NAME: Thomas Residence Well COUNTY: Bulloch DATE SAMPLED: 09/14/1989															
GWN-MI15	4.4	10.0	8.5	1.8	2.0 U	29	13	9.9	2.0 U	14.70	63	100	154	Al = 220	1, 5
WELL NAME: Aldrich Residence Well COUNTY: Bulloch DATE SAMPLED: 09/14/1989															
Average:	6.05	16.95	4.46	7.09	0.06 U	399	41.06	9.04	3.24	2.94	54.18	74.53	165.6		
Maximum:	8.1	56	14.0	22.0	4.0	2,400	220	24.6	38.9	14.70	260	440	496		
Minimum:	4.3	1.7	1.0 U	1.7	2.0 U	20 U	10 U	2.5	2.0 U	0.02 U	10 U	10 U	25		

WATER QUALITY FOR THE PIEDMONT UNCONFINED AQUIFER SYSTEM

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-P1B WELL NAME: Luthersville New Well COUNTY: Meriwether DATE SAMPLED: 08/30/1989	6.2	7.9	2.4	10.0	2.6	2,500	59	5.4	15.0	0.02 U	10	96	119		
GWN-P2 WELL NAME: Riverdale, Delta Drive Well COUNTY: Clayton DATE SAMPLED: 09/15/1989	6.5	20.0	2.3	11.0	2.8	1,500	86	3.5	2.0 U	1.10	41	110	140	Ag = 52 Au = 68 Bi = 150 Co = 30 Mo = 29 Sn = 30 V = 32	10
GWN-P3 WELL NAME: Fort McPherson Well COUNTY: Fulton DATE SAMPLED: 04/18/1989	7.3	9.4	2.3	9.2	5.0 U	980	43	2.0 U	5.8	0.02 U	14	74	108	(Ethylbenzene = 1) (P,M,&O Xylenes = 2) Al = 110	8, 9, 10
GWN-P3 WELL NAME: Fort McPherson Well COUNTY: Fulton DATE SAMPLED: 10/11/1989	6.5	9.0	2.5	9.3	3.7	6,300	62	0.1	6.9	0.02 U	21	72	108	(Trimethyl benzene = 2) (Ethylmethyl benzene = 2) (P&M Xylenes = 5.2) (O Xylene = 2.2) (Ethylbenzene = 1.3) (Toluene = 5.9) (1,2 Dichloropropane = 1.7) Al = 990 Ni = 24 Ti = 100	8, 9, 10
GWN-P4B WELL NAME: Barton Brands, Inc. #2 COUNTY: Fulton DATE SAMPLED: 04/19/1989	6.6	23.0	4.1	36.0	5.0 U	6,300	1.1	18.8	10.4	0.47	140	350	311	Zn = 290	8, 9, 10
GWN-P4C WELL NAME: Barton Brands, Inc. #3 COUNTY: Fulton DATE SAMPLED: 09/11/1989	6.3	6.1	1.1	8.5	2.0 U	130	13	1.6	2.0 U	0.02 U	16	64	79	Al = 38 Zn = 35	8, 9, 10

WATER QUALITY FOR THE PIEDMONT 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	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-P5	7.0	25.0	4.0	1.6	5.0 U	20 U	10 U	1.0	2.0 U	0.02 U	32	90	158		10
WELL NAME: Flowery Branch #1 COUNTY: Hall DATE SAMPLED: 05/25/1989															
GWN-P6A	7.5	16.0	2.5	8.1	2.1	160	86	2.3	5.5	0.02 U	10	10 U	130	Al = 44	
WELL NAME: Shiloh #1 COUNTY: Harris DATE SAMPLED: 11/30/1989															
GWN-P7	6.4	11.0	4.4	8.6	2.0 U	20 U	10 U	2.0	3.8	0.02 U	59	69	122	V = 11	10
WELL NAME: Hampton #6 COUNTY: Henry DATE SAMPLED: 08/30/1989															
GWN-P8	7.1	33.0	10.0	9.3	5.0 U	20 U	10 U	3.1	19.0	0.02 U	10 U	91	271		
WELL NAME: Wayne Poultry Company #4, Pendergrass COUNTY: Jackson DATE SAMPLED: 05/25/1989															
GWN-P9	6.9	20.0	9.7	15.0	5.0 U	2,000	260	8.5	60.0	0.02 U	48	160	252	Ni = 22 Sb = 46	10
WELL NAME: Gray #4 COUNTY: Jones DATE SAMPLED: 06/13/1989															
GWN-P10A	3.4	9.4	8.3	5.9	5.0 U	30,000	760	2.0	85.0	0.02 U	17	93	326	Al = 620 Au = 33 Bi = 55 Co = 19 Ni = 56 (Tl = 94) Zn = 110	
WELL NAME: Franklin Springs #4 COUNTY: Franklin DATE SAMPLED: 05/23/1989															

WATER QUALITY FOR THE PIEDMONT UNCONFINED AQUIFER SYSTEM

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-P11 WELL NAME: Danielsville #1 COUNTY: Madison DATE SAMPLED: 05/23/1989	6.7	11.0	4.8	6.3	5.0 U	84	17	1.3	3.2	0.02 U	10 U	30	124	Zn = 22	
GWN-P12 WELL NAME: Nabisco Plant Well #1, Woodbury COUNTY: Meriwether DATE SAMPLED: 08/30/1989	5.9	11.0	2.6	15.0	3.8	20 U	10 U	13.9	5.2	3.20	60	81	156		
GWN-P13 WELL NAME: Conyers, Rosser Street Well COUNTY: Rockdale DATE SAMPLED: 08/29/1989	7.4	31.0	1.5	13.0	2.0 U	440	78	5.4	15.5	0.02 U	10 U	83	223	Trichloroethylene = 1.6 (Tetrachloroethylene = 7.8) Al = 120 Mo = 30 Ti = 19 Zn = 29	10
GWN-P14 WELL NAME: Upson County, Sunset Village Well #1 COUNTY: Upson DATE SAMPLED: 08/30/1989 1	5.1	1.0	1.0 U	2.2	2.0 U	27	25 U	2.5	2.0 U	0.32	39	10 U	32	Al = 29	
GWN-P15A WELL NAME: Bolton Rental House COUNTY: Dekalb DATE SAMPLED: 04/19/1989	7.9	20.0	4.7	8.4	5.0 U	480	86	5.9	5.9	0.02 U	74	100	179		10
GWN-P15A WELL NAME: Bolton Rental House COUNTY: Dekalb DATE SAMPLED: 09/11/1989	7.0	19.0	4.7	8.1	4.5	480	88	7.6	6.4	0.02 U	68	97	171	Zr = 17	10

WATER QUALITY FOR THE PIEDMONT 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	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-P16C	7.1	12.0	2.1	3.3	5.0 U	3,500	110	1.0 U	10.0	0.02 U	10 U	67	93	Au = 11 Zn = 47	10
WELL NAME: Mt. Airy #4, Chase Road Well															
COUNTY: Habersham															
DATE SAMPLED: 05/23/1989															
Average:	6.57	15.52	3.95	9.94	1.76 U	2,888.5	92.1	4.47	13.66	0.27	34.16	90.9	163.3		
Maximum:	7.9	33.0	10.0	36.0	4.5	30,000	760	18.8	85.0	3.2	140	350	326		
Minimum:	3.4	1.0	1.0 U	1.6	2.0 U	20 U	10 U	2.0 U/ 0.1 D	2.0 U	0.02 U	10 U	10 U	32		

WATER QUALITY FOR THE BLUE RIDGE UNCONFINED 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	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		
WELL ID#															
GWN-BR1	7.0	11.0	2.4	4.7	5.0 U	54	63	1.2	16.0	0.02 U	43	63	105	Bi = 20	10
WELL NAME: Hiawassee #6															
COUNTY: Towns															
DATE SAMPLED: 05/24/1989															
GWN-BR2B	7.3	11.0	2.8	8.8	5.0 U	300	23	0.8	4.2	0.02 U	10 U	110	113	Zn = 22	
WELL NAME: Notla Water Authority #6															
COUNTY: Union															
DATE SAMPLED: 05/24/1989															
GWN-BR3	8.0	16.0	1.0 U	19.0	5.0 U	20 U	10 U	1.0 U	3.7	0.02 U	10	360	163		
WELL NAME: Dawsonville, Shoal Hole Park Well															
COUNTY: Dawson															
DATE SAMPLED: 05/24/1989															
GWN-BR4	6.5	11.0	2.3	6.9	5.0 U	20 U	10 U	2.5	2.0 U	1.90	10 U	100	106	Bi = 21	10, CN
WELL NAME: Morganton Old Well															
COUNTY: Fannin															
DATE SAMPLED: 05/24/1989															
Average:	7.2	12.25	1.87	9.85	5.0 U	88.5	21.5	1.12	5.97	0.475	13.25	158.2	121.7		
Maximum:	8.0	16.0	2.8	19.0	5.0 U	300	63	2.5	16.0	1.90	43	360	163		
Minimum:	6.5	11.0	1.0 U	4.7	5.0 U	20 U	10 U	1.0 U/ 0.8 D	2.0 U	0.02 U	10 U	63	105		

WATER QUALITY FOR THE VALLEY AND RIDGE UNCONFINED AQUIFER SYSTEM

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-VR1	7.9	26.0	14.0	1.3	5.0 U	20 U	10 U	1.5	2.0 U	0.39	10 U	16	230		10
WELL NAME: Kingston Road Well, Rome COUNTY: Floyd DATE SAMPLED: 07/11/1989															
GWN-VR3	7.2	29.0	11.0	1.3	5.0 U	20 U	10 U	1.6	2.0	0.50	62	26	247	Bi = 30	10
SPRING NAME: Chickamauga, Crawfish Springs COUNTY: Walker DATE SAMPLED: 07/12/1989															
GWN-VR4	7.3	81.0	20.0	14.0	5.0 U	81	19	12.2	66.0	0.02 U	120	670	595	Sn = 60	
WELL NAME: American Thread Company #4 COUNTY: Walker DATE SAMPLED: 07/12/1989															
GWN-VR5	7.4	74.0	3.7	5.1	5.0 U	20 U	10 U	8.2	2.0	2.80	97	180	400	Sn = 37	10
WELL NAME: Chattooga County #4 COUNTY: Chattooga DATE SAMPLED: 07/11/1989															
GWN-VR6	7.6	26.0	15.0	3.4	5.0 U	20 U	10 U	3.0	3.0	0.30	590	110	261	Sn = 31	
WELL NAME: Chemical Products Corporation, East Well COUNTY: Bartow DATE SAMPLED: 07/12/1989															
GWN-VR7	7.3	23.0	12.0	1.0 U	5.0 U	44	10 U	1.2	2.0 U	0.36	26	18	223		10
SPRING NAME: Adairsville, Lewis Spring COUNTY: Bartow DATE SAMPLED: 07/12/1989															

WATER QUALITY FOR 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	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-VR8	7.5	36.0	15.0	1.7	5.0 U	27	10 U	1.1	2.0	1.90	15	25	270	Sn = 25	10
SPRING NAME: Cedartown Spring															
COUNTY: Polk															
DATE SAMPLED: 07/11/1989															
GWN-VR9	7.5	39.0	12.0	1.5	5.0 U	20 U	10 U	2.9	3.0	1.00	13	28	290	Bi = 30	
WELL NAME: Polk County #2														Sn = 21	
COUNTY: Polk															
DATE SAMPLED: 07/11/1989															
Average:	7.46	41.75	12.84	3.66	5.0 U	19	2.4 U	3.96	9.75	0.906	115.4	134.1	314.5		
Maximum:	7.9	81.0	20.0	14.0	5.0 U	81	19	12.2	66.0	2.80	590	670	595		
Minimum:	7.2	23.0	3.7	1.0	5.0 U	20 U	10 U	1.1	2.0 U	0.02 U	10 U	16	223		

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