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Test Drilling Report of Northwest Volusia County

by

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Introduction

In a continuing effort to collect hydrological data necessary for proper water resource management, the Water Resources Department of the St. Johns River Water Management District entered into a cooperative agreement to test drill and construct five observation wells for the U. S. Geological Survey in the vicinity of Pierson, Florida. The information collected from the construction along with the ability to observe artesian water levels of the Floridan aquifer on a continuing basis would aid the USGS in assessing the hydrologic impact of the large withdrawals of ground water used for the protection of ornamental ferns during below freezing temperatures.

Acknowledgements

The Department would like to thank Mr. Al Rutledge of the USGS for securing right-of-way and permits for all sites; Mr. Bill Hendrix of Volusia County Department of Building; the town of Pierson for the use of their water supply; and the Union Camp Corporation, Mr. B. B. Welsh, for their extreme willingness to cooperate and provide drilling sites on their land holdings.

Location and Physiography

Volusia County is situated in the east central part of Florida and is bordered by the Atlantic Ocean to the east and the St. Johns River to the west. The county comprises approximately 1,200 square miles (Figure 1). All test drilling was done in the northwestern

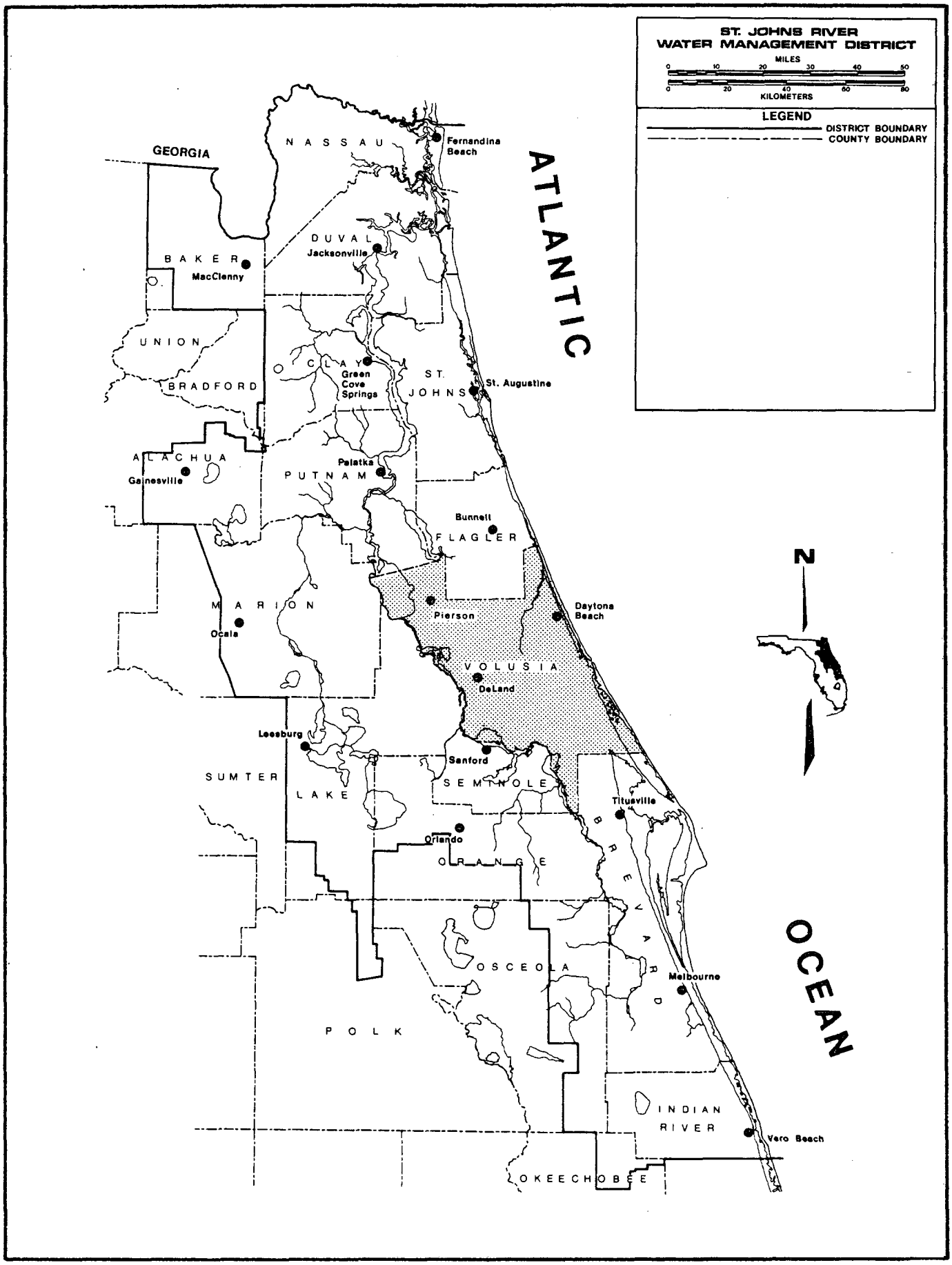

FIGURE 1. -- Map Showing Location of Volusia County Within the St. Johns River Water Management District

locale of the county around the City of Pierson. Physiographically, this area is an extension of the Crescent City Ridge, a marine terrace. This ridge shows many topographical features related to karst processes such as high local relief, dry circular depression, and sinkhole-related ponds and lakes.

Test Drilling

The locations of the five drilling sites are shown in Figure 2. The basic objectives of the program were to (1) collect hydrological data and (2) provide the USGS with monitoring wells to observe Floridan aquifer water levels and quality. Construction of the wells was performed using a CME-75 model drill rig, applying standard rotary construction methods. The basic procedure used on all five wells was as follows:

1. Collect and describe samples every 10 feet or change in formation during drilling of the unconsolidated material;
2. Set and grout into place 4-inch Polyvinyl Chloride (PVC) schedule 40 casing to the top of the limestone (well 5, galvanized steel casing installed);
3. Rotary drilling to a depth necessary to encounter the Avon Park limestone formation when possible (wells 2 and 3);
4. Continuous wire-line coring of the limestone to the top of the Avon Park formation when possible (wells 1, 4, and 5);
5. Develop well using a portable centrifugal pump to insure accurate water level measurements; and

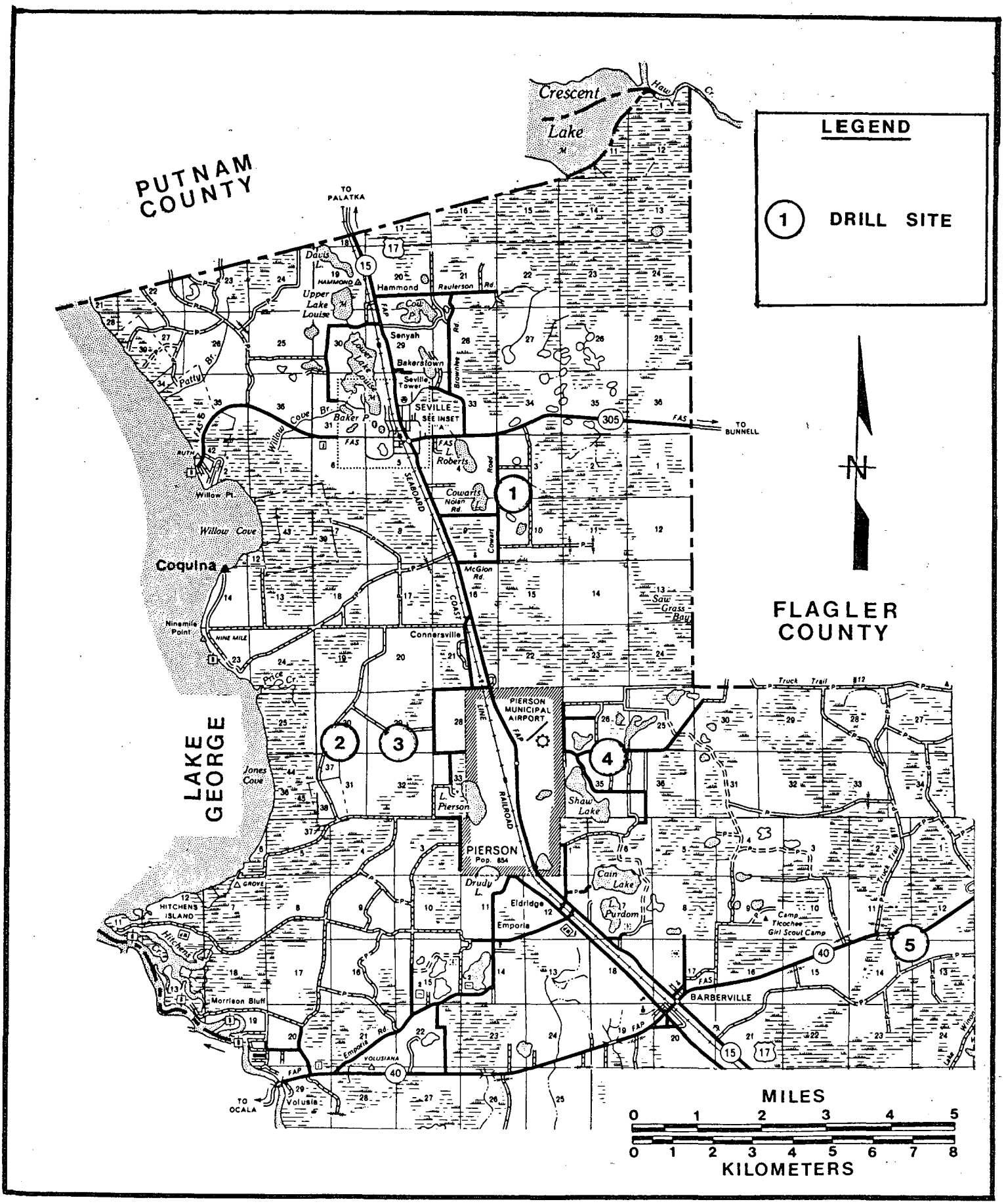

FIGURE 2. -- Map Showing Location of Drill Sites in the Vicinity of Pierson, Volusia County, Florida

6. Geophysically log the wells to aid in the correlation of cores and cuttings.

Samples taken from those wells which were successfully cored were sent to the State of Florida, Bureau of Geology, for description and analysis (Appendix A). Information concerning the data collected during well construction is shown diagrammatically in Figures 3 through 7. Field descriptions of the drill cuttings taken during construction are included in Appendix B. Also provided herein is Figure 8, a map showing the locations of the geologic data used in the construction of Figure 9, a fence diagram that illustrates the stratigraphic relationship of geologic units in the study area. Figure 10 shows the location of hydrogeological data points used in the area to construct a thickness of confining unit map (Figure 11). This map is based on the correlation of drillers' and geophysical logs of successive clay units which appear in the Miocene or Pliocene sediments. Also, from those same data locations, a top (elevation) of the Eocene limestone map (Figure 12) is presented.

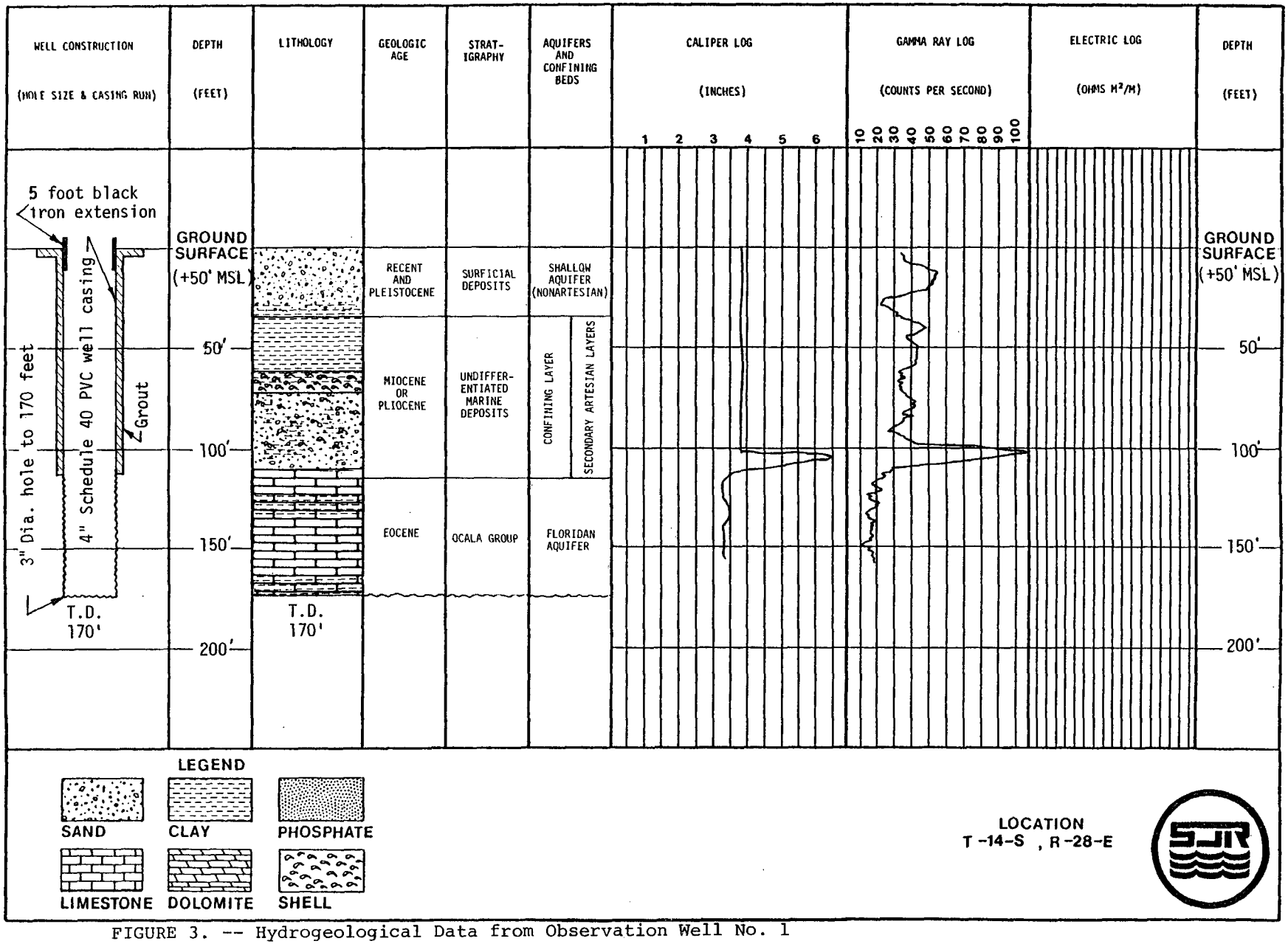

FIGURE 3. -- Hydrogeological Data from Observation Well No. 1

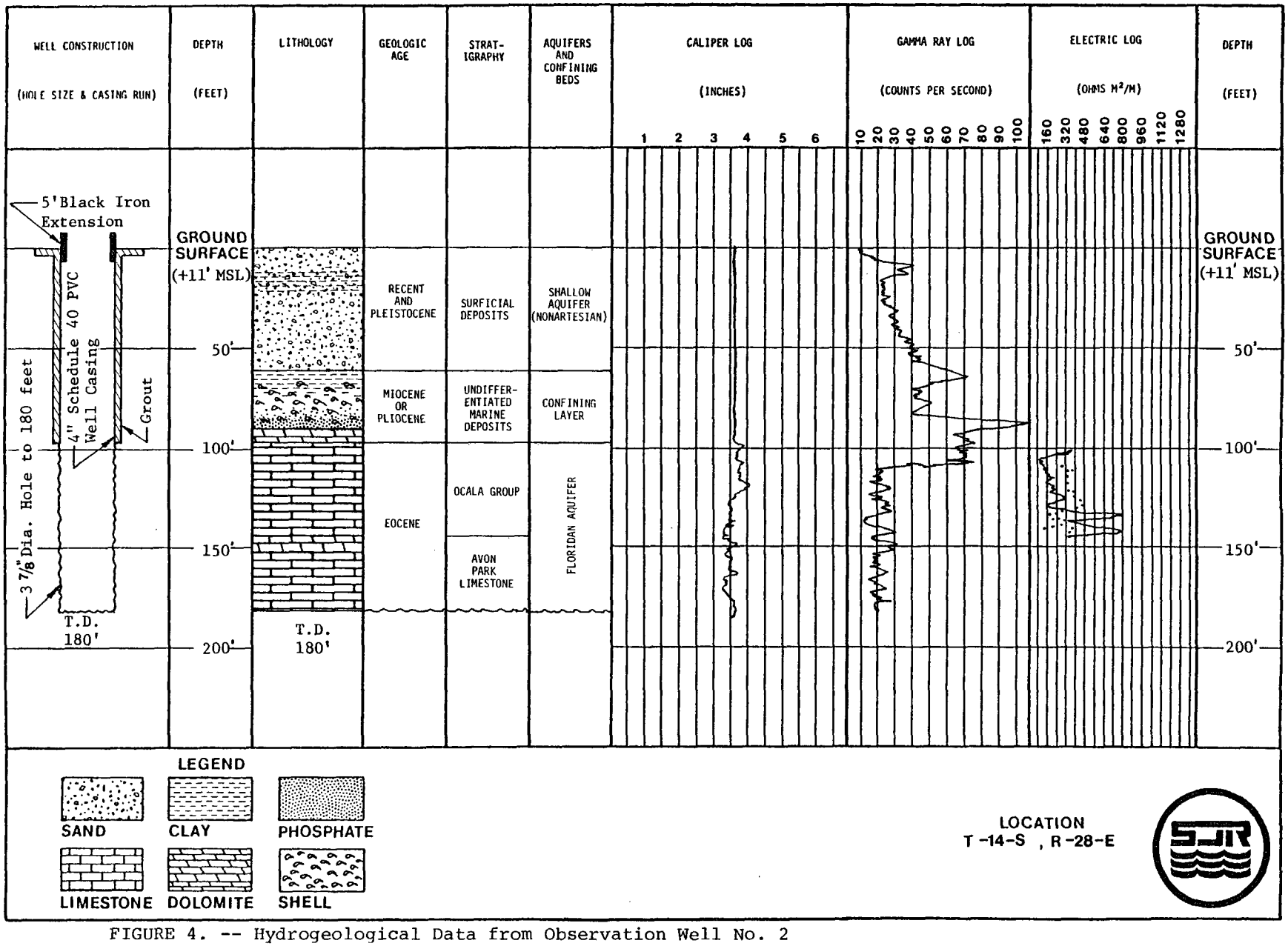

FIGURE 4. -- Hydrogeological Data from Observation Well No. 2

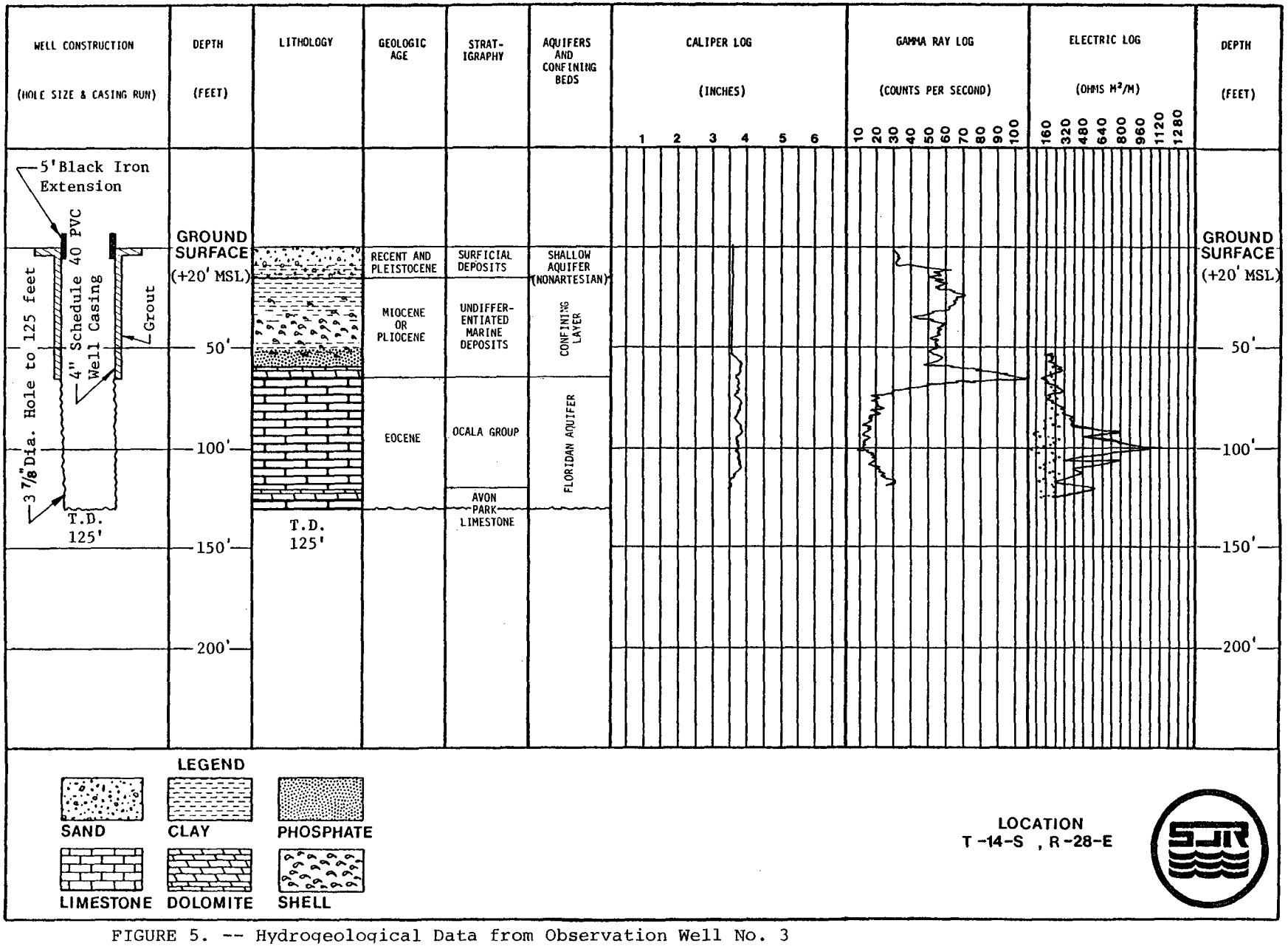

FIGURE 5. -- Hydrogeological Data from Observation Well No. 3

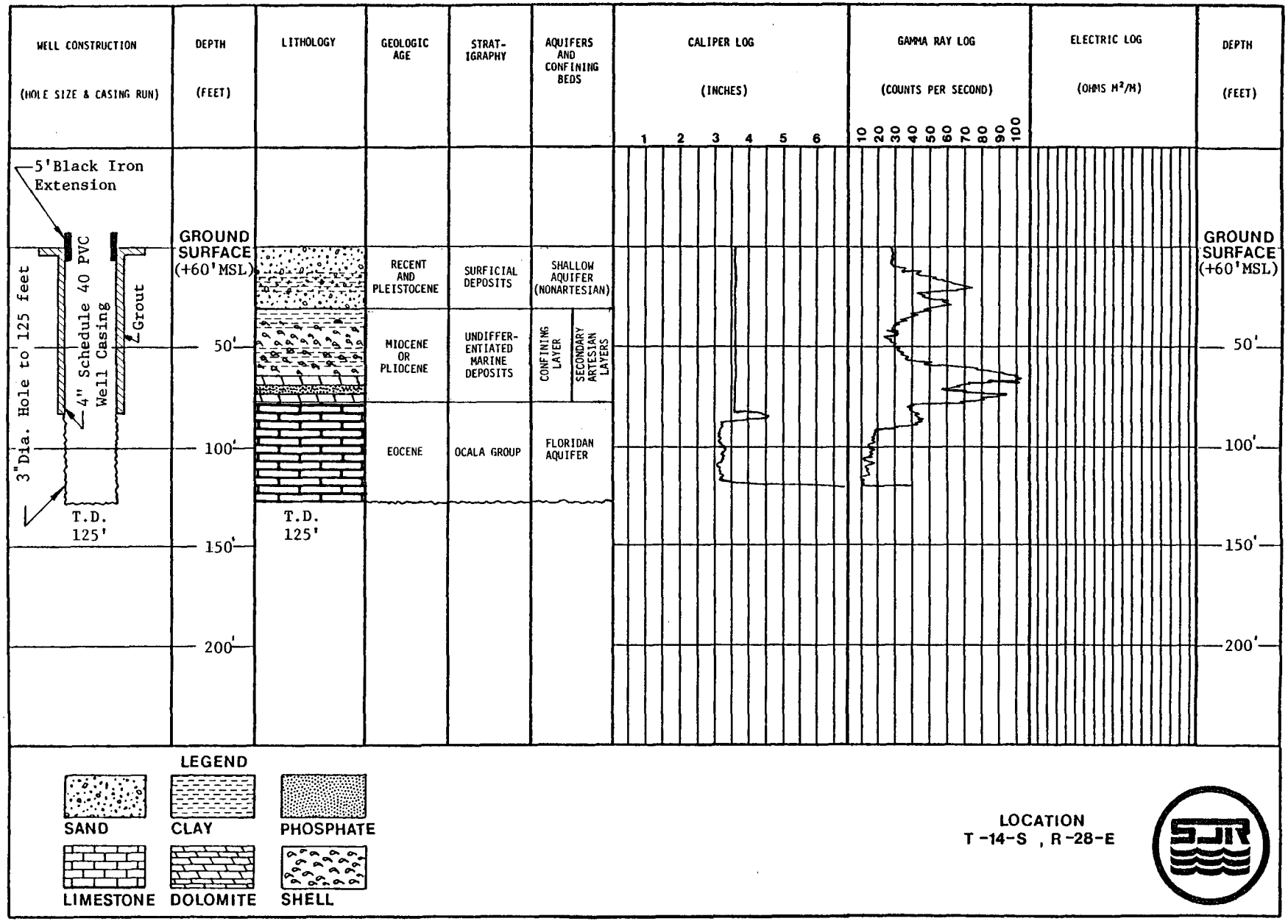

FIGURE 6. -- Hydrogeological Data from Observation Well No. 4

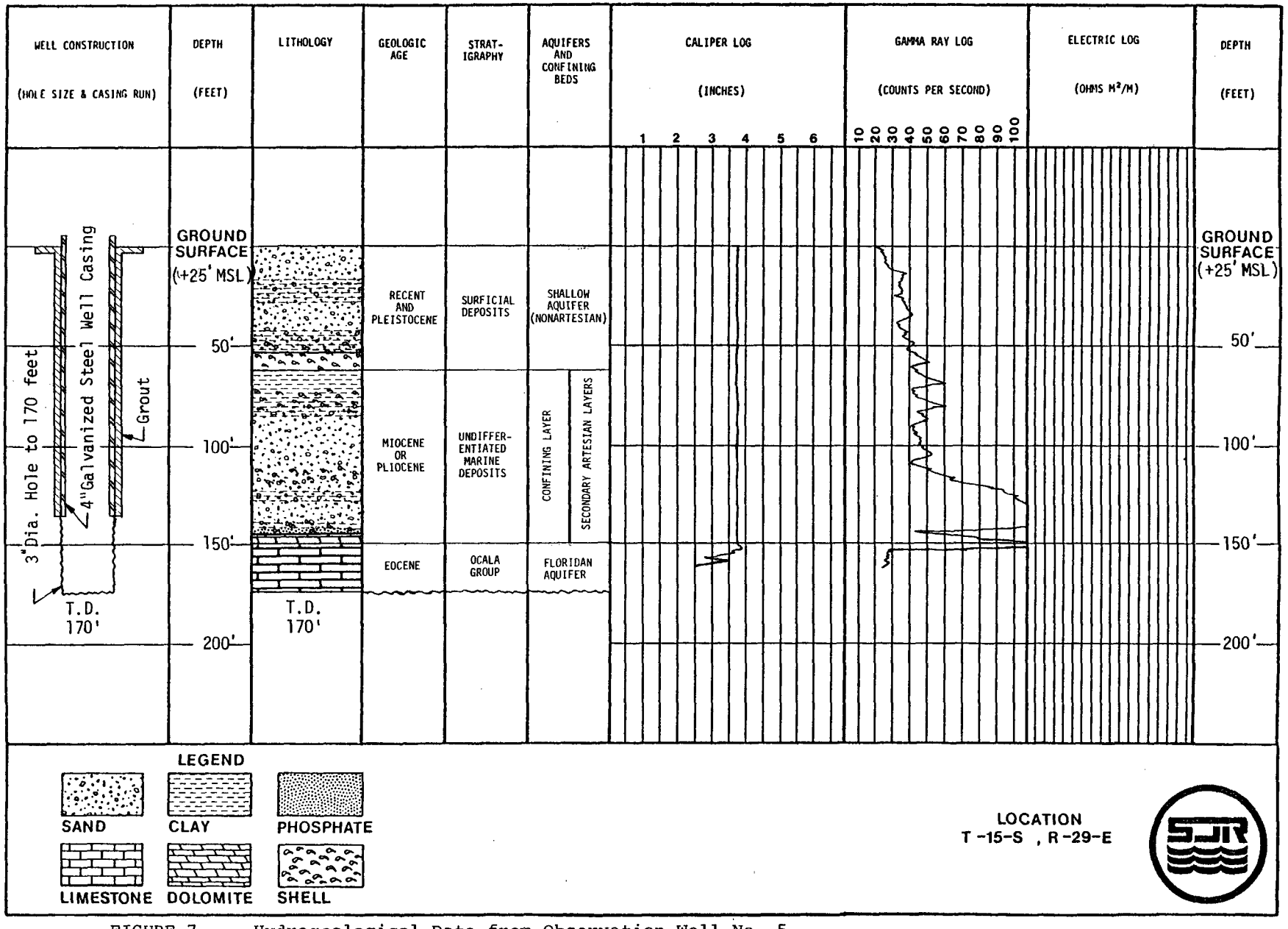

FIGURE 7. -- Hydrogeological Data from Observation Well No. 5

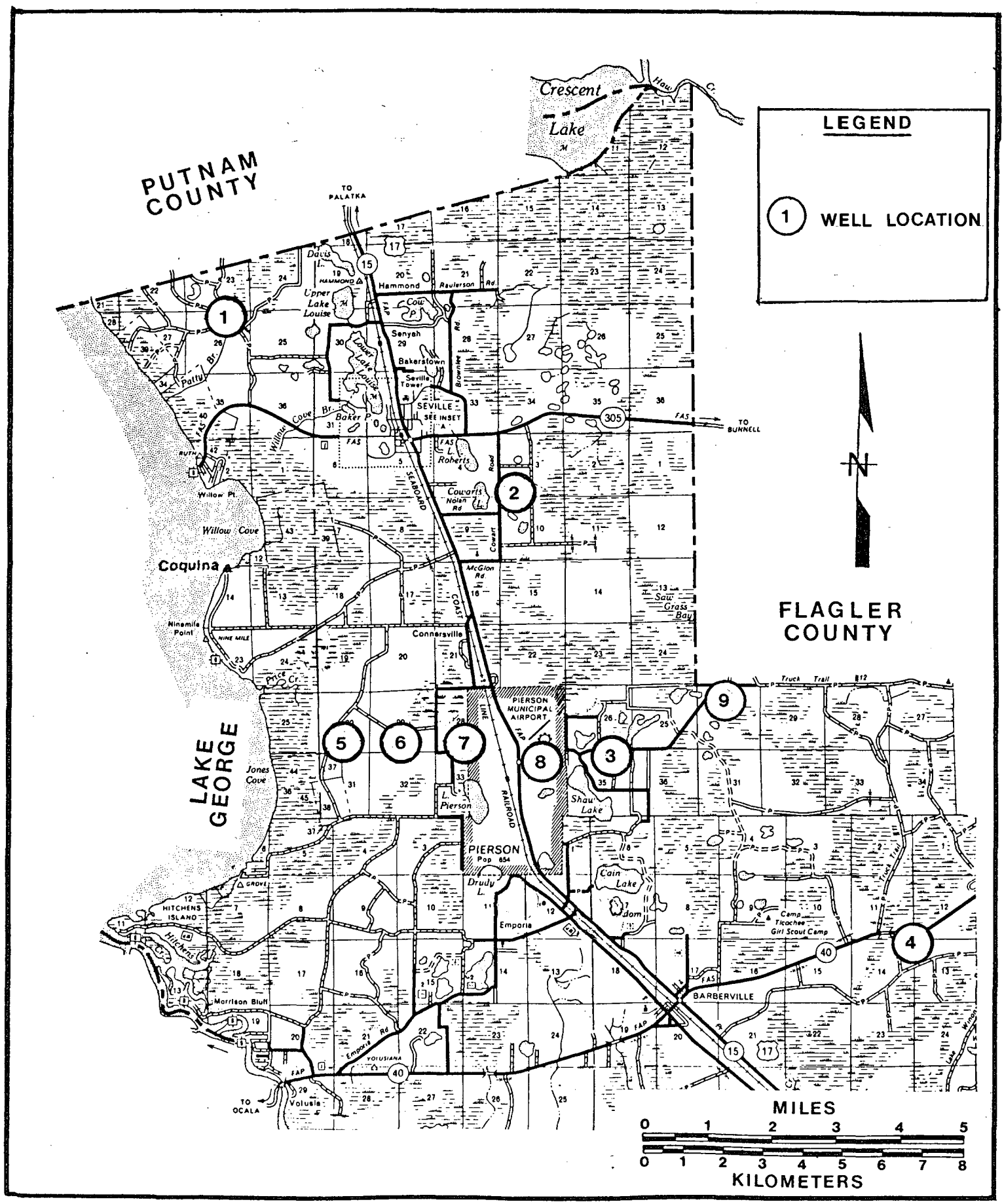

FIGURE 8. -- Location Map of Geological Data Points Used in the Construction of the Fence Diagram

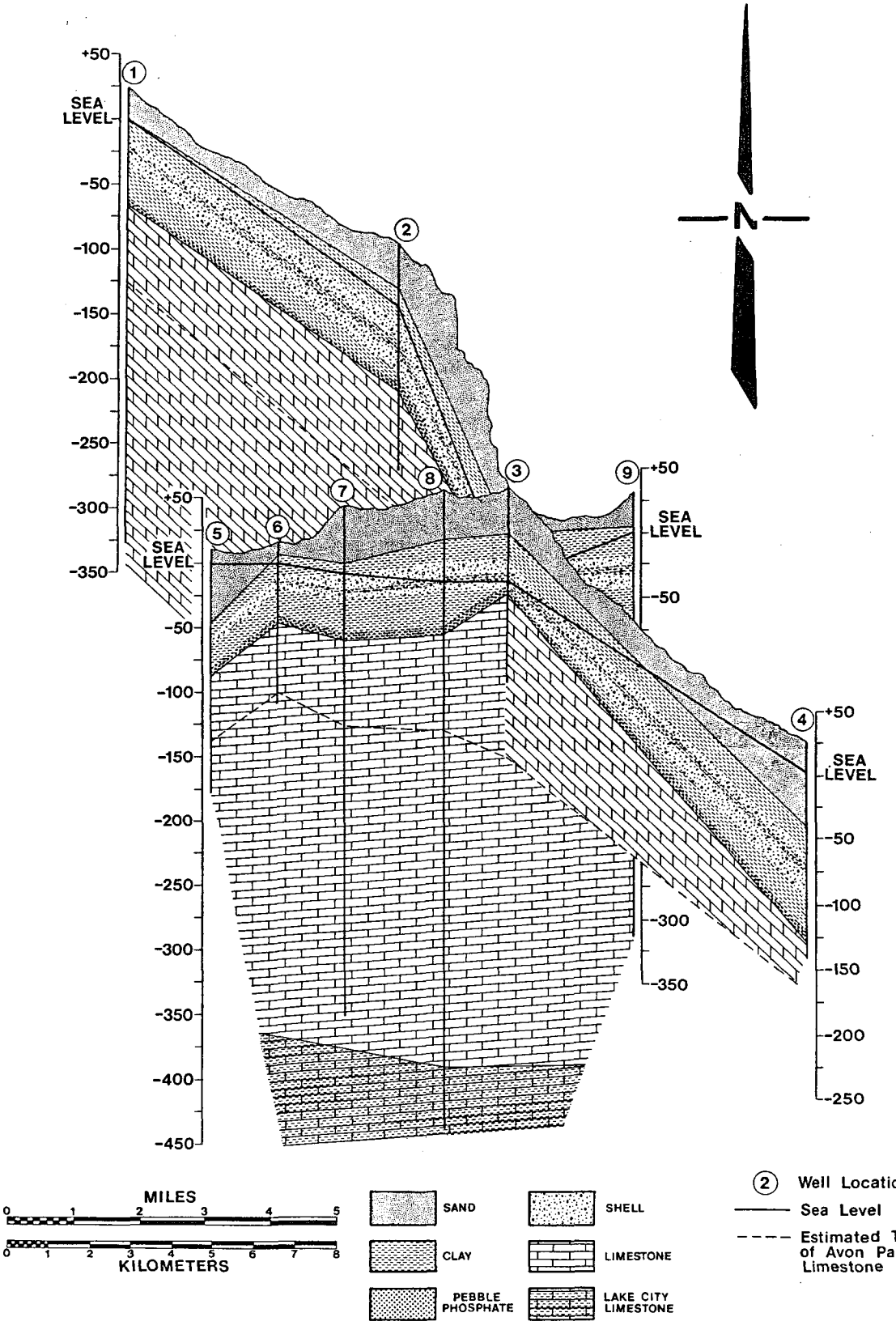

FIGURE 9. -- Fence Diagram of Pierson and the Surrounding Area

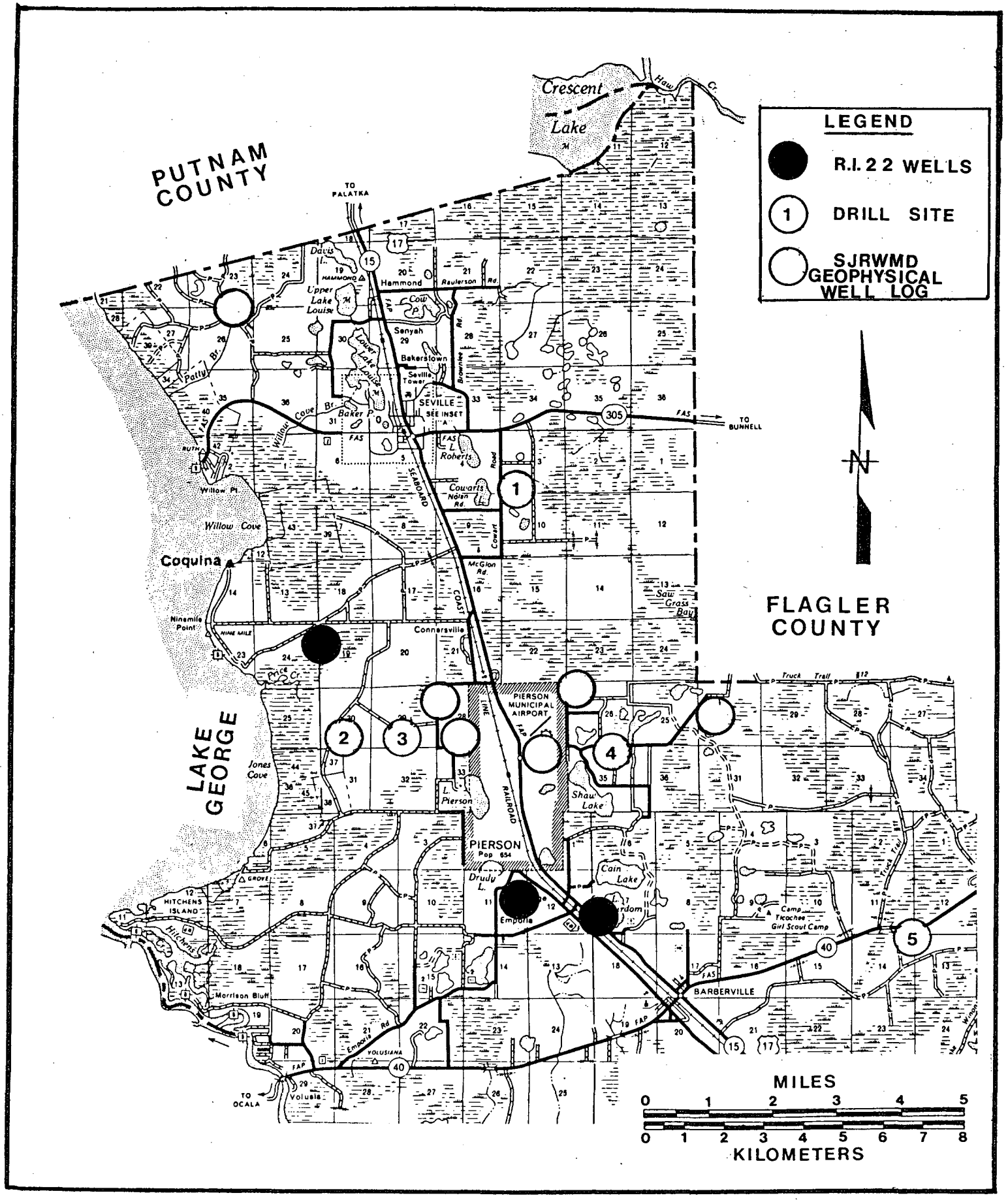

FIGURE 10. -- Map Showing the Source and Location of Pertinent Hydrogeological Data Points Used in the Construction of Figures 11 and 12

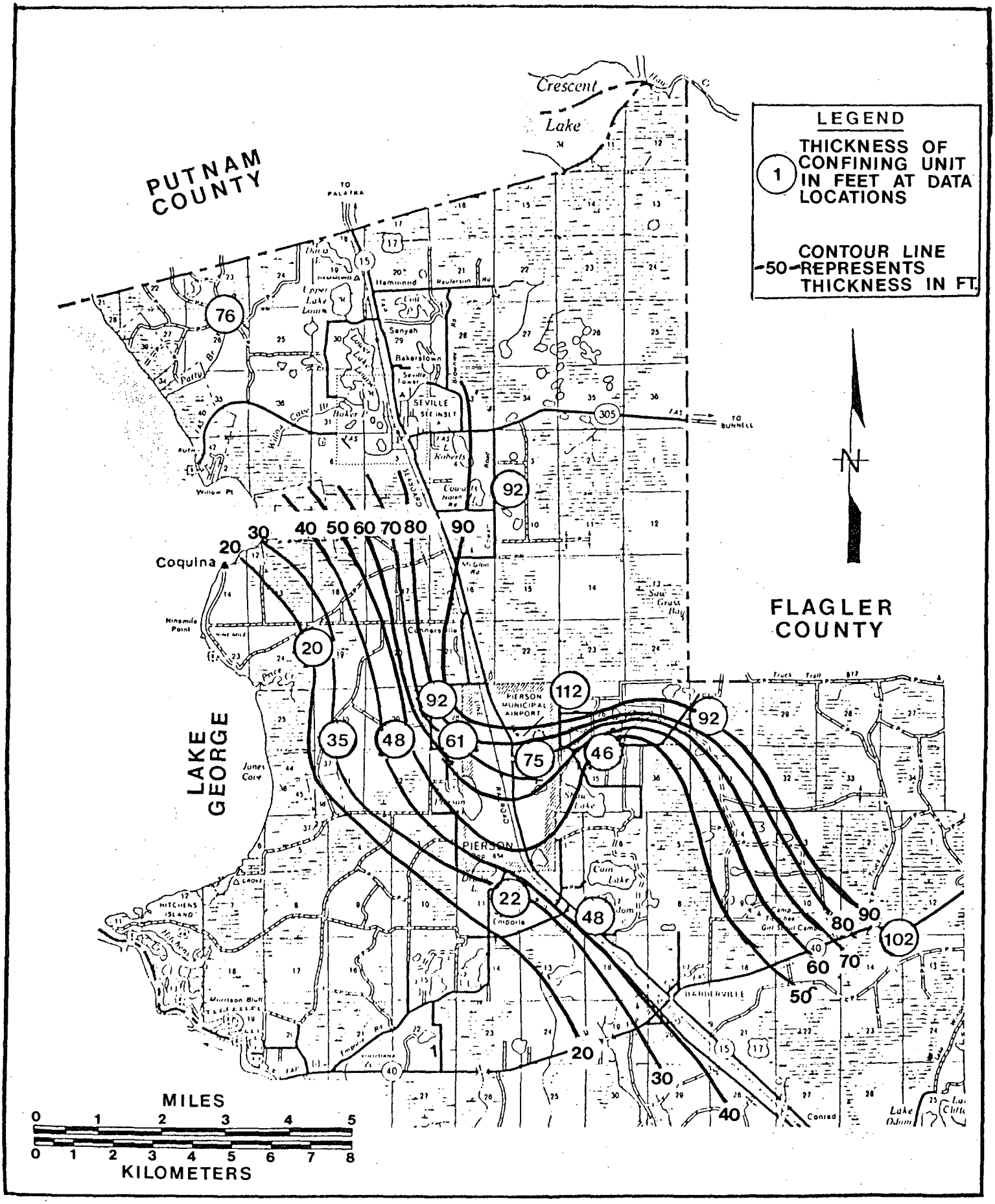

FIGURE 11. -- Map Showing the Thickness of the Confining Unit, Miocene and/or Pliocene Sediments

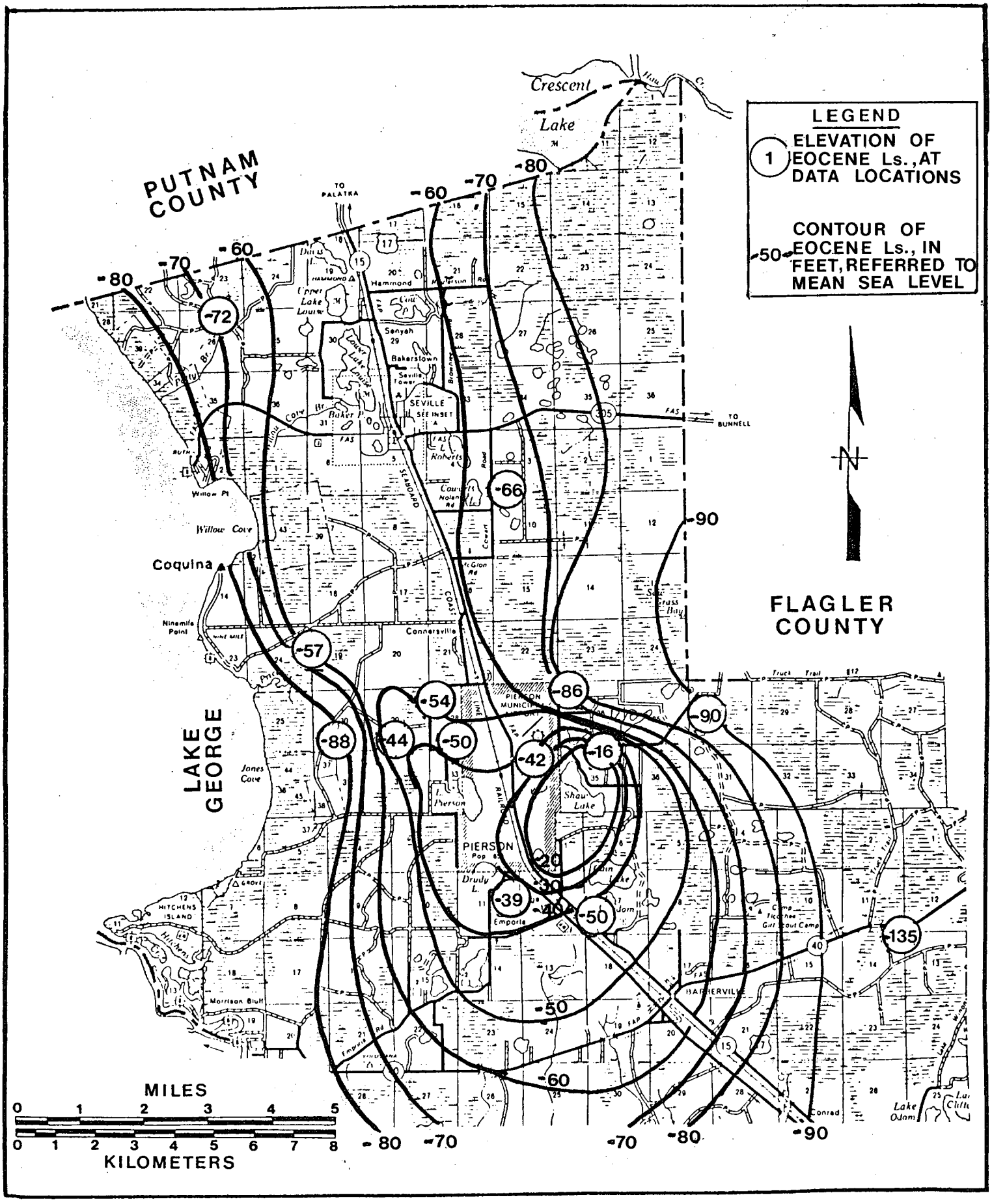

FIGURE 12. -- Map Showing the Top of the Eocene Limestone in Reference to Mean Sea Level

REFERENCE

Wyrick, Granville C., 1960. The ground water resources of Volusia County, Florida: Florida Geological Survey, Report of Investigation No. 22.

APPENDIX A

Cored Sample Descriptions by State of Florida, Bureau of Geology

GLOSSARY OF ABBREVIATIONS USED ON COMPUTER PRINTOUT

A	NW/4 of Section
AA. CO.	Alachua Co.
AN	Anhydrite
ANHYD	"
B	NE/4 of Section
BF. CO.	Bradford Co.
BIOTURBED	Bioturbated
BK	Black
BK. CO.	Baker Co.
BR	Brown
BU	Blue
BV. CO.	Brevard Co.
BW. CO.	Broward Co.
BY. CO.	Bay Co.
C	SW/4 of Section
CALCAREN	Calcarenite
CH. CO.	Charlotte Co.
CI. CO.	Citrus Co.
CHALC	Chalcedony
CMT	Cement
CN. CO.	Calhoun Co.
CO. CO.	Columbia Co.
CR. CO.	Collier Co.
CRSE	Coarse
CRYP	Cryptocrystalline
CY. CO.	Clay Co.
D	SE/4 of Section
DD. CO.	Dade Co.
DK	Dark
DOL	Dolomite
DOLOM	"
DS. CO.	DeSoto Co.
DU. CO.	Duval Co.
DX. CO.	Dixie Co.
E	East
ES. CO.	Escambia Co.
FE STAIN	Iron stain
FG. CO.	Flagler Co.
FK. CO.	Franklin Co.
FL	Florida
FORAMINIF	Foraminifera
FOSS	Fossil
FRAG	Fragment(s)
GA. CO.	Gadsden Co.
GF. CO.	Gulf Co.
GL. CO.	Glades Co.
GLAUCONTE	Glauconite
GN	Green
GR. CO.	Gilchrist Co.
GRAN	Granule
GRAV	Gravel
GRDED	Graded
GY	Gray
GYPSM	Gypsum
HD. CO.	Hardee Co.
HEAVY MIN	Heavy Minerals
HI	High
HI. CO.	Highlands Co.
HL. CO.	Hillsborough Co.
HM. CO.	Hamilton Co.
HO. CO.	Holmes Co.
HR. CO.	Hernando Co.
HY. CO.	Hendry Co.
IN	Inclusion
IND	Induration
INTERCRYS	Intercrystalline
INTERGRAN	Intergranular
INTRACLAS	Intraclast
INTRAGRAN	Intragranular
IR. CO.	Indian River Co.
LB. CO.	Liberty Co.
LE. CO.	Lee Co.
LF. CO.	Lafayette Co.
LITH	Lithographic
LK. CO.	Lake Co.
LN. CO.	Leon Co.
LO	Low
LT	Light
LV. CO.	Levy Co.
MD	Medium or Moderate
MD. CO.	Madison Co.
MED	Medium
METAMORPH	Metamorphic
MICR	Microcrystalline
MICRT	Micrite
MN. CO.	Manatee Co.
MN OXIDE	Manganese oxide
MO. CO.	Monroe Co.
MR. CO.	Marion Co.
MT. CO.	Martin Co.
N	North
NA. CO.	Nassau Co.
NOT OBS	Not observed
OA. CO.	Okaloosa Co.
OE. CO.	Okeechobee Co.
OL	Olive
OOL CAST	Oolite cast
OR	Orange
OR. CO.	Orange Co.
ORTHOQTZT	Orthoquartzite
OS. CO.	Osceola Co.
P P VUGS	Pin point vugs
PB. CO.	Palm Beach Co.
PCT	Percent
PEL CAST	Pellet cast
PERM	Permeability
PHOS	Phosphate
PI. CO.	Pinellas Co.
PLANT REM	Plant remains
PK	Pink
PO. CO.	Polk Co.
PR	Purple
PS. CO.	Pasco Co.
PU. CO.	Putnam Co.
QTZ	Quartz
R	Range
RD	Red
RECRYS	Recrystallization
REM	Remains
S	South
SA. CO.	Sarasota Co.
SAMP	Sample(s)
SATUR	Saturated
SE. CO.	Seminole Co.
SEC	Section
SILIC	Siliceous
SJ. CO.	St. Johns Co.
SKEL CAST	Skeletal cast
SL. CO.	St. Lucie Co.
SM. CO.	Sumter Co.
SPAR	Crystalline calcite
SPH	Sphericity
SR. CO.	Santa Rosa Co.
STROMATAL	Stromatalitic
SUB-ANG	Sub-angular
SW. CO.	Suwannee Co.
T	Township
TRAC.	Track or trace
TRANSPAR	Transparent
TTH	Tooth
TY. CO.	Taylor Co.
UN. CO.	Union Co.
V	Very
VC	Very coarse
VF	Very fine
VARIGATED	Variegated
VERTEBRAT	Vertebrate
VO. CO.	Volusia Co.
W	West
WK. CO.	Wakulla Co.
WL. CO.	Walton Co.
WS. CO.	Washington Co.
X BEDDED	Cross bedded
XL	Crystal
XLS	Crystals
YL	Yellow

FLORIDA BUREAU OF GEOLOGY - LITHO LOG

W14181C

VOLUSIA CO. T14S R28E SEC 10AA 29 18 23 N 81 28 08 W
TOTAL DEPTH- 166 FT. ELEV.- 50 FT. 13 SAMPLES- 115- 166 FT.
COMPLETED- 79.02.27 DEPTH WORKED 166 FT.

OTHER GEOPHYSICAL LOGS AVAILABLE -

CALIPHER
GAMMA

WELL NAME-
USGS NO. 1
REMARKS-
WORKED BY B.A. REIK

STRATIGRAPHIC FORMATIONS -

115.0- 166.0 OCALA LIMESTONE LOWER MEMBER

LITHOLOGIC LOG
W-14181C. VOLUSIA CO. T14S, R28E, SEC 10AA

115.0 LIMESTONE, V LT OR, 22 PERCENT POROSITY-INTERGRAN, MOLDIC, GRAINTYPE- BIOGENIC, SKELETAL, MICRITE, 80 PCT. ALLOCHEMS, SIZE- MED, RANGE- MICR-CRSE, MOD IND,SPARRY CALCITE CMT , MICRT CMT,LO RECRYS,FORAMINIF,MOLLUSKS,

117.0 LIMESTONE, V LT OR, 25 PERCENT POROSITY-INTERGRAN, MOLDIC, GRAINTYPE- BIOGENIC, SKELETAL, MICRITE, 85 PCT. ALLOCHEMS, SIZE- MED, RANGE- MICR-CRSE, MOD IND,SPARRY CALCITE CMT , MICRT CMT,LO RECRYS,MOLLUSKS ,FORAMINIF,ECHINOID ,

123.0 AS ABOVE ,
SOFT CORE SECTION BELOW MISSING

127.0 LIMESTONE, V LT OR, 25 PERCENT POROSITY-INTERGRAN, MOLDIC, GRAINTYPE- BIOGENIC, SKELETAL, 85 PCT. ALLOCHEMS,SIZE- MED, RANGE- MICR-CRSE, MOD IND,SPARRY CALCITE CMT ,MD RECRYS, FORAMINIF,MOLLUSKS ,ECHINOID ,
BURROW REPLACED BY SPARRITE MICRITE

133.0 LIMESTONE,MD OR PK, 25 PERCENT POROSITY-INTERGRAN, MOLDIC, GRAINTYPE- BIOGENIC, SKELETAL, MICRITE, 85 PCT, ALLOCHEMS, SIZE-FINE, RANGE- MICR- MED, MOD IND,SPARRY CALCITE CMT , MICRT CMT, 05 PCT, SAND(QTZ),LO RECRYS,FORAMINIF,

137.0 LIMESTONE,MD OR PK, 22 PERCENT POROSITY-INTERGRAN, MOLDIC, INTERCRYS,GRAINTYPE- BIOGENIC, SKELETAL, 85 PCT. ALLOCHEMS, SIZE- MED, RANGE- MICR-CRSE, MOD IND,SPARRY CALCITE CMT , HI RECRYS,FORAMINIF,ECHINOID ,

142.0 LIMESTONE,MD OR PK, 22 PERCENT POROSITY-INTERGRAN, MOLDIC, INTERCRYS,GRAINTYPE- BIOGENIC, SKELETAL, CRYSTAL, 85 PCT. ALLOCHEMS,SIZE- MED, RANGE- MICR-CRSE, MOD IND,SPARRY CAL CITE CMT ,MICRT CMT, 01 PCT. SAND(QTZ),MD RECRYS,

W14181C (continued)

146.0 LIMESTONE, V LT OR, 20 PERCENT POROSITY-INTERGRAN, MOLDIC, INTERCRYS,GRAINTYPE- BIOGENIC, SKELETAL, 85 PCT, ALLOCHEMS, SIZE-FINE, RANGE- V F-CRSE, MOD IND,SPARRY CALCITE CMT , LO RECRYS,MOLLUSKS ,ECHINOID ,FORAMINIF,
ABUNDANT PELECYPOD SHELLS

152.0 LIMESTONE, V LT OR, 25 PERCENT POROSITY-INTERGRAN, MOLDIC, INTERCRYS,GRAINTYPE- BIOGENIC, SKELETAL, 85 PCT. ALLOCHEMS, SIZE-FINE, RANGE- V F-CRSE, MOD IND,SPARRY CALCITE CMT , MD RECRYS,FORAMINIF,

158.0 AS ABOVE ,

162.0 LIMESTONE, WHITE, 20 PERCENT POROSITY-INTERGRAM, MOLDIC, GRAINTYPE- BIOGENIC, SKELETAL, 60 PCT. ALLOCHEMS,SIZE-FINE, RANGE- MICR- MED, MOD IND,MICRT CMT,SPARRY CALCITE CMT , PYRITE,LO RECRYS,

166.0 AS ABOVE ,
TD

FLORIDA BUREAU OF GEOLOGY - LITHO LOG

W-14183C
VOLUSIA CO. T14S R28E SEC 35AB 29 14 31 N 81 26 30 W
TOTAL DEPTH- 125 FT. ELEV.- 60 FT. 8 SAMPLES- 91- 125 FT.
COMPLETED- 79.02.08 DEPTH WORKED 125 FT.

OTHER GEOPHYSICAL LOGS AVAILABLE -

CALIPHER
GAMMA

WELL NAME-
USGS NO. 4
REMARKS-
WORKED BY B.A. REIK

STRATIGRAPHIC FORMATIONS -

91.0- 125.0 OCALA LIMESTONE LOWER MEMBER

LITHOLOGIC LOG
W-14183C. VOLUSIA CO. T14S, R28E, SEC 34AB

91.0 LIMESTONE, V LT OR, 20 PERCENT POROSITY-INTERGRAN, MOLDIC, GRAINTYPE- BIOGENIC, SKELETAL, 85 PCT. ALLOCHEMS,SIZE- MED, RANGE- V F-CRSE, MOD IND,SPARRY CALCITE CMT ,MICRT CMT, LO RECRYS,FORAMINIF,MOLLUSKS ,
96.0 LIMESTONE, WHITE, V LT OR, 16 PERCENT POROSITY-INTERGRAN, MOLDIC,GRAINTYPE- BIOGENIC, SKELETAL, 75 PCT. ALLOCHEMS, SIZE- MED, RANGE- MICR-CRSE, MOD IND,MICRT CMT,SPARRY CAL CITE CMT ,FORAMINIF,MOLLUSKS ,
99.0 LIMESTONE, V LT OR, 20 PERCENT POROSITY-INTERGRAN, MOLDIC, GRAINTYPE- BIOGENIC, SKELETAL, 85 PCT, ALLOCHEMS,SIZE- MED, RANGE- V F-CRSE, POOR IND,SPARRY CALCITE CMT ,MICRT CMT, LO RECRYS,FORAMINIF,MOLLUSKS ,
106.0 AS ABOVE ,
113.0 LIMESTONE, V LT OR, WHITE, 20 PERCENT POROSITY-INTERGRAN, MOLDIC,GRAINTYPE- BIOGENIC, SKELETAL, 80 PCT. ALLOCHEMS, SIZE- MED, RANGE- MICR-CRSE, GOOD IND,SPARRY CALCITE CMT , MICRT CMT,LO RECRYS,FORAMINIF,MOLLUSKS ,
118.0 LIMESTONE, WHITE, 12 PERCENT POROSITY-INTERGRAN, MOLDIC, GRAINTYPE- BIOGENIC, SKELETAL, 60 PCT. ALLOCHEMS,SIZE- MED, RANGE- MICR-CRSE, GOOD IND,SPARRY CALCITE CMT ,MICRT CMT, 01 PCT. SAND(QTZ),LO RECRYS,FORAMINIF,MOLLUSKS ,
123.0 AS ABOVE ,
125.0 LIMESTONE, V LT OR, MD OR PK, 18 PERCENT POROSITY-INTERGRAN, MOLDIC,GRAINTYPE- BIOGENIC, SKELETAL, 90 PCT. ALLOCHEMS, SIZE- MED, RANGE- MICR-CRSE, MOD IND,SPARRY CALCITE CMT , MICRT CMT,LO RECRYS,FORAMINIF,MOLLUSKS ,
TD

FLORIDA BUREAU OF GEOLOGY - LITHO LOG

W-14182C
VOLUSIA CO. T15S R29E SEC 14AB 29 12 16 N 81 21 55 W
TOTAL DEPTH- 170 FT. ELEV.- 25 FT. 7 SAMPLES- 146- 170 FT.
COMPLETED- 79.02.10 DEPTH WORKED 170 FT.

OTHER GEOPHYSICAL LOGS AVAILABLE-

CALIPHER
GAMMA

WELL NAME-
USGS NO. 5
REMARKS-
WORKED BY B.A. REIK

STRATIGRAPHIC FORMATIONS -

146.0- 170.0 OCALA LIMESTONE LOWER MEMBER

LITHOLOGIC LOG
W-14182C. VOLUSIA CO. T15S, R29E, SEC 14AB

146.0 DOLOMITE , YL GY, 10 PERCENT POROSITY-INTERGRAN, P P VUGS, 50-90 PCT. ALTERED ,SUBHEDRAL,SIZE- V F, RANGE- V F-FINE, GOOD IND,DOLOM CMT,
151.0 LIMESTONE, YL GY, GY OR, 25 PERCENT POROSITY-INTERGRAN, MOLDIC,GRAINTYPE- BIOGENIC, CRYSTAL, 85 PCT. ALLOCHEMS, SIZE-FINE, RANGE- MICR- MED, POOR IND,SPARRY CALCITE CMT , HI RECRYS,
155.0 LIMESTONE, V LT OR, WHITE, 20 PERCENT POROSITY- MOLDIC, INTERGRAN,GRAINTYPE- BIOGENIC, SKELETAL, 80 PCT. ALLOCHEMS, SIZE-FINE, RANGE- MICR- MED, MOD IND,SPARRY CALCITE CMT , MICRT CMT,MD RECRYS,FORAMINIF,
160.0
162.0 LIMESTONE, V LT OR, 20 PERCENT POROSITY- MOLDIC,INTERGRAN, GRAINTYPE- BIOGENIC, SKELETAL, 70 PCT. ALLOCHEMS,SIZE-FINE, RANGE- MICR- MED, MOD IND,SPARRY CALCITE CMT ,MICRT CMT, MD RECRYS,LO RECRYS,FORAMINIF,MOLLUSKS ,
165.0 LIMESTONE, V LT OR, 22 PERCENT POROSITY- MOLDIC,INTERGRAN, GRAINTYPE- BIOGENIC, SKELETAL, 80 PCT. ALLOCHEMS,SIZE-FINE, RANGE- MICR- MED, MOD IND,SPARRY CALCITE CMT ,MICRT CMT, LO RECRYS,FORAMINIF,MOLLUSKS ,
170.0 LIMESTONE, V LT OR, MD OR PK, 25 PERCENT POROSITY- MOLDIC, INTERGRAN,GRAINTYPE- BIOGENIC, SKELETAL, 85 PCT. ALLOCHEMS, SIZE- MED, RANGE- MICR- MED, MOD IND,SPARRY CALCITE CMT , MOLLUSKS ,FORAMINIF,
TD

APPENDIX B

Descriptions of Well Cuttings

LITHOLOGIC LOG

OBSERVATION WELL NO. 1

Owner:	Cowart
County:	Volusia
Location:	A) 29° 18' 23" N 081° 28' 08" W B) T14S, Sec. 3, R28E
Drilled by:	St. Johns River Water Management District
Ground Elevation:	+50 feet MSL
Drill Rig:	CME-75
Started:	January 9, 1979
Completed:	January 15, 1979
Total Depth:	170 feet
Casing:	113 feet

Depth (feet)	Pleistocene to Recent
0 - 5	Sand, gray and white, fine to medium in size
5 - 12	Sand, silt, brown organic
12 - 34	Sandy clay, gray
	Miocene or Pliocene
34 - 44	Hard, gray sandy clay
44 - 64	Gray clay with some sand
64 - 74	Gray clay with fragmented white shell
74 - 84	Cemented broken shell with gray clay and sand
84 - 94	Broken, fragmented, shell-decreasing clay content

OBSERVATION WELL NO. 1 (continued)

Depth (feet)	Miocene or Pliocene (cont'd)
94 - 104	White and gray fragmented shell, no clay
104 - 109	Broken shell, slightly cemented with some gray clay and hard fragmented gray rock
109 - 114	White, granular cemented limestone, fragmented gray and tan rock with broken shell, trace amounts of pebble phosphate
	Eocene
	Ocala Group
114 - 117	White limestone, well cemented, some pelecypods and bryozoans
117 - 127	Hard and soft zone of well cemented limestone, large granular in nature
127 - 135	Fine grained white to buff tan limestone
135 - 137	Coarse grained limestone, same as above
137 - 144	Fine grained white limestone
144 - 160	Medium to coarse grained limestone, light gray in color grades to tan
160 - 162	Soft tan limestone grades to fine grained, hard, well cemented limestone
162 - 166	Very fine grained tan limestone

LITHOLOGIC LOG

OBSERVATION WELL NO. 2

Owner:	Union Camp
County:	Volusia
Location:	A) 29° 15' 02" N 081° 30' 32" W B) T14S, Sec. 30, R28E
Drilled by:	St. Johns River Water Management District
Ground Elevation:	+11 feet MSL
Drill Rig:	CME-75
Started:	November 28, 1978
Completed:	December 5, 1978
Total Depth:	180 feet
Casing:	97 feet

Depth (feet)	
	Pleistocene to Recent
0 - 4	Light gray sand with thin layered clay
4 - 20	Black to dark brown clay with silty sand hardpan
20 - 63	Gray sand, fine to medium
	Miocene or Pliocene
63 - 73	Light gray fine shell with gray clay
73 - 93	White coarse shell, no clay
93 - 96	Extremely large shell fragments with large pebble phosphate
96 - 98	Hard gray rock with small chert fragments

OBSERVATION WELL NO. 2 (continued)

Depth (feet)	Eocene
	Ocala Group
99 - 120	Soft, white granular limestone, several cavities apparent in this area
120 - 125	Light tan granular limestone
125 - 135	Alternating layers of soft gray limestone and hard light tan granular limestone
135 - 140	Tan and gray limestone, fragmental, and fossiliferous
140 - 145	Buff tan limestone, alternating with hard and soft zones of shell fragments, very porous
	Avon Park Limestone
145 - 175	Alternating zones of soft, light tan and hard gray granular limestones; at 155-161 feet, trace amounts of small shell fragments
175 - 182	Hard, light tan to dark brown "honeycomb" and fragmented dolomitized limestone
182	Soft, chalky white, very fine limestone

LITHOLOGIC LOG

OBSERVATION WELL NO. 3

Owner:	Union Camp
County:	Volusia
Location:	A) 29° 14' 58" N 081° 29' 42" W B) T14S, Sec. 29, R28E
Drilled by:	St. Johns River Water Management District
Ground Elevation:	+20 feet MSL
Drill Rig:	CME-75
Started:	November 14, 1978
Completed:	November 23, 1978
Total Depth:	125 feet
Casing:	63 feet

Depth (feet)	Pleistocene to Recent
0 - 2	Gray sand, medium to fine
2 - 5	Black organic hardpan
5 - 16	Gray clay
	Miocene or Pliocene
16 - 34	Gray clay
34 - 40	Gray clay with small amounts of shell
40 - 45	Shell white to tan in color
45 - 54	Shell with gray clay
54 - 60	Shell with dark gray clay, trace amounts of pebble phosphate

OBSERVATION WELL NO. 3 (continued)

Depth (feet)	Miocene or Pliocene (cont'd)
60 - 63	Gray rock, large pebble phosphate, almost gravel in size consistency
63 - 64	Hard gray and tan rock with chert
	Eocene
	Ocala Group
64 - 85	Soft white and tan limestone
85 - 95	Alternating layers of hard and soft, light tan limestone
95 - 97	Soft, light gray granular limestone with some shell
97 - 115	Alternating layers of hard, light gray and soft, light tan granular limestone, no shell
115 - 116	Very porous zone, taking about 30-40 gpm of water, light tan granular limestone
116 - 120	Very hard, light tan and gray limestone
	Avon Park Limestone
120 - 123	Soft brown granular limestone
123 - 124	Very soft, chalky white limestone
124 - 125	Hard, light brown to gray limestone

LITHOLOGIC LOG

OBSERVATION WELL NO. 4

Owner:	Turner
County:	Volusia
Location:	A) 29° 14' 13" N 081° 26' 30" W B) T14S, Sec. 35, R28E
Drilled by:	St. Johns River Water Management District
Ground Elevation:	+60 feet MSL
Drill Rig:	CME-75
Started:	October 31, 1978
Completed:	November 12, 1978
Total Depth:	125 feet
Casing:	85 feet

Depth (feet)	
	Pleistocene to Recent
0 - 10	Sand, brown, fine to medium
10 - 25	Sand, light gray, fine with trace amounts of gray clay
25 - 30	Hard broken shell, layered rock with light gray clay, grades to a medium to coarse sand--light gray and orange/yellow in color
	Miocene or Pliocene
30 - 35	Hard gray clay, dry (impermeable)
35 - 40	Hard sandstone-like rock with small shell, increasing shell content with depth, very porous

OBSERVATION WELL NO. 4 (continued)

Depth (feet)	Miocene or Pliocene (cont'd)
40 - 68	White shell, soft shell, white, fragmented
68 - 71	Soft shell, black and gray clay, black pebble phosphate
71 - 74	Very hard rock, light tan with trace amounts of shell
74 - 75	Soft gray rock, with some gray clay, trace amounts of pebble phosphate, almost no shell
75 - 76	Very hard gray rock, no shell
	Eocene
	Ocala Group
76 - 95	Soft white limestone with shell
95 - 108	Soft white limestone, voids within rock
108 - 115	Hard buff limestone
115 - 118	Soft white limestone, abundant with shell fragments
118 - 125	White to light tan limestone
125	Lost circulation, large cavity

LITHOLOGIC LOG

OBSERVATION WELL NO. 5

Owner:	State Right-of-Way; St. Johns River Water Management District
County:	Volusia
Location:	A) 29° 12' 16" N 081° 21' 55" W B) T15S, Sec. 11, R29E
Drilled by:	St. Johns River Water Management District
Ground Elevation:	+25 feet MSL
Drill Rig:	CME-75
Started:	December 20, 1978
Completed:	January 10, 1979
Total Depth:	170 feet
Casing:	131 feet

Depth (feet)	Pleistocene to Recent
0 - 7	Gray sand, fine to medium, grading into a medium dark brown sand
7 - 9	Black organic hardpan with dark brown sand
9 - 38	Brown sand, medium, with gray clay
38 - 45	Brown sand, medium, no clay
45 - 48	Trace amounts of shell in fine brown sand, with some gray clay
48 - 58	Hard cemented shell bed

OBSERVATION WELL NO. 5 (continued)

Depth (feet)	Miocene or Pliocene
58 - 85	Gray clay intermixed between shell beds
85 - 95	Alternating hard and soft zones of shell, no clay
95 - 96	Medium to coarse-grained white to light gray sand
96 - 123	Very coarse shell fragments with some sand
123 - 125	Hard fragmented shell
125 - 130	Extremely large shell fragments with large pebble phosphate in an olive green clay
130 - 135	A greenish-gray, sandy clay with trace amounts of shell
135 - 146	Light tan to light gray clay with pebble phosphate
146 - 150	Hard brown to tan dolomitized limestone with small pebble phosphate
	Eocene
	Ocala Group
150 - 170	Soft, white fine granular limestone, with alternating layers of hard material with some shell