TECHNICAL MEMORANDUM NO. 1

September 23, 2003

TO: Paul Smith, PE

FROM: Bryan T. Veith, PE
Mike Weinberg, PG

SUBJECT: City of Tarpon Springs
Hydrogeological Compilation and Summary of Findings -
Brackish Groundwater Resources

1.0 Introduction

The City of Tarpon Springs (City) authorized Boyle Engineering Corporation (Boyle) through Amended Purchase Order 031170 dated August 19, 2003 to perform a hydrogeological compilation of readily available existing hydrogeological data on brackish groundwater resources. Boyle's scope of services was outlined in a letter proposal dated August 19, 2003.

This technical memorandum was prepared by Boyle Engineering with assistance from its subconsultant, Water Resource Solutions (WRS), and describes the results of a hydrogeologic compilation of the brackish groundwater resources present in the Tarpon Springs area. The focus of the project described in the memorandum is on the development of a hydrogeologic framework for the upper part of the Floridan aquifer and characterization of lateral and vertical groundwater quality variations through a compilation and evaluation of readily available existing data from sources listed in section 5.0, References.

The information obtained and findings of the study are preliminary in nature, in accordance with the stated project scope of services and budget. The results are therefore intended to serve as an initial step in the more comprehensive process of evaluating the overall feasibility of developing a future brackish groundwater source for membrane treatment and municipal water supply by the City.

2.0 Hydrogeologic Framework

The technical feasibility of developing a reliable brackish water supply is dependent on the ability of the wellfield to provide adequate groundwater yields of predictable quality. From a practical standpoint, this means that the production zone(s) targeted must be at least moderately transmissive and confined from deeper sources of saline groundwater. Permitting of the project will also depend on the potential for adverse impacts to wetlands, existing users, and sites with minimum flows and levels established by the Southwest Florida Water Management District (SWFWMD).

Fresh and brackish quality groundwater occurs in the study area, within carbonate rocks of the Tampa and Suwannee limestones. The portion of the aquifer that contains fresh and brackish water resources in Pinellas County is divided into three regionally-recognized permeable zones separated by sediments that are generally less porous (Hutchinson, 1982, Knochenmus and Swenson, 1996). In descending order of occurrence, the permeable intervals of importance in this evaluation are the Tampa production zone (upper A), upper Suwannee production zone (lower A), and the lower Suwannee production zone (zone B). Deeper strata in the area are thought to contain saline water that is similar to seawater in quality.

A detailed cross section was prepared through the southern portion of the City as part of this study to help identify contacts between the main production zones and confining units present in the upper part of the Floridan aquifer. Lithologic, geophysical, and groundwater quality data for three SWFWMD test wells (ROMP TR 15-1, TR 15-2, TR 15-3) were used in preparing the section, which is illustrated on Figure 2-1. The wells form a west-to-east alignment that extends from the Gulf coast to Lake Tarpon (refer to Figure 2-2 for well locations). The regional hydrostratigraphic units described above appear to be discernable in this part of the City.

Pumping tests conducted at Dunedin and Oldsmar (Knochenmus and Swenson, 1996; Water Resource Solutions and Boyle Engineering, 2003) indicate that all three production zones in the upper part of the Florida aquifer are present and moderately to highly transmissive in those areas. Data described in the City's draft Alternative Water Supply Plan also indicate that three of the four Disston Avenue backup supply wells, which are open to the Tampa production zone (PZ), and possibly the top of the upper Suwannee PZ, have moderate to high specific capacity values (24 to 88 gpm/ft). It therefore appears that transmissive rocks are also present in the southeast portion of Tarpon Springs.

Detailed mapping of the hydrostratigraphy into other areas of the City is beyond the scope of this preliminary investigation. The properties of carbonate rocks tend to be heterogeneous, due to differences in porosity development. This underscores the importance of careful mapping and field testing to help characterize actual conditions at potential wellfield sites.

Based on existing data, it is currently anticipated that at least moderately permeable sediments are probably present within the upper Floridan aquifer throughout much of the Tarpon Springs area that could potentially be developed for water supply. The extent of the brackish water resources within these strata, which will strongly influence the feasibility of the water supply initiative, is addressed in the next section of the memorandum.

3.0 Groundwater Quality Considerations

Cherry (1966) published a map series that delineates areas in Pinellas County interpreted by the author to be subject to saltwater encroachment. Figure 3-1 presents one of these maps showing chloride ion distribution from the surface to a depth of 125 feet, which includes the upper part of the Floridan aquifer. A southeasterly trending band of more mineralized water approximately one-mile wide and eight-miles long is depicted on the figure, extending from the mouth of the Anclote River to the southern end of Lake Tarpon. Groundwater within the more mineralized zone is indicated to contain chloride concentrations of greater than 250 mg/L, while lower values typically occur in adjacent areas. A similar chloride distribution is also shown on other maps in this series for deeper intervals of the aquifer.

Figure 3-2 shows a portion of a more recent regional water quality map prepared by Causseaux and Fretwell (1982) that depicts the position of the fresh-brackish water interface in the Tampa Bay region, as defined by the point where chloride concentrations in the uppermost production interval of the Floridan aquifer exceed 250 mg/L. An inland deflection of the interface is again indicated in the area of the Anclote River, but in this case it parallels the course of the river to the east.

Figures 3-3 and 3-4 show chloride and total dissolved solids (TDS) distributions in the Tampa and Suwannee production zones of the upper Floridan aquifer based on maps published by the SWFWMD (1996). These results are somewhat different compared with the other studies referenced, in that less mineralized water is depicted to occur near the Anclote River and further north. However, a tongue of water with higher dissolved solids concentrations is shown to extend inland from the south side of the river.

It is evident from the previous discussion, that geoscientists have applied different methods of representing lateral groundwater quality variations for the upper Floridan aquifer in the Tarpon Springs area. This is apparently due to the fact that wells used as water quality control points to prepare the various maps are completed at different depths and subject to vertical changes in water quality, which complicates regional mapping of a particular interface. Differences in the previous results are also due to the limited amount of data available and a high degree of water quality variability.

Further examination of water quality changes within the upper part of aquifer was undertaken as part of the hydrogeologic reconnaissance to provide more information. Groundwater quality data were compiled from readily available sources including the SWFWMD, U.S. Geological Survey (USGS), Florida Department of Environmental Protection (FDEP), and other published reports. Figure 2-2 shows the locations of wells included in the preliminary evaluation, while water quality data are summarized in Table 3-1.

The hydrostratigraphic cross-section prepared for the project (Figure 2-1) is also a useful tool to help evaluate water quality variations within the strata of interest. Data for the SWFWMD ROMP (Regional Observation and Monitoring Program) wells indicate that only brackish quality groundwater is present in the Tampa PZ at these sites, with reported chloride concentrations in the range of 250 to 850 mg/L. Many of the other wells included in the reconnaissance survey that appear to be completed in the Tampa PZ, on both the north and south sides of the Anclote River, also reportedly contain brackish groundwater of varying quality.

Reports of fresh water in the Tampa PZ come mainly from the existing Tarpon Springs supply wells. Data for City wells #2 and #3 obtained from a USGS database, and information provided in the draft Alternate Water Supply Plan regarding the Disston Avenue backup wells, indicates that they generally produce fresh water with chloride concentrations of less than 250 mg/L. The common attribute of these wells is that they are all apparently located in areas of relatively high topography compared with surrounding lands. Based on data currently available, it is suspected that the upper Floridan aquifer receives more fresh water recharge from local rainfall in these areas, which explains the presence of less mineralized groundwater.

The ROMP well data for the upper Suwannee PZ indicate that dissolved mineral content rapidly increases with depth through this unit. Reported chloride concentrations near the coast at TR 15-1 increase from 800 to 15,000 mg/L within a vertical interval of less than 40 feet, and the saline water interface (10,000 mg/L) occurs at a depth of only 90 feet below sea level.

The mixing zone between fresh and saline groundwater deepens and thickens inland along the line of section. Chloride concentrations for the upper Suwannee PZ at ROMP TR 15-3, located near Lake Tarpon, range from 350 mg/l to 4,000 mg/L. The saline water interface at this site occurs at a depth of

approximately 180 feet below sea level, in the confining unit between the upper and lower Suwannee PZs. Regional data indicate that the saline water interface continues to deepen east of Lake Tarpon (SWFWMD, 1996).

Water quality data for several other wells that at least partially tap the upper Suwannee PZ, based on well casing and completion depths, are included the preliminary survey. Chloride concentrations for the three well located north of the Anclote River and west of Lake Tarpon range from 575 to 1,200 mg/L. This range is consistent with values reported for the upper part of the production zone at the ROMP well sites in the southern part of the study area, but are low for the deeper strata of the unit. Additional water quality data and geologic correlation would be required to help resolve if the apparent differences observed represent an actual trend of decreasing mineralizion north of the river, or are simply due to partial penetration of the upper Suwannee PZ by the wells identified in that area.

Based on the limited data currently available, the lower Suwannee PZ is believed to contain saline groundwater throughout the study area, with chloride concentrations ranging from 11,000 to 19,000 mg/L. Normal seawater has a value of 19,000 mg/L. This zone therefore does not appear to be suitable for brackish water development by the City.

4.0 Summary of Findings

Results of the hydrogeologic compilation of data and preliminary reconnaissance suggest that brackish groundwater resources in the Tarpon Springs area are limited to the upper 150 feet or less of the Floridan aquifer system. Existing data indicate that the depth to the brackish-saline water interface and thickness of the mixing zone between mildly brackish and saline water both increase inland from the coast. These water trends would favor brackish water development in the eastern part of the City, due to the reduced potential for upconing of saline water during wellfield operation.

The potential target intervals for brackish water supply indicated from this preliminary study are the Tampa production zone (PZ), and possibly the upper Suwannee PZ, of the Floridan aquifer system. Results of the water quality survey suggest that brackish water resources may extend to a somewhat deeper depth north of the Anclote River compared with the southern part of the City. If this is confirmed to be correct, conditions for wellfield development may be more favorable in that area. Additional hydrostratigraphic mapping and water quality data would be required to help determine if this apparent trend reflects actual subsurface conditions. Pinellas County is a possible source of supplemental water quality information that was not contacted in the current phase of the project due to its confidential nature.

The reliability of the brackish groundwater supply will be dependent on the presence of adequate confinement between the target production zone(s) and underlying saline groundwater, which apparently occurs at relatively shallow depth throughout the study area. This can only be determined through the implementation of a well-conceived field-testing program at potential wellfield sites. The degree of confinement between the surficial and upper Floridan aquifers should also be investigated through additional geologic mapping of existing data and field testing, to help assess the potential for adverse impacts to wetlands and other sensitive surface water bodies as part of the wellfield siting process.

5.0 References Cited

Causseaux, K.W., and Fretwell, J.D., 1982, Position of the saltwater-freshwater interface in the upper part of the Floridan aquifer, Southwest Florida, 1979: U.S. Geological Survey Water-Resources Investigations Open-File Report pg. 82-90.

Cherry, R.N., 1966, Chloride content of ground water in Pinellas County, Florida, in 1950 and 1963: Florida Geological Survey Map Series No. 20.

Knochenmus, L.A., and Swenson, E.S., 1996 Assessment of the fresh- and brackish-water resources underlying Dunedin and adjacent areas of northern Pinellas County, Florida:, U.S. Geological Survey Water-Resources Investigations Report 96-4164, 47 pg.

Hickey, J.J., 1982, Hydrogeology and results of injection tests at waste-injection sites in Pinellas County, Florida: U.S. Geological Survey Water-Supply Paper 2183, 42 pg.

Southwest Florida Water Management District, 1996, Northern Tampa Bay water resource assessment project, volume two, saline water intrusion and water quality: SWFWMD, 111 pg.

Water Resource Solutions and Boyle Engineering, 2003, Final phase II well completion report, City of Oldsmar municipal water supply project: Report to the City of Oldsmar, 83 pg.

Enclosures: Figures 2-1, 2-2, 3-1, 3-2, 3-3, 3-4 and Table 3-1

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TABLE 3-1 **CITY of TARPON SPRINGS**

REGIONAL WATER QUALITY DATA SUMMARY

Well Name	Map Ref. Number	Casing Depth (feet)	Total Depth (feet)	Date	Chloride (mg/L)	Sodium (mg/L)	Sulfate (mg/L)	TDS (mg/L)	Sp. Conduct. (umhos/cm)	Source
Mickler HRS34	1	42	47	9/1/1988	42	30	37	N/A	623	USGS NWIS
Fl Power 2 Shallow	2	104	112	9/1/1978	1200	N/A	N/A	N/A	N/A	Causseaux & Fretwell, 1982
Tahitian Deep well	3	35	100	9/1/1978	1200	N/A	N/A	N/A	N/A	Causseaux & Fretwell, 1982
Stauffer Deep 14	4	28	38	AVG	824	N/A	N/A	N/A	3327	USGS NWIS
ROMP TR 15-1	5	68	87	6/11/1985	527	294	15.3	1220	N/A	FDEP GWIZ
				8/23/1993	520	333	18	1170	2125	
				7/10/1996	480	249	14	N/A	1800	
ROMP TR 15-2	6	50	55	7/10/1996	270	160	45	N/A	1100	FDEP GWIZ
ROMP TR 15-3	7	147	150	6/11/1985	630	339	66.3	1280	N/A	FDEP GWIZ
				8/23/1993	276	184	30	N/A	1260	
				7/11/1996	225	139	24.5	N/A	1100	
Innisbrook 12	8	N/A	135	6/7/1972	290	140	36	632	1250	USGS NWIS
				8/7/1975	200	110	31	493	952	
City of Tarpon Springs #3	9	N/A	115	3/7/1949	262	135	39	580	1040	USGS NWIS
City of Tarpon Springs #2	10	40	103	6/5/1975	120	72	28	366	696	USGS NWIS
				9/15/1975	N/A	70	30	N/A	N/A	
Tarpon Ave.	11	N/A	97	9/1/1971	23	14	7.2	201	366	USGS NWIS
				6/5/1975	26	17	10	157	299	
				8/16/1976	30	19	11	169	308	
				11/3/1983	N/A	N/A	N/A	N/A	330	
Carter Pine HRS 1 F	12	63	80	8/3/1988	300	260	54	792	1410	FDEP GWIZ
Tarpon Rd. Deep	13	205	305	11/15/1999	53	26	13	313	525	USGS NWIS
North Lake Tarpon	14	758	780	12/7/1999	17000	N/A	2600	32200	42400	USGS NWIS
Pinellas SWI-7	15	N/A	745	11/16/1999	3100	1500	1000	7970	10700	USGS NWIS
NWHWRAP N3D	16	363	411	N/A	N/A	N/A	N/A	N/A	N/A	SWFWMD, 1996
USGS 28084308245100	17	40	103	06/75	120	N/A	N/A	N/A	N/A	Causseaux & Fretwell, 1982
USGS 280720082454101	18	N/A	98	08/75	1040	N/A	N/A	N/A	N/A	Causseaux & Fretwell, 1982
USGS 281023082450701	19	176	188	09/78	11000	N/A	N/A	N/A	N/A	Causseaux & Fretwell, 1982
USGS 281051082442801	20	69	70	09/78	340	N/A	N/A	N/A	N/A	Causseaux & Fretwell, 1982
USGS 281036082440901	21	112	121	09/69	575	N/A	N/A	N/A	N/A	Causseaux & Fretwell, 1982
Johnson	22	64	74	1994	880	N/A	N/A	N/A	N/A	SWFMWD, 1996

N/A Not Available

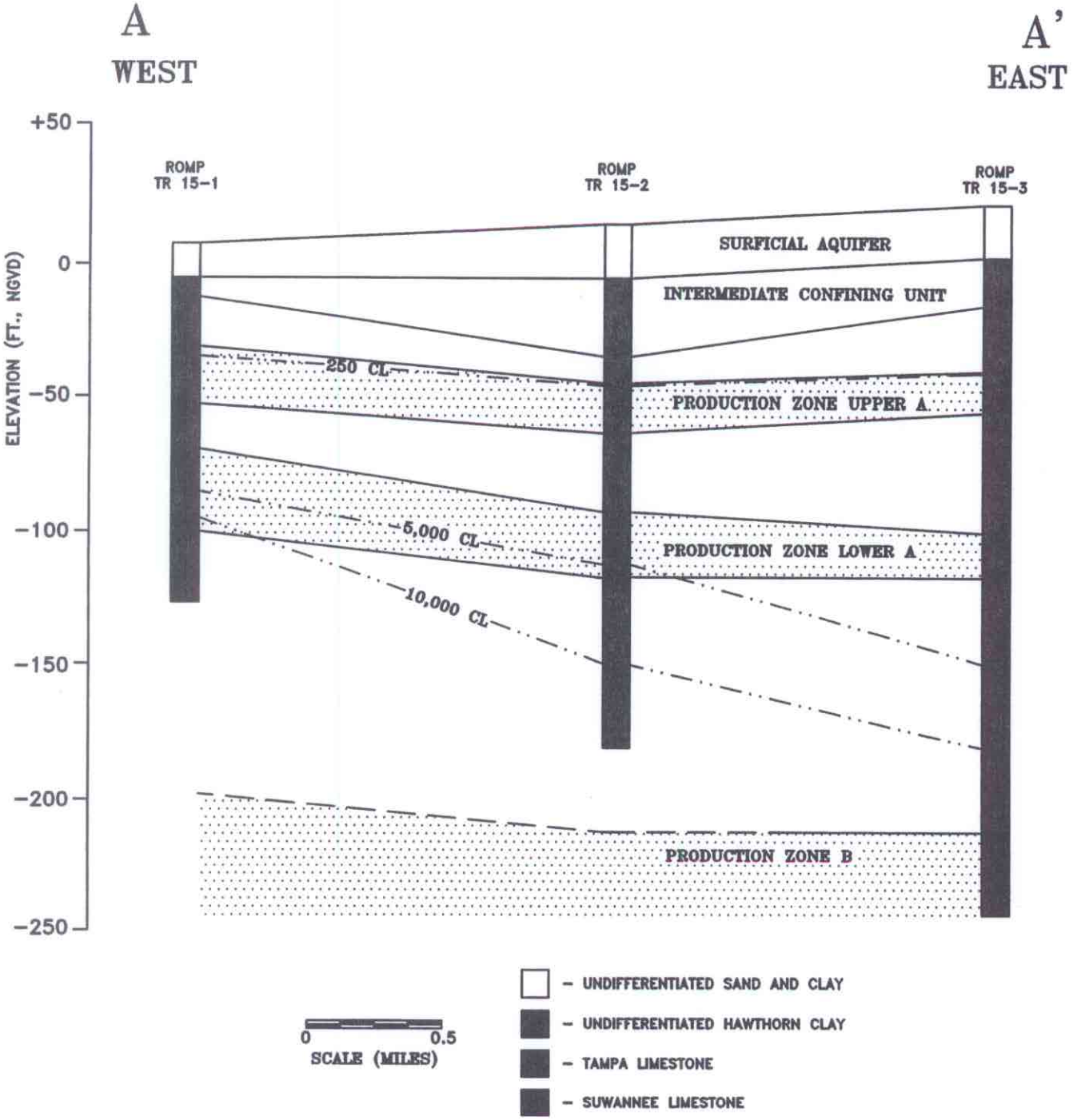

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FIGURE 2-1.
WEST TO EAST CROSS SECTION.

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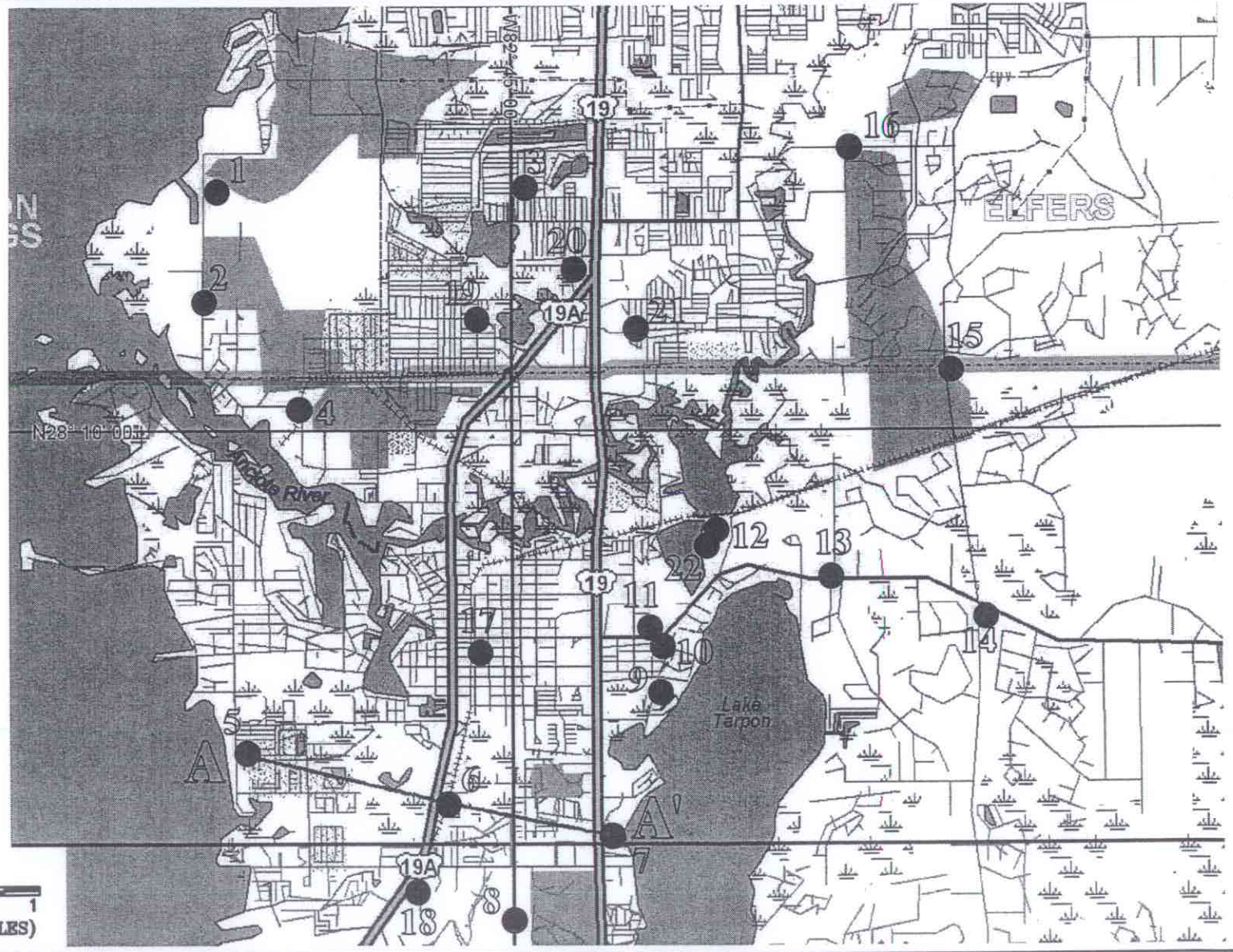

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FIGURE 2-2.
WELL AND CROSS SECTION LOCATION MAP.

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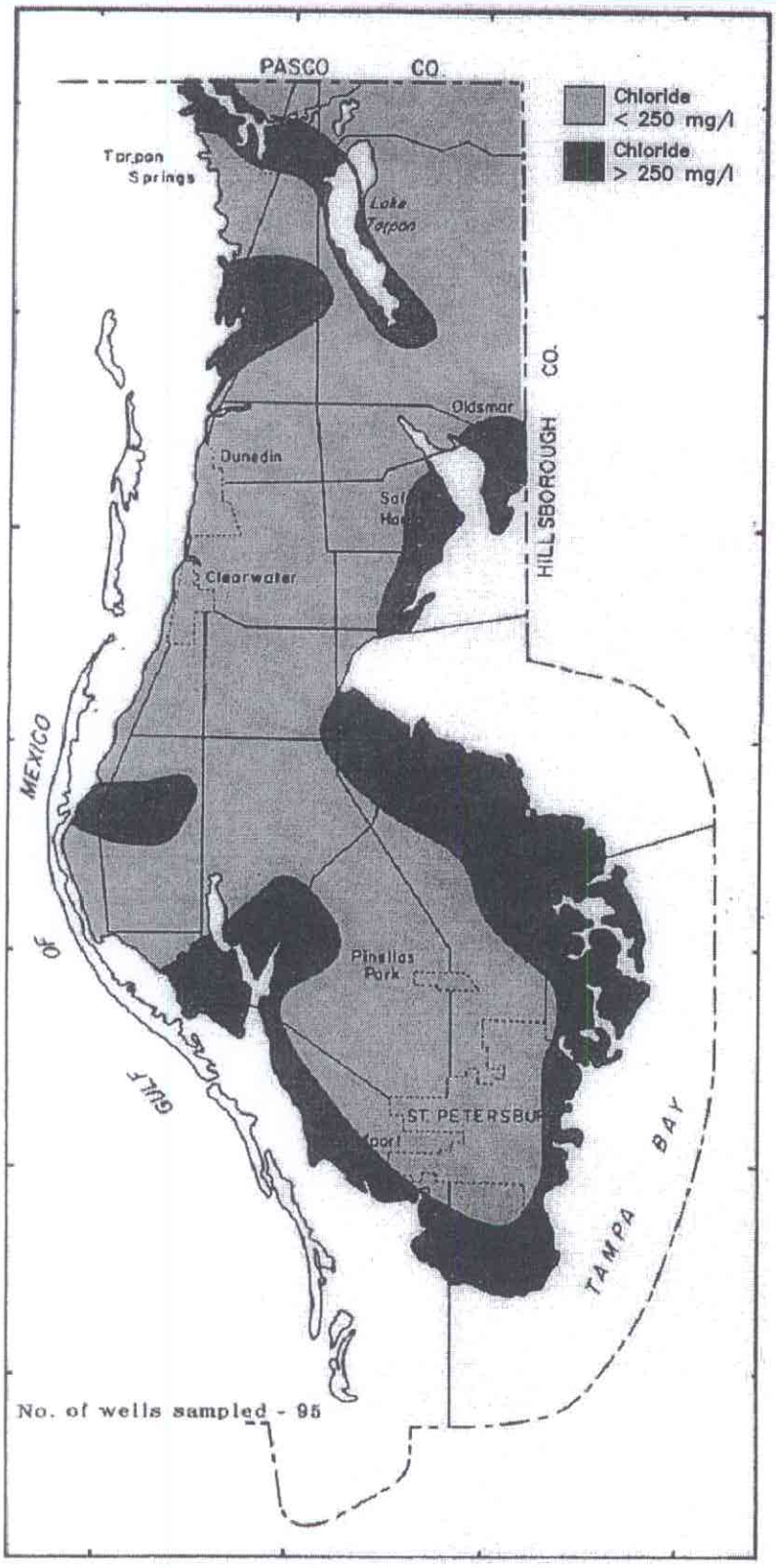

WELL DEPTH 0-125 FEET

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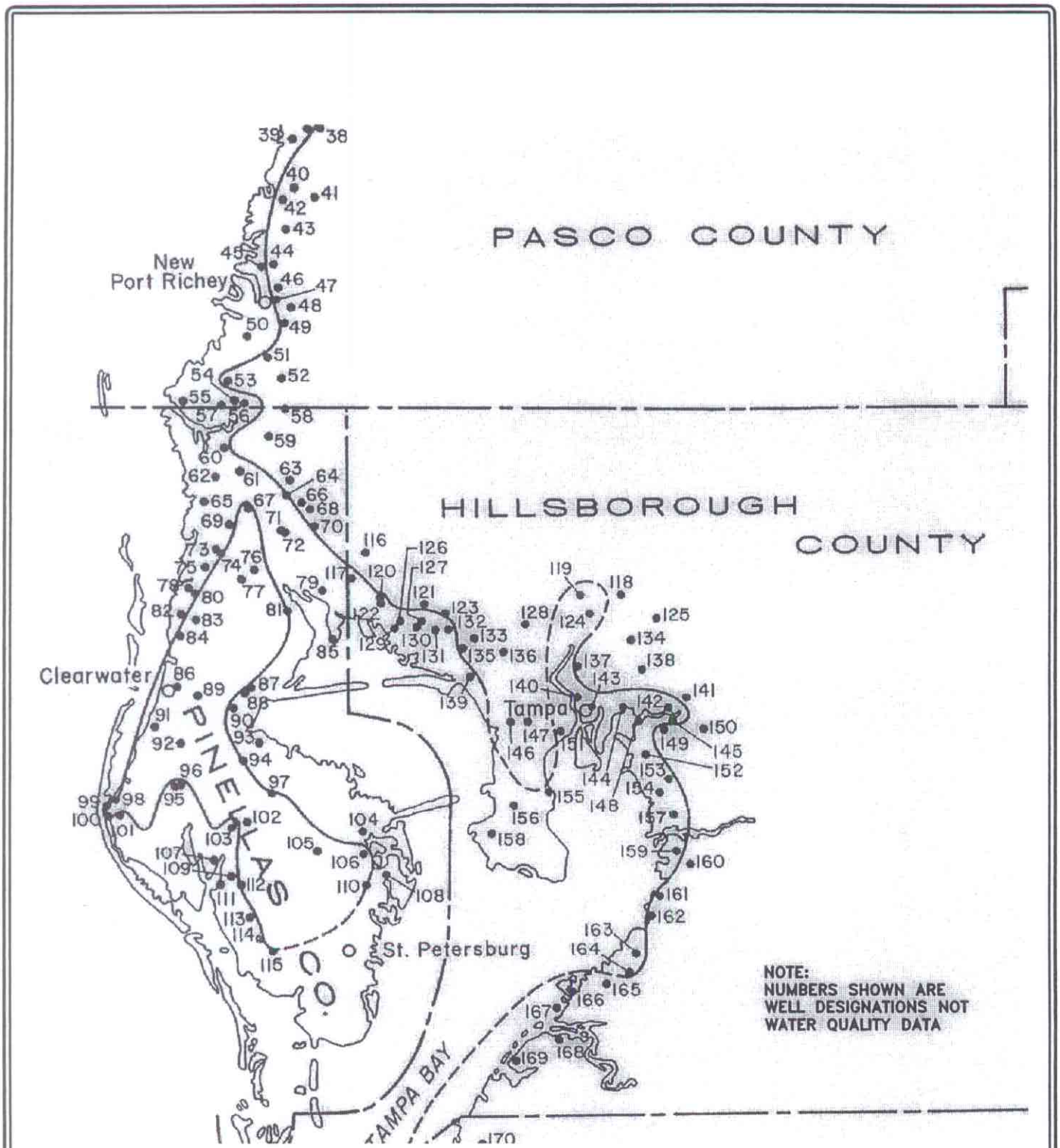

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FIGURE 3-2.
POSITION OF THE 250 MG/L ISOCHLOR IN THE UPPER PART OF THE FLORIDAN AQUIFER (REPRODUCED FROM CAUSSEAUX & FRETWELL 1982).

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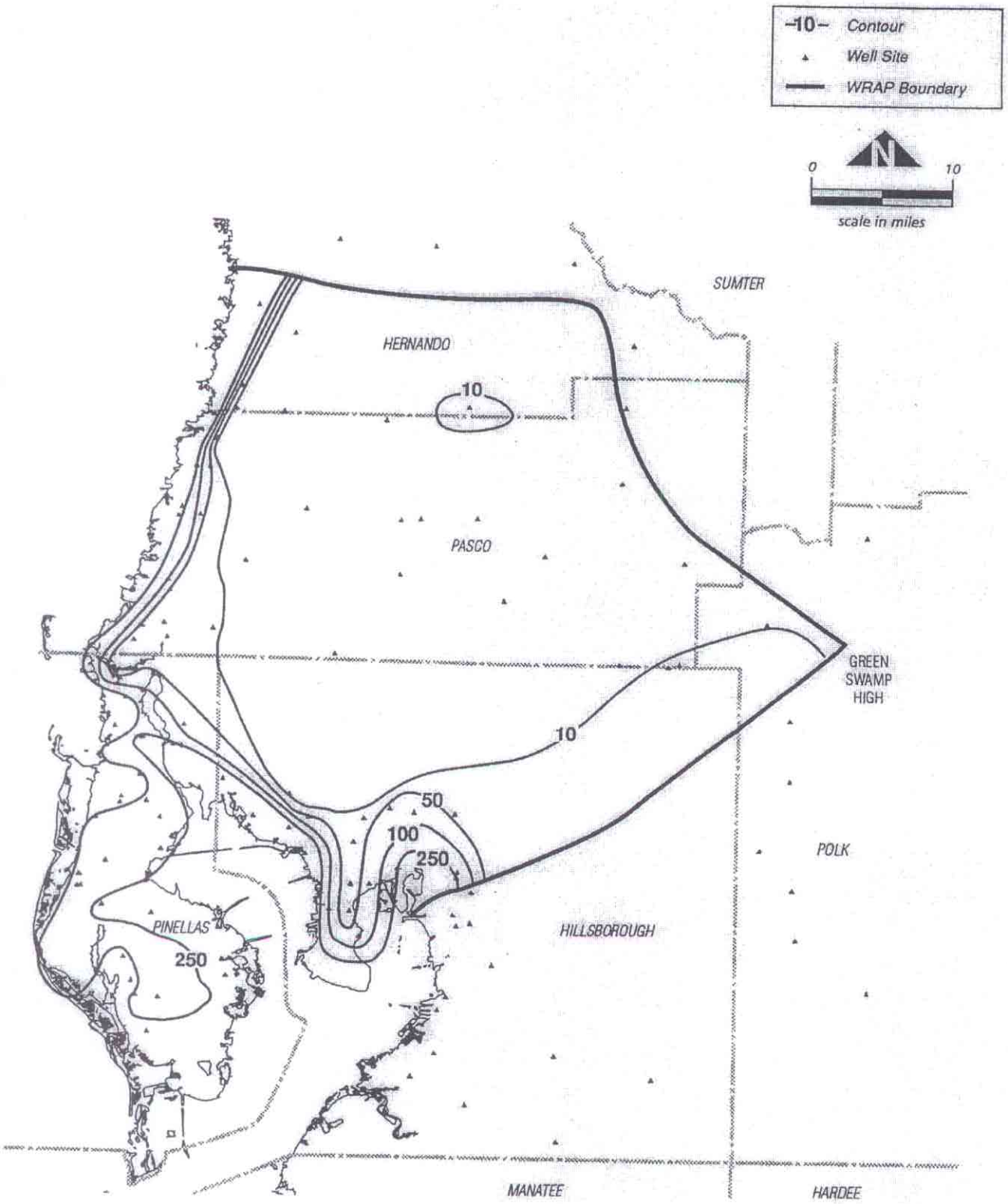

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FIGURE 3-3.
CHLORIDE CONCENTRATIONS IN THE TAMPA AND SUWANNEE PRODUCING ZONES (REPRODUCED FROM SWFWMD, 1996).

Water Resource Solutions

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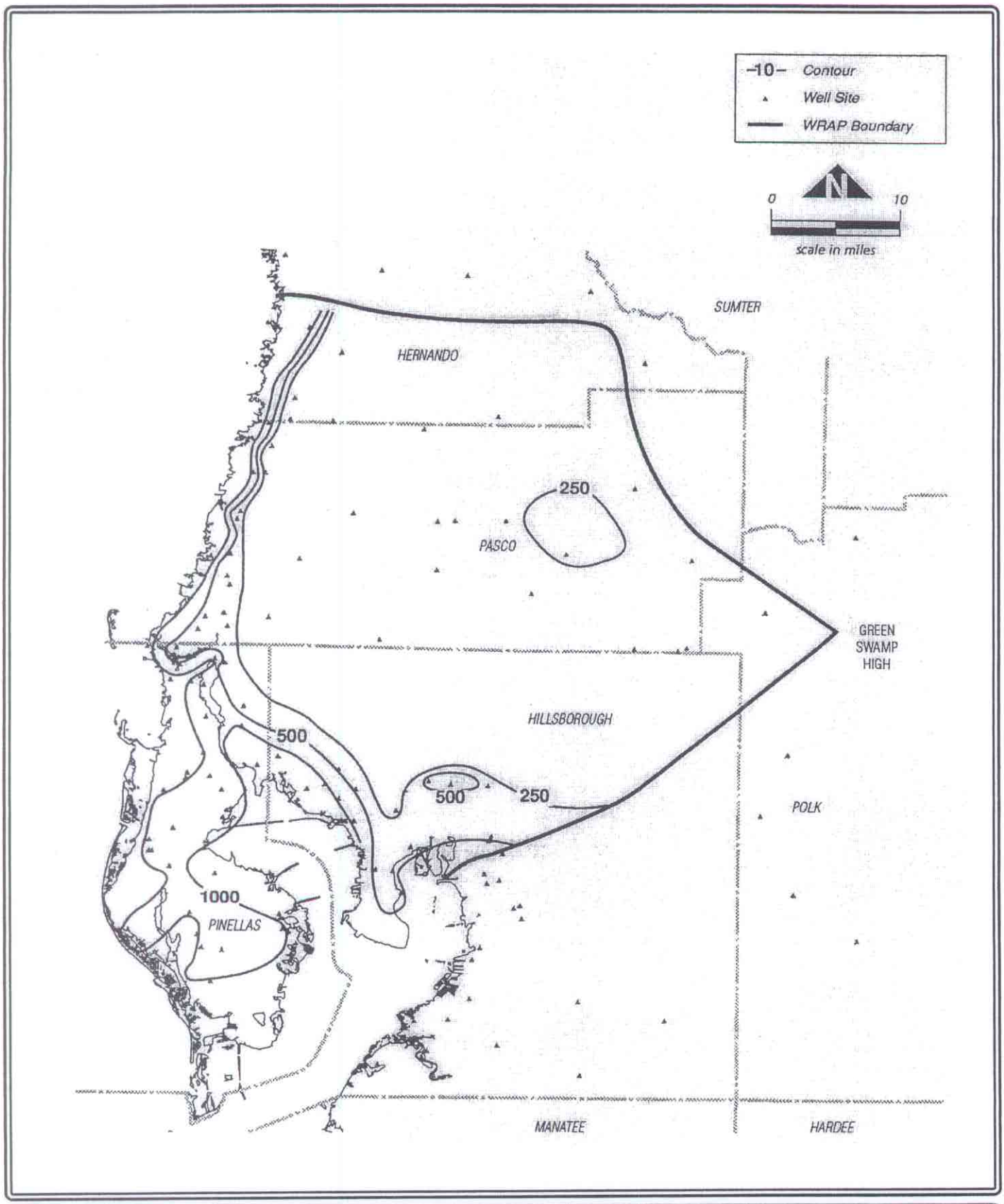

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FIGURE 3-4.
TDS CONCENTRATIONS IN THE TAMPA AND SUWANNEE PRODUCING ZONES (REPRODUCED FROM SWFWMD, 1996).

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