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GEOSTATISTICAL ANALYSIS: POTENTIOMETRIC NETWORK FOR THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

by

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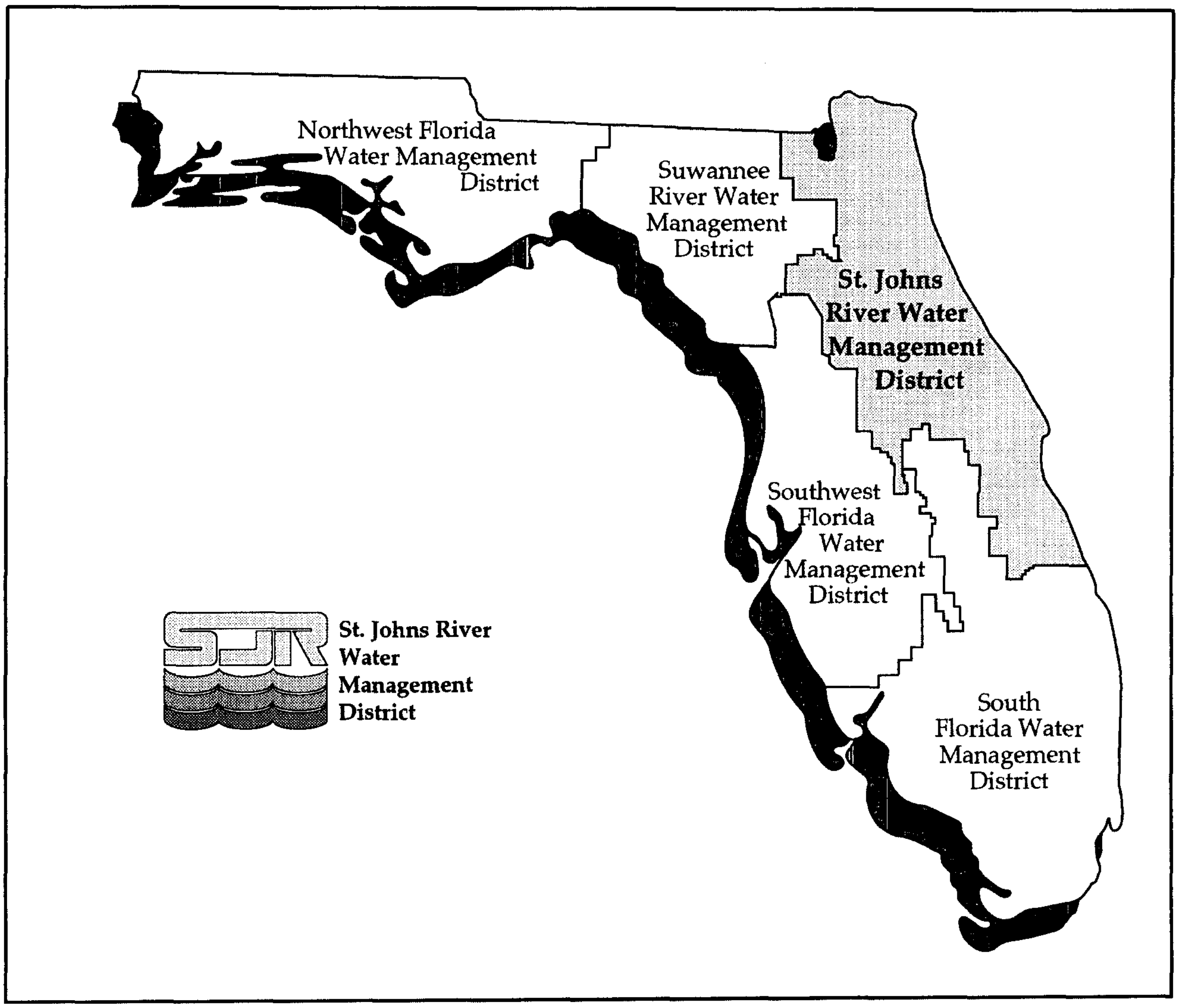

The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 19 counties in northeast Florida. The mission of SJRWMD is to manage water resources to ensure their continued availability while maximizing environmental and economic benefits. It accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land axquisition and management.

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EXECUTIVE SUMMARY

The St. Johns River Water Management District (SJRWMD) maintains or supports several groundwater level networks in central and northeastern Florida. The water levels in the Upper Floridan aquifer are measured in May and September of each year to determine the average annual lows and highs. The number of wells in the network continues to increase. In May 1995, the network contained 921 sites; in 1996, the network included 943 sites.

This study evaluated the overall effectiveness of the network. In specific, the study examined the purpose and objectives for the network, the completeness of knowledge concerning well construction and well use, the areal coverage and temporal suitability of the measurements, and the spatial effectiveness of the network. A literature review and a users survey were used to determine the theoretical and assumed objectives, respectively.

Computer records of open hole intervals, measuring points (indicating whether elevations were surveyed or not), and well use were searched to determine the extent of knowledge about the well construction of those wells in the network. Based on the available data, the aquifer being penetrated by a well is known for only 36% of the evaluated wells. Only 22% of the wells are dedicated observation wells.

The temporal suitability of the measurements (May and September) was examined. Of 250 wells for which 12-month averages could be determined, 41% had an average water level low in May and 27% had an average water level high in October, suggesting that the September measurement event is less than optimal.

The objectives for the existing network match those of a regional network, although some users appear to misuse the data for subregional concerns. The network products—maps of the elevation of the potentiometric surface and maps showing changes in the elevation of the potentiometric surface—are appropriate for a regional network. However, knowledge of well characteristics of the existing network is poor.

The spatial suitability of the network was evaluated using a geostatistical analysis of water levels measured in May 1995. The geostatistical analysis indicated that the network has more than enough wells to characterize water levels and potentiometric surfaces in the Upper Floridan aquifer. A stratified sampling scheme was used to evaluate potential networks containing fewer wells. Six hexagonal grid networks with grid cell diameters of 15,000 feet (ft), 22,500 ft, 30,000 ft, 37,500 ft, 45,000 ft, and 52,500 ft were evaluated. These networks were composed of 917, 789, 669, 560, 442, and 361 wells, respectively. The standard deviation of each network was determined using kriging (a collection of linear estimation methods) and used as a measure of effectiveness. The 45,000-ft stratified hexagonal grid network composed of 442 wells is the recommended network. The change in the standard deviation meets the stated goal of approximately 10% or less. Within the St. Johns River Water Management District, 47 of the 45,000-ft grid cells are not currently being monitored.

If the recommendations of the report are put in place, the final result will be a 53% smaller, more stable (93% dedicated monitor well) and efficient network with known characteristics. Improvements to the existing network are required due to the large percentages of unsurveyed (23%) wells and wells with unknown characteristics (64%). Costs to improve the existing network are estimated at $236,260. The existing network fully upgraded with construction of new wells is estimated at $1,316,260.

Movement of the September measurements to October require the cooperation of Southwest Florida Water Management District (SWFWMD) and South Florida Water Management District (SFWMD). In addition the timing of the average annual potentiometric high may be different for the other water management districts. It would probably be more cost effective for SJRWMD to take some additional measurements beyond its own month end measurements in October in order to obtain the data.

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INTRODUCTION

The St. Johns River Water Management District (SJRWMD) maintains or supports several groundwater level networks in central and northeastern Florida. Water level data from some of these networks are used to contour the potentiometric surface of the Upper Floridan aquifer. One groundwater network used to make these contours is called the Upper Floridan Aquifer Potentiometric network. It covers approximately 26,300 square miles (mi^2), has been operated the longest, and is the largest in the number of water level measurements being taken. The USGS (U.S. Geological Survey) collects the data and produces the maps through a cost-share agreement with SJRWMD, SWFWMD, and SFWMD. At 943 wells in 1996, this potentiometric network was more than three times the size of the next largest groundwater network (monthly water levels), which included 310 wells.

The objectives of this study were

- To analyze the effectiveness and completeness of the potentiometric network of the Upper Floridan aquifer (e.g., knowledge concerning well construction and use)
- To redesign the network, if necessary, to optimize its effectiveness based on its areal and temporal suitability
- To assess the ability of the network to meet current and future water management needs

Water level data provide SJRWMD with information about how much water is available through aquifer storage. Changes in water levels also can provide early warnings of potential water quality problems, which can be evaluated with specific water quality testing. When contoured in potentiometric surface maps, water level data suggest how water moves throughout the aquifer system. Water levels are measured in May and September of each year to determine the water levels at the end of the average wet and dry seasons.

The freshwater used within SJRWMD comes predominantly from the Floridan aquifer system (Florence and Moore 1997). Freshwater is water that contains less than or equal to 1,000 milligrams per liter of total dissolved solids. In 1995, freshwater use in SJRWMD amounted to 1,074 million gallons per day for groundwater, or 76% of the total freshwater use. Most of the groundwater came from the Floridan aquifer system (Florence and Moore 1997).

The Floridan aquifer system is composed of Paleocene to early Miocene carbonate rocks covering an area of approximately 100,000 mi^2. This area extends from the Gulf coast of Mississippi in the west to coastal South Carolina in the east, and it includes the entire state of Florida (Southeastern Geological Society 1986; Miller 1990) (Figure 1). The Floridan aquifer system is confined in some areas and unconfined in others, both within SJRWMD and throughout the full extent of the aquifer.

THE MAY 1995 NETWORK

For more than 20 years, SJRWMD, SWFWMD (Southwest Florida Water Management District), SFWMD (South Florida Water Management District), and USGS (U.S. Geological Survey) have worked together to measure the water levels and to prepare potentiometric surface and change maps based on these data. When this study was initiated, the May 1995 measurement period was the most recent period for which data had been mapped by USGS. Thus, the May 1995 network was considered the most suitable for analysis.

The May 1995 network included wells from southeastern Georgia, all of SJRWMD, and portions of SFWMD, SWFWMD, and SRWMD (Suwannee River Water Management District) (Figure 2). Water levels from a total of 921 measurements—from 918 wells, 2 springs, and 1 sinkhole—were incorporated into the potentiometric surface map (Knowles, et. al. 1995).

Shortly after this study began, it became apparent that some available data had not been used to prepare the map published for May 1995. For the purposes of this study, measurements from 43 additional SJRWMD wells and 10 wells from an Alachua County database were incorporated into this study. With the addition of these 53 wells, the evaluated network contains 974 sites. This network of 974 sites is referred to as the base network. Relevant details of each well were

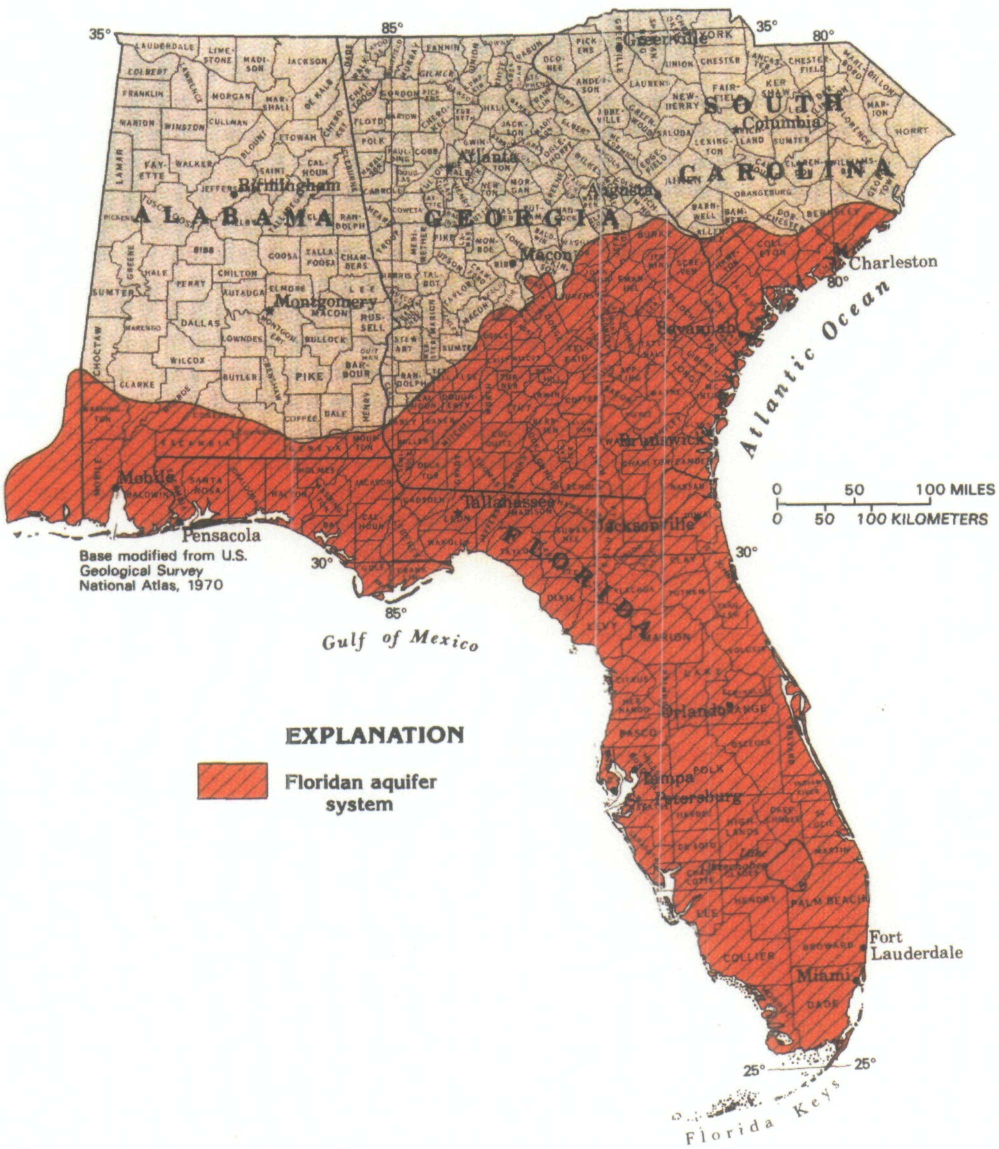


Figure 1. Areal extent of the Floridan aquifer system (Miller 1990)

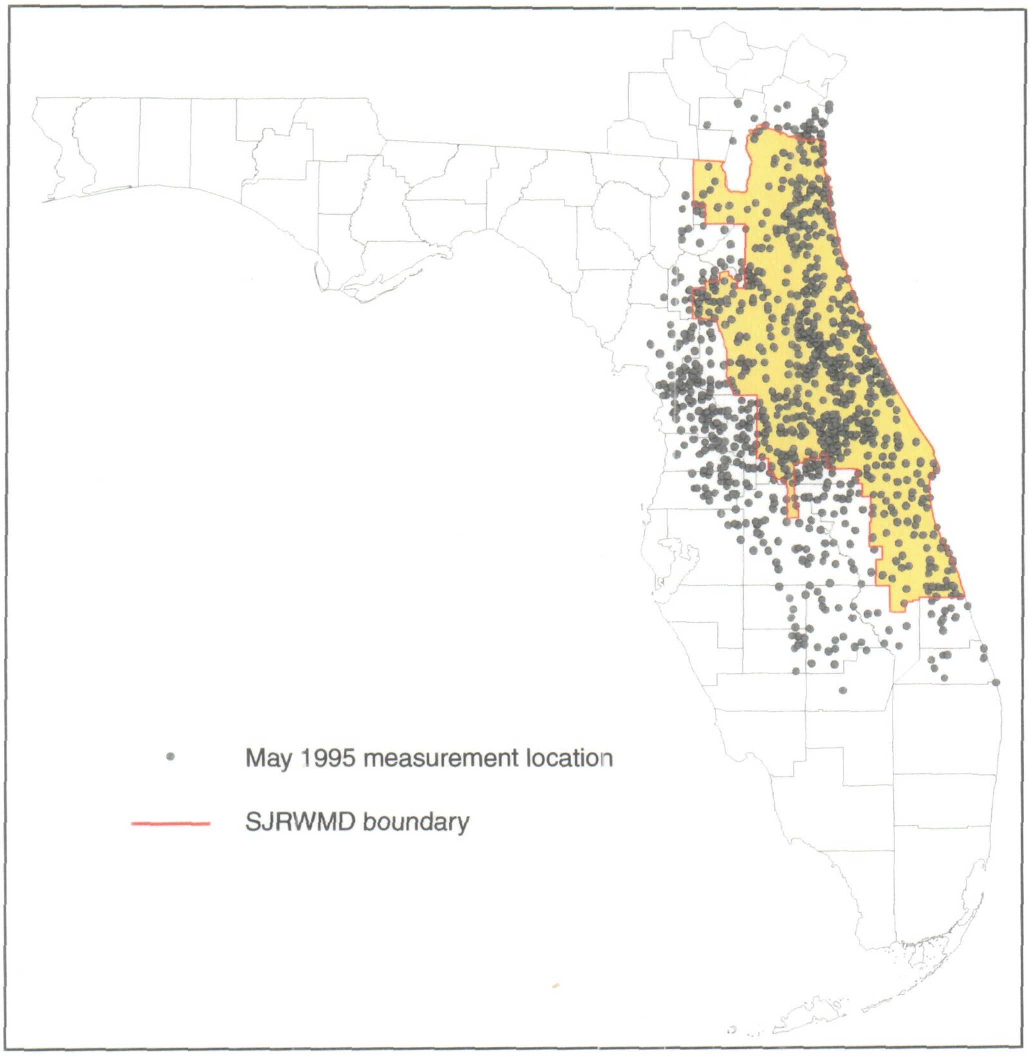


Figure 2. Areal extent of the May 1995 water level measurements mapped by the U.S. Geological Survey

extracted from the computer databases of the USGS Water Resources Divisions (WRDs) in Orlando and Tampa, Florida, and Doraville, Georgia, and were combined with details from the SJRWMD database (Appendix A).

Approach to Network Design

Numerous articles in the 1980s and 1990s demonstrated that only an objective-oriented approach can be used to design or evaluate and redesign, any monitoring network. A representative list includes Heath (1976), Kazmann (1981), Miller (1981), Sgambat and Stedinger (1981), Nacht (1983), Sanders et al. (1983), Montgomery et al. (1987), Whitfield (1988), Spruill (1990), Spruill and Candela (1990), Ward et al. (1990), Loaiciga et al. (1992), and Parsons and Tredoux (1995). All but Heath (1976) were concerned with water quality networks; Heath covered water level networks, the type addressed in this study. Other authors used different terminology and steps, but the predominant design concept introduced by Sanders et al. (1983) uses an information systems approach to designing monitoring networks.

Ward et al. (1990) identified five generalized steps for designing groundwater quality information systems: (1) define information needs of management, (2) define information that can be produced by monitoring, (3) design monitoring network, (4) document data collection procedures, and (5) document information-generating and reporting procedures. The network analysis steps used in this study were modified from the design steps presented by Ward et al. (1990) and follow.

1. Determine network objectives
2. Analyze areal and temporal coverage
3. Summarize characteristics of wells
4. Perform geostatistical analyses
5. Recommend improved network design

Step 1—Determine Network Objectives

In order to design or analyze any monitoring network, the monitoring objectives must be known or determined (Heath 1976; Kazmann 1981; Miller 1981; Sgambat and Stedinger 1981; Sanders et al. 1983). Without knowledge of the objectives for the network, its effectiveness and completeness cannot be analyzed.

Some of the reasons for monitoring groundwater are for use in regulatory matters, for determining seasonal and long-term changes, and for determining flow direction (Heath 1976; Kazmann 1981; Miller 1981; Whitfield 1988; Spruill 1990; and Spruill and Candela 1990). Due to legal and regulatory demands of the last 20 years, most of the literature is concerned with groundwater quality networks.

The first step in the network analysis was to determine the objectives for the network. For this study, the analysis involved (1) a review of the types of water level networks, as described by Heath (1976), to ascertain theoretical objectives and (2) a survey of the users of the network products (i.e., potentiometric surface and change maps and the raw data for these maps) to ascertain the assumed objectives.

Step 2—Analyze Areal and Temporal Coverage

Once the network objectives were determined, the existing coverage of the network was analyzed for effectiveness and completeness in relationship with the objective. The assessment of areal coverage included reviewing the breadth of the network. The evaluation of temporal coverage involved reviewing the frequency and seasonal appropriateness of the existing monitoring schedule.

Step 3—Summarize Characteristics of Wells

In this step, the completeness of the well information in the USGS database was summarized statistically. The availability of additional water level measurements was determined for those wells within the SJRWMD that were not included in the USGS network. For informational purposes, costs for producing the maps were determined.

Step 4—Perform Geostatistical Analyses

Geostatistical analyses provide models of the spatial relationships among data. In this step, water level data were summarized statistically to determine the spatial continuity, then a model representing this relationship was constructed and verified. A geostatistical analysis of the potentiometric network allows the user (1) to more accurately predict spatial distributions, (2) to determine the accuracy of those distributions, and (3) to determine the optimal locations to be sampled.

Step 5—Recommend Improved Network Design

In the final step, the results from the geostatistical analysis were used to design an improved regional network, if warranted. Using the geostatistical model, a set of six network scenarios was evaluated. The network giving the best results with the fewest wells was recommended.

NETWORK OBJECTIVES

In order to determine the actual objectives of the potentiometric network, the analysis involved (1) a review of the types of water level networks, as described by Heath (1976), to ascertain theoretical objectives and (2) a survey of the users of the network products to ascertain the assumed objectives.

THEORETICAL OBJECTIVES

Groundwater level networks are commonly used to determine (1) the effects of stress on recharge and natural discharge conditions of an aquifer, (2) the hydraulic characteristics of groundwater systems, (3) the areal extent of an aquifer, or (4) the degree of confinement of an aquifer (Heath 1976) (see Appendix B for additional discussion). These objectives attempt to determine the yield, or changes in the yield, of an aquifer system.

Using these yield-oriented objectives, Heath (1976) identified three major categories of groundwater level networks. The categories were modified slightly for this study in order to represent the conditions within SJRWMD. The network categories are (1) regional (Heath's *hydrologic*) networks, (2) subregional (Heath's *water-management*) networks, and (3) natural baseline (Heath's *baseline*) networks. Each of the three network types can have one or more objectives, and each results in distinct products (Table 1). The regional and subregional networks are designed to measure changes in the aquifer systems caused by human actions. The natural baseline network quantifies the impact of natural changes on the aquifer system. Due to the differing objectives, each type of groundwater level network must be defined more or less independently of the others. However, wells used in one network may be used in another.

Regional Network

Two objectives are considered in a regional network: (1) to assess the status of storage and (2) to determine the areal extent of the aquifer. The two objectives can be met by the same regional network. The final products of the regional network are regional potentiometric surface

Table 1. Types of groundwater level monitoring networks

Network Types	Objectives	Products
Regional	Assess storage status	Regional potentiometric surface maps
	Define areal extent of an aquifer	Maps showing net change in water levels or storage over a selected period
Subregional	Assess effects of stress on recharge and discharge conditions	Local potentiometric surface maps
	Determine hydraulic characteristics of aquifers	Hydrographs showing change of water levels with time
	Determine degree of confinement	Graphs of water levels versus pumping or rainfall rates
Natural Baseline	Define effect of climate on groundwater storage	Hydrographs showing "natural" changes in storage in different aquifers and topographic situations in each climate zone
	Define effect of topography and geology on climatic response	

Source: Adapted from Heath 1976

maps and change maps covering selected periods. The wells must be open to the same regional interval (e.g., the Upper Floridan aquifer), have the same datum (e.g., mean sea level), and be measured more or less simultaneously. The network should be measured as long as stresses on the aquifer system (or changes to it) continue.

Subregional Network

Three objectives are considered in a subregional network: (1) to assess the effects of stress on recharge and natural discharge conditions of an aquifer, (2) to determine the hydraulic characteristics of an aquifer, and (3) to determine the degree of confinement of an aquifer. The primary object of a subregional network is to determine the effects of stress on recharge and natural discharge conditions of an aquifer. A subregional network must be located near and in the areas of stress, for example pumping centers, recharge wells sites, and injection well sites.

Ideally, a subregional network in an area of stress would include wells open to the stressed zone and wells at varying distances from the center of the stress point. The object is not to monitor the water levels in pumped wells, but to measure the combined drawdowns (recharge mounds) of the wells inducing the stress (Heath 1976). Additionally, the network should include observation wells in aquifers above and below the stressed zones.

The products of a subregional network include local water level maps, hydrographs of individual wells, and graphs of water levels versus pumpage rates for the wellfields. The network measurements should continue for as long as pumpage or injection is increasing, and/or the water levels are changing. Caution should be exercised about discontinuing monitoring of unconfined or poorly confined aquifers when water levels appear to be stable. It is possible for the water levels to appear to be stable for a period of time while water is being depleted from a source (aquifer, lake, stream, etc.) above or below the production aquifer. Once the water source has been depleted, water levels will again begin to drop.

Natural Baseline Network

A natural baseline network is intended to quantify the response of an aquifer to variations in natural changes in the hydrologic system (Heath 1976). The changes could be climatic, geologic, and topographic variations or differences in time or space. A natural baseline network can measure the effects of areal climatic changes on the storage of an aquifer system or systems or it can measure the climatic changes as modified by differences in geology and topography in an aquifer system or systems. In both cases, the network products are hydrographs showing water levels or storage changes in the individual wells. The use of natural baseline networks would be for long, perhaps permanent, durations.

ASSUMED OBJECTIVES

As part of the network analysis, a survey was distributed to most of the individuals on the USGS distribution list for the potentiometric surface maps. Added to this list were individuals who had requested a copy of these maps from SJRWMD, as well as approximately 20 SJRWMD staff who were known to use the data collected using this network.

The survey contained nine questions designed to determine the ways people use data from the maps (Appendix C), thus the assumed objectives for the network. The survey was composed of both essay- and nonessay-type questions.

Out of the approximately 111 questionnaires distributed, 36 were returned. Four of these were from SJRWMD staff. The overall response rate was 32%.

Essay Responses

Five of the survey questions asked the user to provide essay answers (Appendix C). In answering question 2, most respondents (64%) indicated that they believed the purpose of the potentiometric network to be for regional studies. However, many respondents are using the data for countywide or local studies (24%). Most respondents (60%) believed that the current network is measuring the maximum and minimum water levels.

In question 6, many respondents indicated that the map accuracy needed was between ±0.1 to ±5.0 feet (ft). Others wanted more discussion or explanation of this question.

Nearly 53% of the respondents completed question 7—*What changes would you like to see?* The responses can be grouped into seven categories:

1. No change (17%)
2. Include more localized data (6%)
3. Add individual hydrographs, maximums and minimums of record, and rainfall data (8%)
4. Create better quality base maps (14%)
5. Include tabular data and make digital maps available (8%)
6. Produce maps of other aquifers and change maps of other historical periods (6%)
7. Create statewide map (3%).

The second part of question 7—*How would this (the changes) help you in your job?*—was completed by 33% of the respondents. No pattern of response was evident.

Nonessay Responses

Six of the survey questions contained brief nonessay questions (Table 2). Most of the respondents indicated that they used the information contained in the maps in some manner (86%). More respondents used the potentiometric surface maps (83%) than the potentiometric change maps (53%). A small percentage noted they used the raw data directly from USGS (22%). However, the questionnaire was not clear in its wording that raw data use meant use of the raw water levels obtained from USGS, not from the map.

Table 2. Summary of nonessay responses from the network users survey

No.	Question	Checked	Not Checked	Percent Checked
1	Do you use information presented in the maps?	31*	5*	86
3	What do you utilize?			
	Potentiometric surface maps	30	6	83
	Potentiometric change maps	19	17	53
	Raw data	8	28	22
4	Do you digitize data from the maps?	11*	25*	31
	Surface map contours	7	29	19
	Surface map data points	5	31	14
	Change map contours	3	33	8
	Change map data points	1	35	3
	Do your own contouring	6	30	17
5	How do you utilize information presented in the maps?			
	Calibrate models from contours	8	28	22
	Calibrate models from data points	8	28	22
	Conduct regional studies from contours	12	24	33
	Conduct regional studies from data points	11	25	31
	Conduct local studies from contours	20	16	56
	Conduct local studies from data points	15	21	42
	Other	9	27	25
6	Do you need to know the accuracy (standard deviation) of the potentiometric surface maps?	16*	20*	44
9	Do others in your organization use the information presented in the maps?	25*	11*	69

*Yes/no responses

In answering question 4—Do you digitize data from the maps?—only 31% of the respondents indicated that they digitized data. For the potentiometric surface maps, 19% of the respondents digitized contours, and 14% digitized points. For the potentiometric change maps, 8% of the respondents digitized contours, and 3% digitized points. A number of respondents (17%) also reported that they did their own contouring, presumably from the data points or the raw data.

A small number of respondents used both the contours and data points to calibrate models (22%). More respondents used the contours and data points for local than regional studies. Approximately equal numbers of respondents conduct regional studies with the data points and contours (31% and 33%, respectively). In conducting local studies, more respondents used contours than data points (56% and 42%, respectively). Twenty-five percent (9) of the respondents checked "other;" one additional response was "none of the above" (Appendix C, p. 133).

Only 44% of the respondents felt that they needed to understand the accuracy of the resulting maps—that is, the standard error.

The network data are apparently used by a large number of unknown users—69% of the respondents knew of others in their organization who used the data.

Actual Objectives

Based on the review of network types and information gathered from the survey, the existing potentiometric network is appropriately considered a regional network. The network has the following characteristics, which meet the objectives for a regional network as outlined by Heath (1976) (Table 1).

- The network is regional in extent.
- The network products are potentiometric surface maps of the measurement periods and potentiometric change maps showing changes in storage from the previous measurements. In addition, a long-term history of water levels could be generated.

- The network is intended to measure the average annual water level minimums and maximums.

- The network is generally composed of wells presumably open to the target aquifer—Upper Floridan aquifer. Due to time constraints of this study, the open hole intervals of the wells were not compared with water levels in the Upper Floridan aquifer. In addition, review of well details indicated that information about well depths and surveyed elevations is generally lacking (see p. 21).

Ideally, the wells in a regional network should be unaffected by pumpage from local wells. However, a regional network should detect cones of depression over areas larger than 100 to 150 mi^2 or more.

The regional network does not measure specific areas of stress, as does a subregional network. Nor does it measure specific aquifer responses to natural changes, as does a natural baseline network. Thus, the regional network may not provide adequate information to address the following:

- Saltwater intrusion at specific portions of a coastline
- Saltwater intrusion due to upconing in a wellfield
- Subregional modeling data needs
- Information on water levels within specific wellfields

Saltwater intrusion needs to be monitored with water quality samples. However, a regional potentiometric network can help in determining very detailed, localized data on water levels, which can suggest specific areas of possible saltwater intrusion.

Although most respondents to the users survey (64%) indicated that the network was regional (question 2), more respondents are using the potentiometric surface maps and the water level data for subregional then regional projects (question 5). The limitations of the regional data for subregional uses should be made clear to users of the potentiometric surface maps.

AREAL AND TEMPORAL COVERAGE

Areal and temporal coverage should be determined in light of the regional nature of the network. In the following sections, coverage needs are identified and the effectiveness of the existing network in meeting those needs is measured.

AREAL COVERAGE

Although the Upper Floridan aquifer is regional in extent, monitoring of water levels in this aquifer should be performed on a regional basis for the areal extent required by SJRWMD. Thus, monitoring must extend beyond SJRWMD boundaries in order to provide early warning of changes occurring from outside and within SJRWMD—the SJRWMD boundary was delineated using surface water, not groundwater, basins.

The potentiometric network covers 26,300 mi^2, including southeastern Georgia, all of SJRWMD, and portions of SFWMD, SWFWMD, and SRWMD (Figure 2). Beginning in September 1994, wells from southeastern Georgia were added to the map to better define the cone of depression in the Fernandina Beach area.

Given this breadth of coverage, the potentiometric network can be used to assess the regional nature of the Upper Floridan aquifer and to provide early warning of changes in the water levels that may impact SJRWMD.

TEMPORAL COVERAGE

Since 1975, the potentiometric network has been measured almost continually during the months of May and September. Although quarterly or even monthly monitoring would be beneficial, the size of the existing potentiometric network prohibits such frequent monitoring. Due to the current size of the network—more than 900 wells—too much effort would be needed to increase the monitoring frequency of the existing network.

Consequently, this study focused on the appropriateness of the two established monitoring events. A regional network is intended to supply information about the status of groundwater storage. Thus, the semiannual monitoring should assess anticipated seasonal events and water level changes that affect storage—the maximum and minimum water level for the aquifer. As noted earlier, most users (60%) believe the existing network is measuring the yearly maximum and minimum water levels of the aquifer. Thus, most users believe the aim of the existing network is to assess average annual highs and lows for the water levels.

May is the last month of the normal dry season, which starts in October of the previous year. September is the last month of the normal wet season. However, USGS selected September because Hurricane Donna passed over the Florida peninsula in September 1960 (Charles Tibbals, USGS [Orlando, Florida], pers. com., 1997).

Within SJRWMD, 52% of the yearly rainfall occurs during four months, from June through September (Figure 3). The remaining 48% is spread over eight months. The 30-year normal rainfall (1961–90) was averaged for 12 rainfall stations with long-term records within SJRWMD (Figure 3). These rainfall stations, maintained by the National Oceanic and Atmospheric Administration, include Glenn St. Mary, Jacksonville Airport, Gainesville Agricultural Center, Crescent City, Ocala, Daytona, Lisbon, Sandford, Lake Alfred, Orlando Airport, Melbourne, and Vero Beach.

To evaluate whether the water level lows and highs tended to occur during the months of May and September, computerized water level records were reviewed. These records were retrieved from the SJRWMD scientific and the monthly hydrologic conditions databases for all wells in the Upper Floridan aquifer. The levels for each well were then averaged by the month of measurement. Wells were rejected that did not have measurements available for each month. In all, 250 wells had water level measurements that could be averaged for 12 months (Appendix D).

From the average monthly measurements of each well, the month of the average low and average high was extracted and the frequency of the average annual monthly highs and lows was graphed (Figure 4).

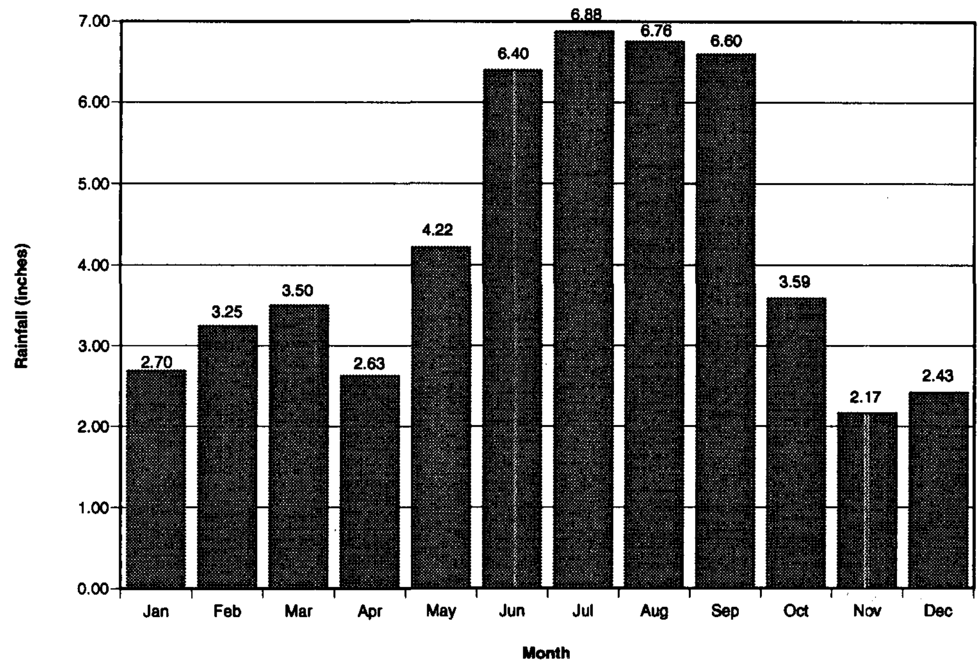


Figure 3. Thirty-year normal (1961–90) monthly rainfall averaged for 12 rainfall stations with long-term records in the St. Johns River Water Management District

The expectation of the users is that the network measures the average yearly water level lows in May and the highs in September. For these 250 wells, the average low for 41% of the wells occurred during the month of May; no other month came close to this percentage. The month of October had the highest percentage of maximum records, 27% of all wells. The months of February, March, and November all had higher numbers of maximums (11%, 12%, and 11%, respectively) than did the month of September (9%). This disparity suggests that the existing network is not measuring the average water level highs within SJRWMD.

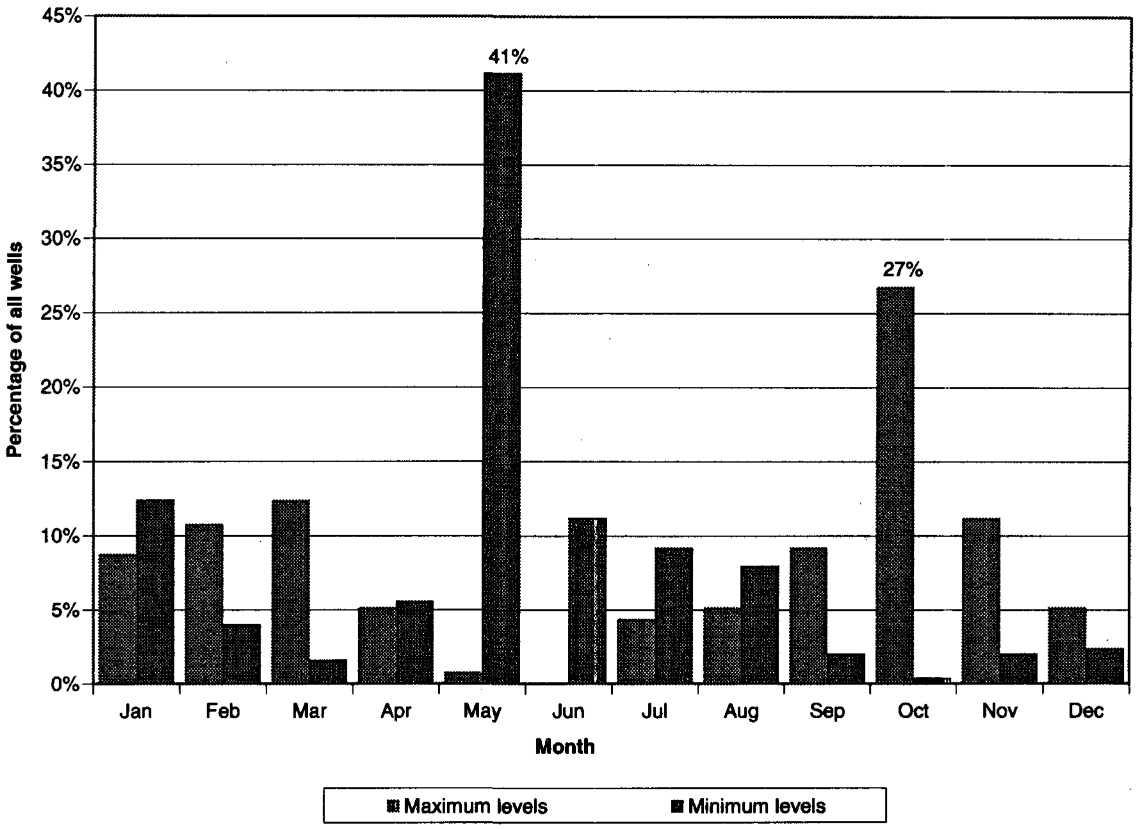


Figure 4. Frequency of monthly average maximum and minimum water levels for 250 wells in the Upper Floridan aquifer

CHARACTERISTICS OF THE EXISTING NETWORK

The existing base network consists of 974 sites maintained by both SJRWMD and USGS. In order to determine whether the Upper Floridan aquifer is being measured when water level measurements are taken at these sites, the completeness of the well information in the USGS database was evaluated. Specific information should be known about the wells in the network. This information should include casing length and the total depth of the well, the type of wells being used for the water level measurements, and the method used for determining measuring point elevations.

WELL CONSTRUCTION, WELL USE, AND SURVEY INFORMATION

Information on well construction, well use, and survey information were retrieved from the water resource databases maintained by USGS in Orlando and Tampa, Florida, and Doraville, Georgia. For a high percentage of wells in the potentiometric network, this information is not available in the computerized records of USGS.

Knowledge of open hole intervals is important to ensure that only the target aquifer is being tapped. The casing length is known for 36% of the wells, and the total depth is known for 23% of the wells (Figure 5). The elevation of the measuring point has been surveyed for 68% of the wells, estimated from a topographic map for 18% of the wells, and is unknown for 14% of the wells.

Knowledge of well use is equally important. Certain uses can interfere with the validity of the water level measurements (e.g., if a well has recently been pumped, the data will not give an accurate representation of the actual water level). Observation and test wells make up 22% of the network; well use is unknown for 74%. Of the remaining wells, 2% are currently in use, and 2% are other unused wells.

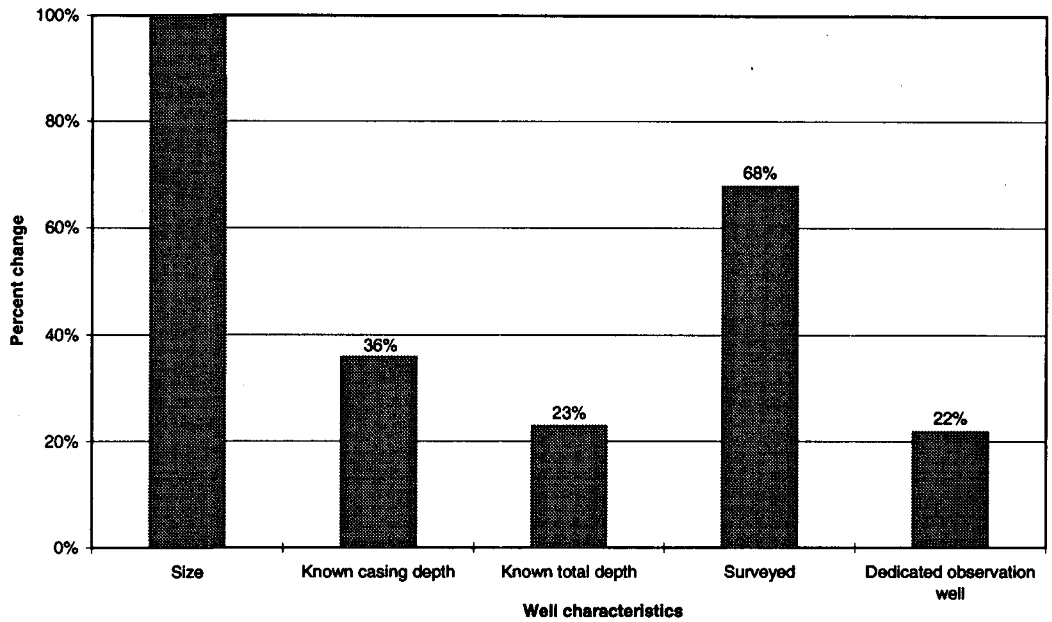


Figure 5. Summary of computerized well characteristics for the base network of 974 wells

COSTS

Costs were reviewed for drilling observation and test wells as well as for taking the measurements.

Drilling Costs

The operation of this groundwater network is costly—both in terms of human and financial resources. In addition, SJRWMD staff have indicated a need for additional observation wells and test drilling. During fiscal year (FY) 1994–95 (October 1, 1994 to September 30, 1995), more than 190 new wells were identified within SJRWMD for future construction. For FY 94–95 and FY 95–96, a total of $2,002,450 was budgeted for drilling of new observation or test wells.

Measuring Costs

The cost to measure water levels throughout the network was not available for the period October 1994–September 1995 (two measurements). However, the cost for the two measurements taken between October 1996 and September 1997 was $320,474 (Table 3). Federal (USGS) and nonfederal (water management district) contributions were approximately equal. Federal funds are expected to remain constant. Nonfederal funds are expected to increase yearly. Two maps were produced for SJRWMD and four maps for SWFWMD using the May 1995 network. Four maps were produced for SWFWMD: two maps for the Upper Floridan aquifer and two maps for the intermediate aquifer system in the southern portion of SWFWMD.

Table 3. Summary of funding sources for the potentiometric network for the period October 1996–September 1997

SJRWMD Funding	SFWMD Funding	SWFWMD Funding	USGS Funding	Total Funding
USGS, Georgia Region				
$8,334	NA	NA	0	$8,334
USGS, Orlando Region				
$50,300	NA	NA	$44,000	$94,300
NA	$19,120	NA	$19,120	$38,240
NA	NA	$6,300	$6,300	$12,600
USGS, Tampa Region				
NA	NA	$83,500*	83,500*	$167,000
Total				
$58,634	$19,120	$89,800*	$152,920*	$320,474

Note: NA = not applicable
SFWMD = South Florida Water Management District
SJRWMD = St. Johns River Water Management District
SWFWMD = Southwest Florida Water Management District
USGS = U.S. Geological Survey

*Includes all wells measured in SWFWMD in the Upper Floridan aquifer and in the intermediate aquifer system

GEOSTATISTICAL ANALYSES

The available literature on the design and analysis of groundwater networks—for both water levels and water quality—has focused attention on the use of geostatistical techniques (Sophocleous et al. 1982; Olea 1984; Englund and Sparks 1988; Whitfield 1988; American Society of Civil Engineers [ASCE] 1990a, 1990b; Spruill 1990; Spruill and Candela 1990; Loaiciga et al. 1992).

INTRODUCTION TO GEOSTATISTICS

Geostatistics is a collection of statistical methods for the analysis and estimation of spatial data for use primarily in the earth sciences. Geostatistical techniques incorporate the spatial characteristics of actual data into statistical estimation processes. Geostatistics has perhaps been most clearly described by ASCE (1990a), as follows:

> Geostatistics...provides the statistical tools for (l) Calculating the most accurate (according to well-defined criteria) predictions, based on measurements and other relevant information; (2) quantifying the accuracy of these predictions; and (3) selecting the parameters to be measured, and where and when to measure them, if there is an opportunity to collect more data.
>
> Since geostatistics deals with making inferences with "incomplete" information, it is not surprising that it often relies on probability theory....It is the methodology one resorts to when one lacks sufficient data to make deterministic inferences. Probability theory allows one to evaluate the plausibility of various outcomes, based on well-defined assumptions, which should be consistent with available knowledge, and guided by the discipline that is characteristic of mathematics.
>
> Geostatistics has adopted the language and some of the most practical, yet powerful, applicable tools of probability theory. Pragmatic and application oriented, geostatistics emphasizes practicality over mathematical generality. The main features of linear geostatistics, which is the most popular branch of geostatistics, are: (1) It uses the spatial-correlation structure of spatial functions; (2) its estimates are calculated by weighting the measurements with coefficients that are determined from the minimization of the mean square error, subject to unbiasedness conditions; and (3) it can process measurements averaged over different volumes and sizes.

In summary, geostatistics permits us (1) to more accurately predict spatial distributions, (2) to determine the accuracy of those distributions, and (3) to determine the optimal sampling locations for additional data and amounts.

GEOSTATISTICAL SOFTWARE AND STANDARD GUIDES

SJRWMD purchased the ISATIS software program for geostatistical analysis. ISATIS was developed by the École des Mines de Paris, Centre de Géostatistique. It is a high-technology software designed for geostatistical processing, estimation, simulation, and cartography of monovariate and multivariate data in either two or three dimensions. ISATIS results have been extensively validated by research work and practical applications in an increasing variety of new fields.

The geostatistical procedures used in this study conform to the American Society for Testing and Materials (ASTM) standard guidelines. The following ASTM standard guides were used:

- D 5549-94 for reporting geostatistical site investigations (ASTM 1994)
- D 5922-96 for analyzing spatial variation in geostatistical site investigations (ASTM 1996a)
- D 5923-96 for selecting kriging for use in geostatistical site investigations (ASTM 1996b)

GEOSTATISTICAL ANALYSIS STEPS

This section gives a simplified overview of the geostatistical approach and analysis steps used in this study. As a result, more questions may be generated than this simplified approach can answer. If so, please consult some of the reference materials included at the end of this report (see Glossary and Suggested Readings in Geostatistics).

In geostatistical analyses, spatial variability is characterized. Geostatistical data analyses can be performed in one, two, or three dimensions. In a one-dimensional analysis, spatial variability is characterized along a line or at a point with time represented along the line. In a two-dimensional analysis, spatial variability is characterized on a plane surface. In a three-dimensional analysis, the spatial variability is characterized within a solid body. The geostatistical analysis steps used in this report have been adapted from Englund and Sparks (1988), Krajewski and Gibbs (1993), Pannatier (1996), and Gelot (1995). Pannatier (1996) provided a generalized conceptual framework for the geostatistical approach (Figure 6).

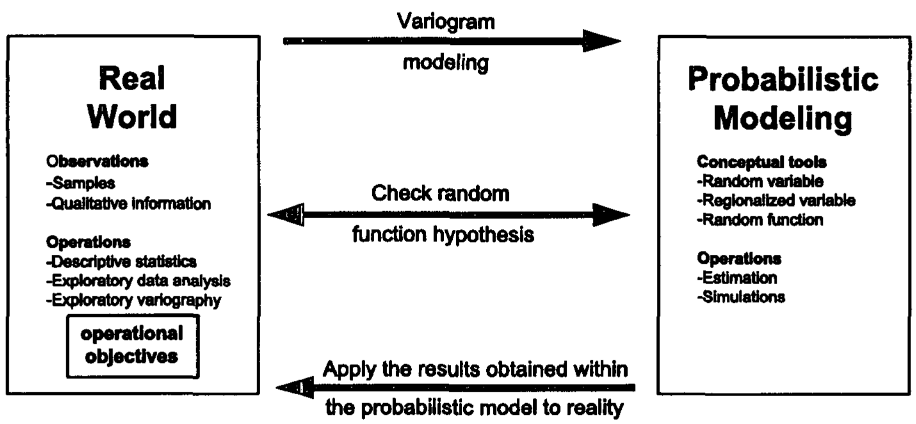


Figure 6. Conceptual framework for the geostatistical approach (Pannatier 1996)

Several steps must be performed in any geostatistical data analysis.

1. Prepare sample database
2. Summarize data with descriptive univariate statistics
3. Summarize data with descriptive multivariate statistics
4. Plot data on a base map
5. Characterize spatial continuity
6. Model spatial continuity
7. Conduct sensitivity analysis
8. Define search neighborhood
9. Cross-validate the model
10. Estimate using kriging

A few of the required steps may be eliminated from a geostatistical study depending on the type of analysis (one-, two-, or three-dimensional); the type of regionalized variable being analyzed (univariate, bivariate, or multivariate); and the software or methods used. All of these steps can be performed in an iterative manner.

Step 1—Prepare Sample Database

You must have data in order to undertake a geostatistical analysis, and you must understand any regionalized variables. A regionalized variable is a variable distributed in space (e.g., water levels, transmissivity, formation top) (Pannatier 1996). The best geostatistical results will be achieved if a regionalized variable is composed of homogeneous elements. To ensure homogeneity, sampling protocols should be the same and there should be no geologic or hydrogeologic differences in the regionalized variable. The regionalized variable must be in a format that can be used by the statistical and geostatistical analysis tools. Any duplicate locations must be removed from the data set.

Step 2—Summarize Data with Descriptive Univariate Statistics

Univariate statistical analyses provide statistical descriptions of one variable of a data set. In descriptive univariate statistics, a regionalized variable is summarized by statistical descriptors and graphical methods. A univariate statistical analysis must be performed for each regionalized variable in the data set. The usual descriptors are the mean, median, mode, minimum, maximum, quartile, quantile, variance, standard deviation, interquartile range, coefficient of skewness, and coefficient of variation. For the geostatistical analysis, the regionalized variable to be analyzed should be composed of normally distributed data from one population data set.

Graphical summaries are histograms and cumulative frequency plots. The use of these graphical displays helps determine if more than one sample population exists and if outliers or data errors are present.

Step 3—Summarize Data with Descriptive Multivariate Statistics

Multivariate statistical analyses provide descriptions of the relationships between two (bivariate) or more variables (multivariate) of a data set. Graphical summaries of multivariate statistical analyses are scatter plots, quantile-quantile plots, normal probability plots, trellis plots, and lognormal probability plots.

Within descriptive multivariate statistics, the methods for summarizing the regionalized variables are the principal component analysis, the cluster analysis, the canonical correlation analysis, and discriminate functional analysis. Multivariate analysis were not performed in this study.

Step 4—Plot Data on a Base Map

Graphical relationships can often be used to show spatial relationships in either two or three dimensions. In addition, they can be used to identify errors, outliers, anisotropy, and inhomogeneity. Base maps must be constructed for both two- and three-dimensional regionalized variables. Perspective views can be used for both two- and three-dimensional regionalized variables. Cross sections are perhaps best used only on three-dimensional regionalized variables.

Step 5—Characterize Spatial Continuity

In this step, an understanding is being built using graphics tools about the relationships between a data point at location "x" and all other data points out to a given distance. This understanding of the spatial continuity is used in the next step—modeling. The distance over which the spatial continuity is characterized is generally limited to one-half the maximum distance of the study area. In many cases, the distance is much smaller than this value. The geostatistical model may be isotropic (omnidirectional) or anistropic (directional).

Typical plots used to characterize spatial continuity and to model are variogram clouds, variogram maps (also called semivariogram maps), bull's-eye plots, and omnidirectional and directional variograms (also called semivariograms). All but the bull's-eye plot was used in this study. The experimental variogram is the end product of this step.

Step 6—Model Spatial Continuity

For any geostatistical estimation or simulation, a model of the spatial continuity must exist. This model is called a variogram or a variogram model. The variogram model must include all of the significant features found in the regionalized variables. ISATIS allows the geostatistician to use up to ten different models, either uniquely or nested, for the variogram model. A nested model is one with a combination of two or more models or structures. For example, a model could use a nugget, a linear curve, and a power curve to produce one curve. The best model of spatial continuity is selected as the variogram model and for use with the remaining steps.

Step 7—Conduct Sensitivity Analyses

In this step, the spatial model is examined to ensure that the selected variogram model replicates the main shape of the experimental variogram at different lag spacing intervals. Several lag spacings, both lower and higher than the one chosen, should be examined. This step is done graphically by comparing the experimental and model variograms over different lag spacings.

Step 8—Define Search Neighborhood

In this step, the number of neighboring regional variables must be identified for use in estimation and in limiting the search distance. This step and the kriging step are performed on a grid (point matrix). The mathematics used in the matrix inversions requires limiting the number of points used in the estimations. Limiting the number of points is especially true if the number of regionalized variables is greater than 100 points. In addition, limiting the neighborhood distance may allow one to ignore any drift (regional trends) in the data.

Step 9—Cross-Validate the Model

The appropriateness of the variogram model is verified by cross-validation. During cross-validation, each data point is temporarily removed from the data population and the value of that data point is estimated from the surrounding data points using the variogram model. The cross-validation continues with the systematic removal of one data point at a time and calculation of its estimated value until all data points have been processed. Then the resulting estimates are compared with the actual values. Large differences between the estimated and actual values may indicate the presence of outliers or errors which were missed in steps 2, 3, or 4.

Step 10—Estimate Using Kriging

In this last step, the regionalized variables are estimated at locations in the study area where data do not exist. The value of the investigated variable at an unsampled location is estimated using sample values from the neighborhood of that location and the variogram modeling—a process called kriging. Kriging is a collection of linear estimation methods in which sample values are weighted using a linear least-squares optimization procedure based on the variogram model and neighborhood data (ASTM 1996b). In kriging, the variogram model is applied to a weighted, moving-average interpolation. Kriging minimizes the estimation variance. It is computed as a function of the variogram model and the locations of the regionalized variables relative to each other and to the point or block to be estimated. The kriging standard deviation is computed for the estimates made during kriging. It is highly dependent on the variogram model used (ASTM 1994).

PREPARATION OF THE STUDY DATABASE (STEP 1)

As previously discussed, the network to be evaluated combined two data sets: the USGS water level data for May 1995 (from 918 measurements) and the SJRWMD and Alachua County water level data from the same period (from 53 wells) (see p. 2). These data met the requirements for geostatistical analysis: they constituted regionalized variables distributed in space and single duplicate data points had been eliminated. The spatial model uses the water level measurements from the base network of 974 sites.

The expanded network was used in the models to determine the best configuration of a network. Since May 1995, SJRWMD has constructed or acquired 43 wells in the Upper Floridan aquifer (Table 4). SJRWMD constructed 29 observation wells and obtained 10 wells from the Artesian Well Plugging Program (D-0221, D-1292, IR0931, L-0620, L-0658, L-0677, M-0367, M-0380, P-0830, and S-1056). SJRWMD drilled two supply wells, BR1559 and SJ0796. BR1559 is on SJRWMD land, and SJ0796 is on publicly owned land. The City of Ormond Beach drilled two observation wells, V-0788 and V-0790; SJRWMD has permission to use these wells.

Table 4. Wells constructed or acquired after May 1995 and included in the analysis of the kriging standard deviation for the recommended network

County	Station Name	SJRWMD Site Name*	Latitude'	Longitude	USGS Site ID	Well Use
Alachua	A-0693	ALACHUA FAIRGROUNDS CF	294105	821715	294105082171501	OU
Brevard	BR1526	SEMINOLE RANCH REPLACEMENT	283644	805744	283644080574402	OU
Brevard	BR1557	COCOA HS BR1557	282301	804606	282301080460601	OU
Brevard	BR1558	KENNEDY HS BR1558	281937	804420	281937080442001	OU
Brevard	BR1559	FLEMING GRANT	275003	803302	275003080330201	WS
Duval	D-0221	ROLLING HILLS	301758	814629	301758081462900	OU
Duval	D-0673	TISONIA FIRE TWR CF	303209	813718	303209081371801	OU
Duval	D-1292	INDIAN TRAILS	301157	814616	301157081465201	OU
Indian River	IR0693	CORRIGAN RANCH 390-440 FT	274126	803049	274125080304800	OU
Indian River	IR0696	DELTA FARMS 275-295 FT	273941	803754	273941080375400	OU
Indian River	IR0931	VBPP POCAHONTAS PARK	273826	802352	273826080235201	OU
Indian River	IR0954	SJWCD 432-480 FT	273515	803443	273515080344303	OU
Indian River	IR0968	BLUE CYPRESS 303-440 FT	274217	804642	274217080464201	OU
Lake	L-0290	LEESBURG FIRE TWR CF	285144	814750	285144081475002	OU
Lake	L-0620	NEAR CABBAGE HAMMOCK CF	285359	814726	285531081482701	OU
Lake	L-0658	TOWN OF MONTVERDE	283608	814030	283608081403001	OU
Lake	L-0677	LYKES #1 TWIN LAKES	282533	814308	282533081430801	OU
Marion	M-0367	HUFF WELL NEAR MCINTOSH	292622	821318	292622082131801	OU
Marion	M-0380	OXNER PROPERTY	290327	815620	290327081562001	OU
Marion	M-0410	FSR 88 & 31	292817	814836	292817081483602	OU
Marion	M-0413	FSR 90 WELL SR19 60-75 FT	291781	814143	291751081414301	OU
Marion	M-0414	FSR 31 & FSR 97 71-91 FT	292816	815137	292816081513701	OU
Marion	M-0419	MARION COUNTY SHERIFF US 301	291625	820859	291625082085901	OU
Nassau	N-0220	CALLAHAN, FL 458-650 FT	303543	814948	303543081494801	OU
Nassau	N-0221	ST. MARYS, FL 539-812 FT	304700	815710	304700081571001	OU
Nassau	N-0237	CAREY STATE FOREST	302409	815516	302409081551603	OU
Orange	OR0617	LONGBRANCH NEAR BITHLO	283126	810645	283126081064501	OU
Orange	OR0662	ROCK SPRINGS 180 FT	284634	812620	284634081262001	OU
Putnam	P-0830	PUTNAM BARGEPORT PS	294113	813920	294113081392001	OU
Seminole	S-0972	S-0972 LAKE MARY CF	284553	812048	284553081204801	OU
Seminole	S-1056	CITRUS ROAD 156-365 FT	283936	811628	283936081162801	OU
Seminole	S-1193	OVIEDO WTP 220 FT CF	283933	811231	283933081123103	OU
Seminole	S-1201	SNOW HILL RD @ ECON	284050	810653	284050081065302	OU
Seminole	S-1230	YANKEE LAKE STP 122-403	284923	812348	284923081234802	OU
Seminole	S-1253	GENEVA FIRE STATION	284412	810711	284412081071102	OU
St. Johns	SJ0796	IFAS - YELVINGTON FARMS	294131	812629	294131081262901	WI

Table 4—*Continued*

County	Station Name	SJRWMD Site Name*	Latitude†	Longitude	USGS Site ID	Well Use
Volusia	V-0777	LAKE HELEN UPPER CF	285813	811424	285813081142402	OU
Volusia	V-0788	ORMOND BEACH SR40 EAST SR 11	291417	811446	291417081144601	OU
Volusia	V-0790	ORMOND BEACH MW3	291016	811439	291016081143901	OU
Volusia	V-0791	SOAKING GULLY 290-425 FT	291016	811439	291016081143902	OU
Volusia	V-0808	LAKE DAUGHARTY CF	290552	811626	290552081162601	OU
Volusia	V-0810	SNOOK ROAD CF 290-312 FT	285211	811316	285211081131601	OU
Volusia	V-0818	OSTEEN RANCH 128-188 FT	284840	811157	284840081115701	OU

Note: OU = observation well
SJRWMD = St. Johns River Water Management District
USGS = U.S. Geological Survey
WI = irrigation well
WS = stock well

*Site names are presented in this column as they appear in the various databases
†Latitude and longitude are abbreviated, for example, 294105 is 29º41'25"

Because these wells were drilled or access was obtained after the May 1995 event, they were not used in the construction of the variogram model. However, these wells are available for use, and because many are dedicated observation wells, they have a high priority as potential sites for inclusion in an improved network. Thus, although no May 1995 water levels existed for these wells, fictitious water level values were included in the network evaluation solely for the purpose of evaluating the resulting standard deviation of the new network. Although the fictitious water level values used zero, any value would have sufficed. Naturally, the resulting estimated water levels are not valid and cannot otherwise be used. Though these wells were included in the network evaluation process they may or may not have been selected for inclusion in the recommended network.

EXPLORATORY DATA ANALYSIS (STEPS 2–4)

Combined, steps 2–4 of the geostatistical analysis are described as exploratory data analysis (EDA) (Tukey 1977). This analysis must be performed on all data that will be statistically described and graphed. The following sections describe the results of the exploratory analysis of the water level data. Multivariate analyses (step 3) were not performed as part of this study because the only regionalized variable was the water level of the Upper Floridan aquifer.

Network Statistics

The distances between nearest neighbors in the network ranged from a minimum of 441 ft (0.08 miles [mi]) to a maximum of 76,308 ft (14.45 mi) (Table 5). The mean distance to a nearest neighbor is 14,866 ft (2.82 mi). The information on nearest neighbors was used to estimate the initial lag spacing in the geostatistical analysis and to determine the grid size.

Table 5. Statistical measures of the distance to the nearest neighbor, base network

Statistical Measure	Value
Number of samples	974
Sum	14,493,915 ft
Mean	14,866 ft
Variance	75,770,151 ft^2
Standard deviation	8,704.6 ft
Standard error	278.7
Skewness	1.7765
Kurtosis	6.5388
Minimum	441 ft
10th percentile	6,140 ft
25th percentile	9,128 ft
Median	13,155 ft
75th percentile	18,539 ft
90th percentile	25,964 ft
Maximum	76,308 ft
Mode	441 ft
95% Confidence Interval of Mean	
Minimum	14,318 ft
Maximum	15,413 ft

Note: ft = feet
ft^2 = square feet

The mean and median of the base network water level measurements were 41 and 38 feet above sea level, respectively (Table 6). Examination

Table 6. Statistical measures of water levels, base network

Statistical Measure	Value
Number of samples	974 ft
Sum	39,556 ft msl
Mean	41ft msl
Variance	626.61 ft^2 msl
Standard deviation	25.03 ft msl
Standard error	0.80 ft msl
Skewness	0.6082
Kurtosis	1.1777
Minimum	-84 ft msl
10th percentile	12 ft msl
25th percentile	23 ft msl
Median	38 ft msl
75th percentile	52 ft msl
90th percentile	77 ft msl
Maximum	127 ft msl
Mode	38 ft msl
95% Confidence Interval of Mean	
Minimum	39.00 ft msl
Maximum	42.14 ft msl

Note: ft = feet
ft2 = square feet
msl = mean sea level

of the histogram and probability plot of the water levels reveals any data outliers (Figures 7 and 8). The -84 ft mean sea level (msl) measurement (Figure 7) is from an observation well next to a pumping well in Camden County, Georgia.

The curve on the probability plot shows some deviation from a straight line, especially on the left and right sides of curve (Figure 8). If the probability plot of the water levels approximates a straight line, then the levels might be considered normally distributed. The curve is close enough to a straight line that the data are considered to approximate normally distributed data.

Post-Plot Review

The water level measurements from the base network show the general features of the potentiometric surface for the Upper Floridan

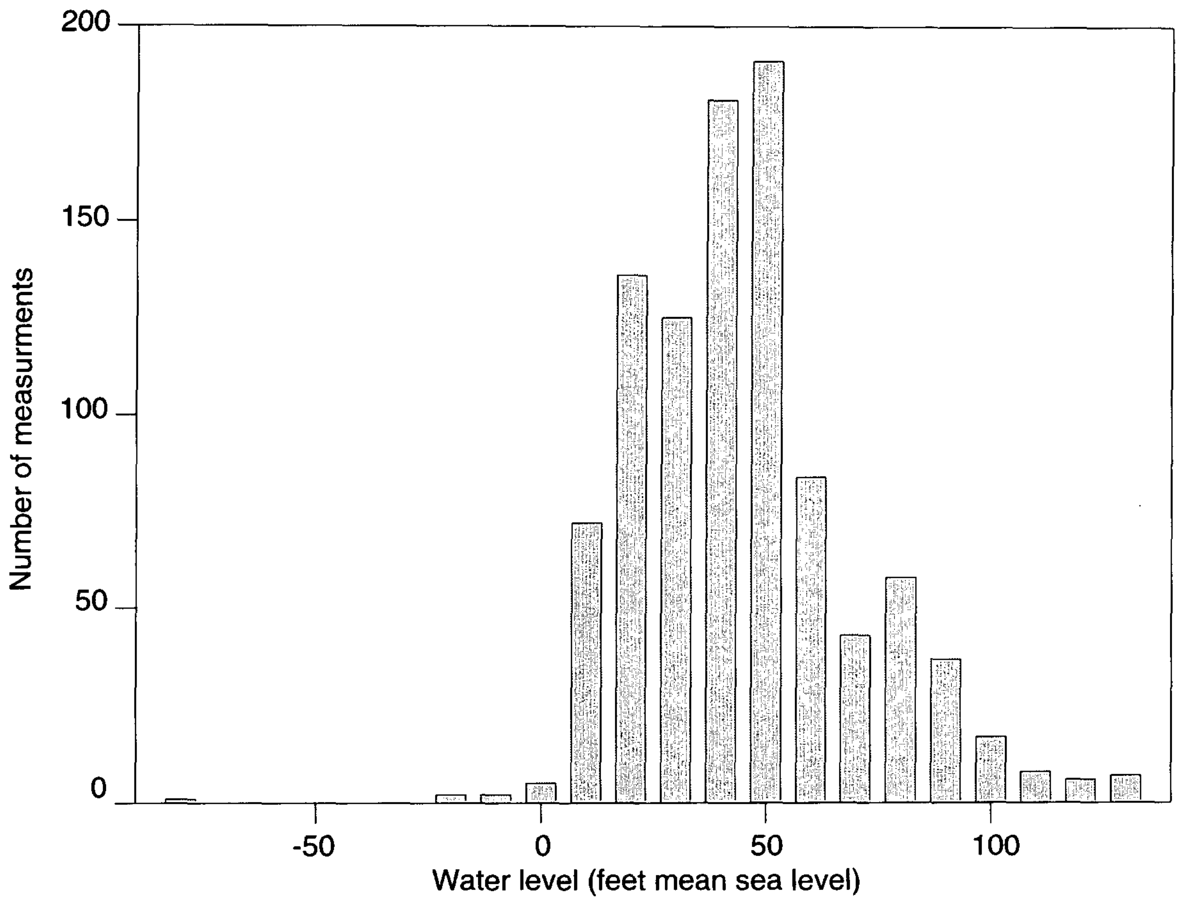


Figure 7. Histogram of water levels in the base network

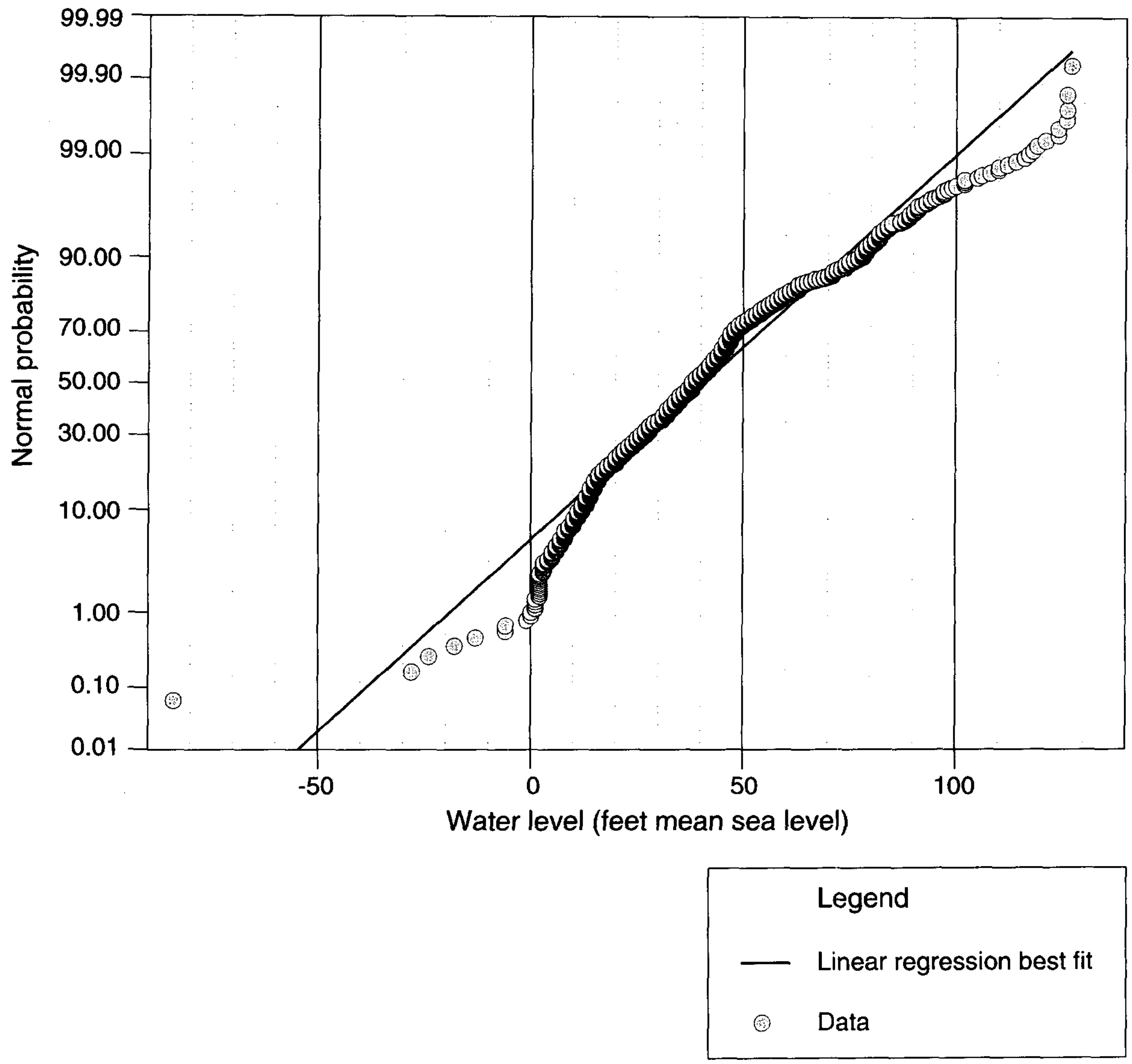


Figure 8. Probability plot of water levels in the base network

aquifer (Figure 9). The potentiometric surface is dominated by two highs along the central portion of the peninsula, with a saddle between them. The saddle contains elevations between 40 and 51 ft above msl. The highs have elevations more than 75 ft msl. The highs are located in northern Polk and southern Lake counties and at the junction of Alachua, Bradford, Clay, and Putnam counties. The saddle is located in Marion County.

VARIOGRAM ANALYSIS (STEPS 5–8)

Spatially correlated data are characterized through the analysis of variograms. Variograms plot the distance (*h*) between all data points verses one-half the average squared differences ($\gamma/2$) between the data points (Isaaks and Srivastava 1989; Brooker 1991; Olea 1991; Krajewski and Gibbs 1993). Variograms can be used to assess how well a sample measurement at one location can represent the value at another location.

Variogram Plots

The variogram map (variogram surface) is a valuable tool for revealing anisotropy in data sets (Isaaks and Srivastava 1989). In a variogram map, the variogram calculations for all pairs of data are grouped by separation distance and direction and then averaged. In this manner, a two-dimensional surface is created to show changes in the variogram calculations with distance and direction (Isaaks and Srivastava 1989; Pannatier 1996).

The variogram map of all water level measurements for the base network indicated strong anisotropy (Figure 10). The direction of the maximum range (OX) is found to be at 105° and the direction of the minimum range (OY) at 15°. For comparison, the variogram map also is shown over a limited range of 0 to approximately 82,500 ft (Figure 11). Over this range, the measurements do not show appreciable anisotropy.

Omnidirectional (isotropic) and directional (anisotropic) experimental variograms were examined with lag distances varying between 5,000 and 25,000 ft at 2,500-ft intervals. In plotting a variogram, the lag distance along the *x*-axis is divided into consecutive intervals as in a

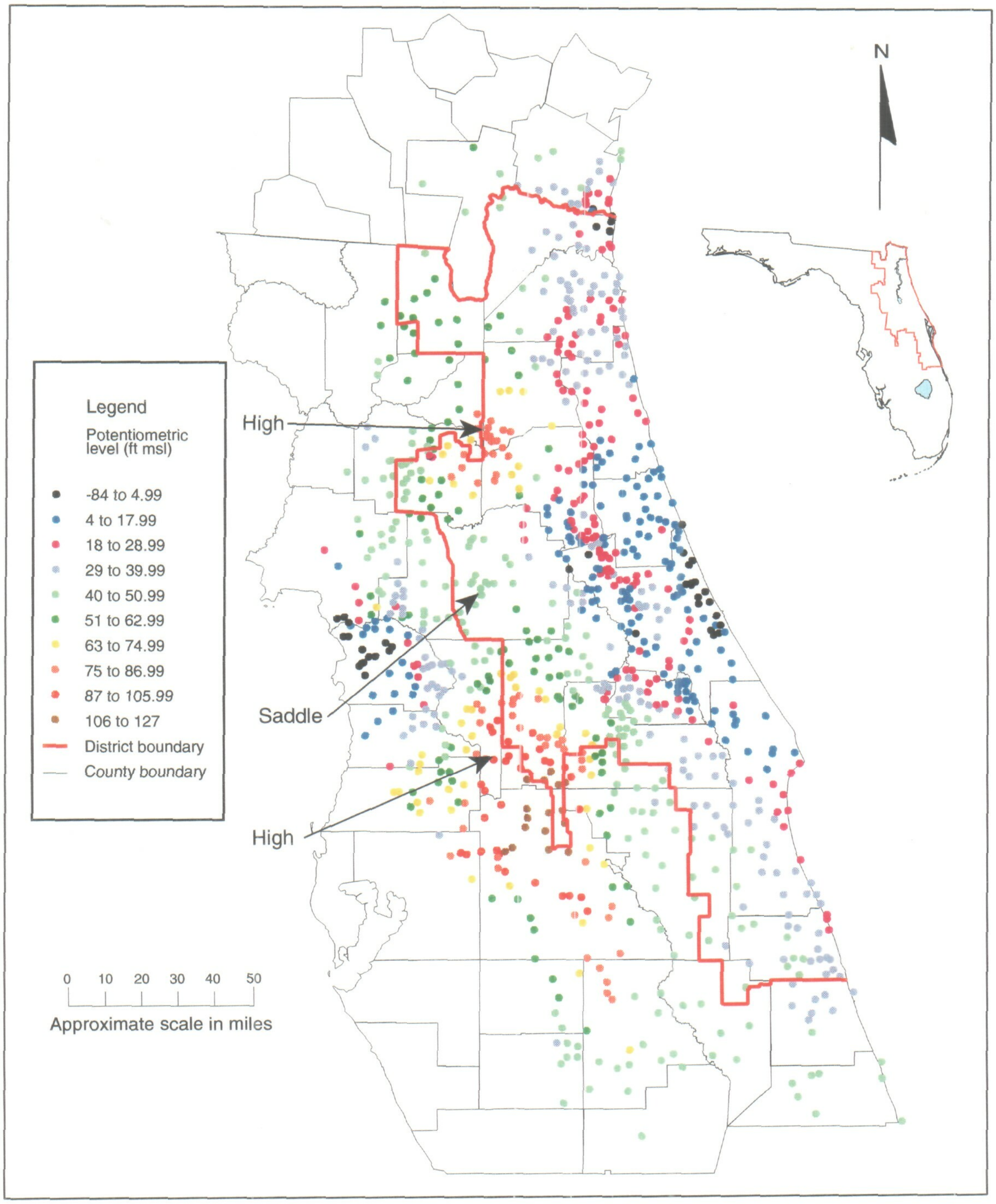


Figure 9. Post-plot of the base network (974 sites)

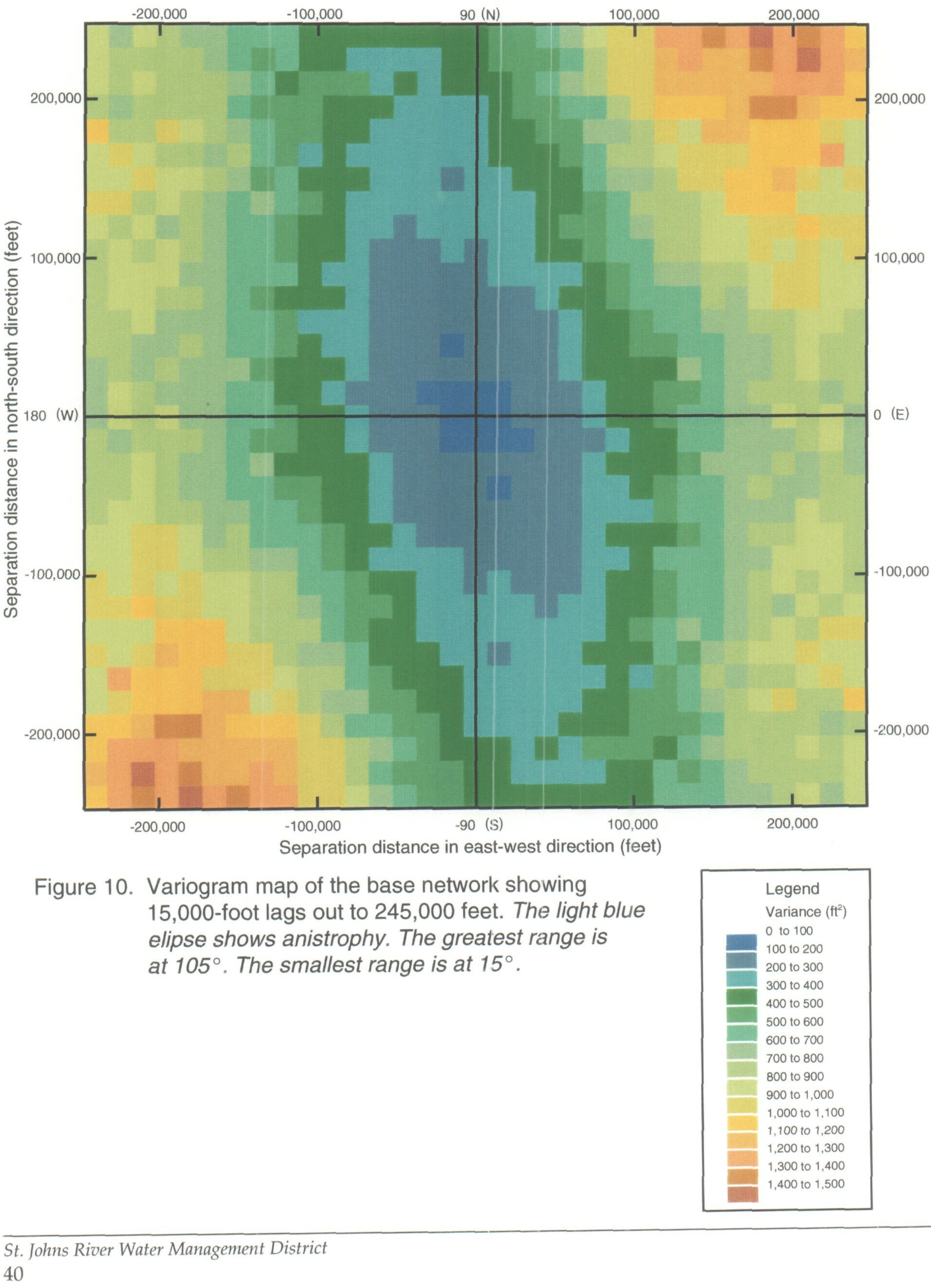


Figure 10. Variogram map of the base network showing 15,000-foot lags out to 245,000 feet. *The light blue elipse shows anistrophy. The greatest range is at 105°. The smallest range is at 15°.*

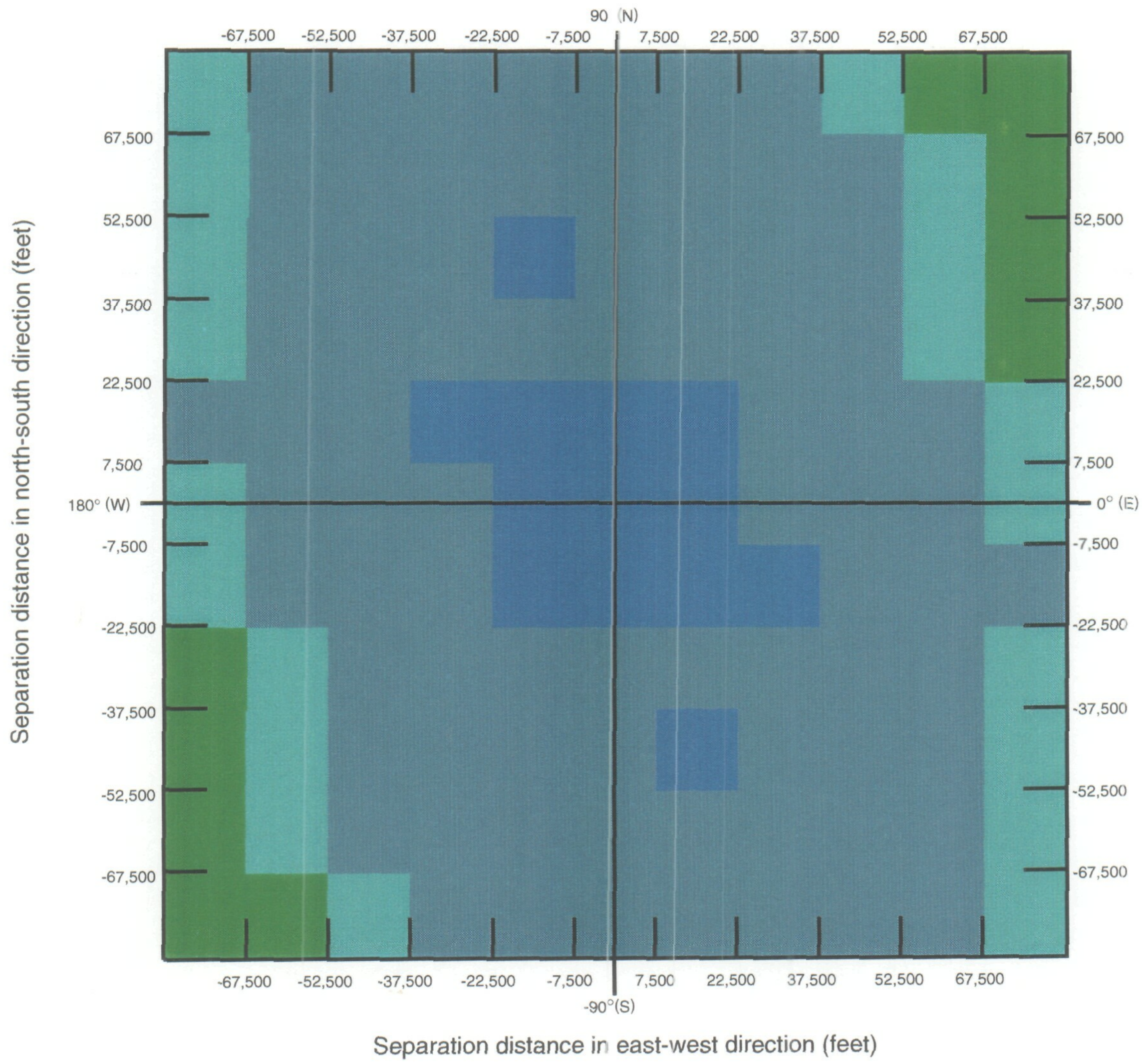


Figure 11. Variogram map of the base network showing 15,000-foot lags out to 82,500 feet

Legend

Variance (ft^2)

- 0 to 100
- 100 to 200
- 200 to 300
- 300 to 400

histogram. The interval is plotted as a single point. The x-axis can be the average of the values in the lag, the median of the values, or the midpoint of the values. ISATIS uses the average of the values in each lag. The y-axis is the mean of the $\gamma/2$ values of the lag interval.

Generally, one should not expect to produce a smooth experimental variogram when the lag spacing is less than the minimum distance between data points. In this case, the mean minimum distance between data points was 14,866 ft. A lag spacing of 15,000 ft was selected as the optimum for the experimental variograms.

Variogram Model

Directional (anisotropic) experimental variograms with the 15,000-ft lag spacing and angles between 0° and 145° were examined for anisotropy. Two measurements exhibited a strong anomalous influence on the experimental model. One measurement (-84 ft msl) is from an observation well near a pumping well in Georgia. The other measurement (1 ft msl) is in the cone of depression of a wellfield in Alachua County.

For the purpose of creating the experimental variogram and the variogram model, these two measurements were masked (Figure 12). However, during all subsequent cross-validation and kriging, the measurements were included—not masked.

Directional experimental variograms in the OX and OY directions represent the data relationships and show the anisotropy over the lag distances (Figure 13). Values in the OX direction reached a high of 527 ft^2 (Table 7); values in the OY direction peaked at 850 ft^2 (Table 8).

After the lag distances, anistropic characteristics, and experimental variograms were determined, a variogram model was fit to the data. The best-fit model was determined to be one with power and gaussian curves, nested (Figure 14). As a consequence of the anisotropy of the network, the power curve is the dominant structure in the OX direction, while the gaussian curve is the dominant structure in the OY direction (Table 9). A comparison of the experimental variogram and the variogram model at 15°, 60°, 105°, and 150° shows that the

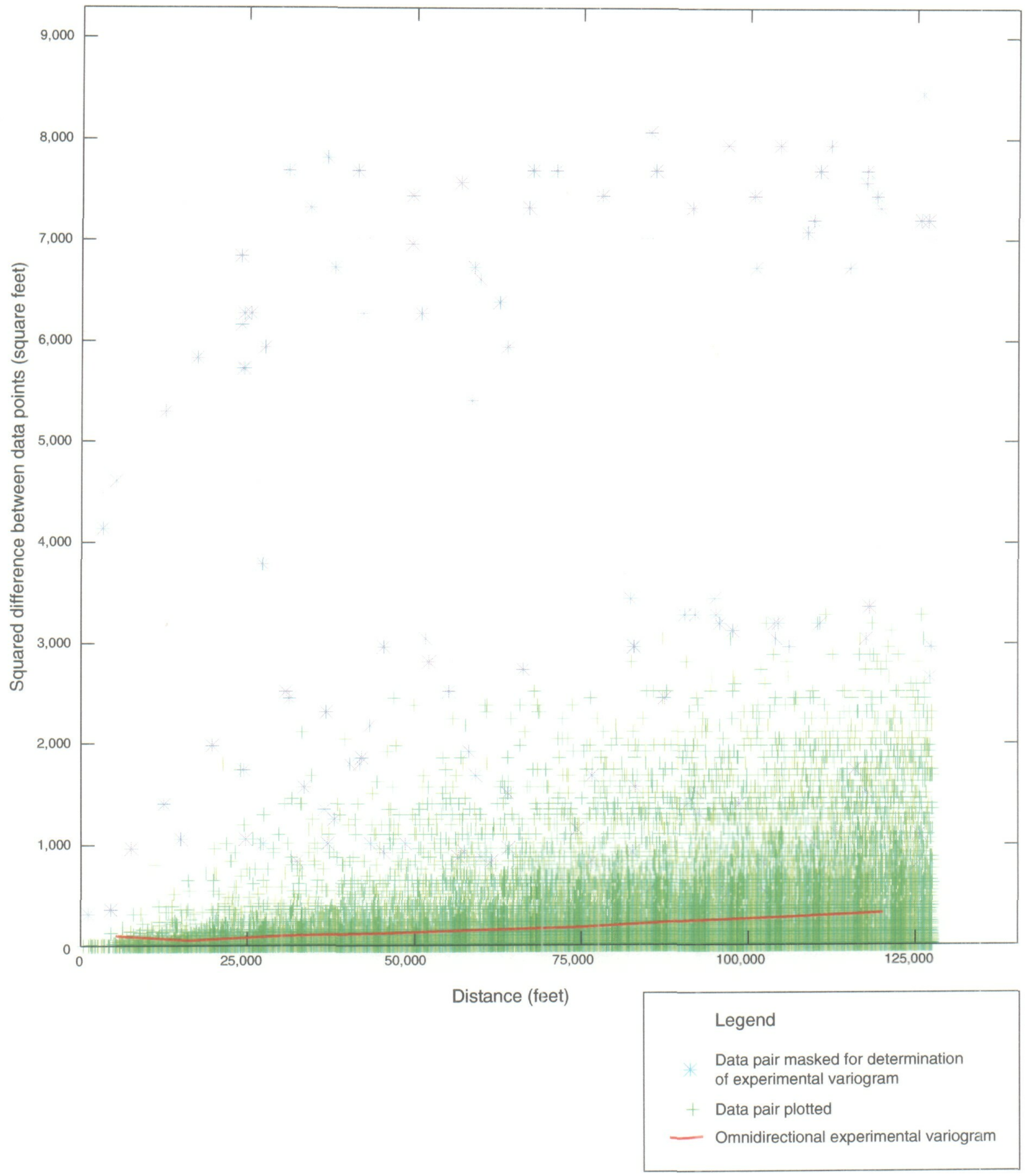


Figure 12. Variogram cloud of all measurements out to a distance of 135,000 feet (lag 9)

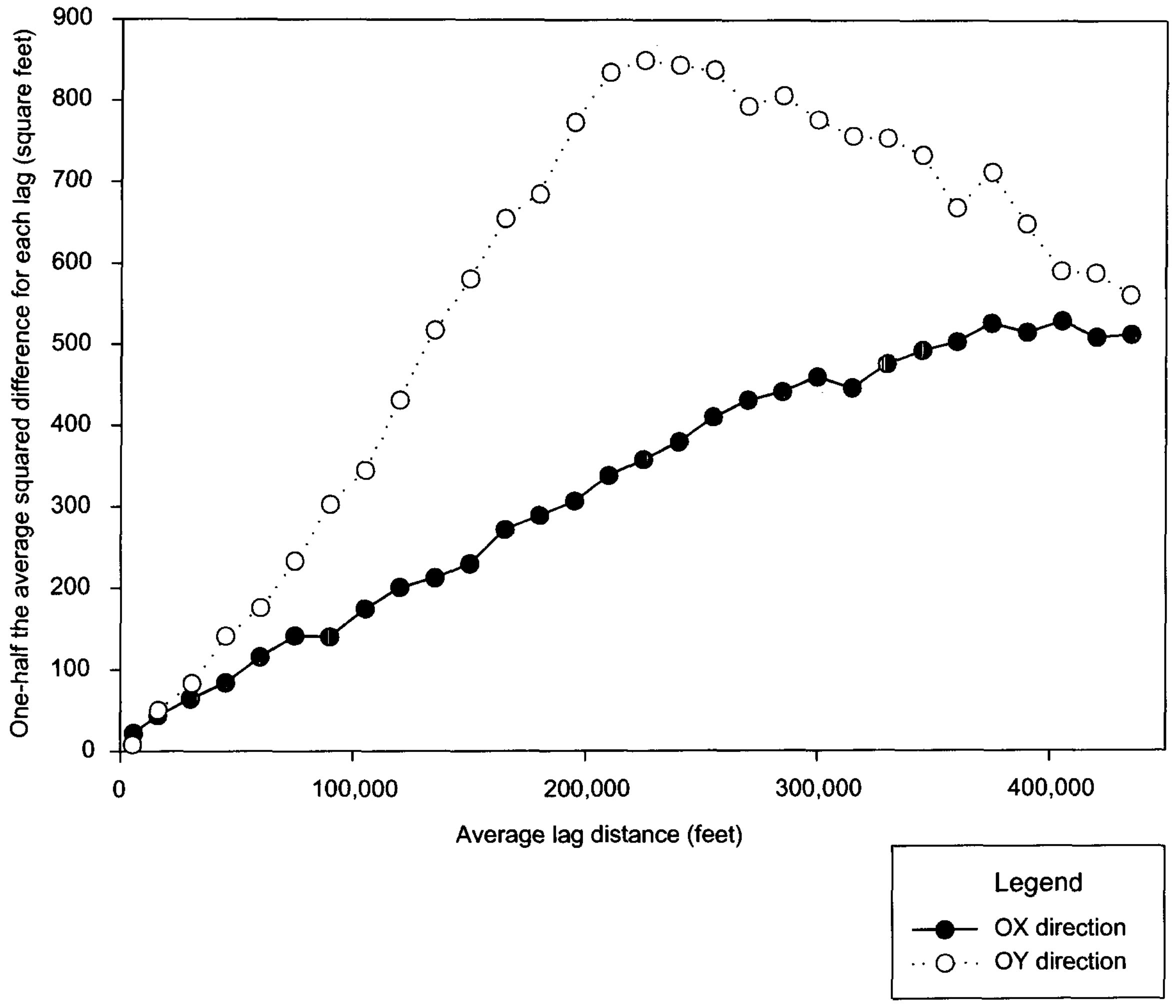


Figure 13. Experimental variograms in the maximum range (OX) and minimum range (OY) directions

Table 7. Details of the experimental variogram in the maximum range (OX) direction

Lag	Lag Distance	Number of Pairs	Average Distance	γ/2 Value (ft^2)
0	0	26	5,702	22.1
1	15,000	365	16,229	43.7
2	30,000	710	30,106	64.3
3	45,000	1,010	45,212	83.7
4	60,000	1,185	60,158	115.3
5	75,000	1,454	75,185	141.4
6	90,000	1,644	90,105	139.8
7	105,000	1,858	105,172	174.1
8	120,000	2,114	120,094	200.5
9	135,000	2,280	135,192	212.2
10	150,000	2,560	150,133	229.7
11	165,000	2,752	165,194	272.0
12	180,000	2,895	180,022	289.3
13	195,000	3,061	195,136	307.5
14	210,000	3,252	210,028	338.5
15	225,000	3,442	225,074	358.6
16	240,000	3,550	240,176	380.2
17	255,000	3,598	254,979	411.1
18	270,000	3,677	270,083	431.9
19	285,000	3,721	284,902	442.4
20	300,000	3,833	299,904	461.0
21	315,000	3,935	314,984	447.1
22	330,000	4,029	329,962	477.0
23	345,000	4,027	345,119	493.6
24	360,000	4,181	359,920	504.2
25	375,000	4,134	374,939	527.2
26	390,000	4,230	390,015	516.0
27	405,000	4,266	405,124	529.8
28	420,000	4,144	420,014	510.0
29	435,000	4,215	435,029	513.1

Note: ft^2 = square feet
γ/2 = one-half the average squared difference between the data points

Table 8. Details of the experimental variogram in the minimum range (OY) direction

Lag	Lag Distance	Number of Pairs	Average Distance	γ/2 Value (ft^2)
0	0	29	5,241	8.2
1	15,000	354	16,214	49.8
2	30,000	636	30,788	83.2
3	45,000	817	45,416	141.0
4	60,000	1,062	60,274	175.8
5	75,000	1,266	75,090	233.2
6	90,000	1,477	90,103	302.8
7	105,000	1,546	105,220	345.0
8	120,000	1,696	119,976	431.5
9	135,000	1,734	134,878	517.7
10	150,000	1,792	150,193	581.2
11	165,000	1,896	165,104	655.2
12	180,000	1,894	179,945	685.1
13	195,000	1,972	194,971	773.4
14	210,000	2,038	209,978	835.1
15	225,000	2,140	224,943	850.3
16	240,000	2,237	239,975	844.1
17	255,000	2,244	255,005	838.2
18	270,000	2,419	269,920	793.6
19	285,000	2,538	285,001	806.8
20	300,000	2,582	300,037	777.2
21	315,000	2,750	314,922	756.8
22	330,000	2,650	329,911	754.3
23	345,000	2,515	345,001	733.8
24	360,000	2,423	359,881	669.0
25	375,000	2,345	374,859	713.3
26	390,000	2,093	389,857	649.3
27	405,000	1,967	404,774	591.6
28	420,000	1,775	419,734	589.3
29	435,000	1,603	434,783	561.9

Note: ft^2 = square feet
γ/2 = one-half the average squared difference between the data points

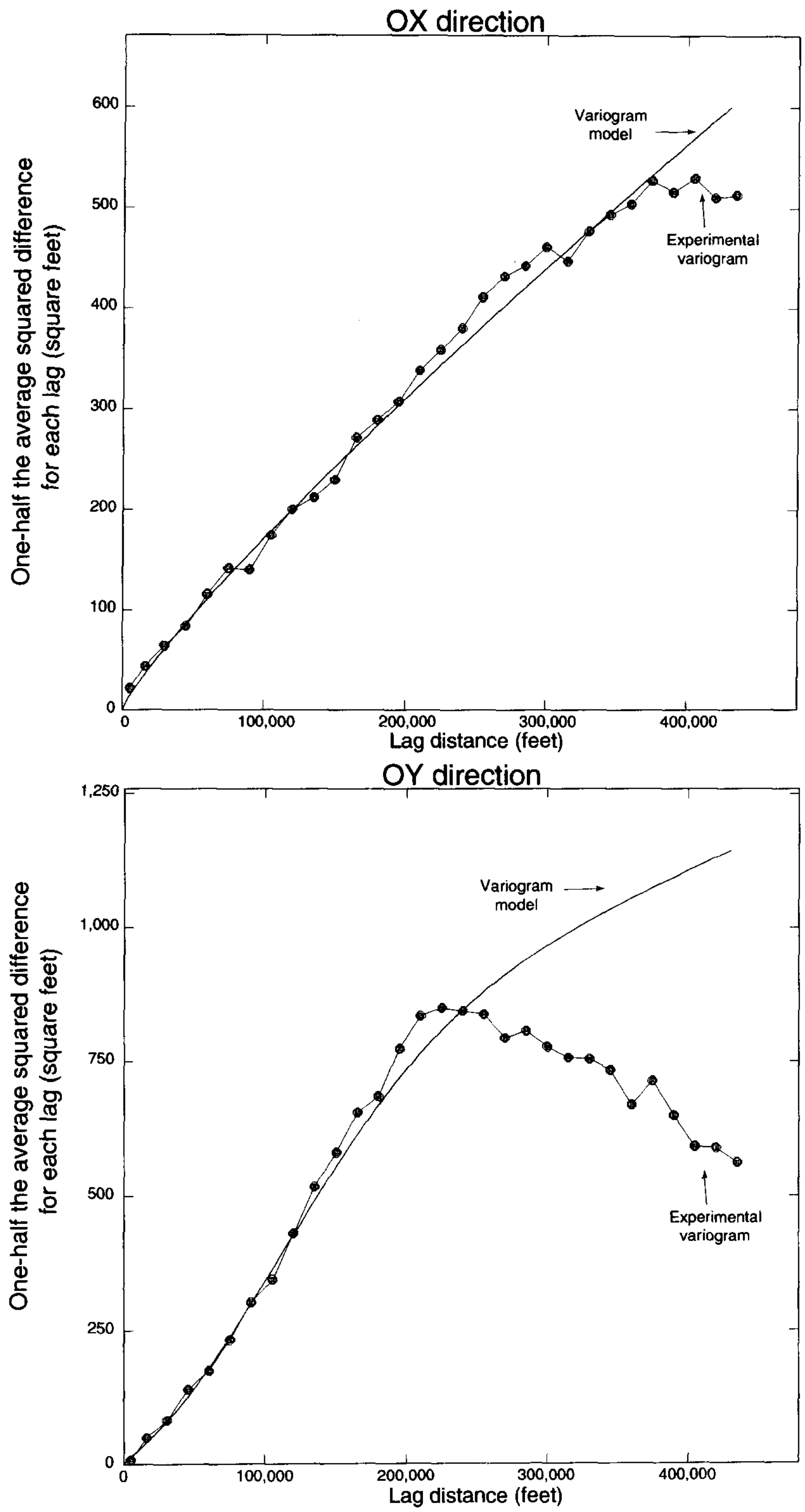


Figure 14. Comparison of experimental variogram and variogram model in the maximum range (OX) and minimum range (OY) directions

Table 9. Summary of variogram model parameters and anisotropy

Curve	Scale (feet)	Exponent	Sill	Anisotropy	
				OX	OY
Power	384,900	0.86	545	1.0	0.0
Gaussian	162,250		545	0.0	1.0

Note: OX = maximum range
OY = minimum range

variogram model captures the main features of the data regardless of direction (Figure 15).

Sensitivity Analysis

In order to further confirm the suitability of the selected variogram model, lag sensitivity tests were performed in both the OX and OY directions. Experimental variograms with lags of 11,000 ft, 13,000 ft, 17,000 ft, and 19,000 ft were compared with the model variogram, which used 15,000-ft lags. As shown by the lag tests for the OX direction, the variogram model captured the main features of the experimental variograms (Figure 16). The lag tests for the OY direction were similar to the OX direction.

Neighborhood

The variogram model and experimental variograms in the OX direction have a good match until lag 6 at 90,000 ft (17.04 mi) (Figure 14). At lag 6, the variogram model is under the experimental variogram curve. As a result, the maximum neighborhood in the OX direction was conservatively set at 80,000 ft.

Although the experimental model for the OY direction supports a neighborhood distance until lag 7 at 105,000 ft (19.88 mi) (Figure 14), it also was set to 80,000 ft. This selection was intended to provide a conservative influence on the use of the model.

The maximum and minimum number of points to use in the neighborhood was set at 14 and 1, respectively. For each point to be estimated, the percentage weights on each known data point were

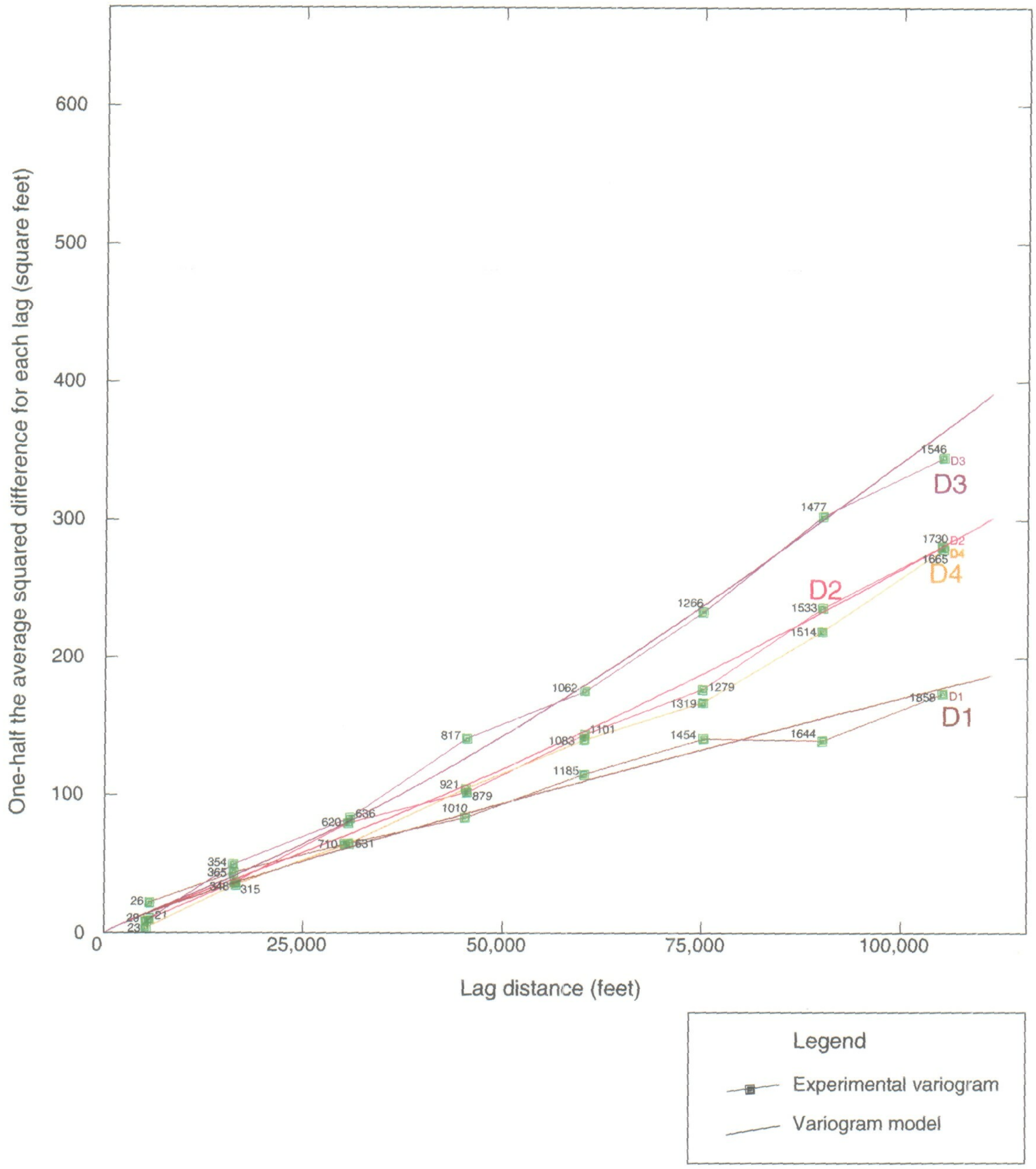


Figure 15. Comparison of experimental variograms and the variogram model at 15° (D1), 60° (D2), 105° (D3), and 150° (D4) out to a distance of 105,000 feet (lag 7). *The 60° and 150° variograms are identical. The numbers represent the total pairs averaged for each experimental variogram data point.*

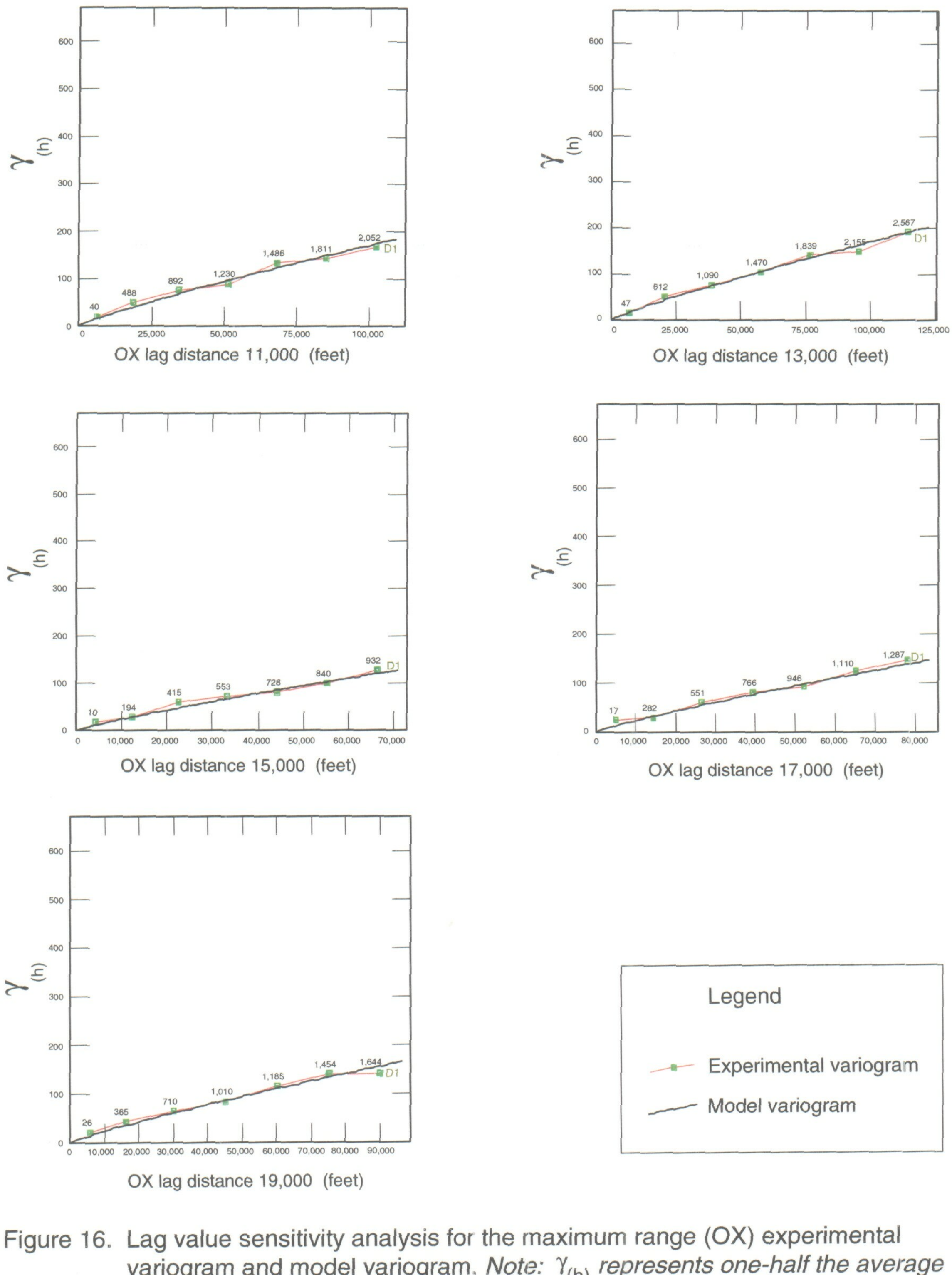


Figure 16. Lag value sensitivity analysis for the maximum range (OX) experimental variogram and model variogram. *Note:* $\gamma_{(h)}$ *represents one-half the average squared difference for each lag in square feet.*

assigned based upon the variogram model and out to the limits of the neighborhood (Figure 17).

CROSS-VALIDATION RESULTS (STEP 9)

To cross-validate the variogram model, data points were systematically removed and estimated from the remaining data points. Actual and estimated values were then compared. Data points for which the standard deviation was greater than ±2.5 were considered nonrobust, because such values lie outside the 95% confidence limit of a normal distribution. Cross-validation identified 17 nonrobust data points (Figure 18, Table 10): 8 are in SJRWMD, 1 is in Georgia, and 8 are in SWFWMD.

All but one of the nonrobust data points appeared to be associated with water supply wells, pumping centers, or a small but very high-gradient potentiometric high and an associated first-magnitude artesian spring (Table 10). Ten of the wells are supply wells (in use) or are in pumping centers. Six of the wells are clustered around Rainbow Springs and a small steep potentiometric high where Citrus, Levy, and Marion counties are joined. Nothing is known as to why the cross-validation at one well was nonrobust. Two of the nonrobust data points were identified as outliers in early steps (the Camden County, Georgia well 304401081323701 and well 294228082181801 in Alachua County).

ESTIMATION (STEP 10)

Point kriging was used to estimate the water levels and the associated kriging standard deviation at locations other than the data points (Figure 19 and Figure E1, Appendix E). The mean standard deviation estimated by kriging for all of the points in the base network was ±6.15 ft. The maximum standard deviation was ±19.05 ft, and the minimum was ±0.31 ft. The grid used was 1,000 ft by 1,000 ft for the area containing data. The kriging process with a moving neighborhood does not allow for any value estimation if the point to be estimated does not have any data points within the neighborhood. In this project, the neighborhood was limited to a radius of 80,000 ft, as previously discussed.

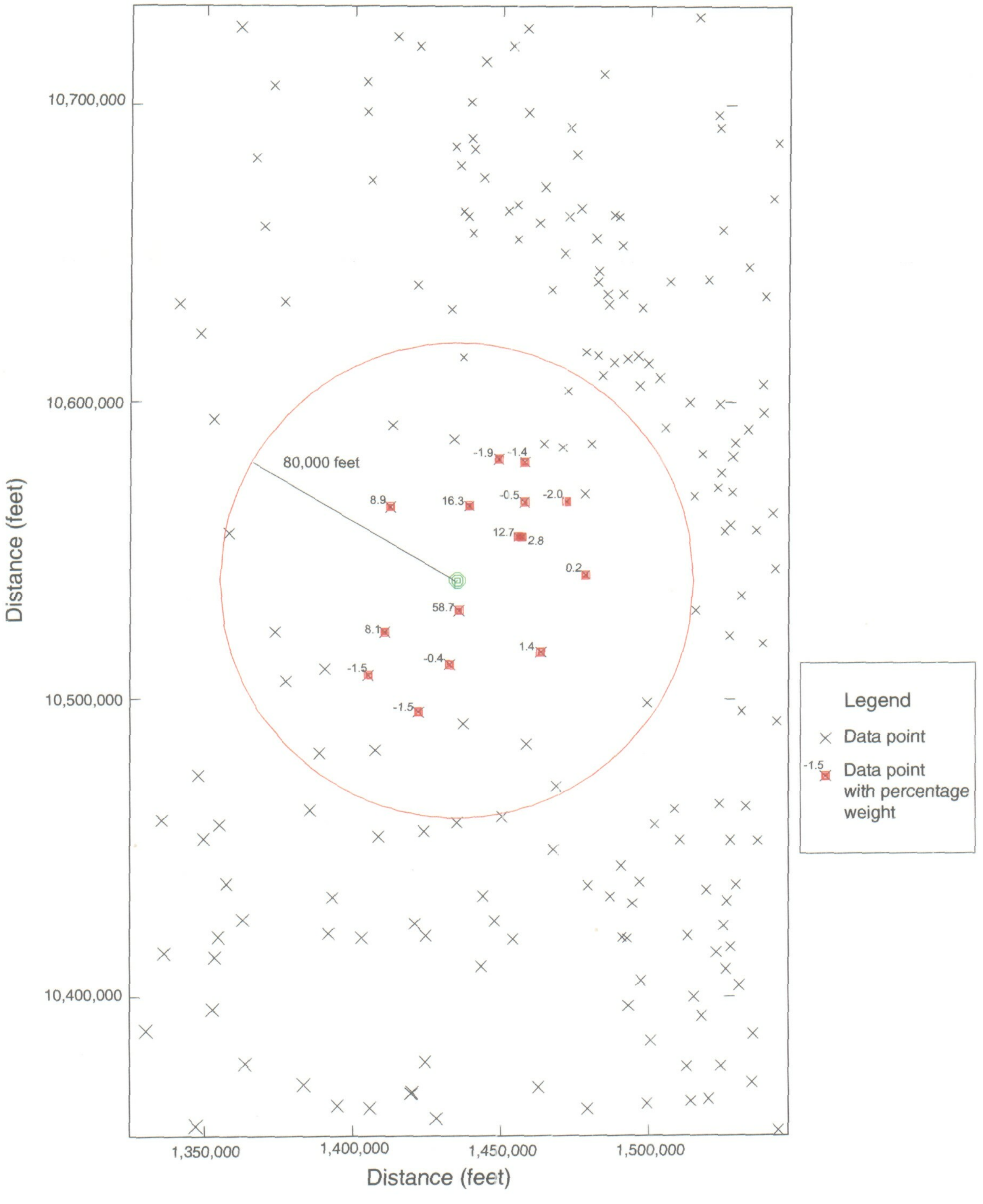


Figure 17. The neighborhood distance and example percentage weights used for water level estimation at a grid point

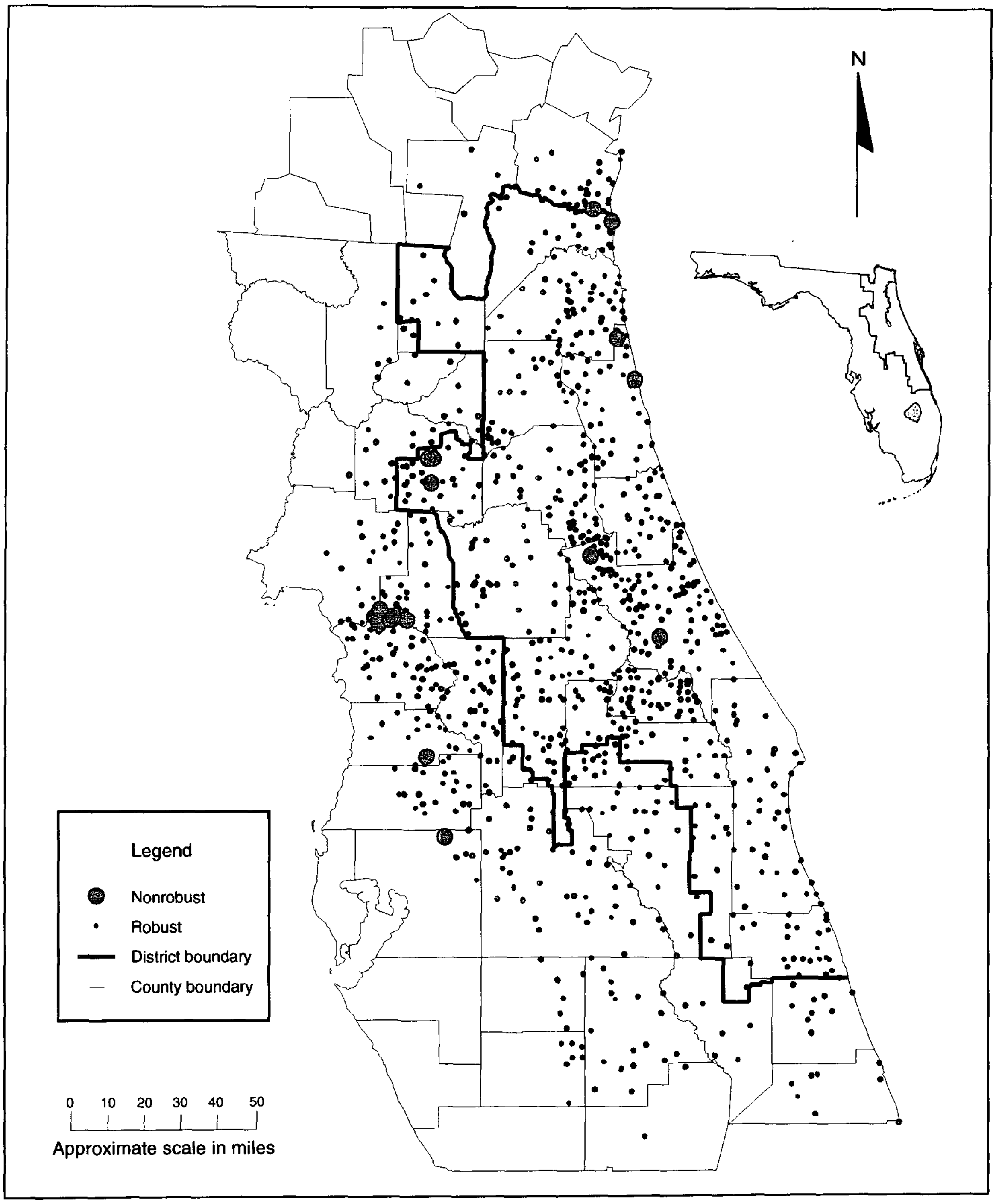


Figure 18. Location of the nonrobust cross-validated data points

Table 10. Summary of data points with a cross-validated standard deviation outside the 95% confidence limit of a normal distribution

County	Site Name*	Latitude†	Longitude	USGS Site ID	Comments
Alachua	SUPPLY WELL, DNR DIST 3 H	293625	821810	293625082181001	Supply well
	94221804 CITY OF GAINESV	294228	821818	294228082181801	Near pumping center
	ALACHUA COUNTY F-4	294239	821822	294239082182201	Near pumping center
Citrus	90123202 17S17E01 EMORY	290132	823242	290132082324201	Near Rainbow Springs
	90222901 16S18E33 CE 77	290216	822920	290216082292001	Near Rainbow Springs
Camden County, GA	33D022	304401	813237	304401081323701	Near pumping well
Hernando	82821901 RUSSELL BLACKET	282839	821908	282839082190801	Near pumping center
Hillsborough	TPA POT MAP SITE	280852	821356	280852082135601	Near pumping center
Levy	90323301 16S17E35 DEL W	290301	823356	290301082335601	Near Rainbow Springs
	90523201 16S17E13 SCE 1	290503	823231	290503082323101	Near Rainbow Springs
Marion	90222501 16S19E31 CE 75	290227	822508	290227082250801	Near Rainbow Springs
	90322802 16S18E27 AK:54	290325	822837	290325082283701	Near Rainbow Springs
Nassau	N-56 CCR-11	304055	812720	304028081272101	In a pumping center
St. Johns	GUANA PARK FLORIDAN	300203	812027	300203081202701	Supply well
	SJ-63 DEE DOT RANCH AT B	301212	812524	301212081252401	Supply well
Volusia	85811303 J. B. EVANS LAKE	285811	811309	285811081130901	
	91813201 USED 426 PINE I	291835	813242	291835081324201	Supply well

Note: USGS = U.S. Geological Survey

*Site names are presented in this column as they appear in the various databases.
†Latitude and longitude are abbreviated, for example, 293625 is 29°36'25".

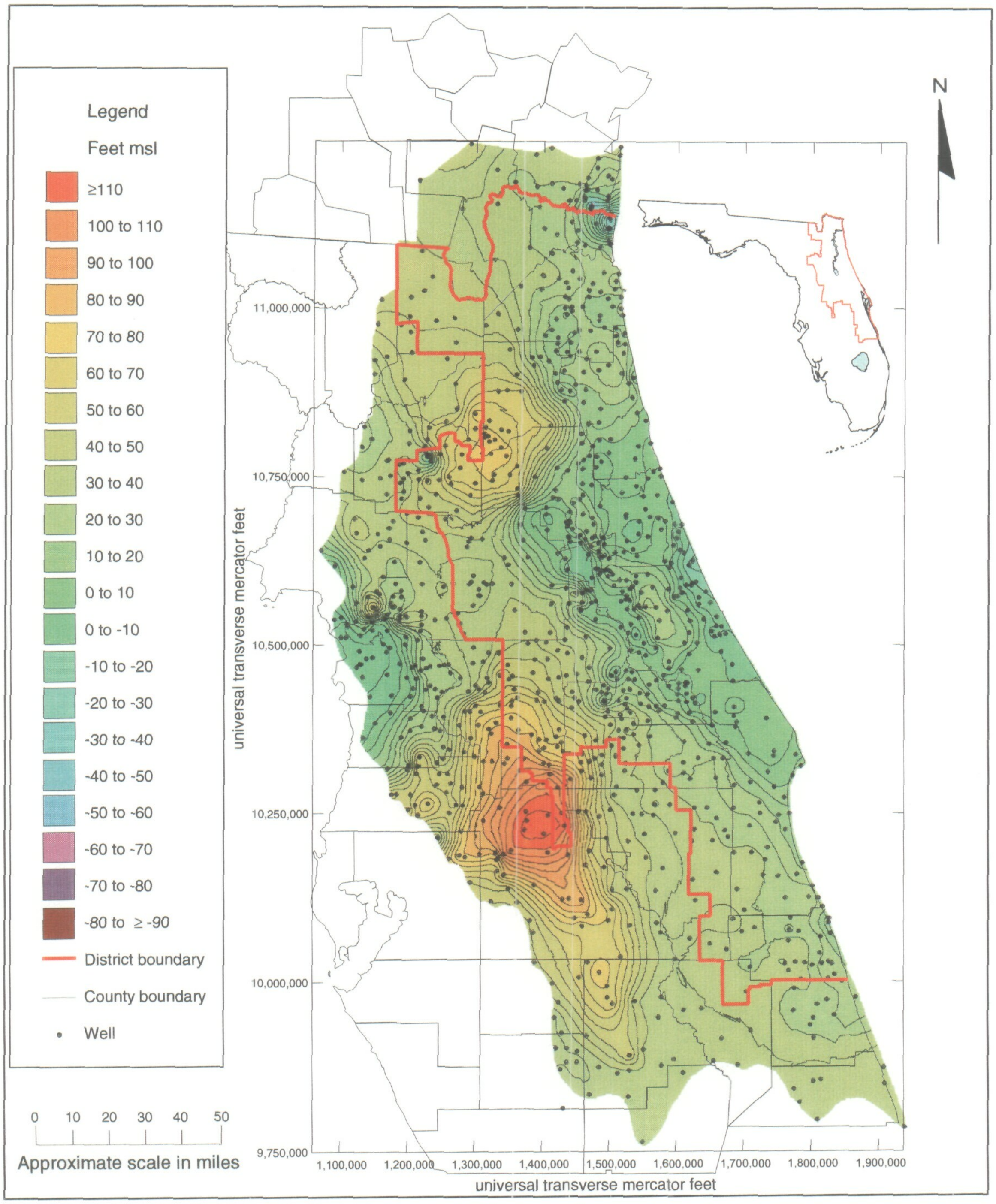


Figure 19. Potentiometric surface of the base network estimated by kriging. *Areas with a potentiometric surface deeper than 60 feet below msl are not discernable at this map scale.*

NETWORK DESIGN

Once the geostatistical analysis was completed, the resulting model was used to design an improved regional network. With the model, six network scenarios were created and evaluated.

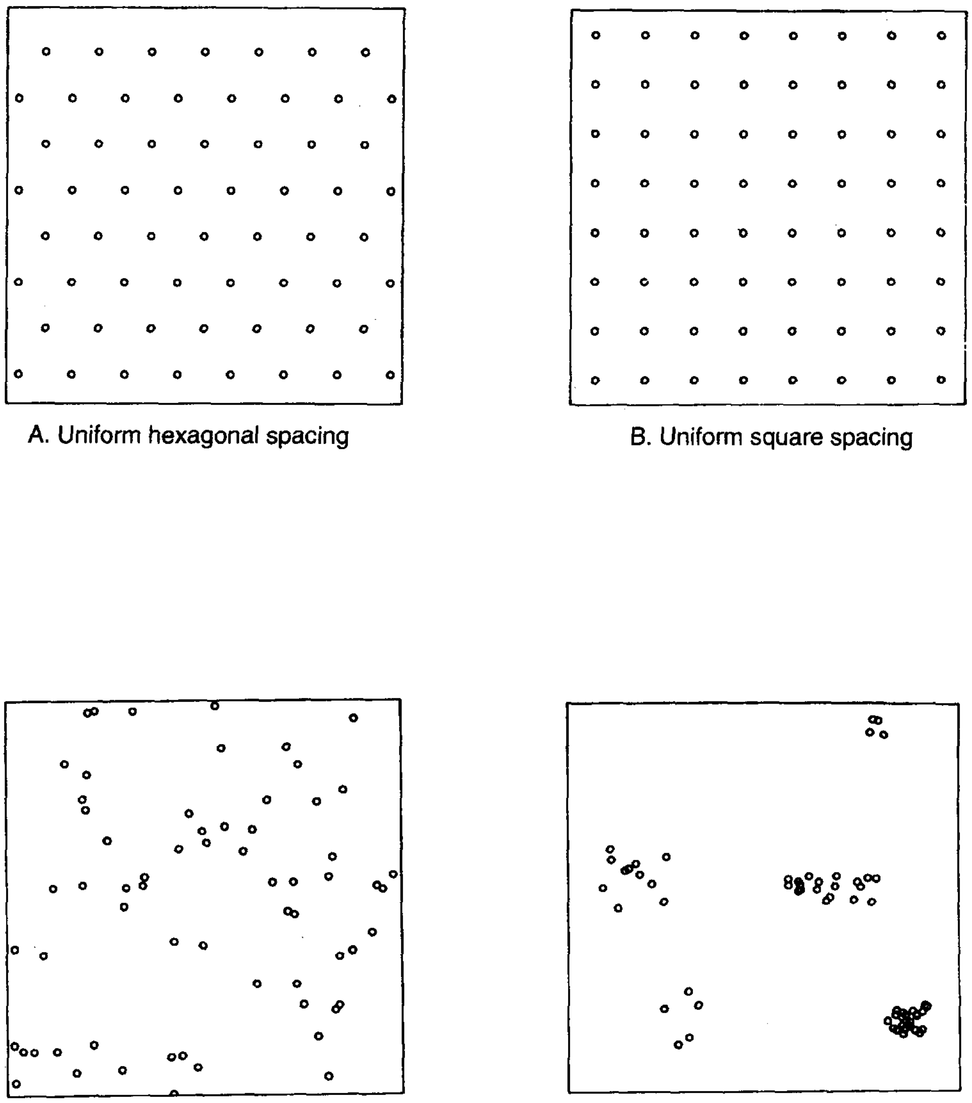
GRID TYPES

Olea (1984) evaluated the efficiencies of various groundwater network sampling strategies. The evaluation considered several data spacing patterns, including uniform hexagonal and square, random, and clustered data points (Figure 20). Olea (1984) determined that spatial networks with a uniform hexagonal spacing were the most efficient and that networks with clustered data were the least efficient. One of the objectives of this study was to determine the most efficient sampling strategy for the potentiometric network by determining a spatial pattern or patterns to minimize the number of data points needed.

Because a regularly spaced network of wells would be highly impractical, a stratified sampling pattern was selected. In stratified sampling, the area of interest is apportioned into mutually exclusive partitions and then one data point per partition is randomly selected from each partition. Olea (1984) found the stratified hexagonal pattern to be slightly more efficient than the stratified square pattern (Figure 21).The stratified hexagonal pattern requires fewer neighbors than the stratified square in all studied cases. At the minimum, the stratified hexagonal pattern requires six data points to the stratified square pattern of eight data points.

MEASURE OF NETWORK EFFECTIVENESS

Six hexagonal grids with grid cell diameters of 15,000 ft, 22,500 ft, 30,000 ft, 37,500 ft, 45,000 ft, and 52,500 ft were created using ARC/INFO in a geographic information system. The incremental spacing used was 7,500 ft, one-half the variogram lag spacing. Each well was assigned to a corresponding grid cell in each of the six network scenarios.



A. Uniform hexagonal spacing

B. Uniform square spacing

C. Random spacing

D. Clustered spacing

Figure 20. Examples of data point spacing (adapted from Olea 1984)

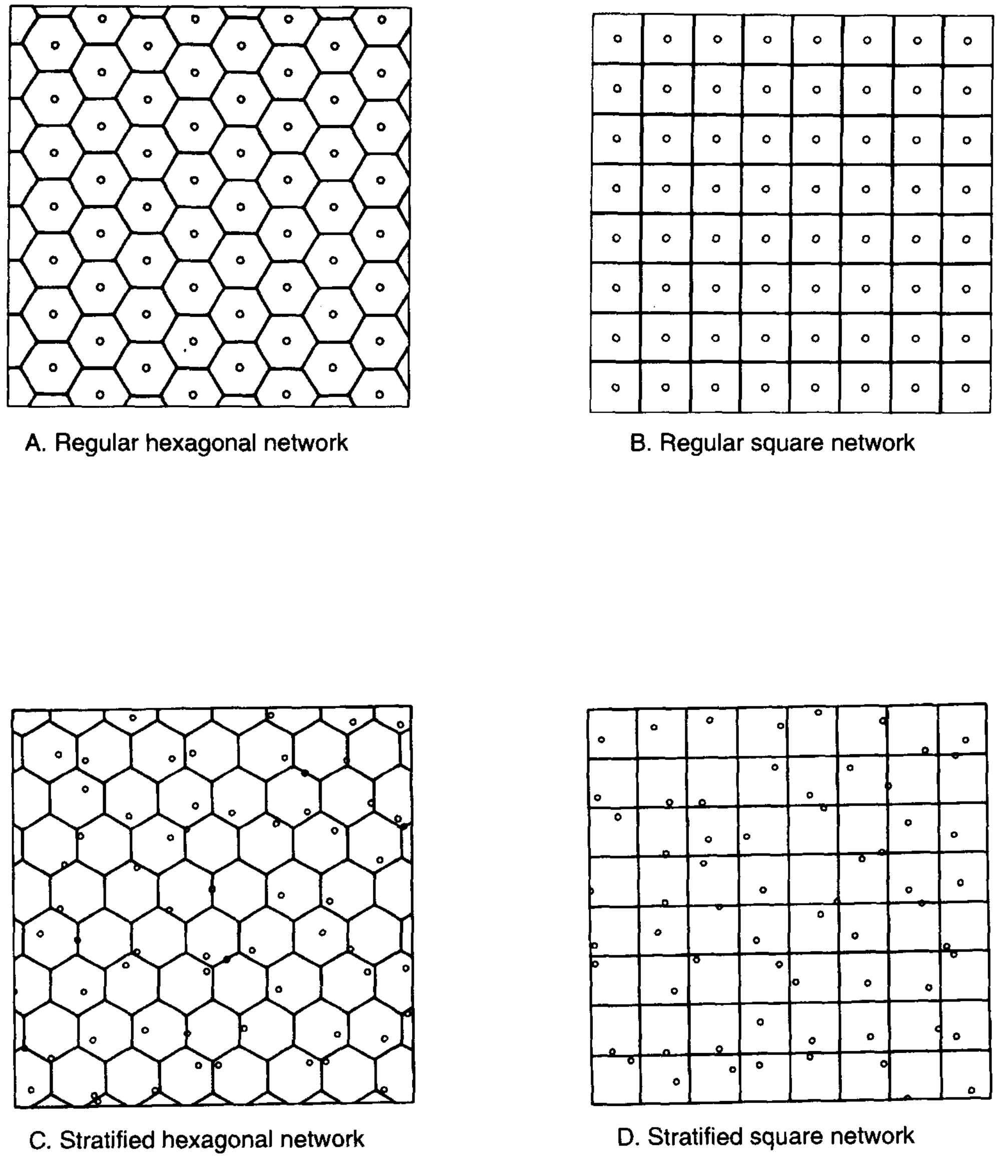


Figure 21. Examples of regular and stratified hexagonal and square sampling networks (adapted from Olea 1984)

The kriging standard deviation of the water level measurements was used as a measure of effectiveness of each of these networks.

The goal was to select the stratified hexagonal grid network that had the least number of wells and an overall kriging standard deviation of approximately 10% of the existing standard deviation of ±6.15 ft.

WELL SELECTION METHODOLOGY

Each well was ranked for suitability, and the highest ranked well within each grid cell was selected to be the single well used for that cell and spacing. The scoring criteria were (1) use of the well, (2) knowledge of the casing depth, (3) knowledge of the total depth, and (4) method for determining the measuring point elevation. The point values assigned varied depending on the criteria:

1. Dedicated observation well, 10 points
2. Known casing depth, 5 points
3. Known total depth, 5 points
4. Surveyed measuring point, 5 points
5. Variable, varying points

After initial examination of the criteria, two modifications were made to eliminate possible sources of error. First, a fudge factor (variable) was applied to the weighting scheme to ensure selection of one well and the nonselection of another. Well S-1253 has been completed recently in the center of the Geneva freshwater lense and a fudge factor was applied to ensure its selection. Another fudge factor was applied to well L-0045 to ensure its nonselection because this well has a blocked casing and cannot be repaired.

Second, missing well construction information for some wells were replaced with known values. The USGS computer records did not indicate the casing depths, total depths, or surveyed measuring points for a number of SJRWMD wells, although this information was available. As a result, the ranking weights were not being assigned correctly. For these wells, casing depths, total depths, and surveyed measuring point elevations were corrected in the database used for this project. The well characteristic statistics reflect the corrected database values.

Kriging with Data Error

Combining surveyed and unsurveyed measurement values introduces systematic error in the elevation of water levels. The magnitude of this error is unknown. If the variance error of unsurveyed measurements is known, it can be accounted for in the kriging estimations.

The site inventories were searched for wells within SJRWMD that had both estimated measuring point elevations (or estimated land surface elevations) and corresponding surveyed elevations. A total of 56 wells were located. For these wells, USGS had originally estimated either the land surface or measuring point elevation; later the elevation was surveyed. Some, but not all, of the wells for which these values were located were used in the May 1995 network. The elevation data for the 56 wells could be used to estimate the possible data error variance resulting from the lack of a survey. The variance for 56 wells was 8.1 square feet. A box plot of the differences indicates a general under estimation of elevations (Figure 22).

Kriging was performed on the water level data using (1) the elevations in the database (surveyed and unsurveyed) and (2) the 8.1-square-foot variance in elevation of the unsurveyed wells. Kriging using the data variance increased the kriging standard deviation by 1.1% for the base network to 0.7% for the 52,000-ft grid network (Table 11).

Grid Selection Results

After well selection, the six network scenarios were composed of 918, 789, 669, 550, 442, and 361 wells for the 15,000-, 22,500-, 30,000-, 37,500-, 45,000-, and 52,500-ft grids, respectively (Table 11, Figure 23). For comparison, the base network used 974 measurements, and the published May 1995 network included 921. Using the six scenarios, kriging was applied to a 1,000-by-1,000-ft grid and the average standard deviation of each grid network was obtained by using or not using the data variance.

The mean kriging standard deviation was used as a measure of the effectiveness of each network. The standard deviation of the base network was ±6.15 ft without using the data variance and ±6.22 ft using the data variance. The mean kriging standard deviations of the

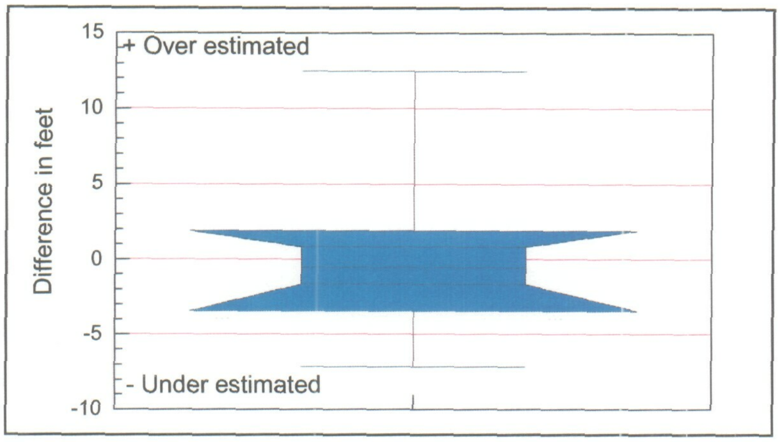


Figure 22. Box plot of the differences between unsurveyed and surveyed land surface elevations or measuring point elevations

Table 11. Summary of the kriging standard deviations determined with and without data error for the network scenarios

Analytical Parameter	Base	15K HEX	22K HEX	30K HEX	37K HEX	45K HEX	52K HEX
Number of wells	974	918	789	659	550	442	361
Mean STD, not using the data variance	±6.15 ft	±6.13 ft	±6.23 ft	±6.38 ft	±6.54 ft	±6.80 ft	±7.11 ft
Mean STD, using the data variance	±6.22 ft	±6.20 ft	±6.29 ft	±6.44 ft	±6.60 ft	±6.86 ft	±7.16 ft
Percent difference in mean between using and not using the data variance	1.1%	1.1%	1.1%	0.9%	0.8%	0.7%	0.7%
Percent change from base network, not using the data variance	N/A	-0.3%	1.1%	3.7%	6.3%	10.6%	15.6%
Percent change from base network, using the data variance	N/A	-0.3%	1.1%	3.5%	5.9%	10.1%	15.1%
Percent reduction in wells from base network	NA	6%	19%	32%	44%	55%	63%

Note: Column headings including HEX refer to the six network scenarios—the 15,000-, 22,500-, 30,000-, 37,500-, 45,000- and 52,500-ft grid networks. Data variance is due to unsurveyed wells.

ft = foot
HEX = hexagonal grid network
NA = not applicable
STD = standard deviation

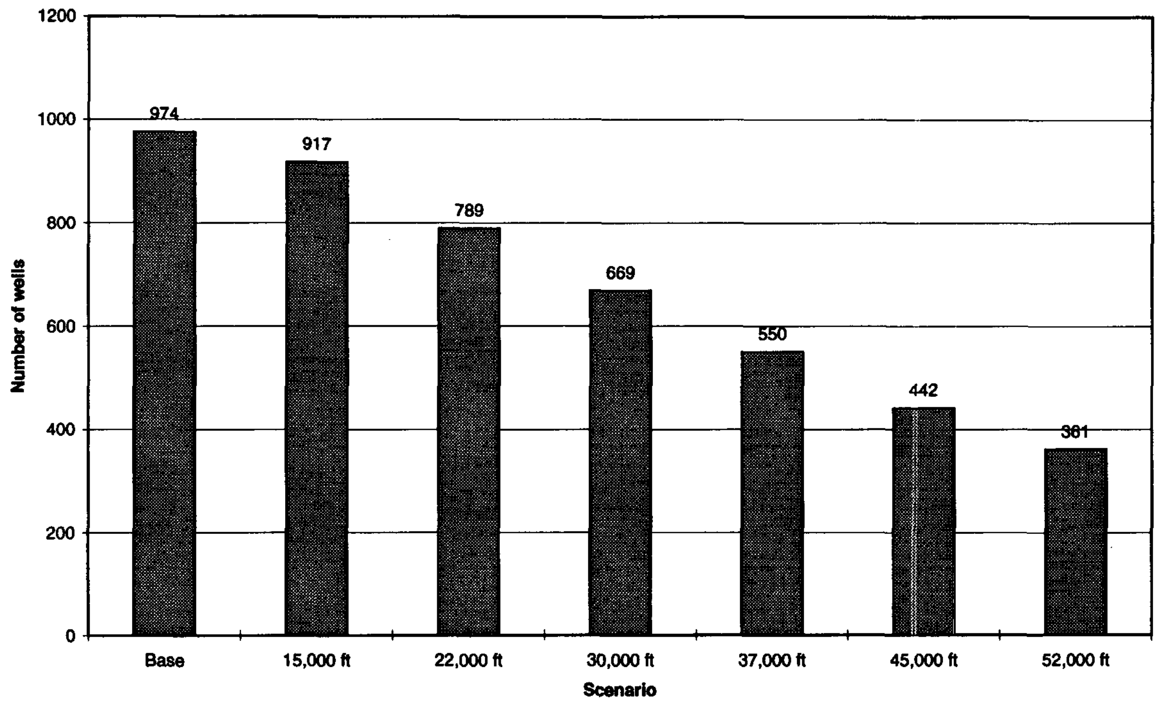


Figure 23. Change in the number of wells for each of the network scenarios

six network scenarios without using the data variance ranged from ±6.15 to ±7.11 ft (Table 11). The percent change from the base network for the six network scenarios ranged from -0.3% to 15.6% without using the data variance. The hexagonal grids from 15,000 to 45,000 ft were at or below the stated goal of a change in the mean standard deviation of approximately 10%. Appendix E, Figures E1 through E7, show the kriging standard deviation and the locations of the wells used for the base network and the six hexagonal grids.

The network that showed the greatest reduction in wells and that still met the change of no more than approximately 10% in the mean kriging standard deviation was the 45,000-ft grid network (Figure E6, Appendix E). The reduction in well measurements was 55% compared with the base network and 52% compared with the published May 1995 network.

FEATURES OF THE NETWORK

The 45,000-ft hexagonal grid network would use 442 wells from SFWMD, SJRWMD, and SWFWMD (Figure 24). Only 279 of the 442 wells are from an area funded by SJRWMD. Of these, 248 are actually within SJRWMD.

The new network of 442 wells has a higher percentage of observation wells and known well characteristics than the base network (Figure 25). The increase in the number of observation wells from 22% to 93% should increase the stability and reliability of the network. The smaller number of wells in the network will make it feasible to determine the well characteristics where they are currently unknown.

Of the grid cells that lie fully or partially within SJRWMD, 47 are not currently being measured (Figure 26, Table 12). Grid cells with a high priority are in areas undergoing rapid development, where the potentiometric surface has a steep slope, or around the periphery of Duval County. Grid cells with a low priority are (1) partial grid cells along the Atlantic coast, (2) grid cells located in the national forests, or (3) partial grid cells located along the SJRWMD border where little water is used. If all 47 grid cells were filled in, the resulting increase in standard deviation over the base network would be approximately 7.5%.

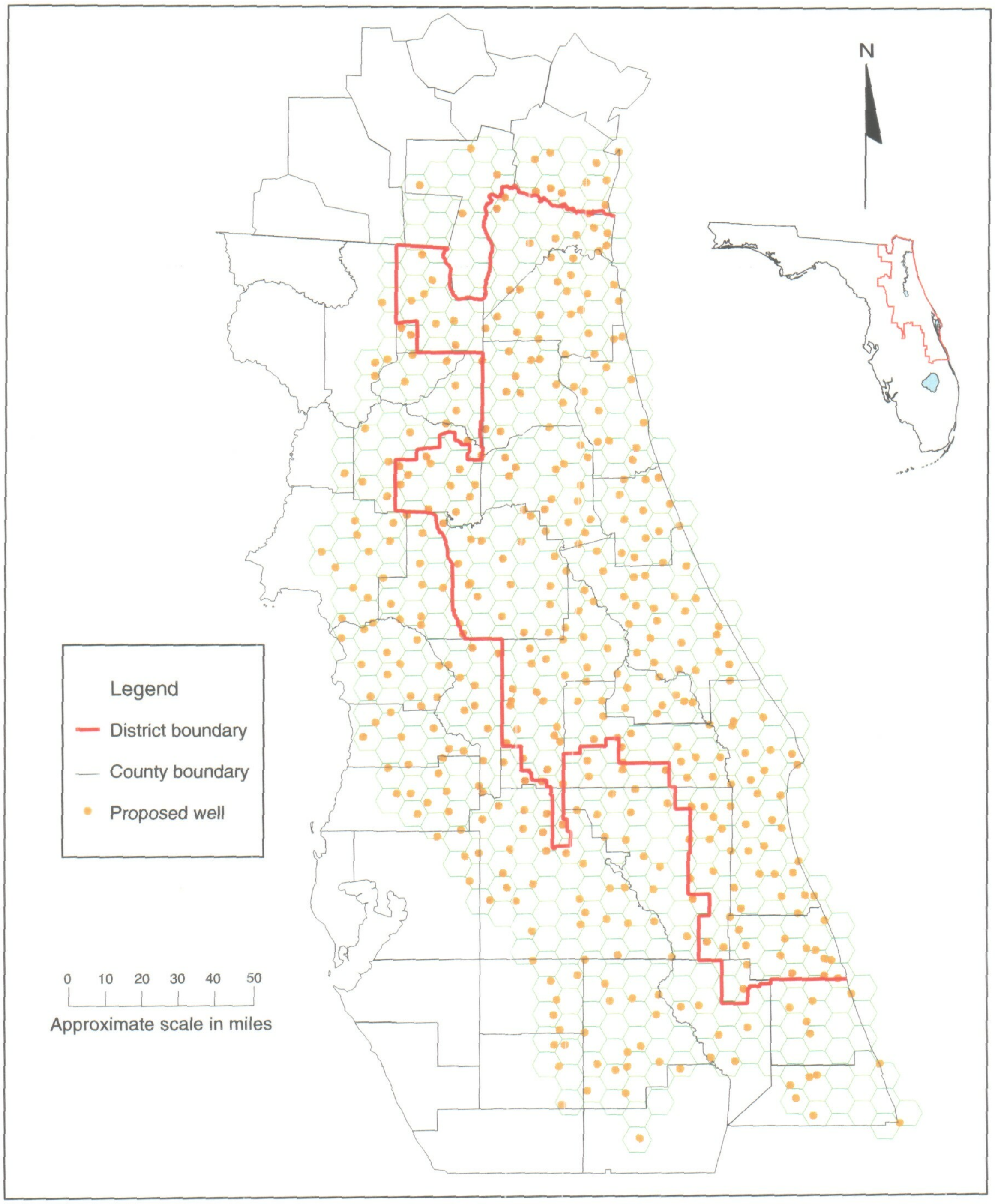


Figure 24. Recommended network of 442 wells using a stratified hexagonal 45,000-foot grid design

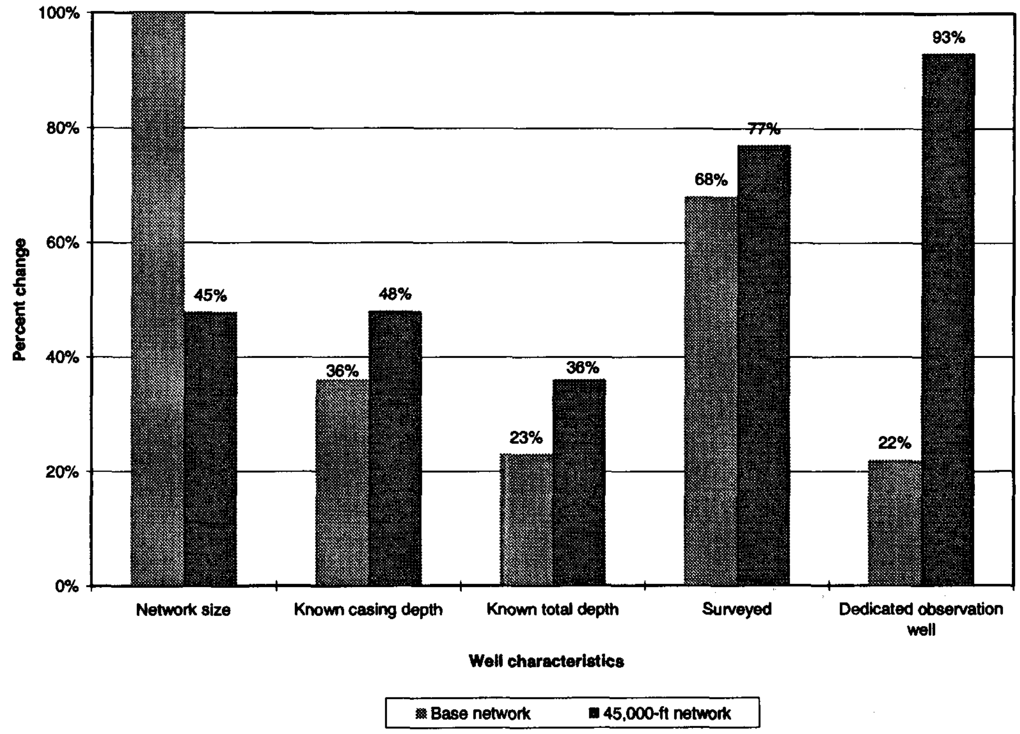


Figure 25. Summary of well construction, well use, and survey information from the U.S. Geological Survey computerized records

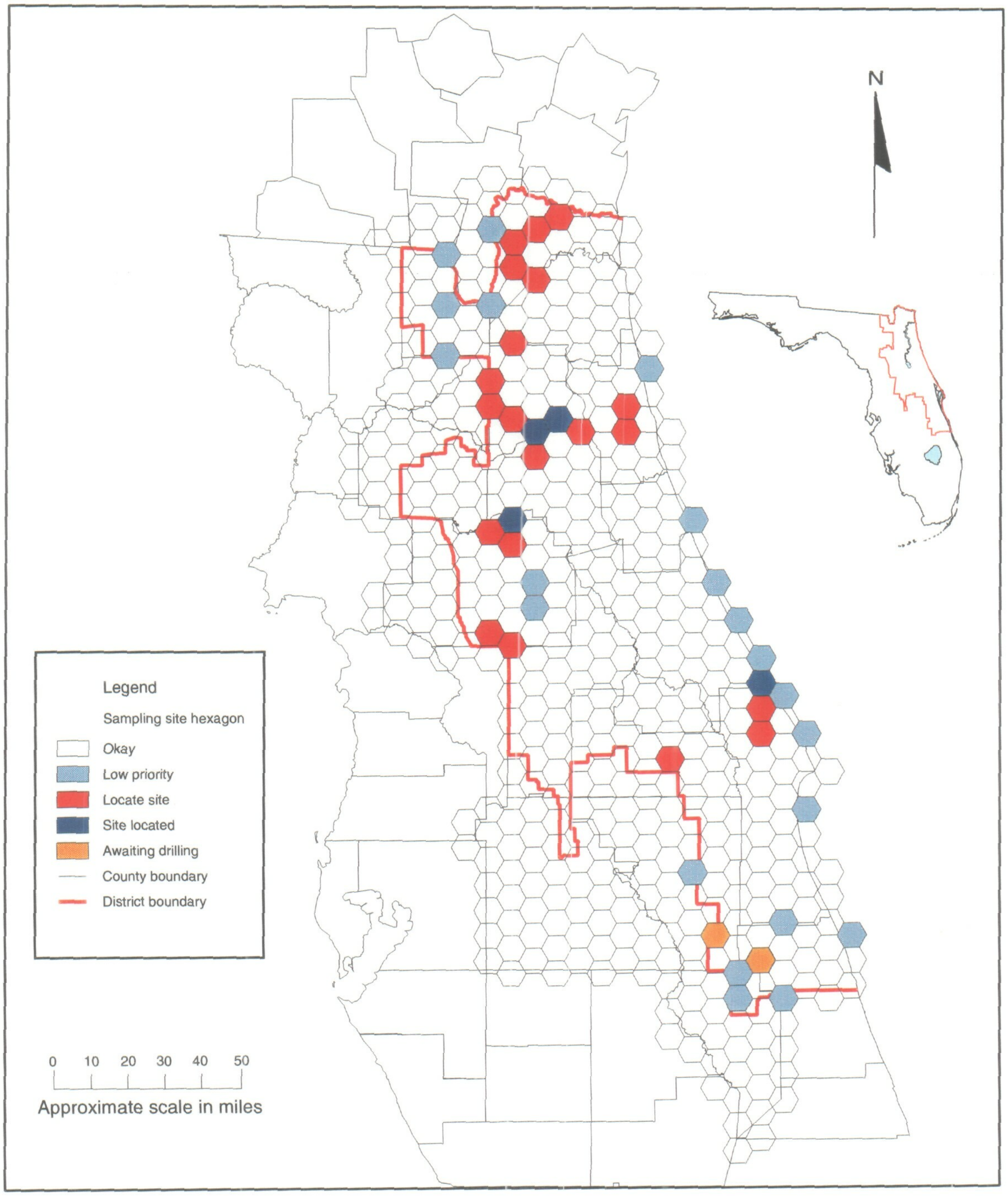


Figure 26. Priority for vacant cells within the St. Johns River Water Management District

Table 12. Summary of the vacant grid cells within the St. Johns River Water Management District for the recommended 45,000-foot grid network

County	Vacant Cells	Awaiting Drilling	Site Located	Site to Locate	Low Priority
Baker	3				3
Brevard	6			2	4
Clay	6		2	4	
Duval	1			1	
Flagler	1				1
Indian River	3	1			2
Marion	7		1	4	2
Nassau	7			5	2
Ockeechobee	2				2
Orange	1			1	
Osceola	2	1			1
Putnam	1			1	
St. Johns	3			2	1
Volusia	4		1		3
Total	47	2	4	20	21

CONCLUSIONS AND RECOMMENDATIONS

This study was undertaken to evaluate the effectiveness of the existing potentiometric network for the Upper Floridan aquifer and, if necessary, to refine the network based on the spatial findings. The outcome is a recommendation for an improved network that will reduce the number of wells being monitored from 921 (May 1995 levels) to 442. This reduction may result in significant cost savings without sacrificing important data. In fact, the wells selected represent a spatial distribution that will better define the regional potentiometric surface. In addition, the reduced network will have slightly better known well characteristics. Lastly, the measurements in September (purported end of the wet season when groundwater levels should be high) should be moved to October or November (actual months of high groundwater levels). The major findings and recommendations are discussed below.

NETWORK OBJECTIVES

The potentiometric network is a regional network. It is supposed to monitor a single aquifer that is regional in extent and to collect water levels to assess storage status. The products of this network would be regional potentiometric surface maps and maps showing net change in water levels or storage over a selected period. When a regional network is maintained over many years, it provides a multiyear history of water levels. Such data can be used to produce long-term hydrographs (with two data points per year) or to assist in groundwater model calibration.

TEMPORAL SUITABILITY

The measurements taken in May and September of each year are intended to coincide with the average yearly low and high water levels. The May measurements do coincide with the average yearly low. This fact was determined from a data set of 250 wells with enough data to determine an average monthly water level for each month of the year. However, the same data set indicated that September was, on average, the fifth highest month for water levels. September has fewer wells with average monthly highs than February, March, November, and October. Measurements should be taken in October or early November rather than in September.

NETWORK SIZE

The base network of 974 sites or the May 1995 network of 921 sites can be reduced to a network of 442 wells. The recommended network of 442 wells includes wells that have become available since May 1995. The network design uses a stratified hexagonal grid with grid-cell diameters of 45,000 ft. The best well in each grid cell was selected for monitoring based on established criteria. The resulting increase in standard deviation over the base network, when the elevation error of unsurveyed measurements is considered, meets the selected goal of approximately 10% or less. Where SJRWMD collects and funds the USGS to collect data, the recommended well network contains 279 wells.

The proposed 45,000-ft hexagonal grid does not have wells in each grid. Within SJRWMD, 47 grid cells do not have wells that are being monitored. If all 47 grid cells were filled in, the resulting increase in standard deviation over the base network would be approximately 7.5%. Existing usable wells should be located or dedicated observation wells should be constructed. Grid cells with the highest standard deviation and the highest areas of growth or water use should receive the highest priority for inclusion in the network.

Regional potentiometric surface maps and any maps showing net changes in water levels or storage should be produced with a geostatistical model as opposed to hand-contouring.

KNOWLEDGE OF THE WELLS

Knowledge of well construction remains poor, even in the improved network. The network wells for which measuring point elevations are unknown or estimated from a map should be surveyed for elevations. Wells for which the casing depth and total depth are unknown should be geophysically logged. If a well cannot be geophysically logged, it should be considered for replacement. Without the geophysical information, the open hole interval cannot be determined and no assurance can be made that the wells tap only the Upper Floridan aquifer. To date, no comparison of the known open hole intervals and the upper and lower boundaries of the water levels for the Upper Floridan aquifer have been made.

The use of each network well should be identified. The improved network has 93% of its wells dedicated as observation wells. However, the remaining wells that are in use may be giving inaccurate water level information. These wells should be considered for replacement with dedicated observation wells.

DATA MANAGEMENT

The USGS database should be reviewed to ensure accuracy and completeness of the well characteristics and the water level data. USGS and SJRWMD staff also should meet regularly to discuss the potentiometric network and to ensure that information is being exchanged.

PRODUCT CHANGES

The network users survey indicated that several improvements could be made to enhance the usability of the network products. Users requested the following changes or additions.

SJRWMD should make raw data available in an electronic format for each measurement period or period of record for the potentiometric network. The information should include records from the USGS database and should include, at minimum, the following details:

- USGS site identification number of the well
- The well name
- Latitude and longitude
- Date of the measurement
- The water level to the limit of accuracy (2 decimals places)
- The method for determining the elevation at the measuring point
- The cased depth of the well below land surface
- The total depth of the well below land surface
- The primary use of the well

SJRWMD should make the same information available electronically for wells that have not been incorporated into the final USGS products. This information should be available in either a merged period of record for the potentiometric network database or a complementary set of SJRWMD data.

The well locations on the map products should be coded with three different symbols indicating the method for determining the measuring point: (1) surveyed, ±0.01 ft, (2) map estimate, ±2.5 ft, and (3) map estimate, ±5.0 ft. These codes are used in the USGS database.

FISCAL IMPLICATIONS

The fiscal implications of the recommendations can only be estimated at this time. This is primarily due to the limited knowledge about the individual well characteristics of the existing network and the amount of effort that will be required to update the computer records.

Initially the data collection reduction costs due to the smaller network will be offset by an increase in costs due to time spent updating computer records, geophysical logging, surveying MP elevations, and locating or constructing new wells. However, the end result will be a stable network of dedicated monitor wells known to be monitoring the upper Floridan aquifer.

At a planning level the cost estimate to implement these recommendations is $1,316,260 spread over five years (Table F1 and F2). The majority of the estimated cost ($939,000) would be for construction of new monitor wells or re-constructing existing wells if needed. Since the knowledge of the existing wells in the network is so poorly known, it may take more than five years to fully upgrade the network.

GLOSSARY

estimation. A procedure by which the value of the investigated variable at an unsampled location is predicted using sample values from the neighborhood of that location.

estimation variance. See kriging variance.

geostatistics. A collection of statistical methods for the analysis and estimation of spatial data for use in the earth sciences. These techniques incorporate the spatial characteristics of actual data into statistical estimation processes.

ISATIS. A geostatistical software program that includes extensive estimation and simulation options combined with an efficient data management system. It is widely used in mining and oil and gas technologies.

kriging. A collection of linear estimation methods in which sample values are weighted using a linear least-squares optimization procedure based on a variogram model and neighborhood data.

kriging standard deviation. The positive square root of the (kriging) variance.

kriging variance. The expected value of the square difference between the true value of an unknown variable and its kriging estimate.

lag. The distance at which sample differences are compared.

multivariate statistical analysis. A system of analysis that provides descriptions of the relationships between two (bivariate) or more variables of a data set.

nonrobust data point. A data point for which the standard deviation is greater than ±2.5. When the standard deviation exceeds ±2.5, it lies outside the 95% confidence limit of a normal distribution.

nugget. A jump up the *y* axis from the origin of the variogram plot. A nugget represents microscale variations and/or measurement errors. The ratio of the nugget to the sill represents the level of unexplained variations.

potentiometric surface. Surface to which water in an aquifer would rise by hydrostatic pressure.

regionalized variable. A variable distributed in space. Typical regionalized variables are water levels, transmissivity, and the top of the formation. For geostatistical purposes, the regionalized variable should be composed of homogeneous elements.

sill. The point at which the variogram plot levels off.

univariate statistical analysis. A system of analysis that provides description of each individual regionalized variable in a data set.

variogram. Variograms plot the distance (h) between all data points verses one-half the average squared differences ($\gamma/2$) between the data points.

Source: Pannatier 1996; Olea 1991; ASTM 1996b; American Geological Institute 1962

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APPENDIX A—SUMMARY OF WELLS USED IN THE STUDY

Table A1. Summary of sites used in the study (see enclosed diskette)*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
Alachua County									
292909082095101	A-0034	92920901 11S21E36 YEARL	56			Surveyed		5	B, FN, M, R
292951082174001	A-0035	THOMAS 66STA WELL NR MIC	59			Surveyed		5	B, FN, M, R
293148082251201	A-0069	BRICE WELL NR KANAPAHA	49			Surveyed		5	B, M, R
293203082200601	A-0037	CHITTY WELL AT KIRKWOOD	56			Surveyed		5	B, M, R
293252082292301	A-0004	ALTO STRAUGHN-ARCHER WEL	44			Surveyed		5	B, FN, M, R
293253082055701	A-0038	DRISCOLL WELL NR LOCHLOO	71			Surveyed		5	B, FN, M, R
293301082153501	A-0039	JENSEN WELL NR MICANOPY	59	80		Altimeter		5	B, M, R
293329082243801	A-0070	PARISH WELL NR WACAHOOTA	45			Surveyed		5	B, M, R
293539082112601	A-0005	OWENS-ILLINOIS #1	72		217	Surveyed	WH	10	B, FN, M, R
293542082253801	A-0008	U.S.G.S./HOWELL WELL AT	43	55		Surveyed	OU	20	B, FN, M, R
293556082043401	A-0071	A-0071 HAWTHORNE TOWER D	78	95	113	Surveyed	OU	25	B, FN, R
293620082362001	A-0068	93623601 10S17E22 CE-1A	41	136		Surveyed		10	B, FN, M, R
293625082181001	A-0032	SUPPLY WELL DNR DIST 3 H	69			Surveyed		5	B, M, NR
293634082144901	A-0054	HOLBACK WELL NR G.VILLE	61			Surveyed		5	B, M, R
293644082244201	A-0017	RUB MONITOR NO 1 AT KANA	46			Altimeter	OU	10	B, M, R
293645082202701	A-0020	93622003	53			Surveyed		5	B, M, R
293653082311601	A-000X	A-000X	42			Unknown		0	B, M, R
293723082120102	A-0058	93721202 10S21E15 DICK	78	162		Surveyed		10	B, M, R
293728082282401	A-0041	93722801 10S18E14 PARKE	42			Surveyed		5	B, M, R
293809082232901	A-0714	ALACHUA COUNTY VISA # 4	51	60	75	Surveyed	OU	25	B, FN, R
293857082203901	A-0019	GEOLOGY DEPT WELL GAINES	47			Surveyed	OU	15	B, M, R
293943082085901	A-0708	ALACHUA COUNTY F-5	76		191	Surveyed	OU	20	B, FN, R
294011082260401	A-0713	ALACHUA COUNTY VISA # 3	46	65	80	Surveyed	OU	25	B, FN, R
294028082245301	A-0712	ALACHUA COUNTY VISA # 2	46	65	80	Surveyed	OU	25	B, R
294105082171501	A-0693	ALACHUA FAIRGROUNDS CF		192	440	Surveyed	OU	25	FN, NB
294108082293101	A-0057	94122901 09S18E27 U OF	43			Map estimate		0	B, M, R
294119082290401	A-0711	ALACHUA COUNTY VISA # 1	44	75	90	Surveyed	OU	25	B, FN, R
294121082231801	A-0055	PINE GROVE CHURCH AT GAI	46			Surveyed		5	B, M, R
294209082173101	A-0042	RUB WELL N-7 AT GAINESVI	28	180		Surveyed		10	B, M, R
294228082181801	A-0047	94221804 CITY OF GAINESV	1	189		Surveyed		10	B, M, NR

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
294239082182201	A-0707	ALACHUA COUNTY F-4	26	153	210	Surveyed	OU	25	B, FN, NR
294259082083401	A-0049	OR. HTS. BPST. CHURCH WE	79			Surveyed		5	B, M, R
294339082184501	A-0706	ALACHUA COUNTY F-3	45		210	Surveyed	OU	20	B, R
294415082170701	A-0052	NEWMANS WELL NR FAIRBANK	54			Map estimate		0	B, M, R
294428082362901	A-0114	UNDETERMINED	33			Unknown		0	B, M, R
294453082185601	A-0705	ALACHUA COUNTY F-2	47		190	Surveyed	OU	20	B, R
294501082131001	A-0051	CARY MEMORIAL FOREST WEL	71			Surveyed		5	B, M, R
294530082232001	A-0056	DEERHAVEN POWER PLT WELL	42			Surveyed		5	B, M, R
294629082181301	A-0704	ALACHUA COUNTY F-1	60		192	Surveyed	OU	20	B, R
294631082334801	A-00XX	A-00XX	35			Unknown		0	B, M, R
294640082064501	A-0135	UNDETERMINED	75			Unknown		0	B, FN, M, R
294839082230701	A-0053	CELLON WELL NR LA CROSSE	44			Surveyed		5	B, FN, M, R
294923082174501	A-0065	MONTEOCHA	62	120	140	Surveyed		15	B, M, R
294928082355301	A-0002	94923502 08S17E03 CITY	34			Surveyed		5	B, FN, M, R
295253082143601	A-0709	ALACHUA COUNTY NE-2D	64			Surveyed	OU	15	B, R
Baker County									
301022082103301	BA0019	B-17 MANNING WELL NEAR M	57	410	710	Surveyed	OU	25	B, FN, M, R
301245082233001	BA0096	OLUSTEE STATE MONU	55	233	253	Map estimate	OU	20	B, FN, M, R
301423082261101	BA0015	B-15	58			Surveyed		5	B, FN, M, R
301535082162001	BA0011	B-11 USGS WELL AT SANDER	54	282		Surveyed	OU	20	B, FN, M, R
301618082110901	BA0054	MACCLENNY FT CF	54	368	706	Surveyed	OU	25	B, FN, M, R
301635082234001	BA0024	UNDETERMINED	54			Unknown		0	B, M, R
301702082271401		SRWMD B-3	55			Unknown		0	B, M, R
302115082232201	BA0005	UNDETERMINED	52	134	134	Unknown		10	B, FN, M, R
302251082194901	BA0018	B-25 ONF NO.6 FLORIDAN W	52	320	338	Surveyed	OU	25	B, FN, M, R
302620082173501	BA0009	B-9 USGS WELL NEAR TAYLO	52	417		Surveyed	OU	20	B, FN, M, R
303235082203501	BA0057	EDDY FIRE TOWER CF	50	360	700	Surveyed	OU	25	B, FN, M, R
Bradford County									
294920082044501	B-0001	B-1 BAKER CTY USGS	78	168	208	Unknown	OU	20	B, M, R
295055082130801	B-0012	GRAHAM USGS	63	172	206	Surveyed	OU	25	B, FN, M, R
295257082045701	B-0011	SOUTH OF STARKE	84	234	284	Surveyed		15	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
295410082100801		UNDETERMINED - FL	57			Unknown		0	B, FN, M, R
300020082103001	B-0010	2102	60	247	294	Surveyed		15	B, FN, M, R
300629082030001	B-0007	LOUIS HILL FIRE TWR	57	418	438	Surveyed	OU	25	B, FN, M, R
Brevard County									
274925080361701	BR0060	749036002 30S37E35 433	40			Surveyed		5	B, M, R
275003080330201	BR1559	FLEMING GRANT (BR155()		339	411	Surveyed	WS	15	FN, NB
275125080485501		751048003 30S35E22 123	40			Map estimate		0	B, FN, M, R
275210080272202	BR0625	DR0625 SEB. INLET TW SHA	34			Surveyed		5	B, M, R
275422080374001	BR0288	754037007 29S37E04 232	39			Map estimate		0	B, FN, M, R
275425080283101	BR0107	754028002	34			Surveyed		5	B, FN, M, R
275435080311001	BR0038	754031001 29S38E34 343	37			Map estimate		0	B, FN, M, R
275629080504901		756050001 29S35E20 243	42			Surveyed		5	B, FN, M, R
275720080300601	BR0179	757030004 29S38E14 334	35			Map estimate		0	B, M, R
275948080393501	BR0424	759039005 29S37E06 322	38			Surveyed		5	B, FN, M, R
275955080434601	BR0645	759-043-02 PLATT WELL NE	40	125		Surveyed		10	B, FN, M, R
280008080342601	BR0341	800034072 28S37E36 424	32			Surveyed		5	B, FN, M, R
280256080325601		802032002 28S38E17 432	28			Surveyed		5	B, FN, M, R
280348080431201	BR0295	803043006 28S36E10 313	40			Map estimate		0	B, M, R
280532080514501		805051003 27S35E31 331	41			Map estimate		0	B, FN, M, R
280534080465101		192-SJR DEER PARK SE - UNIT 13	41			Surveyed		5	B, FN, M, R
280648080422801		DAN PLATT SARNO RD REPLA	37			Map estimate		0	B, FN, M, R
281109080373701		811037014 26S37E33 122	28			Surveyed		5	B, FN, M, R
281210080473001		DUDA RANCH L-2 (81204700	38			Map estimate		0	B, FN, M, R
281306080401201	BR0127	813040016 26S37E18 233	31			Surveyed		5	B, FN, M, R
281447080392601	BR0299	814039076 26S36E06 444	29			Surveyed		5	B, M, R
281508080443501		815044001 26S36E05 213	32			Map estimate		0	B, M, R
281509080363001	BR0689	815036012 26S37E03 224	27			Surveyed		5	B, M, R
281744080444001	BR0134	817044004 25S36E20 I-95	32			Surveyed		5	B, M, R
281905080375001		819037196 25S37E16 212	22			Map estimate		0	B, FN, M, R
281937080442001	BR1558	KENNEDY HS BR1558		140	180	Surveyed	OU	25	FN, NB
282143080403401		KIWANIS PARK	20			Map estimate		0	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
282204080514301	BR0074	822051001 24S35E30 342	31	138		Surveyed		10	B, FN, M, R
282245080471601	BR0202	82204702 USGS OBSERVATIO	27	114		Surveyed	OU	20	B, M, R
282301080460601	BR1557	COCOA HS BR1557		150	190	Surveyed	OU	25	FN, NB
282423080353601	BR0208	824035001 24S37E11 444	20			Surveyed		5	B, M, R
282524080422301		MERRITT ISLAND INJECTION	16			Surveyed		5	B, FN, M, R
282647080331301	BR0002	826033001 23S38E32 321	22			Surveyed		5	B, FN, M, R
282921080404701	BR0608	829040001 23S36E13 322	13			Surveyed		5	B, M, R
282929080343601		829034001 23S37E13 222	18			Surveyed		5	B, FN, M, R
282945080473901	BR0586	BR-586 TICO AIRPORT	15	93	135	Surveyed	OU	25	B, FN, R
283027080403601		830040002 23S37E01 444	12			Map estimate		0	B, FN, M, R
283236080535101	BR0159	832053001 22S34ESG ---	18	149		Map estimate		5	B, M, R
283627080512001	BR0001	836051001 22S35E06 332	16	132		Surveyed		10	B, FN, M, R
283644080574402	BR1526	SEMINOLE RANCH REPLACE		235	300	Surveyed	OU	25	FN, NB
283644080574901	BR0660	8360573	16	98		Map estimate		5	B, M, R
283732080510001	BR0585	ASTRONAUT H.S. CF	13	107	195	Surveyed	OU	25	B, FN, R
283835080424501	BR1050	838042002 21S36E27 MERRI	11			Map estimate		0	B, FN, M, R
283906080514501	BR0022	839051005 21S35E19 431	13	133		Map estimate		5	B, M, R
283955080565701	BR0170	839056002	13			Map estimate		0	B, M, R
284116080514001	BR0443	841051226 21S35E06 343	20			Map estimate		0	B, M, R
Citrus County									
284101082184301		84121801 21S20E04 OAK F	29			Surveyed		5	B, FN, M, R
284317082330601		CHASSAHOWITZKA WELL 1 NR	6	166		Surveyed	OU	20	B, FN, M, R
284330082215401		ROMP 109 NEAR FLORAL CIT	16			Surveyed	OU	15	B, FN, M, R
284339082270401		LECANTO WELL 1	8	168		Surveyed		10	B, M, R
284439082131401		84421301 TRAILS END FIS	39			Surveyed		5	B, M, R
284508082174601		845217332 FERRIS PACKING	33			Surveyed		5	B, M, R
284519082150701		84521501 20S21E07 HOMER	40			Surveyed		5	B, M, R
284528082211801		84522101 20S19E12 WSF-M	16			Surveyed		5	B, M, R
284609082163001		DUVAL ISLAND WELL NR FLO	39			Surveyed		5	B, M, R
284752082202501		84722001 19S20E31 HIGHL	19			Surveyed		5	B, M, R
284803082351701		NORRIS WELL AT HOMOSASSA	2			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
284805082225701		84822201 19S19E26 WSF-H	15			Surveyed		5	B, M, R
284844082282801		84822801 19S18E22 WSF-P	6			Surveyed		5	B, FN, M, R
284958082190401		84921901 19S20E16 CITRU	37	45		Surveyed		10	B, M, R
285020082365301		OZELLO WELL 3 NR CRYSTAL	2			Surveyed		5	B, M, R
285026082174101		85021701 19S20E15 CITRU	39			Surveyed		5	B, M, R
285037082213801		85022101 19S19E12 INVER	20			Surveyed		5	B, M, R
285056082163001		85021601 19S20E11 CITRU	38	34		Surveyed		10	B, M, R
285102082204001		851220343 DOT HY41 OBSER	29	290		Surveyed	OU	20	B, M, R
285102082361001		OZELLO WELL 4 NR CRYSTAL	2			Surveyed		5	B, M, R
285105082135802		USGS WELL 0.7MI.W OF WIT	37	22		Surveyed	OU	20	B, FN, M, R
285112082354401		TPA POT MAP SITE	1	105	111	Surveyed		15	B, FN, M, R
285124082245601		85122401ROMP DEEP WELL 1	7	130	150	Surveyed	OU	25	B, FN, M, R
285234082341901		TPA POT MAP SITE	2	240	252	Surveyed		15	B, M, R
285248082183201		85221801 18S20E33 ELMER	38			Surveyed		5	B, M, R
285254082323001		LECANTO WELL 7 NR LECANT	3			Map estimate		0	B, M, R
285414082284201		85422801NORTH LECANTO DE	4	288		Surveyed		10	B, FN, M, R
285421082361602		CRYSTAL RIVER D. WELL NR	1			Surveyed		5	B, M, R
285514082275402		85522704 18S18E14 BEVER	5			Surveyed		5	B, M, R
285608082233401		856223342A CAMP MINING W	20			Surveyed		5	B, M, R
285612082294201		85622901 18S18E04 PINE	5			Surveyed		5	B, M, R
285720082201301		85722001ROMP DEEP WELL 1	32			Surveyed	OU	15	B, FN, M, R
285737082400601		FPC WELL 3 NR CRYSTAL RI	3			Surveyed		5	B, M, R
285737082413001		FPC WELL 2 NR CRYSTAL RI	3			Surveyed		5	B, FN, M, R
285812082360901		85823601 17S17E29 CE 7	10	30		Surveyed		10	B, M, R
285833082233301		85822301 17S19E34 CE 16	15			Surveyed		5	B, M, R
285930082283702		85922803 17S18E22 CITRU	8			Surveyed		5	B, M, R
285935082324501		85923201 17S17E24 MELOD	7			Surveyed		5	B, M, R
285951082350901		85923501 17S17E15 CE 6	14	39		Surveyed		10	B, FN, M, R
290023082393601		90023901 17S16E11 CE 89	9	21		Surveyed		10	B, M, R
290107082400501		90124001 17S16E11 CE 88	2	19		Surveyed		10	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
290132082324201		90123202 17S17E01 EMORY	12			Surveyed		5	B, FN, M, NR
290216082292001		90222901 16S18E33 CE 77	13	171		Surveyed		10	B, M, NR
Clay County									
294313082024601	C-0009	C-9 MELROSE	84	204	259	Surveyed	OU	25	B, FN, R
294611082004901	C-0436	LAKE GENEVA CF	82	146	146	Surveyed	OU	25	B, M, R
294634081591401	C-0031	C-31 USGS	81	192	244	Surveyed	UU	15	B, M, R
294715082020601	C-0132	CLAY ELECTRIC CF	82	150	170	Surveyed	UN	15	B, R
294728082010901	C-0442	CHESTER MOODY CF	81	185	240	Surveyed	OU	25	B, R
294807082020903	C-0120	9482028 WELL AT KEYSTONE	82	57	218	Surveyed	OU	25	B, M, R
294846081552001	C-0457	MCCRAE FIRE STN CF	78	180	261	Surveyed	OU	25	B, M, R
294911081572601	C-0453	GOLD HEAD CF	79	196	375	Surveyed	OU	25	B, FN, M, R
294937082014501	C-0451	LK MAGNOLIA CF	80	200	294	Surveyed	OU	25	B, FN, M, R
295016081433501	C-0123	SUNGARDEN TWR OCALA	69	348	457	Surveyed	OU	25	B, FN, M, R
295116082005801	C-0439	LOWERY LAKE CF	78	190	198	Surveyed	OU	25	B, M, R
295615081394701	C-0122	C-36	35			Surveyed		5	B, FN, M, R
295835081515001	C-0018	C-17	71			Surveyed		5	B, FN, M, R
295838081582501	C-0104	C-104	70			Surveyed		5	B, M, R
295847081380601	C-0121	C-78	19			Surveyed		5	B, M, R
295851081555301	C-0128	PENNY FARMS TWR CF	70	366	405	Surveyed	OU	25	B, FN, M, R
295900081403201	C-0082	C-82	20			Surveyed		5	B, M, R
300048081414301	C-0001	C-30	26	300		Surveyed		10	B, FN, M, R
300242081532002	C-0015	C-15	57			Map estimate		0	B, FN, M, R
300300081422501	C-0016	C-16	29			Surveyed		5	B, M, R
300450081482801	C-0038	C-18 MUIR WELL NEAR DOCT	45			Map estimate		0	B, M, R
300604081441501	C-0040	C-22	30			Surveyed		5	B, M, R
300649081485901	C-0059	C-5 JOHN HUNTLEY WELL NE	38	157		Surveyed		10	B, FN, M, R
300656081463401	C-0094	C-94 TEST WELL NEAR ORAN	33	391		Surveyed		10	B, FN, M, R
300834081421301	C-0007	C-7 HANSON WELL NEAR ORA	24			Surveyed		5	B, M, R
300850081552001	C-0010	C-29	59			Map estimate		0	B, FN, M, R
301018081415101	C-0004	C-4	28	350		Surveyed		10	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
Columbia County									
300221082332601		SRWMD C-3	41			Unknown		0	B, FN, M, R
300542082332101		UNDETERMINED	45			Unknown		0	B, FN, M, R
300635082295901		SRWMD C-2	52			Unknown		0	B, FN, M, R
301437082324801	ONF #9	UNDETERMINED	57			Unknown		0	B, M, R
302032082314301		SRWMD C-1	53			Unknown		0	B, FN, M, R
De Soto County									
270302081383401		TPA POT MAP SITE	47			Unknown		0	B, FN, M, R
271232081392201		TPA POT MAP SITE	47			Surveyed		5	B, FN, M, R
271416081374601		TPA POT MAP SITE	44	514	1,490	Map estimate		10	B, M, R
271417081344801		TPA POT MAP SITE	42	178	810	Map estimate		10	B, M, R
271655081345001		TPA POT MAP SITE	46	447	1,330	Map estimate		10	B, M, R
271743081374601		TPA POT MAP SITE	46	482	698	Surveyed		15	B, FN, M, R
271746081404301		TPA POT MAP SITE	39	1,030	1,250	Map estimate		10	B, FN, M, R
Duval County									
300812081390801	D-1097	D-1097 BARNES AT MANDARI	23			Surveyed		5	B, FN, M, R
300820081354001	D-1017	D-0296 HOOD LANDING AT M	34			Map estimate		0	B, M, R
300824081305401	D-1021	D-0169 POWEL AT BAYARD,	38			Surveyed		5	B, FN, M, R
301032081380401	D-2846	D-2846 CLARE RD AT MANDA	25			Surveyed		5	B, M, R
301144081413801	D-0126	D-0126 J-0190	27			Surveyed		5	B, M, R
301157081465201	D-1292	INDIAN TRAILS		432	621	Surveyed	OU	25	FN, NB
301216081451201	D-0321	D-0321 J-0386	28			Surveyed		5	B, M, R
301255081371001	D-0282	D-0282 J-0347 3715 RUBIN	24			Surveyed		5	B, M, R
301333081324101	D-2847	D-2847 GOLF COURSE AT DE	31			Map estimate		0	B, FN, M, R
301335081355001	D-0536	D-0536 J-0603	33			Map estimate		0	B, M, R
301339081433401	D-1055	D-1055 J-1109 VISTA VERD	30			Surveyed		5	B, M, R
301339081531203	D-0326	D-0326 J-0391	48			Map estimate		0	B, FN, M, R
301415081284801	D-0658	D-0658 J-0721 BEACH BLVD	30			Map estimate		0	B, M, R
301434082021401	D-0085	D-0085 J-0149 OIL TEST S	53			Map estimate		0	B, FN, M, R
301607081301001	D-0991	D-0991 J-1001	27			Map estimate		0	B, M, R
301617081421601	D-0115	D-0115 J-0179	28			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
301714081233301	D-1034	D-0072 J-0136 JAX BCH WA	31			Map estimate		0	B, M, R
301715081300001	D-0298	D-0298 J-0363 BEACH BLVD	27			Surveyed		5	B, M, R
301725081392101	D-0048	D-0048 J-0112 3450 SUNNY	23			Surveyed		5	B, M, R
301725081584501	D-0254	D-0254 J-0321	54			Map estimate		0	B, FN, M, R
301758081462900	D-0221	ROLLING HILLS				Surveyed	OU	15	FN, NB
301817081374901	D-425T	D-425T J-492	34			Surveyed		5	B, FN, M, R
301846081240201		D-0246 J-0313 NEPTUNE BE	34			Map estimate		0	B, M, R
301900081342801	D-0094	D-0094 J-0158	30			Surveyed		5	B, FN, M, R
301902081394601	D-0297	D-0297 J-0362	27			Surveyed		5	B, M, R
301919081375401	D-0376	D-0376 J-0442 BRYANT AND	32			Surveyed		5	B, M, R
301925081262501	D-1039	D-0934 J-1032 ATLANTIC B	25			Map estimate		0	B, M, R
302112081384701	D-0210	D-0210 J-0276 16TH ST. E	35			Map estimate		0	B, M, R
302122081274001	D-1045	D-0400 J-0467 1669 GIRVI	26			Map estimate		0	B, M, R
302137081240001	D-0084	D-0084 J-0148 SEMINOLE D	28			Surveyed		5	B, FN, M, R
302142081330701	D-0277	D-0277 J-0342 9005 FT. C	28			Map estimate		0	B, M, R
302145081394201	D-0043	D-0043 J-0107 3926 LAURI	35			Surveyed		5	B, M, R
302300081295101	D-0396	D-0396 J-0463 AT FORT CA	33			Map estimate		0	B, M, R
302317081330401	D-0488	D-0488 J-0555 JPA AT BLO	36			Map estimate		0	B, FN, M, R
302330081463001	D-0420	D-0420 J-0487 WING-LEE F	39			Map estimate		0	B, M, R
302339081254702	D-0464	D-464A J-0531 1459 JULIA	35			Map estimate		0	B, M, R
302351081390201	D-0151	D-0151 J-0215 OLD BROWAR	36			Surveyed		5	B, FN, M, R
302416081522601	D-0348	D-0348 J-0413	42			Surveyed		5	B, FN, M, R
302502081321001	D-1048	D-0270 J-0335 5186 HECKS	32			Map estimate		0	B, M, R
302514081393701	D-0227	D-0227 J-0294 10402 MONA	37			Map estimate		0	B, M, R
302538081253101	D-0164	D-164 J-228 GOLF COURSE	39			Surveyed		5	B, FN, M, R
302608081354903	D-0264	D-0264 J-0030	36			Surveyed		5	B, M, R
302616081413901	D-0305	D-0305 J-0370 DUNNS RD N	40			Map estimate		0	B, FN, M, R
302647081460201	D-1068	D-1068 J-1127	46			Map estimate		0	B, M, R
302724081244801	D-0395	D-0395 J-0462 LITTLE TAL	35			Surveyed		5	B, M, R
302738081290001	D-1078	D-1078 J-1106 7124 CEDAR	32			Map estimate		0	B, M, R
302801081375101	D-0145	D-0145 J-0209	38			Surveyed		5	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
303209081371801	D-0673	TISONIA FT CF		450	857	Surveyed	OU	25	FN, NB
303216081433301	D-0401	D-0401 J-0468 DUVAL COUN	37			Map estimate		0	B, FN, M, R
303458081364001	D-1052	D-0411 J-0478	32			Map estimate		0	B, M, R
Flagler County									
291625081092001	F-0286	ORMOND BCH FLAGLER 2	8	90	270	Surveyed	OU	25	B, M, R
291658081110401	F-0285	ORMOND BCH FLAGLER 1	14	180	247	Surveyed	OU	25	B, FN, R
291818081190401	F-0251	RELAY TOWER DEEP WELL (F	17	78	147	Surveyed	OU	25	B, FN, M, R
291913081224201	F-0257	13S29E33	17			Surveyed		5	B, FN, M, R
291955081200901	F-0097	91912003 13S29E36	11			Surveyed		5	B, M, R
292156081215001	F-0260	92112103 13S29E37	10			Surveyed		5	B, M, R
292302081155901	F-0240	SR304 WELL AT SWEETWATER	14	120	190	Surveyed	WU	15	B, FN, M, R
292342081183701	F-0261	92311805 13S30E06	8			Surveyed		5	B, M, R
292448081121301	F-0161	ITT-PALM COAST WELL LW-1	19	141		Surveyed	OU	25	B, FN, M, R
292603081082502	F-0176	F-176 BULLOW RUINS	8	91	120	Surveyed	OU	25	B, M, R
292604081062401	F-0174	SJRWMD SHALLOW WELL F17	5	110	118	Surveyed	OU	25	B, FN, M, R
292645081110301		ITT PALM COAST WELL SW-8	15			Surveyed		5	B, M, R
292647081182001	F-0126	92611803 12S30E19	9			Surveyed		5	B, M, R
292728081125601	F-0278	BUNNELL AIRPORT WELL AT	16	105	255	Surveyed		15	B, M, R
292737081220201	F-0182	F-182 KINGS FARM	11	192	446	Surveyed	OU	25	B, FN, R
292750081152001	F-0087	92711501USGS OBSER WELL	13			Surveyed	OU	15	B, M, R
292820081221001	F-0215	92812201OBSERVATION WELL	12		159	Surveyed	OU	20	B, M, R
292947081164401		ITT-PALM COAST WELL LW-6	15			Surveyed	OU	15	B, FN, M, R
293034081293001	F-0262	93012901 11S28E32	14			Surveyed		5	B, M, R
293128081090501	F-0225	LENSSEN WELL AT BEVERLY	7			Surveyed		5	B, FN, M, R
293257081171601	F-0263	93211702 11S30E16	15			Surveyed		5	B, M, R
293313081132402	F-0158	*SJ* F158 11S31E18 ITTPA	14			Surveyed		5	B, M, R
293344081232401	F-0294	DINNER ISLAND CF	16	95	124	Surveyed	UN	15	B, FN, M, R
293529081191701	F-0165	*SJ* F165 10S30E31 PALMC	15	127	140	Surveyed	OU	25	B, M, R
293724081160101	F-0128	ITT-PALM COAST WELL LW-5	15			Surveyed	OU	15	B, FN, M, R
293754081121901	F-0200	*SJ* F200 10S31E WASHI	14			Surveyed	OU	15	B, FN, M, R
293905081142701	F-0264	939114 10S30E39 WADSW	14			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
293943081124301	F-0265	93911201	14	100	300	Surveyed		15	B, M, R
Gilchrist County									
293817082412601		D.ROYER NR TRENTON,FL	41			Map estimate		0	B, FN, M, R
Glades County									
265452081165401		65411601 41S30E12 CLEMO	49			Map estimate		0	B, FN, M, R
271150081054401		71110501OBSER WELL GL155	47			Surveyed	OU	15	B, FN, M, R
Hardee County									
272129081391001		TPA POT MAP SITE	47			Map estimate		0	B, FN, M, R
272509081410401		TPA POT MAP SITE	44		1,100	Map estimate		5	B, FN, M, R
272855081400701		TPA POT MAP SITE	56	141	1,160	Map estimate		10	B, FN, M, R
273331081414601		TPA POT MAP SITE	59	382	1,200	Map estimate		10	B, FN, M, R
273458081342601		TPA POT MAP SITE	73	93	1,090	Map estimate		10	B, FN, M, R
273834081464701		TPA POT MAP SITE	59		850	Surveyed		10	B, FN, M, R
Hernando County									
282620082193801		82621901	71			Surveyed		5	B, M, R
282636082221401		WEEKI D WELL 11 NR MASAR	39	68		Surveyed	OU	20	B, FN, M, R
282839082190801		82821901 RUSSELL BLACKET	71	309	428	Surveyed		15	B, M, NR
282851082035301		82820301 23S22E13 E H B	82			Surveyed		5	B, M, R
283001082064702		83020602 23S22E09 WSF-R	72			Surveyed		5	B, FN, M, R
283036082105502		83021002 23S21E02 RIDGE	52			Surveyed		5	B, FN, M, R
283108082123401		83121201 22S21E04 LE:CO	46			Surveyed		5	B, M, R
283313082350101		TPA POT MAP SITE	8	440	603	Unknown		10	B, FN, M, R
283321082241601		ROMP DP 105 AT BROOKSVIL	31			Unknown	OU	10	B, FN, M, R
283508082215101		83522101 22S19E12 CLARE	36			Surveyed		5	B, M, R
283510082133701		CROOM RR SIDING WELL NR	41			Surveyed		5	B, M, R
283537082151501		83521501 ROMP DEEP WELL	39			Surveyed	OU	15	B, FN, M, R
283613082184301		83621801 22S20E04 DELMA	35			Surveyed		5	B, M, R
283650082313301		TPA POT MAP SITE	10	122	170	Map estimate		10	B, FN, M, R
283806082214801		83822101 21S19E25 EDEN	31			Surveyed		5	B, M, R
283840082154801		838215132 BARNHART WELLC	39			Surveyed		5	B, M, R
283924082272301		TPA POT MAP SITE	11	140	240	Surveyed		15	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
283957082181001		83921801 21S20E16 W A B	32			Surveyed		5	B, M, R
270556081204701		HIF-26 J H HENDRIE DAIR	47			Surveyed		5	B, FN, M, R
Highlands County									
270627081313101		HIF-23 GRAHAM CO DAIRY	46			Surveyed		5	B, FN, M, R
271134081234301		HIF-5 CHARLES STIDHAM	47			Surveyed		5	B, FN, M, R
271223081202601		TPA POT MAP SITE	49			Map estimate		0	B, FN, M, R
271306081284801		HIF-8 BOX RANCH	47			Surveyed		5	B, FN, M, R
271330081113401		HIF-37 SUN-RAY FARMS	45			Map estimate		0	B, FN, M, R
271503081080901		71510801 37S32E20 LYKES	47			Map estimate		0	B, M, R
271559081202301		TPA POT MAP SITE	67			Surveyed		5	B, FN, M, NR
271726081163901		HIF-14 P G PHYPERS	48			Surveyed		5	B, FN, M, R
272048081322101		HIF-16 C M PAYNE	56			Surveyed		5	B, FN, M, R
272512081122901		HIF-13 PHILLIP METZGER	46			Surveyed		5	B, FN, M, R
272835081251701		728125-- 34S29E16 NARAN	80			Map estimate		0	B, FN, M, R
272915081190201		HIF-32 GUILFORD TOMLINSO	51			Surveyed		5	B, FN, M, R
273007081263901		TPA POT MAP SITE	79			Unknown		0	B, M, R
273252081264101		TPA POT MAP SITE	80			Map estimate		0	B, FN, M, R
273615081284901		TPA POT MAP SITE	85			Unknown		0	B, M, R
273845081321901		TPA POT MAP SITE	77			Unknown		0	B, FN, M, R
Hillsborough County									
275802082044701		TPA POT MAP SITE	65	100	530	Surveyed		15	B, FN, M, R
280350082104401		TPA POT MAP SITE	78			Unknown		0	B, M, R
280413082061401		TPA POT MAP SITE	88	80	216	Map estimate		10	B, FN, M, R
280438082075301		TPA POT MAP SITE	91			Unknown		0	B, M, R
280852082135601		TPA POT MAP SITE	38	37	50	Surveyed		15	B, FN, M, NR
Indian River County									
273357080220201	IR0368	73302201 MIDWAY MHP SOUT	35			Surveyed		5	B, FN, M, R
273423080332201	IR0370	MORRISON GROVES	45	888	990	Surveyed	WI	15	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
273435080255101	IR0312	73402501 USDA SOUTH WELL	33	120	568	Surveyed	OU	25	B, FN, M, R
273515080344303	IR0954	SJWCD 432-480 FT		432	480	Surveyed	OU	25	FN, NB
273536080240201	IR0040	73502403 REVERSE OSMOSIS	31			Surveyed		5	B, M, R
273633080364301	IR0017	RIO GROVES INC	45			Surveyed	WI	5	B, M, R
273758080301501	IR0330	73703001 VILLAGE GREEN S	36			Surveyed		5	B, M, R
273814080245201	IR0372	73802402 IR 24 1ST CHRIS	34	126		Surveyed		10	B, M, R
273821080273901	IR0333	73802701 CHAUNCEY HATCH	34			Surveyed		5	B, M, R
273822080374402	IR0373	73803703 CARDINAL GROVES	39			Surveyed		5	B, M, R
273826080235201	IR0931	VBPP POCAHONTAS PARK		250	640	Surveyed	OU	25	FN, NB
273827080322001	IR0374	73803201 SR 60 WEST OF I	43			Surveyed		5	B, M, R
273835080345801	IR0376	D. KROMHOUT	45		600	Surveyed	WI	10	B, M, R
273846080254701	IR0313	73802501 USDA NORTH WELL	32	163	511	Surveyed	OU	25	B, FN, M, R
273941080375400	IR0696	DELTA FARMS 275-295 FT		277	295	Surveyed	OU	25	FN, NB
274055080281301	IR0379	74002801 IR 210 WALTER P	37	240		Surveyed		10	B, FN, M, R
274125080304800	IR0693	CORRIGAN RNCH 390-440 FT		390	440	Surveyed	OU	25	FN, NB
274217080464201	IR0968	BLUE CYPRESS 303-440 FT		303	440	Surveyed	OU	25	FN, NB
274350080364501	IR0383	74303601 JACK BERRY GROV	43			Surveyed		5	B, FN, M, R
274452080275501	IR0384	74402701 IR 147 A S PFAR	35			Surveyed		5	B, M, R
274534080251101	IR0387	74502502 MARSH ISLAND SR	24			Surveyed		5	B, M, R
274606080335401	IR0388	74603301 SCHINER MEMORIA	39			Surveyed		5	B, M, R
274607080493001	IR0189	74604901USGS OBSER WELL	44			Surveyed	OU	15	B, FN, M, R
274635080363001	IR0389	74603601 IR 183 JOE SCRE	31			Surveyed		5	B, M, R
274705080460301	IR0390	74704603 ROLLINS RANCH S	42			Surveyed		5	B, M, R
274815080254101	IR0391	74802501 IR 33 A J BYRD	21			Surveyed		5	B, FN, M, R
274916080520701	IR0366	IR-366 MACE RANCH	50	120	260	Surveyed	TU	25	B, FN, M, R
274921080254201	IR0394	74902501 IND RIV CO A1A	22			Surveyed		5	B, M, R
Lake County									
2236095		ALEXANDER SPRINGS	15			Surveyed		5	B, M, R
282126081403901		821140 24S26E35	117			Surveyed		5	B, M, R
282241081443901	L-0051	SAND MINE ROAD DEEP WELL	116	85	115	Surveyed	OU	25	B, FN, M, R
282245081492601		822149213 USGS OBSER WEL	110			Surveyed	OU	15	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
282443081425201		82414201 24S26E09 LYKES	114			Surveyed		5	B, M, R
282532081511801	L-0569	82515101 24S25E06 JACK	105			Surveyed		5	B, M, R
282533081430801	L-0677	LYKES #1 LLSP		150	357	Map estimate	OU	20	FN, NB
282705081430701		TROUT LAKE WELL	93			Surveyed		5	B, M, R
282717081553101	L-0056	82715502ROMP DEEP WELL 1	97			Surveyed	OU	15	B, FN, M, R
282729081443301	L-0053	LK LOUISA STATE PARK (SJ	97	70	85	Surveyed	OU	25	B, M, R
282823081500401		82815001 23S25E20 D D G	102	96		Surveyed		10	B, FN, M, R
282833081544201	L-0570	82815402 23S24E21 BROWN	95			Surveyed		5	B, M, R
283019081455701		LCFD DIST.9 STATION 1	88			Map estimate		0	B, M, R
283116081442301	L-0141	83114401 23S26E05 RINGS	82			Surveyed		5	B, M, R
283128081404701	L-0052	JOHNS LAKE WELL NR CLERM	82	73	115	Surveyed	OU	25	B, M, R
283204081544901	L-0062	832154334 MASCOTTE DEEP	99	63		Surveyed	OU	20	B, FN, M, R
283232081394101	L-0146	83213902 22S26E25	80			Surveyed		5	B, FN, M, R
283307081435301	L-0144	83314301 22S26E20 JACKS	80			Surveyed		5	B, M, R
283314081455501	L-0001	CITY WELL AT CLERMONT	82			Map estimate		0	B, M, R
283355081411701	L-0199	TURNPIKE CF	73	110	146	Surveyed	OU	25	B, FN, R
283359081411501	L-0148	22S26E14 332	74	107		Surveyed		10	B, M, R
283422081480401		834148 22S25E15 SAND	91			Surveyed		5	B, M, R
283530081514501		83515101 22S24E12 NEAR	87	73		Surveyed		10	B, FN, M, R
283540081402401	L-0153	22S26E01 333	74			Surveyed		5	B, M, R
283608081403001	L-0658	TOWN OF MONTVERDE		164	291	Surveyed	OU	25	FN, NB
283830081534901		83815301 21S24E27	87	200		Surveyed		10	B, M, R
284122081534401	L-0095	GROVELAND TWR CF	83	148	364	Surveyed	OU	25	B, FN, R
284135081565501		84115601 21S24E06 84115	77	483		Surveyed		10	B, M, R
284232081533001		842153142 20S24E34	81	100		Surveyed		10	B, FN, M, R
284233081442801		WEST ASTATULA WELL	71		160	Unknown		5	B, FN, M, R
284241081402601	L-0082	84214001 20S26E25 USGS	58			Surveyed	OU	15	B, M, R
284245081463301		843145331 20S25E26 HOWEY	77			Unknown		0	B, M, R
284320081410701	L-0139	843141-- 20S26E26 APOP	58	575		Map estimate		5	B, M, R
284328081515901	L-0442	843151 20S24E25	79			Surveyed		5	B, M, R
284445081462101	L-0043	LK YALE GROVES	66	112	200	Surveyed	OU	25	B, FN, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
284528081530201		CHURCH OF GOD OF PROPHECY	72		80	Unknown		5	B, FN, M, R
284728081322201	L-0339	LAKE 847-132-1 SORRENTO	49	60		Surveyed		10	B, FN, M, R
284757081543002		C R WILLIAMS WELL	67			Map estimate		0	B, M, R
284808081432801	L-0344	84814301 19S26E28 TAVER	60	98		Surveyed		10	B, M, R
284827081403501	L-0348	848140-- 19S26E26	59			Surveyed		5	B, M, R
284842081533001	L-0054	84815301COLLEGE STREET W	64	90		Surveyed		10	B, M, R
284855081255801		NORTH SECTION 29	18			Map estimate		0	B, M, R
284856081383001	L-0351	CITY OF MT.DORA,FL. WELL	50			Surveyed		5	B, FN, M, R
284857081570901		84815701 19S24E19 84815	70	68		Map estimate		5	B, M, R
284917081353701	L-0356	84913501 19S27E22	50			Map estimate		0	B, M, R
284934081474801	L-0566	849147-- 19S25E22	63	218		Surveyed		10	B, M, R
285057081321301	L-0365	NEW HEINDRICK WELL NR MO	42			Map estimate		0	B, FN, M, R
285129081541002		CITY OF FRUITLAND PK #2	63			Map estimate		0	B, M, R
285144081475002	L-0290	LEESBURG FIRE TWR CF		190	400	Surveyed	OU	25	FN, NB
285244081471401		852147 18S25E35	60			Map estimate		0	B, M, R
285257081434201	L-0373	852143121 18S26E32 J EIC	59	108		Map estimate		5	B, FN, M, R
285318081340601	L-0375	853134 18S27E25 EUSTI	48			Map estimate		0	B, M, R
285426081380901	L-0379	854138 18S27E20 N B M	53			Map estimate		0	B, M, R
285452081563201		85415601 18S24E19	54			Map estimate		0	B, M, R
285504081405901	L-0380	855140-- 18S26E14	52			Map estimate		0	B, M, R
285531081482701	L-0620	NR CABBAGE HAMMOCK CF		147	304	Surveyed	OU	25	FN, NB
285539081262901		PINE LAKES WELL ON SR 44	37	155	200	Surveyed		15	B, FN, M, R
285645081492401		856149-- 18S25E09	56			Surveyed		5	B, M, R
285707081441101	L-0385	857144-- 18S26E05	50			Map estimate		0	B, M, R
285726081465601		857146-- 18S25E02	55			Map estimate		0	B, M, R
285743081390201		ALTOONA POST OFFICE	48			Unknown		0	B, FN, M, R
285827081331401	L-0390	85813301 17S28E31	44			Map estimate		0	B, FN, M, R
290000081380001		90013801 17S27E17 PITMA	47			Surveyed		5	B, FN, M, R
290047081232501	L-0059	900123-- 17S29E--	17			Surveyed		5	B, M, R
290244081302601	L-0405	90213001 17S28E03	16	85		Surveyed		10	B, M, R
290451081344401	L-0066	ALEXANDER SPRS OB	17	74	102	Surveyed	OU	25	B, FN, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
290633081375201	L-0407	90613701 16S27E18 CAMP	32			Map estimate		0	B, M, R
290647081342101	L-0040	NR ALEX SPRS CF	37	143	171	Surveyed	OU	25	B, R
290650081314001	L-0409	906131 15S28E-- JOHNS	18			Surveyed		5	B, M, R
290820081305001		908130 16S28E-- FRANK	15	135		Surveyed		10	B, FN, M, R
290900081342002		909134 15S27E-- ASTOR	35	135		Surveyed		10	B, M, R
290910081360001	L-0417	909136 15S27E33 4 H C	43			Surveyed		5	B, M, R
290950081315501	L-0045	L-45 AT ASTOR	12	204	254	Surveyed	OU	25	B, R
291002081330601	L-0455	ASTOR 150 Ft CF	10	100	150	Surveyed	OU	25	B, FN, M, R
291449081381701	L-0340	91413801 14S27E30 ENGLI	4			Surveyed		5	B, FN, M, R
Levy County									
290138082371901		UNDETERMINED	19			Unknown		0	B, M, R
290200082432301		ROMP DEEP WELL 124 NR YA	3			Surveyed	OU	15	B, M, R
290230082412501		90224102ROMP DEEP WELL 1	3			Surveyed	OU	15	B, FN, M, R
290301082335601		90323301 16S17E35 DEL W	52			Surveyed		5	B, M, NR
290503082323101		90523201 16S17E13 SCE 1	72			Surveyed		5	B, M, NR
290605082372601		90623701 16S17E07 GEOTH	27			Surveyed		5	B, M, R
290743082341501		TIDEWATER WELL 1 NEAR DU	54			Surveyed		5	B, FN, M, R
291004082382901		91023801 15S16E24 91023	25	100		Surveyed		10	B, FN, M, R
291508082432901		GULF HAMMOCK	10			Surveyed		5	B, FN, M, R
291620082265101		UNDETERMINED - FL	38			Unknown		0	B, M, R
291712082351801		SOUTH OF BONSON-RO	45			Surveyed		5	B, M, R
291855082472601		HUDSON NR OTTER CREEK,FL	22			Map estimate		0	B, FN, M, R
291910082341101	LE-001	91923401BULLOCK-HUBER WE	45	68		Surveyed		10	B, FN, M, R
292009082305901		UNDETERMINED	43			Unknown		0	B, M, R
292143082282201		92122801 13S18E11 WILLI	46			Surveyed		5	B, FN, M, R
292307082313901		UNDETERMINED	47			Unknown		0	B, M, R
292310082373701		ERCELL SMITH	56			Surveyed		5	B, FN, M, R
292430082283001		92422801DEVILS DEN SINK	46			Surveyed	OU	15	B, M, R
292615082272601	LE0002	ROMP 134 NEAR WILLISTON,	46			Surveyed	OU	15	B, FN, M, R
292640082381201		92623801 12S17E17 92623	51	240		Surveyed		10	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
Marion County									
2236130		JUNIPER SPRINGS	31			Surveyed		5	B, FN, M, R
285900082072001	M-0031	USGS OBSER WELL CE36 AT	47	45		Surveyed	OU	20	B, FN, M, R
285928081500501	M-0320	MARION48 NR WEISDALE	52		152	Surveyed		10	B, FN, M, R
285930081430901	M-0062	85914301 KOA WELL ON SR-	52			Surveyed		5	B, FN, M, R
285933082192501		85921901 17S20E20 CE 24	38	21		Surveyed		10	B, M, R
290106082191001	M-0360	USGS OBSER WELL CE 23 NR	42	19		Surveyed	OU	20	B, FN, M, R
290130082082001	M-0042	90120801 USGS OB WELL CE	47	40		Surveyed	OU	20	B, FN, M, R
290215082152401		902215431OBSER WELL CE 7	43			Surveyed	OU	15	B, M, R
290227082250801		90222501 16S19E31 CE 75	54	62		Surveyed	OU	20	B, FN, M, NR
290238082120901		90221201 17S21E03 SCE 1	45			Surveyed		5	B, M, R
290306082232802		903223433 FIRE TOWER W C	53	26		Surveyed		10	B, M, R
290312082190601		90321901 16S20E33 CE 22	48	40		Surveyed	OU	20	B, FN, M, R
290312082250801	M-0255	90322501USGS OBSER WELL	38	112		Surveyed	OU	20	B, M, R
290325082283701		90322802 16S18E27 AK:54	38			Surveyed		5	B, M, NR
290327081562001	M-0380	OXNER PROPERTY		98	462	Surveyed	OU	25	FN, NB
290400082091001	M-0041	90420901 USGS OB WELL CE	45	29		Surveyed	OU	20	B, M, R
290421082190801	M-0050	90421901 16S20E28 CE 21	43	55		Surveyed		10	B, M, R
290447082250901		90422501 16S19E20 CE 13	32	43		Surveyed		10	B, M, R
290455081530401	M-0013	90415301USGS OBSER WELL	52	80	225	Surveyed	OU	25	B, M, R
290514082270701		90522701RAINBOW SPRINGS	28	125		Surveyed		10	B, M, R
290552082044701	M-0058	90520401 USGS WELL CE81	44			Surveyed	OU	15	B, M, R
290614082274801		90622701 16S18E11 SCE 1	33	150		Surveyed		10	B, FN, M, R
290628081425301	M-0061	90614201 LOOKOUT TOWER W	48			Map estimate		0	B, FN, M, R
290739082245701		90722401 15S19E32 CE 12	34	38		Surveyed		10	B, M, R
290752082271101		90722701 15S18E35 SCE 1	34			Surveyed		5	B, M, R
290815082025701	M-0269	CE 40 REPLACEMENT WELL N	43	47	105	Surveyed	OU	25	B, M, R
290820082032001	M-0037	M-37 USGS CE39	43	51	72	Surveyed	OU	25	B, FN, R
290822082310101		90823101 15S18E32 LAKE	43			Surveyed		5	B, M, R
290910082315001		90923101 15S18E30 SCE 1	41			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
290913082245601		90922401 15S19E29 SCE 1	36	90		Surveyed		10	B, M, R
290953082031301	M-0038	90920301 USGS OB WELL CE	43	60	86	Surveyed	OU	25	B, M, R
291015081385001	M-0049	91013801 15S26E DOT 4	38			Surveyed		5	B, M, R
291022082131101		OCALA AIRPORT WELL	46			Map estimate		0	B, FN, M, R
291056082263201		91022601 15S18E13 HERSH	38			Surveyed		5	B, M, R
291059082190801	M-0059	ROMP 120 NR COTTON PLANT	43	110	403	Surveyed	OU	25	B, FN, M, R
291100082010003	M-0028	M-28 USGS CE76	42	124	153	Surveyed	OU	25	B, R
291110082060001	M-0032	USGS OBSER WELL CE44 AT	42	34	91	Surveyed	OU	25	B, FN, M, R
291115081592501	M-0048	911159433SHARPES FERRY W	47			Surveyed		5	B, M, R
291115082102901	M-0321	CE 31 REPLACEMENT WELL N	43	27	55	Surveyed	OU	25	B, M, R
291117081540501	M-0044	REDWATER LAKE DEEP WELL	49	46	205	Surveyed	OU	25	B, FN, M, R
291130082015001	M-0026	USGS OBSER WELL CE 47 NE	41	174		Surveyed	OU	20	B, M, R
291140082052701	M-0040	CE80 AT SILVER SPGS	41	61	90	Surveyed	OU	25	B, FN, R
291241082300101		91223001 15S18E04 PETTY	41			Surveyed		5	B, FN, M, R
291310082045001	M-0039	91320401 USGS OB WELL CE	41	20	40	Surveyed	OU	25	B, M, R
291600081550001	M-0036	91615501 USGS OB WELL CE	44	85	165	Surveyed	OU	25	B, M, R
291618082194800		BLITCHTON FIRETOWER NR BLITCHTON	44			Unknown		0	B, FN, M, R
291625082085901	M-0419	MARION CNTY SHERIFF US 301		47	64	Surveyed	OU	25	FN, NB
291728081390501	M-0316	91713901 14S26E12 UNKNO	15			Surveyed		5	B, M, R
291740081562001	M-0025	USGS OBSER WELL CE54 NEA	45	258	280	Surveyed	OU	25	B, FN, M, R
291750081494001	M-0318	917149 14S25E06 C E 5	31			Surveyed		5	B, M, R
291751081414301	M-0414	FSR 90 W SR19 60-75 FT		60	75	Surveyed	OU	25	FN, NB
291849081411401	M-0021	LAKE GEORGE WELL NEAR SA	16	267	298	Surveyed		15	B, M, R
292019082064201	M-0063	CE 66 REPLACEMENT WELL	47	61	120	Surveyed	OU	25	B, M, R
292101082233601		92122301 13S19E15 HOMES	47			Surveyed		5	B, M, R
292138082061601	M-0012	JOHNSTON C.C.	48	53	63	Surveyed	UH	15	B, R
292146082182501		92121801 13S20E09 SR 31	48			Surveyed		5	B, M, R
292200081510001	M-0024	USGS OBSER WELL CE84 NR	25	53	90	Surveyed	OU	25	B, FN, M, R
292204082022801	M-0052	FT MCCOY DEEP	50	60	160	Surveyed	OU	25	B, FN, M, R
292225082053601	M-0284	BLACK SINK WELL CF	51	80	170	Surveyed	OU	25	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
292349082191501		92321901 12S20E33 E H U	48			Surveyed		5	B, FN, M, R
292546081513301	M-0023	925151124USGS OBSER WELL	21	307	340	Surveyed	OU	25	B, M, R
292622082131801	M-0367	HUFF WELL NR MCINTOSH		71	215	Surveyed	OU	25	FN, NB
292656082125001	M-0351	SPORTSMAN COVE CF	54	45	54	Surveyed	OU	25	B, M, R
292718082202601		92722001 12S20E18 MAHAF	52			Surveyed		5	B, M, R
292816081513701	M-0413	FSR 31 & FSR 97 71-91 FT		79	91	Surveyed	OU	25	NB
292816082234501		92822301 12S19E03 SMITH	54			Surveyed		5	B, FN, M, R
292817081483602	M-0410	FSR 88 & 31		154	200	Surveyed	OU	25	FN, NB
Martin County									
270010080290001		MF-35	50			Surveyed		5	B, FN, M, R
270425080334701		MF-23 FLORIDA POWER&LIGH	48			Surveyed		5	B, FN, M, R
270742080352501		MF-33	47			Surveyed		5	B, FN, M, R
270847080103801		MF-31	45			Surveyed		5	B, M, R
270939080300501		MF-2 ALLAPATTAH PROP	48			Surveyed		5	B, FN, M, R
271003080280001		MF-9 ALLAPATAH PROP INC	49			Surveyed		5	B, FN, M, R
271249080104403		MF-3A INDIAN R PLANT DE	50			Surveyed		5	B, FN, M, R
Nassau County									
302409081551603	N-0237	CAREY STATE FOREST		450	500	Surveyed	OU	25	FN, NB
303340081500001	N-0051	N-51	40			Surveyed		5	B, M, R
303357081295601		N-119 CHARLES ALLEN WEL	29			Map estimate		0	B, FN, M, R
303417081342201	N-0036	N-118 COX WELL HART	31			Map estimate		0	B, M, R
303435081271401	N-0046	N-46	25			Map estimate		0	B, M, R
303518081275001	N-0129	N-3	20			Surveyed		5	B, FN, M, R
303543081494801	N-0220	CALLAHAN FL 458-650 FT		450	650	Surveyed	OU	25	FN, NB
303658081422601	N-0012	N-50	37			Surveyed		5	B, FN, M, R
303754081362701	N-0044	N-44	28			Surveyed		5	B, FN, M, R
303819081455701	N-0105	N 98	38			Map estimate		0	B, M, R
303823081273304	N-0190	ITT WELL#8	-18	565	1,020	Surveyed	OU	25	B, FN, R
303836081274201	N-0011	N-32	-24			Map estimate		0	B, M, R
303939081312601	N-0007	N-20	3			Map estimate		0	B, FN, M, R
304005081380201		N-121 BECKER OIL TEST SU	32			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
304028081272101	NS-2	N-56 CCR-11	-28			Map estimate		0	B, M, NR
304213081270801	G114	N-19 FT CLINCH STATE PAR	-13			Surveyed	OU	15	B, M, R
304317081372301	N-0013	N-67	28			Map estimate		0	B, M, R
304410081592101	N-0120	N-120 HUMPHREYS MINING N	43	525	923	Surveyed	OU	25	B, FN, M, R
304640081583801	WN0018	WN 18	43			Surveyed	WH	5	B, M, R
304700081571001	N-0221	ST MARYS FL 539-812 FT		535	820	Surveyed	OU	25	FN, NB
Okeechobee County									
271340080504001		OKF-31	48			Surveyed		5	B, FN, M, R
271438080571901		714057--	47			Surveyed		5	B, FN, M, R
272010080550801		DIXIE RANCH (OKF-17)	46			Surveyed		5	B, FN, M, R
272158080470901	OK0043	JONES WELL S DARK HAMMOC	45			Surveyed		5	B, FN, M, R
272704081053501	OK0019	727105--	47			Surveyed		5	B, FN, M, R
272726081003901	OK0018	727100-- 35S33E02 BASS	45			Surveyed		5	B, FN, M, R
273007081114601	OK0037	OKF-40 EXP WELL S65C	45			Surveyed		5	B, FN, M, R
273127080481401	OK0001	OK-1 AT FORT DRUM	44		960	Surveyed		10	B, FN, M, R
273726080471701	OK0046	73704701 LATT MAXCY J-1	39			Map estimate		0	B, FN, M, R
Orange County									
282051081183401	OR0030	82011801 24S30E34 BOGGY	47			Surveyed		5	B, FN, M, R
282141081241701	OR0121	82112401 24S29E34 TELY	46			Surveyed		5	B, M, R
282202081384601	OR0064	82213801LAKE OLIVER DEEP	108	103		Surveyed	OU	20	B, FN, M, R
282241081112801	OR0031	82211103 24S31E23 MOSS	41	240		Surveyed		10	B, M, R
282331081370801		82313702 27416 E USGS	102			Surveyed	OU	15	B, M, R
282341081040101		82310401USGS OBSER W. CO	35			Surveyed	OU	15	B, FN, M, R
282348080564701	OR0029	82305601 24S34E18	35			Surveyed		5	B, FN, M, R
282354081313001		82313104 24S28E17 RCID	74	145		Surveyed		10	B, FN, M, R
282434081283102		SEA WORLD DR REPLACEMENT	58			Surveyed		5	B, M, R
282510081054501	OR0025	82510502USGS OBSER W. CO	35	316		Surveyed	OU	20	B, M, R
282528081340901		82513402BAY LAKE DEEP WE	83	104		Surveyed		10	B, M, R
282531081095701	OR0082	82510901USGS OBSER W. CO	32	226		Surveyed	OU	20	B, FN, M, R
282534081220601	OR0001	82512203 24S29E01	45	202		Map estimate		5	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
282543081385801		82513801	97			Surveyed		5	B, M, R
282709081283001		82712804 23S28E25 USGS	55			Surveyed		5	B, M, R
282718081215101		PINECASTLE POST OFFICE A	47			Map estimate		0	B, FN, M, R
282738081341401		82713405 LAKE SAWYER WEL	78			Surveyed		5	B, M, R
282739081054501	OR0265	82710502USGS OBSER W. CO	35	200		Surveyed	OU	20	B, FN, M, R
282749081315801		82713101 23S28E29	75	120		Surveyed		10	B, FN, M, R
282835081305201		82813001 PALM LAKE DRIVE	61			Surveyed		5	B, M, R
282838080572401		82805701 23S34E18	35	80		Surveyed		10	B, M, R
282847081013701	OR0003	82810101USGS OBSER W. CO	34	252		Surveyed	OU	20	B, FN, M, R
282848080544501		82805402 23S34E15	32			Surveyed		5	B, FN, M, R
282911081243601		100 FT S OF AMERICAN BLV	45			Map estimate		0	B, M, R
282923081282801		82912802	59			Map estimate		0	B, M, R
282936081340201		82913405 23S27E12 ROSS	79			Surveyed		5	B, M, R
283017081391301		DAVENPORT RD 4" WELL, S	79			Surveyed		5	B, M, R
283105081222201		83112203 23S29E36	46	153		Surveyed		10	B, FN, M, R
283121081311601	OR0246	O-197 LK OLIVIA DRAIN WE	65	344		Surveyed		10	B, M, R
283126081064501	OR0617	LONGBRANCH NR BITHLO 210		210	550	Surveyed	OU	25	FN, NB
283144081254201	OR0104	83112504 LK MANN DRAIN	50			Surveyed		5	B, M, R
283157081180401	OR0563	83111802 22S30E34 ENGLE	46			Surveyed		5	B, M, R
283214080583501	OR0011	83205801 22S33E36	25			Surveyed		5	B, M, R
283249081053201	OR0007	83210501BITHLO 1 WELL AT	35	151		Surveyed		10	B, M, R
283307081300801	OR0101	83313001 22S28E22 W-511	62	118		Surveyed		10	B, FN, M, R
283326081262101	OR0114	83312601 22S29E20 LK LA	48			Surveyed		5	B, M, R
283333081233502	OR0046	83312310 LAKE ADAIR 10 W	46	105		Surveyed	OU	20	B, FN, M, R
283340081222803	OR0468	LAKE IVANHOE UPPER FLORI	46	189	450	Surveyed	OU	25	B, M, R
283406081150601		UNION PARK P.O. ON ECONL	38			Map estimate		0	B, M, R
283417081331401		83413302 22S28E18	69			Surveyed		5	B, M, R
283436081194501		83411901 22S30E17 LK SP	45			Surveyed		5	B, FN, M, R
283528081235201		83512302 22S29E10	47			Surveyed		5	B, M, R
283530081214301	OR0116	83512107 LAKE MIDGET DRA	44			Surveyed		5	B, M, R
283654081260801	OR0118	83612604 21S29E32	55	250		Surveyed		10	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
283816081225501		83812201 21S29E26 LK CH	46	325		Surveyed		10	B, M, R
284059081365401	OR0492	84013601 21S27E09	59	132		Surveyed		10	B, M, R
284230081345301	OR0106	PLYMOUTH TOWER	54	100	395	Surveyed	OU	25	B, FN, M, R
284234081273901	OR0042	84212702 20S28E36	21			Surveyed		5	B, M, R
284238081275803	OR0548	WEKIVA SP ST PK UCF	21	100	155	Surveyed	OU	25	B, FN, R
284330081360501		84313603 20S27E27 JEWEL	55			Map estimate		0	B, M, R
284429081272001	OR0035	84412701 20S29E19	29			Map estimate		0	B, M, R
284453081284401	OR0044	84412801 20S28E14	36			Surveyed		5	B, M, R
284453081365101	OR0163	84413601 20S27E16 SADLE	51			Map estimate		0	B, M, R
284529081301001	OR0170	84513001 20S28E10	35	143		Surveyed		10	B, M, R
284541081265201	OR0068	84512601 20S29E07	32			Map estimate		0	B, M, R
284634081262001	OR0662	ROCK SPRINGS 180 FT		150	180	Surveyed	OU	25	NB
284635081280601	OR0463	84612801	34			Map estimate		0	B, M, R
Osceola County									
274149080534801		OSF-60A TEST WELL	40			Unknown	OU	10	B, FN, M, R
274307080582401	OS0038	OSF-42	43			Surveyed		5	B, FN, M, R
274428081035201	SR-60	SR-60 WELL LATT-MAXEY	46			Map estimate		0	B, FN, M, R
275347081022601		OSF-62 TEST WELL	43			Unknown	OU	10	B, FN, M, R
275609081132001	OSF-4	JOE OVERSTREET WELL (OS-	47			Surveyed		5	B, FN, M, R
275852081030501	OS0047	TH-10 WILLIAMS RD	44			Map estimate		0	B, FN, M, R
280036080563801	OS0019	BULL CK LOOP RD SW	42	240	400	Surveyed	OU	25	B, FN, M, R
280141081112701		OSF-66 TEST WELL	48			Unknown	OU	10	B, FN, M, R
280418081160401		OSF-64 TEST	51			Unknown	OU	10	B, FN, M, R
280823081210301	OS0082	OSF-53 S-61 WELL NR ALCO	51			Surveyed		5	B, FN, M, R
280826081031801		HOLOPAW TEST NO 1	42			Surveyed	OU	15	B, FN, M, R
280829080574001	OS0069	808057 27S34E18 TH-6	42			Surveyed	OU	15	B, FN, M, R
280905081270101	OS0049	REEDY CREEK OVERLOOK WEL	61			Surveyed		5	B, FN, M, R
280928080532001	OS0192	80905301 27S34E02 DSR18	37			Map estimate		0	B, M, R
281006081162601	OSF-18	CANOE CREEK CAMPGROUND W	49			Surveyed		5	B, M, R
281023081075401		OSF-68 TEST WELL	44			Unknown	OU	10	B, M, R
281105080541401	X-22	811054-- 26S34E34 RODEO	38			Surveyed	WR	5	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
281116081024101	OS0035	81110201 26S33E29 DSRW5	40			Surveyed		5	B, M, R
281354080563301	X-21	813056 26S34E08 TH-4	40	173	373	Surveyed	TU	25	B, FN, M, R
281429081290501	OS0050	OS-254 MERCANTILE LANE W	63			Surveyed		5	B, FN, M, R
281443081140501		ASHTON FORESTRY TOWER WE	46			Surveyed		5	B, M, R
281456081171701	OS0081	ST.CLOUD POWER PLANT WEL	46			Surveyed		5	B, M, R
281506081194601		OSF-70 TEST WELL	48			Unknown	OU	10	B, FN, M, R
281536081324801		FLORIDA POWER WELL(SRK01	73			Surveyed		5	B, M, R
281559081260701		SHINGLE CREEK WELL	57			Surveyed		5	B, M, R
281630080591001	OS0051	TH-3 LAKE POINSETT SW	38			Surveyed		5	B, FN, M, R
281630081024401	OS0052	TH-9 NOVA RD 532 WEST	40			Surveyed		5	B, FN, M, R
281632080515001	OS0033	816051 25S34E36 DSR38	34			Map estimate		0	B, FN, M, R
281714081093001	OS0001	81710901LAKE JOEL W. NR.	43			Surveyed		5	B, FN, M, R
281719081134001	OS0174	SOUTH EAGLE ROAD GROVE W	38			Map estimate		0	B, M, R
281937081245901		81912401 25S29E09 OS U.	46			Surveyed		5	B, FN, M, R
282051081133201	OS0078	82011301	44			Surveyed		5	B, M, R
Palm Beach County									
265811080051601		PBF-1 BROADVIEW CONDOS	48			Surveyed		5	B, FN, M, R
Pasco County									
281037082071801		J ALSTON WELL NR CRYSTAL	85	47		Surveyed		10	B, FN, M, R
281424082192702		TPA POT MAP SITE	74	160	300	Surveyed		15	B, FN, M, R
281504082104801		ROMP DP WELL 86	66			Unknown	OU	10	B, FN, M, R
281548082220601		TPA POT MAP SITE	58			Unknown		0	B, M, R
281654082065901		81620601U.S.HIGHWAY 98 W	76			Surveyed		5	B, M, R
281654082201601		TPA POT MAP SITE	71	185	230	Map estimate		10	B, M, R
281704082085201		81720801 25S22E30 RICHL	63			Surveyed		5	B, M, R
281715082164401		SR 577 D. WELL NR SAN AN	82	57		Surveyed	OU	20	B, FN, M, R
281918082264601		SR52 DP WELL EAST OF GOW	67	38		Surveyed	OU	20	B, M, R
281923082252201		ROMP 93 DEEP WELL NEAR G	65	153	700	Surveyed	OU	25	B, FN, M, R
281926082212901		JCT OF SR 52 & 581 WELL	63	83		Surveyed	OU	20	B, FN, M, R
282005082112801		82021104 25S21E03 STEAR	64			Surveyed		5	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
282121082071101		82120702 24S22E32 CUMME	71			Surveyed		5	B, M, R
282154082142401		82121401 24S21E30 HAYCR	63			Surveyed		5	B, M, R
282221082103001		82221001 24S21E26 COLLU	63			Surveyed		5	B, M, R
282428082134501		82421301 24S21E08 LEE W	62	200		Surveyed		10	B, FN, M, R
282430082112101		82421102 24S21E10 SELF	61			Surveyed		5	B, M, R
282434082200301		AIRSTREAM TRL PARK D. WE	64			Unknown		0	B, M, R
282534082222802		TPA POT MAP SITE	45			Map estimate		0	B, M, R
282540082275701		MASARYKTOWN D. WELL AT M	27	29		Surveyed	OU	20	B, FN, M, R
282717082142001		82721401 23S21E30 ROSSI	53			Surveyed		5	B, M, R
282816082123701		82821201 23S21E21 TOMKO	49			Surveyed		5	B, FN, M, R
Polk County									
273929081080601	POF-20	POF-20 S-65A WELL NR S C	45			Surveyed		5	B, FN, M, R
273954081230601		USAF AVON PARK #3	76			Map estimate		0	B, FN, M, R
274547081470902	ROMP 4	TPA POT MAP SITE	61	285	400	Map estimate		10	B, FN, M, R
274553081115601		745111-- 31S31E23 RIVER	45			Surveyed		5	B, M, R
274730081333801		TPA POT MAP SITE	75	212	1,200	Map estimate		10	B, FN, M, R
274746081202201		747120-- 31S30E08 INDIA	63			Surveyed		5	B, FN, M, R
274815081130301		74811301RIVER RANCH WELL	46			Surveyed		5	B, FN, M, R
274841081480901		V. C. CORP OFFICE WELL A	60			Map estimate		0	B, M, R
274846081262001		74812601OBSER W. AT L. W	79			Surveyed	OU	15	B, FN, M, R
274926081355301		TPA POT MAP SITE	85	232		Unknown		5	B, M, R
275023081321501		TPA POT MAP SITE	89			Unknown		0	B, FN, M, R
275137081252501		751125-- 30S29E21 E. LK	78			Surveyed		5	B, M, R
275314081514201		ROMP 59 AVON PARK WELL A	63	200	1,050	Surveyed	OU	25	B, FN, M, R
275326081585801		ROMP 60 DEEP WELL AT MUL	61			Surveyed	OU	15	B, FN, M, R
275348081335701		TPA POT MAP SITE	98			Surveyed		5	B, FN, M, R
275403081391301	SR 60	SR 60 D. WELL NR LAKE WA	96			Map estimate		0	B, M, R
275411081372001		TPA POT MAP SITE	100			Surveyed		5	B, M, R
275622081252301		756125 29S29E28	58			Surveyed		5	B, FN, M, R
275628081541201		TPA POT MAP SITE	65			Map estimate		0	B, FN, M, R
275634081211801		756121-- 29S30E19 KISS	56			Surveyed		5	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
275723081465701		TPA POT MAP SITE	89			Map estimate		0	B, FN, M, R
275959081552501		SANLON RANCH D. WELL NR	91	293		Surveyed	OU	20	B, FN, M, R
280053081572301		TPA POT MAP SITE	76			Map estimate		0	B, M, R
280153081274101		801127-- 28S29E19 LK HA	68			Surveyed		5	B, M, R
280229081325201	SR 542	LAKE HATCHINEHA ROAD WEL	81			Surveyed		5	B, FN, M, R
280338081572901		TPA POT MAP SITE	84			Map estimate		0	B, M, R
280420081570101		LAKELAND STADIUM WELL AT	91			Map estimate		0	B, M, R
280455082021501		TPA POT MAP SITE - PLANT	94			Unknown		0	B, FN, M, R
280456081374301		SMITH WELL AT HAINES CIT	110	110		Surveyed		10	B, FN, M, R
280503081552801		80515502FISH LAKE DP W.	112			Surveyed		5	B, M, R
280520081575201		TPA POT MAP SITE	93			Map estimate		0	B, M, R
280531081431601	PO0014	80514301LAKE ALFRED DP W	118	282		Surveyed		10	B, FN, M, R
280556081532601		80515321 1TENNOROCK RD W.	119			Surveyed		5	B, FN, M, R
280558081314801		805131-- 27S28E29 KIMBE	71			Surveyed		5	B, M, R
281008081441801	PO0006	810144432LAKE ALFRED W.	126	102		Surveyed		10	B, FN, M, R
281057081495002		81014903 POLK CITY ROMP	127	264	315	Surveyed	OU	25	B, FN, M, R
281202081391701	PO0001	PO-1 THORNHILL DEEP NR D	124	108	151	Surveyed	OU	25	B, FN, M, R
281312082011601		ROMP 87 NR LAKELAND , FL	102			Surveyed	OU	15	B, FN, M, R
281317081491301		813149423 26S25E16	126	78		Surveyed		10	B, M, R
281440081431701		814143232 26S26E04	126	80		Surveyed		10	B, FN, M, R
281511081393101	PO0012	815139342 26S26E01	121			Surveyed		5	B, M, R
281532081345001		815134134 26S27E02 LOUGH	90			Surveyed		5	B, FN, M, R
281532081493001		815149233 25S25E32	124	78		Surveyed		10	B, FN, M, R
281631081564501		SPEARS WELL NR ROCK RIDG	106			Map estimate		0	B, FN, M, R
Putnam County									
292124081345202	P-0736	MIDDLE RD UPPER CF	8	70	100	Surveyed	OU	25	B, FN, M, R
292143081374601	P-0423	*SJ* P423 13S27E39 DRAYT	9			Surveyed		5	B, M, R
292218081333101	P-0410	*SJ* P410 13S27E11 UNION	24	81	156	Surveyed	OU	25	B, M, R
292238081380301	P-0422	*SJ* P422 13S27E39 DRAYT	14			Surveyed	WH	5	B, M, R
292239081282401	P-0255	WESNOFFSKE WELL	13			Map estimate	WI	0	B, M, R
292239081313702	P-0696	NR SILVER POND CF	27	80	400	Surveyed	OU	25	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
292246081284301	P-0495	S. END CRESCENT LK	14	132	246	Surveyed	WI	15	B, R
292254081382101	P-0421	*SJ* P421 13S27E39 DRAYT	11			Surveyed	WH	5	B, R
292257081353001	P-0469	PARADISE LAKES EAST	18	105	190	Surveyed	OU	25	B, M, R
292307081305201	P-0341	*SJ* P341 13S28E06 OLDHW	26			Surveyed		5	B, M, R
292318081345703	P-0744	PARADISE LAKES CF	20	90	140	Surveyed	OU	25	B, M, R
292418081330902	P-0705	NILES RD CF	29	105	400	Surveyed	OU	25	B, FN, M, R
292435081441301	P-0427	NR FRONTIER D H NR SALT	11			Surveyed	OU	15	B, FN, M, R
292447081370601	P-0776	MARVIN-JONES RD CF	23	155	160	Surveyed	OU	25	B, M, R
292528081383501	P-0270	92513801 26S12E26 PUTNA	17			Surveyed		5	B, M, R
292606081311101	P-0242	*SJ* P242 12S28E25 DGAUT	29	105	135	Surveyed	OU	25	B, M, R
292621081375101	P-0373	*SJ* P373 MANSFIELD FERN	22	73	205	Surveyed	WU	15	B, M, R
292628081385501	P-0396	*SJ* P396 12S26E23 WELAK	11			Surveyed		5	B, M, R
292657081375201	P-0416	P-416 MORRIS FERNERY	21	95	187	Surveyed	OU	25	B, FN, M, R
292736081313401	P-0517	NEWBOLD FERNERY	23	144	202	Surveyed	OU	25	B, FN, R
292824081341501	P-0246	P-0246 COL. SAULS	30	104	144	Surveyed	OU	25	B, M, R
292824081443301	P-0472	JOHNSONS FIELD NR WELAKA	8	96	144	Surveyed	OU	25	B, FN, M, R
292859081375701	P-0408	P-408 HWAY 308B	17	127	148	Surveyed	OU	25	B, M, R
292948081503001	P-0450	RD 77-G WELL NR ORANGE S	20	215	241	Surveyed	OU	25	B, FN, M, R
293004081443601	P-0128	CARAVELL RANCH CF	16	90	186	Surveyed	WU	15	B, M, R
293113081370301	P-0382	*SJ* P382 11S27E19 MAINR	28			Surveyed		5	B, M, R
293203081411501	P-0395	MRS. HAMILTON CF	18	320	320	Surveyed		15	B, R
293206081351701	P-0817	NR LK BROWARD CF	25	100	200	Surveyed	UN	15	B, FN, M, R
293234081424101	P-0280	93214201 --S--E-- RODEH	21			Surveyed		5	B, FN, M, R
293300081523901	P-0306	933152 11S24E11 CE 60	61	105	189	Surveyed	OU	25	B, M, R
293304081342301	P-0411	*SJ* P411 11S27E09 PINEY	22			Surveyed	WU	5	B, M, R
293420081415601	P-0462	93414101 11S26E04 AM TH	23			Surveyed		5	B, M, R
293439081524301	P-0017	*SJ* P17 10S24E35 DEEP	74			Surveyed		5	B, M, R
293543081315301	P-0480	93513101 11S26E-- B.T.	16			Surveyed		5	B, M, R
293554081342601	P-0474	SAN MATEO TOWERSITE DEEP	17			Surveyed	OU	15	B, FN, M, R
293633081594601	P-0464	DRAINAGE WELL COWPEN LAK	81	194	210	Surveyed	RU	25	B, M, R
293733081474801	P-0510	HOLLISTER WORKCTR CF (P-	49	175	300	Surveyed	OU	25	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
293802081591901	P-0008	P-8 CHESSER	79	131	144	Surveyed	WU	15	B, R
293806081544901	P-0016	*SJ* P16 10S24E08 KELLE	74	225	257	Surveyed	WU	15	B, FN, R
293913081384001	P-0483	93913801 10S26E01	25			Surveyed		5	B, M, R
293933081342801	P-0172	93913411 10S27E04 P-172	18	112	543	Surveyed	OU	25	B, M, R
293951081413901	P-0123	DHQ DEEP WELL	28	178	394	Surveyed	OU	25	B, FN, M, R
294012081525701	P-0772	LK GRANDIN CF	75	165	200	Surveyed	OU	25	B, FN, M, R
294055081354501	P-0077	*SJ* P77 09S27E EASTP	20			Surveyed		5	B, M, R
294113081392001	P-0830	PUTNAM BARGEPORT PS		216	328	Surveyed	OU	25	FN, NB
294144081341801	P-0490	94113401 09S27E-- 41-34	20			Surveyed		5	B, M, R
294243081555901	P-0822	FLORIDA ROCK GRANDIN CF	83	144	254	Surveyed	OU	25	B, FN, M, R
294255081323501	P-0076	A.J. ROBERTS	20	104	235	Surveyed	WI	15	B, FN, M, R
294308082002201	P-0001	DRAINAGE WELL SWAN LK NR	84	96	167	Surveyed	OU	25	B, M, R
294441081442903	P-0486	94414403 09S26E06	58	201	386	Surveyed	WU	25	B, M, R
294449081573301	P-0487	94415701 09S23E01 PROGR	81			Surveyed		5	B, M, R
294515081314001	P-0010	*SJ* P10 08S27E36 FEDER	20			Surveyed		5	B, M, R
294553081344301	P-0493	94513401 08S27E-- RIVER	25			Surveyed		5	B, FN, M, R
294814081345201	P-0488	94813401 08S27E15 ART R	28			Surveyed		5	B, M, R
Seminole County									
283717081194202		83711904 LAKEMONT AVE D	47			Surveyed		5	B, M, R
283740081031401		83710302 21S33E30	27	84		Surveyed		10	B, M, R
283754081154301		83711502 21S31E30	42			Surveyed		5	B, M, R
283843081075501		83810706 21S32E20	31	95		Map estimate		5	B, M, R
283849081273401		83812702	51			Surveyed		5	B, FN, M, R
283920081232501		83912302 21S29E14 SPANI	46			Surveyed		5	B, M, R
283933081123103	S-1193	OVIEDO WTP 220 FT CF		87	220	Surveyed	OU	25	FN, NB
283936081162801	S-1056	CITRUS ROAD 156-365 FT		166	365	Surveyed	OU	25	NB
283945081071901	S-0003	83910702 21S32E16	25			Surveyed		5	B, M, R
283956081040201		83910402 21S32E13	16			Surveyed		5	B, M, R
283958081203401		84012002 21S30E17	49			Surveyed		5	B, M, R
284012081264601		84012603 21S29E07	48			Surveyed		5	B, M, R
284025081123001	S-0312	84011201 21S31E10	34	85		Surveyed		10	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
284050081065302	S-1201	SNOW HILL RD @ ECON 100-		100	140	Surveyed	OU	25	NB
284052081212601	S-1014	NORTH STREET UP CF	44	142	300	Surveyed	OU	25	B, FN, M, R
284120081152201	S-0012	84111501 21S31E06	36			Surveyed		5	B, M, R
284125081131701		84111301 21S31E04	29	80		Surveyed		10	B, M, R
284133081105701		FLORIDA AVE WELL NR OVIE	21			Surveyed	OU	15	B, FN, M, R
284147081220201	S-0125	84112101USGS OBSER WELL	42	63		Surveyed	OU	20	B, M, R
284207081174401		84211703 20S30E35	33			Surveyed		5	B, M, R
284217081023001	S-0025	KILBEE #3 TEST NR ST JOH	8	58	154	Surveyed	OU	25	B, FN, M, R
284235081044902	S-0042	S-42 KILBEE # 2 CF	15	106	133	Surveyed	OU	25	B, FN, R
284244081234901		84212302 20S29E34	36			Surveyed		5	B, M, R
284247081070801	S-0001	GENEVA WELL S-0001 NR GE	21	92	204	Surveyed	OU	15	B, M, R
284317081213401		MARTIN MARIETTA	37			Surveyed		5	B, M, R
284331081031001	S-0114	84310302 20S33E30	11			Surveyed		5	B, M, R
284412081071102	S-1253	GENEVA FIRE STATION 132-		132	280	Surveyed	OU	35	FN, NB
284428081072603		USGS AVENUE C 6" ANNULAR	15	117	353	Surveyed	OU	25	B, M, R
284428081155201		LARGENT WELL SANFORD AVE	28			Surveyed		5	B, M, R
284434081050101		84410503 POT MAP WELL NR	13			Surveyed		5	B, M, R
284440081175901	S-0111	84411722 20S30E15	35	75		Surveyed		10	B, M, R
284516081224001	S-0019	84512203 20S29E14	34			Surveyed		5	B, M, R
284533081204801	S-0224	84512005 20S30E08	33	97		Surveyed		10	B, M, R
284550081071501	S-0304	84510703 CAMERON WELL NR	13	77		Surveyed		10	B, M, R
284553081204801	S-0972	S-0972 LAKE MARY CF		162	500	Surveyed	OU	25	FN, NB
284618081095401		84610902 20S31E12	14			Surveyed		5	B, M, R
284626081051801	S-0026	K RD TEST WELL OSCEOLA R	12			Surveyed	OU	15	B, M, R
284645081152401		84611515 20S31E06	21	108		Surveyed		10	B, M, R
284706081070801	S-0305	84710703 THRASHER PASTUR	10	99		Map estimate		5	B, M, R
284712081044301	S-0029	84710401 CO. LANDFILL OS	10	70		Surveyed		10	B, M, R
284715081051802	S-0086	OSCEOLA LANDFILL	12	70	225	Surveyed	OU	25	B, R
284750081132301	S-0257	84711306OBSER WELL SEMIN	22			Surveyed	OU	15	B, M, R
284802081192701	S-0123	WELL JORDAN BAPTIST UPSA	27			Surveyed		5	B, M, R
284802081211101	S-0206	84812106 19S30E31	32	81		Surveyed		10	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
284802081242101	S-0122	VIA HERMOSA WELL	23			Surveyed		5	B, M, R
284923081234802	S-1230	YANKEE LAKE STP 122-403		122	403	Surveyed	OU	25	FN, NB
284945081244201	S-0037	84912407 19S29E39	13			Surveyed		5	B, M, R
284954081201101	S-0243	ANDERSON WELL MISSOURI S	27			Surveyed		5	B, M, R
285002081215101	S-0020	85012101 19S29E38	26			Surveyed		5	B, M, R
St. Johns County									
293729081221201	SJ0115	SJ-104 MEADOWBRICK WELL	16	142	609	Surveyed	OU	25	B, FN, M, R
294003081304601	SJ0152	SJ-152 TILTON	14	90	448	Map estimate	UU	10	B, M, R
294128081291301	SJ0263	SJ-263 D. REID	14	117	320	Surveyed	WI	15	B, M, R
294131081262901	SJ0796	IFAS - YELVINGTON FARMS		196	245	Surveyed	WI	15	NB
294213081194401	SJ0602	DOT I 95 SOUTH	16	163	193	Surveyed	OU	25	B, FN, M, R
294238081303701	SJ0169	SJ-169 HASTINGS HS	12	140	202	Map estimate	WU	10	B, M, R
294334081270801	SJ0076	SJ-84 FORTNER	16			Surveyed		5	B, M, R
294519081184502	SJ0516	SJ-516 DUPONT CTR CF	16	204	238	Surveyed	OU	25	B, FN, R
294602081151901	SJ0432	SJ-94 HOWARD AT CRESCENT	13			Surveyed		5	B, M, R
294647081294401	SJ0290	SJ-290 NR ELKTON	18	125	212	Map estimate	WU	10	B, FN, M, R
294701081263301	SJ0317	SJ-317 SIKES WELL	22	99	290	Surveyed	OU	25	B, FN, M, R
295039081325401	SJ0133	SJ-133 WILSON	23	140	450	Map estimate	WI	10	B, M, R
295105081300401	SJ0571	SJ-118 AT MOLASSES JUNCT	29			Surveyed		5	B, M, R
295132081164801	SJ0092	SJ-92 ANASTASIA WATER PL	19			Surveyed		5	B, FN, M, R
295333081191401	SJ0415	SJ-90 MARSH NR ST. AUGUS	20			Unknown		0	B, M, R
295427081293101	SJ0028	SJ-161	28			Surveyed		5	B, FN, M, R
295556081342101	SJ0019	SJ-19	26			Surveyed		5	B, M, R
295713081203401	SJ0412	SJ-0089	29			Map estimate		0	B, M, R
295903081334301		SJ-119 (SUB FOR SJ-11)	28			Map estimate		0	B, FN, M, R
300019081363301	SJ0003	SJ3	30			Surveyed		5	B, FN, M, R
300036081213501	SJ0438	SJ-88 CHARD NR STOKEE CR	32			Map estimate		0	B, M, R
300203081202701	SJ0548	GUANA PARK FLORIDAN	13	316	433	Map estimate	WR	10	B, FN, NR
300307081234201	SJ0112	SJ-99 BOREHOLE MINE ON P	39			Map estimate		0	B, M, R
300322081342801	SJ0427	SJ-24	34			Surveyed		5	B, M, R
300341081395401	SJ0061	SJ-12	32			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
300354081301201	SJ0422	SJ-26	36			Map estimate		0	B, M, R
300507081272701	SJ0029	SJ-163 SJRWMD DURBIN OBS	38	86	242	Surveyed	OU	25	B, FN, M, R
300632081334301	SJ0241	SJ-27	34			Map estimate		0	B, M, R
300717081381001	SJ0436	SJ-15	26			Surveyed		5	B, M, R
300758081230501	SJ0005	SJ-0005	32			Surveyed		5	B, M, R
301037081243901	SJ0002	SJ-10	26	348		Map estimate		5	B, M, R
301212081252401	SJ0102	SJ-63 DEE DOT RANCH AT B	38		1,000	Map estimate		5	B, FN, M, NR
301249081225801	SJ0062	SJ-0122	20			Map estimate		0	B, FN, M, R
301408081253101	SJ0099	SJ-60 DEE DOT RANCH AT C	24			Map estimate		0	B, M, R
301411081224202		SJ-169 OCEAN PUMP HOUSE	32			Map estimate		0	B, M, R
		St. Lucie County							
272017080295301		SLF-50 RECOVERY TEST SITE	41		1,000	Surveyed		10	B, FN, M, R
272322080304901	SLF-27	BLUE TWO GROVES	37		900	Unknown	UN	5	B, FN, M, R
272503080295701	SLF-40	UNDETERMINED	38			Unknown		0	B, M, R
272537080240901	SLF-21	AGRI EXP STATION	35	156	700	Unknown	UN	10	B, M, R
272650080265001	SLF-9	ADAM S RANCH	38	263	1,058	Unknown	UN	10	B, FN, M, R
272823080290201	SLF-4	ORANGE CO OF FLA	38	482	993	Unknown	UN	10	B, FN, M, R
272927080261601		SLF-3 ROY HAMILTON	38		1,106	Surveyed		10	B, M, R
273007080182501		SLF-46	31		1,100	Surveyed		10	B, FN, M, R
273212080351101	SLF-11	34S37E12 STL- 218 GREEN	39			Surveyed		5	B, M, R
		Sumter County							
281951082012001		81920101GREEN SWAMP L11M	89			Surveyed		5	B, FN, M, R
282127082022501	SU0002	82120241 1CUMPRESSCO RANC	90	20		Surveyed		10	B, FN, M, R
282740082012101		82720101GREEN SWAMP L12B	90			Surveyed		5	B, FN, M, R
282741081585701		827158131WITHLACOOCHEE S	94	99		Surveyed		10	B, M, R
283324082050601		83320501 22S22E23 WILSO	74			Surveyed		5	B, M, R
283432081592401		83415901 22S23E15 JC 51	92			Surveyed		5	B, M, R
283539082000301		83520001 25S23E10 JC 67	88			Surveyed		5	B, FN, M, R
283637082081501		83620801 21S22E32 SCL R	64			Surveyed		5	B, M, R
283638082025702		83620204 TOWN OF WEBSTER	83			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
283718081580201		THELMA ILEY WELL NR CENT	89			Map estimate		0	B, M, R
283829082123701		83821202 21S21E21 JC 47	43			Surveyed		5	B, M, R
283952082022001		83920201 21S23E18 JC 42	77			Surveyed		5	B, M, R
283953082051401		83920501 21S22E14 JC 36	75			Surveyed		5	B, M, R
284002082064201		84020602 21S22E16 JC 53	67	598		Surveyed		10	B, FN, M, R
284119082034501		84120304 21S22E01 JC 44	78			Surveyed		5	B, FN, M, R
284317082142601		84321401 20S21E30 TRAIL	40			Surveyed		5	B, FN, M, R
284435082011701		BRENTWOOD WELL NR SUMTER	63			Map estimate		0	B, M, R
284449082055201		84420502 20S22E15 WOODW	41			Map estimate		0	B, M, R
284528082030001		DIXIE LIME NO.1	50			Surveyed		5	B, M, R
284619082035101	SU0003	84620301ROMP DP WELL 111	52			Surveyed	OU	15	B, FN, M, R
284703082001701		LOWES BURNED HOUSE WELL	55			Map estimate		0	B, M, R
284809082080701		84820801 19S22E30 HOWAR	39			Surveyed		5	B, FN, M, R
284810082004001		HOGEYE SINK WELL NR WILD	54			Map estimate		0	B, M, R
284921082105701		WYSONG DAM WELL NR CARLT	38			Surveyed		5	B, M, R
285112082124001		85121201 19S21E09 JC 60	36	20		Surveyed		10	B, M, R
285121082112201	SU0013	851211414SUMTER WELL NUM	41	26		Surveyed		10	B, FN, M, R
285150082044001		85120401 19S22E02 JC 58	47	27		Surveyed		10	B, M, R
285207082014501	SU0001	852201334MASTERS AVENUE	49	62		Surveyed		10	B, M, R
285420081571901		SMITH WELL NO.2 NR CHERR	59			Surveyed		5	B, FN, M, R
285422082001901		HATCHER WELL AT LAKE MIO	47			Surveyed		5	B, M, R
285536082044001		85520401 18S22E14 G N S	48	72		Surveyed		10	B, FN, M, R
Union County									
300101082245201	U-0004	12241	56	198		Surveyed		10	B, FN, M, R
300615082130501		RAIFORD	58			Surveyed		5	B, FN, M, R
300747082225801	U-0001	72221	57	694		Surveyed		10	B, FN, M, R
Volusia County									
284743080520101	V-0520	84705101 WL CANTRELL N O	9			Surveyed		5	B, FN, M, R
284840081115701	V-0818	OSTEEN RANCH 128-188 FT		128	188	Surveyed	OU	25	FN, NB
284902081112001		84911101 FLOW WELL,N.OF	13			Map estimate		0	B, M, R
285016081014101	V-0103	85010102 USGS WELL NEAR	15	102	107	Surveyed	OU	25	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
285031081062301	V-0165	TOOK FARM CF	12	58	255	Surveyed	OU	25	B, FN, R
285044081094901		85010903 OSTEEN CONVENIE	22			Surveyed		5	B, M, R
285143080521401	V-0376	85105202 LOOMIS NURSERY	9			Map estimate		0	B, FN, M, R
285211081131601	V-0810	SNOOK RD CF 290-312 FT		290	312	Surveyed	OU	25	FN, NB
285221081095002	V-0102	85210902 USGS TEST WELL	23	74		Surveyed	OU	20	B, M, R
285359081161701		85311601 DELT. P.S. WELL	17	76		Surveyed		10	B, M, R
285419081041001	V-0198	LK ASHBY TWR DEEP	13	88	122	Surveyed	OU	25	B, M, R
285437081181401	V-0196	85411801 SJRWMD TEST ORA	22			Surveyed	OU	15	B, FN, M, R
285452080551801	V-0521	VALCO RD CF	10	80	145	Surveyed	OU	25	B, FN, R
285512081202801	V-0082	85512001 USGS WELL 1.9MI	18			Surveyed	OU	15	B, M, R
285543081133803	V-0772	GALAXY MIDDLE SCHOOL U CF	11	100	140	Surveyed	OU	25	B, R
285655081165601	V-0104	85611601 USGS TEST WELL	11	152		Surveyed	OU	20	B, M, R
285700081021001	V-0113	85710201 USGS TEST WELL	16	90		Map estimate	OU	15	B, M, R
285745081054001	V-0101	85710501 USGS OBSER WELL	28	113		Surveyed	OU	20	B, FN, M, R
285811081130901		85811303 J B EVANS LAKE	35			Map estimate		0	B, M, NR
285813081142402	V-0777	LK. HELEN UPPER CF		115	193	Surveyed	OU	25	FN, NB
285833080571701	V-0435	85805701 GLENCOE RD SAND	4			Map estimate		0	B, M, R
285859081191001		85811901 MCGREGGOR RD.4"	5			Surveyed		5	B, M, R
285904080554601	V-0399	85905504 EDGEWATER P.S.	5			Map estimate		0	B, FN, M, R
285921080541001	V-0400	85905402 MOORE WELL RIVE	7			Map estimate		0	B, M, R
285923081211601		85912012 ST.JOHNS RD+HON	14			Map estimate		0	B, M, R
285934081041801	V-0110	85910401 USGS TEST WELL	24	105		Surveyed	OU	20	B, M, R
285950080580101	V-0407	85905803 4"OBS.WELL NEXT	2			Map estimate	OU	10	B, M, R
290102080564201	V-0164	90105611 CITY TEST WELL,	6			Surveyed		5	B, M, R
290103080551902	V-0508	NEW SMYRNA BCH	3	170	210	Surveyed	OU	25	B, FN, R
290138081203202	V-0115	90112002 USGS J-2 TEST W	10	252		Surveyed	OU	20	B, FN, M, R
290225081040301	V-0117	90210402 17S32E11 USGS T	20			Map estimate	OU	10	B, M, R
290230081123401	V-0118	90211203 USGS TEST HOLE	33	72		Surveyed	OU	20	B, FN, M, R
290251081001401	V-0119	90210001 USGS TEST WELL	12	316		Surveyed	OU	20	B, M, R
290308081182301		90311801 DELAND P.S. WEL	15			Map estimate		0	B, M, R
290325080563401	V-0294	90305601 NSB AIRPORT WEL	2			Map estimate		0	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
290447081102301	V-0120	90411004 I-4 DEEP WELL,	33			Surveyed	OU	15	B, M, R
290456081044401	V-0123	90410404 USGS TEST WELL	18	90		Map estimate	OU	15	B, FN, M, R
290512081213602	V-0157	GLENWOOD 2 INCH WELL.	15			Surveyed		5	B, M, R
290517081193601		90511902 16S30E19 MCDON	21			Map estimate		0	B, M, R
290534081175001	V-0027	90511701 USGS TEST WELL	33	85		Surveyed	OU	20	B, M, R
290541081132902	V-0081	90511304 USGS 04 DP TEST	35	85		Surveyed	OU	20	B, FN, M, R
290550081162601		90511601 LAWRENCE WELL,	36	70		Map estimate		5	B, M, R
290552081162601	V-0808	LK DAUGHARTY CF		90	140	Surveyed	OU	25	NB
290614081183301	V-0742	LEE AIRSTRIP CF	32	140	460	Surveyed	OU	25	B, FN, M, R
290626081013701	V-0492	90610102 SERVICE STA.WEL	2			Map estimate		0	B, M, R
290651080582802	V-0085	90605814 HARBOUR OAKS SU	2			Surveyed		5	B, M, R
290708081233101	V-0129	90712301 SJRWMD 4"WELL 2	11	100	165	Map estimate	OU	25	B, M, R
290723081210601		90712103 16S29E39 4" WE	12			Map estimate		0	B, M, R
290737081220301		90712201 HAGSTROM IRRIG	9			Map estimate		0	B, M, R
290806081013901	V-0162	90810115 CITY OBS.WELL #	2			Map estimate	OU	10	B, FN, M, R
290813081083201	V-0094	90810806 4"OBS.WELL100FT	10			Surveyed	OU	15	B, M, R
290828081215103	V-1030	1030 WELL AT DELEON SPRI	18	120	200	Surveyed	OU	25	B, FN, M, R
290834081073802	V-0188	TOMOKA TOWER OCALA	14	92	150	Surveyed	OU	25	B, FN, M, R
290920081063001	V-0080	90910601USGS OBSER NR DA	13	102		Surveyed	OU	20	B, R
290920081063002	V-0008	90910609USGS 2-INCH OBSE	13	480		Surveyed	OU	20	B, M, R
290923081174301	V-0555	90911701 15S30E33 WELL	33			Surveyed		5	B, M, R
290928080594401	V-0457	90905904 WELL AT REED CA	0			Map estimate		0	B, M, R
290930081230201	V-0213	90912303 15S29E34 WELL	17			Surveyed		5	B, M, R
291006081101004	V-0086	91011004 TIGER BAY TEST	24			Surveyed	OU	15	B, M, R
291009081205801	V-0215	BLACKWELDER'S	17	191	450	Map estimate	WS	10	B, R
291016081143901	V-0790	ORMOND BEACH MW3 TOP		78	230	Surveyed	OU	25	NB
291016081143902	V-0791	SOAKING GULLY 290-425 FT		290	425	Surveyed	OU	25	NB
291032081065201	V-0456	91010601 DAYTONA P.S. WE	8	96		Surveyed		10	B, M, R
291040081143701	V-0700	ORMOND B DAN FORD RD	31	85	300	Surveyed	OU	25	B, R
291052081200901	V-0552	91012007 15S30E19 CAMP	27			Surveyed		5	B, M, R
291056081252401	V-0214	91012502 BARBERVILLE WE	22			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
291107081034201	V-0187	AIRPORT WELL AT DAYTONA	2	97	817	Surveyed	OU	25	B, M, R
291113081050601	V-0097	91110503 CITY WELL 44 AT	2	111		Surveyed		10	B, M, R
291139081032401	V-0454	91110305 DAYTONA P.S. WE	0	135		Map estimate		5	B, M, R
291149081190801	V-0729	91111901 15S30E17 L.BLA	24			Surveyed		5	B, M, R
291155081022901	V-0453	91210237 DAYTONA P.S. WE	-1	96		Surveyed		10	B, M, R
291216081215601	V-0062	91212101 STRWMD TEST WEL	25	132	155	Surveyed	OU	25	B, M, R
291221081235101	V-0217	91212306 15S29E09 RICHA	25			Map estimate		0	B, M, R
291258081313701	V-0040	91213103 4" SUPPLY WELL,	6	80	90	Surveyed		15	B, M, R
291302081063801	V-0127	91310601 USGS WELL, SITE	7	84	240	Surveyed	OU	25	B, M, R
291315081270301		91312701 MCLAUGHLINS 2IN	26			Surveyed		5	B, M, R
291323081191202	V-0769	SR 40 & SR 11 CF	26	85	440	Surveyed	OU	25	B, FN, M, R
291343081254601	V-0089	91312501 JONES WELL NEAR	31	112	414	Surveyed	OU	25	B, M, R
291344081155701	V-0090	91311501 UNION CAMP DP W	26	74	151	Surveyed	OU	25	B, FN, M, R
291351081292502	V-0577	SHELL HARBOR RD CF	23	75	120	Surveyed	OU	25	B, M, R
291417081144601	V-0788	ORMOND BCH SR40 E. SR11		111	300	Surveyed	OU	25	NB
291431081263101	V-0144	91412611 14S28E35 SJRWMD	29	85	125	Surveyed	OU	25	B, M, R
291433081284102	V-0066	91412818 SJRWMD DEEP TES	22	250	365	Surveyed	OU	25	B, M, R
291448081274905	V-0531	PIERSON AP UPPER CF	25	130	210	Surveyed	OU	25	B, FN, R
291457081270901	V-0147	USGS FRANKLIN ST CF	29	128	140	Surveyed	OU	25	B, R
291458081294201	V-0068	91412901 SJRWMD WELL 1.0	15			Surveyed	OU	15	B, M, R
291508081302801	V-0065	91513001 SJRWMD WELL 2 M	14	97	180	Surveyed	OU	25	B, M, R
291523081095001	V-0130	91510902 USGS WELL #1,SR	14	82	242	Surveyed	OU	25	B, M, R
291607081042301	V-0450	91610408 ORMOND P.S. WEL	-6			Surveyed		5	B, FN, M, R
291712081032102	V-0449	91710301 ORMOND, W.END O	-6			Map estimate		0	B, M, R
291737081265501		91712602 14S28E11 BOCKS	19			Map estimate		0	B, M, R
291748081290301	V-0510	J.C.MEW REPLACEMENT	23	85	130	Surveyed	OU	25	B, R
291823081280801	V-0064	COWARTS ROAD V-0064	24	113	158	Surveyed	OU	25	B, R
291823081290901		91812903 14S28E04 M.MCB	22			Map estimate		0	B, M, R
291835081324201	V-0155	91813201 USED 426 PINE I	5			Surveyed		5	B, M, R
291903081294601		91912901 13S28E32 OLD S	24			Surveyed		5	B, M, R
291904081055501	V-0447	91910504 TOMOKA ESTATES	1			Surveyed		5	B, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name†	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
291905081251001	V-0096	91912501 R. NOLAND WELL	20			Surveyed		5	B, M, R
291941081294301	V-0184	SEVILLE FIRETOWER CF	26	75	100	Surveyed	OU	25	B, FN, R
291949081065901	V-0446	91910604 PINE TREE DR. 6	7			Map estimate		0	B, M, R
292038081315302	V-0567	PATTY WIGGINS BR CF	31	86	120	Surveyed	OU	25	B, R
292053081084701	V-0445	92010803 13S31E26 US1 6	15			Map estimate		0	B, M, R
292105081281201	V-0734	92112801 13S28E22 WELL	14			Surveyed		5	B, M, R
292128081295401		92112902 HERRENS 4IN WEL	32			Surveyed		5	B, M, R
292245081074801	V-0443	92210701 WELL,S.OF ORM.T	6			Map estimate		0	B, M, R
292421081072301	V-0442	92410701 HALIFAX PLANT.W	6			Map estimate		0	B, M, R
Camden County, Ga.									
304313081330001		NATIONAL PARK SERVICE CI	12	467	575	Map estimate		10	B, FN, M, R
304401081323701	33D061	33D022	-84			Unknown		0	B, M, NR
304516081385901	32E033	USGS-GA	37			Unknown	UN	0	B, M, R
304522081281301	34E001	CUMBERLAND ISL GGS TW 01	23	540	640	Map estimate		10	B, FN, M, R
304608081345201		FINN & NEIGHBOR	24			Map estimate		0	B, M, R
304619081280501		MISSOE	25			Map estimate		0	B, M, R
304740081343001		KINGSBAY BAY NO1 (1984)	23	590	900	Surveyed		15	B, M, R
304809081404601		GROSS, E (1950)	38	466	516	Surveyed		15	B, FN, M, R
304830081481201		BROWN, E	40	400	500	Surveyed		15	B, FN, M, R
304916081360701		JOINER-GREENE	41	548	650	Map estimate		10	B, M, R
304922081435501		B&S CHICKEN FARM	40			Map estimate		0	B, FN, M, R
305029081265101		YANKEE PARADISE TRAIL	34			Map estimate		0	B, M, R
305045081334601		AMER LEGION, ST MARYS	40	250	565	Map estimate		10	B, FN, M, R
305316081310101		CABIN BLUFF	39	477	675	Map estimate		10	B, M, R
305538081305401		UNION CARBIDE 4	40	534	832	Map estimate		10	B, FN, M, R
305619081244601		KEER, A W	43	560	720	Map estimate		10	B, M, R
305804081441301		WILLIAMS, H	42	399	783	Map estimate		10	B, FN, M, R
305824081243501		POMEROY, MR.	42	498	698	Map estimate		10	B, FN, M, R

Table A1—*Continued*

USGS Site ID	SJRWMD Station Name	Site Name[†]	May 1995 Water Level (ft msl)	Cased Depth (ft bls)	Total Depth (ft bls)	Elevation Method	Water Use	Ranking Points	Comments
Charlton County, Ga.									
304256082092101		USF&W CHESSER ISLAND	45	471	595	Map estimate		10	B, FN, M, R
304330081324801		CITY OF ST.MARYS #1	7			Unknown		0	B, M, R
304510081343801		HUNTLEY-JIFFY (DAVIS)	19			Unknown		0	B, M, R
304514081365801		OSPRAY COVE	33			Unknown		0	B, M, R
304749081335301		UNDETERMINED - GA	27			Unknown		0	B, M, R
304751081311101		USN KINGS BAY #4	28			Unknown		0	B, M, R
304854081342001		RAYLAND CO.#1	40			Unknown		0	B, M, R
304937081542601		UNDETERMINED - GA	38			Unknown		0	B, M, R
304943082213801		USGS TW OK 9	49			Unknown		0	B, FN, M, R
305122081275501		UNDETERMINED - GA	28			Unknown		0	B, FN, M, R
305228081593501		UNDETERMINED - GA	42			Unknown		0	B, FN, M, R
305623081483501		J VANN	42			Unknown		0	B, FN, M, R
305849082071301		J. DRURY	55			Unknown		0	B, FN, M, R

Note: B = base network site
FN = final network site, 45,000-foot grid
ft bsl = feet, below sea level
ft msl = feet, mean sea level
ID = identification
M = used in the USGS May 1995 potentiometric surface map
NB = not in base network
NR = nonrobust data point
OU = observation well, unused
R = robust data point
RU = recharge well, unused
SJRWMD = St. Johns River Water Management District
TU = test well, unused
UH = unused domestic well
UN = unused industrial well
USGS = U.S. Geological Survey
UU = unused well
WH = withdrawal, domestic well
WI = withdrawal, irrigation well
WR = withdrawal, recreation well
WS = withdrawal, stock well
WU = withdrawal, unused well

Blank cells indicated no data or not applicable.

*The 1,017 sites in this table include 921 sites from the U.S. Geological Survey databases maintained by three water resource divisions, 53 sites identified in databases maintained by the St. Johns River Water Management District and Alachua County, and 43 sites used after May 1995.
[†]Site names are presented in this column as they appear in the various databases.

APPENDIX B—GROUNDWATER LEVEL MONITORING NETWORKS: THEORY AND PRINCIPLES

GROUNDWATER LEVEL MONITORING NETWORKS: THEORY AND PRINCIPLES

Groundwater level networks are commonly used to determine (1) the effects of stress on recharge and natural discharge conditions of an aquifer, (2) the hydraulic characteristics of groundwater systems, (3) the areal extent of an aquifer, or (4) the degree of confinement of an aquifer (Heath 1976). These objectives attempt to determine the yield or changes in the yield of an aquifer system.

STRESS EFFECTS

To determine the effects of stress on the recharge and natural discharge conditions of an aquifer, time periods between water level measurements range from 1 day to several years. Stresses on an aquifer may result from pumping, seasonal changes, or long-term climatic variation. Water level measurements over time are compared for stressed and unstressed portions of an aquifer. When necessary, the effects of seasonal and long-term climatic changes must be accounted for in order to determine the effects of pumping.

HYDRAULIC CHARACTERISTICS

The hydraulic characteristics of basic concern in any aquifer system are its transmissivity and storage coefficient. Transmissivity is a measure of the ability of a water-bearing formation to transmit water. It is specifically defined as the product of the average hydraulic conductivity and the thickness of the aquifer (Kruseman and De Ridder 1976). The storage coefficient refers to the ability of an aquifer to store and release water due to the elasticity of the aquifer material and water. The storage coefficient is defined as the volume of water released or stored per unit surface area of the aquifer per unit change in the component of head normal to that surface (Kruseman and De Ridder 1976).

In most cases, transmissivity and storage are determined by aquifer performance tests which range from 1 to 100 days in duration. In only a few cases, the parameters are determined from the analysis of water level maps. These map analyses are made from a series of different measurement periods, combined with the analysis of continuous records which show the effects of pulses on the aquifer system (Heath 1976).

In areas where the water being supplied from an aquifer system is coming primarily, or in large part, from storage, the rate of change in storage is of considerable importance. For determining the status of storage, water level change maps (difference maps) are constructed from measurements taken from different measurement periods. Changes in status of storage are a long-term phenomena and network measurements are taken at intervals of more than 100 days.

The status of storage has primarily been of interest for aquifers found where arid conditions exist on the surface. However, any aquifer system in which there are declining water levels may cause a study to be undertaken on the status of storage.

Areal Extent

Because the ultimate yield of any aquifer system depends on its areal extent, the extent of all aquifers should be determined. The extent of many aquifers, such as the Upper Floridan aquifer of Florida, can only be determined by observing the regional continuity of the water levels in an observation well network. In other aquifers, areal extents may be determined through the examination of topographic and geologic maps.

Ideally, the water level measurements are made simultaneously. If simultaneous measurements cannot be made then adjustments are made to the water levels to get them to a common time period. Repeated network measurements made to determine areal extent can be used for analysis of status of storage and stress effects.

Degree of Confinement

Aquifer response to stress is strongly dependent on whether or not the aquifer is confined or unconfined. If it is confined, the stress response also is dependent on the amount of hydraulic resistance or leakage of the upper and lower confining beds. Hydraulic resistance is defined as the ratio of saturated thickness of the semipervious (confining) unit to the hydraulic conductivity of the semipervious unit for vertical flow (Kruseman and De Ridder 1976).

The degree of confinement is usually measured on a well-by-well basis over a period of hours to hundreds of days using continuous recorders.

APPENDIX C—NETWORK USERS SURVEY

Floridan Aquifer Potentiometric Network Survey

The St. Johns River Water Management District, in cooperation with the US Geological Survey collects potentiometric water levels in the Floridan aquifer each May and September. Approximately 980 wells are measured in this undertaking. The aerial extent of the measurements is depicted in Figure 1. The St. Johns River Water Management District is in the process of reviewing this network for completeness and effectiveness.

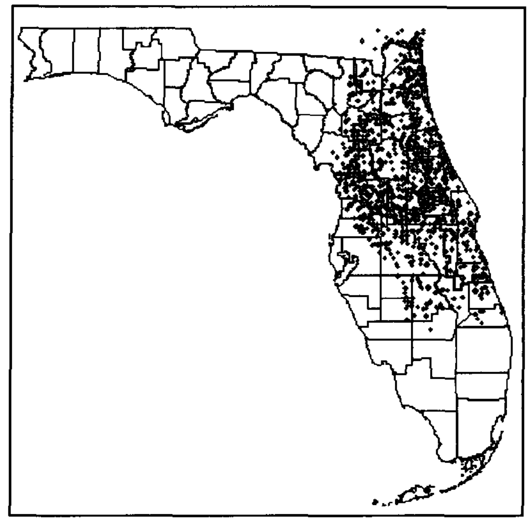

Figure 1: Aerial extent of the Floridan aquifer potentiometric network.

The final products of each of the measurements is a map of the potentiometric levels, and two change maps of the potentiometric level differences between that time period, and the previous two measurement periods. The maps and data sets are available from the US Geological Survey - WRD office at 224 West Center Street, Suite 1006, Altamonte Springs, FL 32714, (407) 865-7575 (Voice), or (407) 865-6733 (FAX).

We are asking you, as a possible user of this data, to respond to this survey so we may better evaluate the effectiveness of the Floridan aquifer potentiometric monitoring network. If you know of someone else in your organization who utilizes the data would you please forward a copy of the survey to them, or contact William L. Osburn so a survey form and SASE may be sent to them.

If you have any questions please contact

William L. Osburn, Hydrologist IV
Division of Ground Water Programs
St. Johns River Water Management District
P.O. Box 1429
Palatka, FL 32178-1429

(800) 451-7106 , Ext 4150 (In Florida)
860-4150 SUNCOM
(904) 329-4150
(904) 329-4508 FAX
860-4508 SUNCOM FAX
E-Mail: Bill_Osburn@district.sjrwmd.state.fl.us

1

Floridan Aquifer Potentiometric Network Survey

Date: __/__/96

Name: ______________________ Title: ______________________

Address: ______________________ Organization: ______________________

Phone Number: (___)______________________ (Voice) ______________________ Fax

E-Mail: ______________________

1. Do you use the information presented in the maps represented by the U.S. Geological Survey publications Potentiometric Surface of the Upper Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, Month, Year ?

Yes ☐ No ☐
If **No** skip to question **9**

2. How would you describe the purpose of Floridan Aquifer Potentiometric Network?

____
____
____
____
____
____

3. What do you utilize (check all that apply)
   - Potentiometric Surface Maps .... ☐
   - Potentiometric Change Maps .... ☐
   - Raw data .... ☐

4. Do you digitize data from the maps?

Yes ☐ No ☐

If **Yes** do you (check all that apply).
   - Digitize contours - Potentiometric Surface Maps .... ☐
   - Digitize data points - Potentiometric Surface Maps .... ☐
   - Digitize contours - Potentiometric Change Maps .... ☐
   - Digitize data points - Potentiometric Change Maps .... ☐
   - Contour the data utilizing your own methods .... ☐

2

5. How do you utilize the information presented in the maps?

(check all that apply)

Utilize contours to calibrate models ☐
Utilize data points to calibrate models ☐
Utilize contours to conduct regional studies ☐
Utilize data points to conduct regional studies ☐
Utilize contours to conduct local studies ☐
Utilize data points to conduct local studies ☐
Other ☐
(please explain below)

____
____
____

6. Do you need to know the accuracy (standard error) of the Potentiometric Surface Maps.

Yes ☐ No ☐

What level of accuracy in the data do you want? ______________________________
Why do you want this level of accuracy? ______________________________

____
____
____

7. What changes would you like to see in the information presented in the maps?

____
____
____

How would this help you in your job?

____
____
____
____

8. Comments: ______________________________

____
____
____
____

3

9. Do others in your organization use the information presented in the maps represented by the US Geological Survey publications Potentiometric Surface of the Upper Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, Month, Year ?

Yes ☐ No ☐

A SASE envelope is enclosed to return the survey. Thank you for your time.

4

Responses

1. Do you use the information presented in the maps represented by the U.S. Geological Survey publications Potentiometric Surface of the Upper Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, Month, Year ?

Yes—31
No—5

2. How would you describe the purpose of Floridan Aquifer Potentiometric Network? [The key to the letters in brackets following each response to this question is at the end of the list. This key ties to the interpretation of the responses in the text.]

- Reference database [U, N]
- Provides info on the status of the aquifer, flow direction, hydraulic gradient, and potential problem areas[R, H]
- It is important as a geotechnical tool to evaluate site hydrogeologic conditions and how it relates to sinkhole formation [S, W]
- To provide data on the hydrologic head of water in the Floridan aquifer relative to mean sea level [R, H]
- Provides the only source of reliable potentiometric information with enough different locations to be able to correlate the data to specific project locations [S, N]
- To maintain current data on the shape of our drinking water supply [R, N]
- Keeping up-to-date on Marion County and other areas in central Florida on the hydrogeological system, and changes through the seasonal lows & high conditions; along with other USGS publications such as "WR Data for Florida" - all volumes [S, H]
- I would describe the purpose as quantification of the hydrology. The potentiometric surface can give an indication of potential recharge to aquifer or release from aquifer [R, H]
- The purpose of the network is to maintain a database of potentiometric surface elevations for the Floridan aquifer to note changes between seasons (dry and wet) and between years. The impacts from changes in rainfall and withdrawals affect the potentiometric surface elevations reflected on these maps as point data and contoured elevations [R, W]
- Change detection [U, H]
- Network of monitoring wells or wells monitored to observe changes in the potentiometric surface of the Floridan aquifer [R, H]
- Monitor the dynamics of potentiometric levels of the aquifer at selected locations. Data provides a series of "snapshots" of the nature of change in aquifer levels [R, H]
- Resource assessments and trends [R, H]
- To assist in determining direction of flow and fluctuations in groundwater levels [R, H]
- For water resource planning and management. To show regional water levels and use this data in scientific studies for planning and management. [R, N]

- Provide regional information of the potentiometric surface of the Upper Floridan aquifer [R, H]
- To describe water levels in this aquifer regionally and temporally [R, H]
- Graphical representation of data in a usable format for reference purposes. [R, N]
- To determine short and long-term changes or impacts to groundwater usage and changes [R, N]
- One-stop, general overview of regional groundwater levels [R, H]
- To monitor change to indicate areas of concern [R, H]
- An educational tool used to inform the public, political officials, municipal employees & private consultants of the status of the Volusian aquifer & surrounding areas at a specific point in time (May or September) and historically from year to year [S, W]
- We utilized the PM information to assess the behavior of the aquifer. In some instances the initial stage used in our surface water runoff model has been interpreted from this map [S, H]
- Excellent [U, N]
- Detect trends for aquifer in Brevard County and associate changes with causes [S, H]

R = regional network
S = subregional network
U = unknown network
H = low/high potentiometric levels
N = undetermined network purpose
W = end of wet or dry season potentiometric levels

3. What do you utilize (check all that apply)
    Potentiometric Surface Maps—30
    Potentiometric Change Maps—19
    Raw data—8

4. Do you digitize data from the maps?

    Yes—11
    No—25

If **Yes** do you (check all that apply).
    Digitize contours - Potentiometric Surface Maps—7
    Digitize data points - Potentiometric Surface Maps—5
    Digitize contours - Potentiometric Change Maps—3
    Digitize data points - Potentiometric Change Maps—1
    Contour the data utilizing your own methods—6

5. How do you utilize the information presented in the maps?
    (check all that apply)
    Utilize contours to calibrate models—8

Utilize data points to calibrate models—8
Utilize contours to conduct regional studies—12
Utilize data points to conduct regional studies—11
Utilize contours to conduct local studies—20
Utilize data points to conduct local studies—15
Other—9
(please explain below)

- As a first look in planning for site-specific investigations.
- Build TIN models to create a 3-D image using ARC INFO GIS tools.
- Compare map elevations to estimated elevations at contamination assessment sites in order to discuss site groundwater elevation relative to mapped data.
- Educational/informational.
- Information only.
- None of the above.
- Reference to determine impact of groundwater withdrawals on adjacent lands.
- The data is utilized in GIS to support a number of projects and studies. Creates lattices for GIS modeling.
- Utilize contours to check against our monitoring wells.
- Utilize data points if capable.

6. Do you need to know the accuracy (standard error) of the Potentiometric Surface Maps.

Yes—16
No—20

What level of accuracy in the data do you want?

- ±0.5 ft
- ± 1 ft
- ?
- 0.1 ft
- 0.1 ft
- 1 ft
- 1/2 contour interval.
- 45% confidence.
- A few feet.
- As much as reasonably possible.
- Generally.
- Not an issue yet - further discussion needed.
- What is the accuracy ?
- Is this possible (accuracy) since all the wells are not surveyed ?
- What's reasonable!

Why do you want this level of accuracy?

- Calibrate impact of well drawdowns on potentiometric surface.
- Distinguish groundwater level changes.
- I am conducting a water budget of southwest Volusia County. City of DeBary reading for September 95 appears to be an outlier.
- I am mostly interest in fluctuations. Thus I prefer pot data to the 0.01 ft for fluctuations. However, I can live with +- 2- 5 ft with regards to the elevation of the measuring point.
- Model calibration at boundaries. Probably could get by with 0.5 ft accuracy.
- One thing that comes to mind is understanding flood problems and giving facts to the public and other interested people.
- Statistical modeling.
- The degree of change in some areas need to be represented in greater detail to depict minor changes which are significant in nature. Particularly low head springs.
- This may assist with model calibration.

7. What changes would you like to see in the information presented in the maps? [The key to the number(s) in brackets following each response to this question is found on page 12.]

- (1) If available maps of the lower Floridan and surficial aquifer system. (2) Water quality data maps. For example maps which would delineate the 250 milligrams per liter isochlor would be helpful. [6]
- A graph showing the historical trends of the water levels in the aquifer. A contour line identifying the predominant soil strata (i.e., Type A, B, C, or D soils). [3, 4]
- A map of Volusia County only. [2]
- Available as a digital overlay. [5]
- Better prints showing lakes and rivers; plus towns. [4]
- Blow ups - enlargements, with more detail at the county level. [4]
- Contour from a seamless network of data points, statewide. [4]
- Do a "historical" change map using pre-development groundwater base elevation data. [6]
- Existing features and locations names should be more legible. Possibly include wet season rainfall amount associated with pot surface elevations being contoured. [3, 4]
- Is it possible to print the min and max historical recorded levels along with the current next to each sample location. You may wish to put the year next to the data as well. [3]
- More well data in southeast Florida, Dade, and Broward counties. [2]
- None - Maps are OK. [1]
- None. [1]
- None. [1]
- None at this time. [1]
- None, present format is fine. [1]
- Spot elevations to 0.5 ft in elevation. Data in tabular form and digitized map form would also be helpful. [4, 5]

- The trend of the groundwater can be assessed by reviewing these maps. Interpretations can be drawn on the groundwater Table during dry and wet seasons. [Not applicable]
- Sufficient for our use. [1]

How would this help you in your job?

- Use for independent research.
- Define potentiometric drawdowns with rise in chlorides.
- I am currently working on groundwater reconnaissance study of Osceola County. Later I will develop a groundwater flow model. This information would be helpful with the studies.
- If maps are in ARC/INFO format would appreciate files instead of hard copies.
- In the estimation of stormwater infiltration rates. In assessing the initial stages for certain areas for surface water runoff modeling.
- Increase productivity by reducing data reduction steps.
- It would help relate the changes that are occurring in the various local and regional areas to particular conditions and would put the current data in historical perspective.
- No job - retired.
- Not a whole lot really. It would just be easier to read and show layman.
- To improve planning accuracy.
- We would avoid the problem associated with edge matching contours between different water management districts.
- Would help me in developing FAS model in CEC.

8. Comments:

- The existing Potentiometric Network appears to be adequate for our use of the map.
- I would like to see data analyzed more quickly and maps made available sooner. Also it would be nice to be able to monitor specific wells on a monthly basis.
- None at this time.
- Please call.
- Please remove us from your mailing list !!
- Thank you for sending the maps to us as they become available.
- Thanks Bill for all your past help!
- They are of great benefit. Please keep sending them.
- Useful information is on the maps. Please continue to mail them to me.

9. Do others in your organization use the information presented in the maps represented by the US Geological Survey publications Potentiometric Surface of the Upper Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, Month, Year ?

Yes—25
No—11

APPENDIX D—MONTHLY AVERAGE WATER LEVELS FOR SELECTED WELLS IN THE FLORIDAN AQUIFER SYSTEM

Table D1. Monthly average water levels (in feet, mean sea level for the period of the computer record) for selected wells in the Floridan aquifer system

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum	Minimum
A-0001	52.39	52.78	51.92	51.10	50.21	51.00	51.11	51.10	50.42	50.64	51.88	52.51	52.78	50.21
A-0002	33.53	34.36	34.53	34.49	34.35	33.88	34.04	33.97	34.63	34.22	34.12	33.71	34.63	33.53
A-0004	44.16	44.87	45.89	46.14	45.50	44.86	44.95	44.93	45.60	45.63	45.28	44.95	46.14	44.16
A-0005	70.92	71.11	71.74	71.71	71.06	70.79	70.74	70.92	70.93	71.55	71.30	70.79	71.74	70.74
A-0008	45.07	44.56	45.97	45.79	45.83	44.91	44.77	44.79	45.21	45.58	44.97	45.16	45.97	44.56
A-0019	45.87	46.25	47.22	47.29	47.39	46.35	46.90	46.76	46.62	47.35	46.80	45.73	47.39	45.73
A-0033	54.79	54.43	54.01	49.79	47.74	47.88	47.67	47.52	46.71	48.21	48.81	53.80	54.79	46.71
A-0056	42.27	42.90	43.23	43.84	43.06	42.85	42.73	43.53	42.51	42.80	43.48	42.87	43.84	42.27
A-0068	41.99	42.52	43.07	43.42	43.13	42.68	42.72	43.04	42.96	43.07	42.88	42.64	43.42	41.99
A-0071	75.79	76.27	77.12	76.33	76.05	75.96	75.52	76.17	76.28	76.06	76.37	75.99	77.12	75.52
A-0075	57.89	60.90	62.67	59.69	56.93	55.33	59.40	58.24	58.90	57.03	57.92	57.28	62.67	55.33
B-0010	58.53	59.37	60.36	59.95	59.69	58.53	58.69	57.40	59.04	58.70	58.52	58.77	60.36	57.40
B-0011	83.34	83.61	84.22	83.50	83.71	83.20	83.23	83.16	82.71	83.32	83.16	83.18	84.22	82.71
B-0012	61.66	62.54	63.37	63.55	62.60	61.55	61.64	61.34	61.59	61.62	61.77	61.69	63.55	61.34
BA0009	51.18	52.09	53.19	52.17	51.52	50.48	50.26	49.82	50.34	50.46	50.41	50.57	53.19	49.82
BA0011	53.65	54.34	55.22	54.84	54.06	53.12	52.93	52.47	53.07	53.14	53.08	53.17	55.22	52.47
BA0015	55.84	58.65	58.78	58.95	56.70	56.94	56.36	56.25	55.81	56.48	55.51	56.17	58.95	55.51
BA0018	51.31	52.66	53.37	53.09	51.65	50.71	50.54	50.57	50.69	50.90	50.74	50.87	53.37	50.54
BA0019	56.21	56.59	57.26	57.21	56.59	55.44	55.48	55.31	55.54	55.85	55.84	55.70	57.26	55.31
BA0054	53.38	54.86	54.83	55.13	53.78	52.67	52.42	52.22	52.70	53.15	53.38	53.60	55.13	52.22
BA0057	50.32	51.05	51.26	51.63	50.04	48.67	48.27	47.99	48.57	49.23	49.19	49.43	51.63	47.99
BR0001	16.27	16.10	16.00	15.65	14.19	14.86	15.20	15.82	15.72	16.35	16.16	16.06	16.35	14.19
BR0189	25.62	25.67	25.43	24.94	23.14	23.22	23.59	24.05	24.98	25.71	26.45	26.29	26.45	23.14
BR0202	28.68	27.49	27.77	28.13	25.88	26.46	28.12	27.34	27.77	28.86	28.14	27.96	28.86	25.88
BR0585	12.57	12.98	12.78	12.00	11.47	11.36	11.95	12.27	12.69	13.22	12.94	13.30	13.30	11.36
BR0586	14.49	14.32	13.63	12.27	13.17	15.90	15.66	16.66	16.10	15.71	14.93	14.63	16.66	12.27
BR0608	13.30	13.84	13.34	12.90	11.22	10.53	11.79	12.57	13.11	13.60	13.56	13.84	13.84	10.53
BR0624	34.07	33.35	31.98	33.21	31.34	31.84	33.20	34.12	35.01	35.23	35.01	34.89	35.23	31.34
BR0625	34.55	33.38	33.20	33.50	32.37	32.52	32.83	34.03	35.29	35.07	34.88	34.43	35.29	32.37
BR0645	40.34	40.45	40.18	39.56	38.09	38.91	39.40	40.37	40.07	40.64	40.54	40.23	40.64	38.09
C-0007	30.12	30.43	29.93	28.01	26.03	26.45	26.85	26.70	27.53	29.30	29.68	29.93	30.43	26.03
C-0009	83.06	83.25	83.62	83.69	82.84	82.77	82.67	83.20	82.54	83.47	83.24	83.00	83.69	82.54
C-0018	69.03	69.15	69.34	68.73	68.51	68.12	68.09	68.12	68.51	68.97	68.94	68.90	69.34	68.09
C-0031	79.31	78.79	79.59	70.56	78.77	78.43	78.50	78.85	78.78	79.65	79.81	79.57	79.81	70.56
C-0034	75.94	75.75	75.90	75.67	75.56	75.73	75.88	75.49	74.89	73.99	73.37	75.43	75.94	73.37
C-0094	37.21	37.05	36.59	34.99	33.15	33.58	33.44	33.91	35.04	35.87	36.81	36.74	37.21	33.15

Table D1–*Continued*

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum	Minimum
C-0120	81.16	82.07	81.88	81.72	81.07	81.31	81.35	81.33	80.89	81.49	81.84	81.45	82.07	80.89
C-0123	67.04	67.23	67.55	66.79	66.36	65.86	65.86	65.94	66.33	66.99	67.36	66.71	67.55	65.86
C-0128	68.74	68.53	69.34	68.94	68.52	67.76	67.79	67.70	67.88	68.45	68.58	68.42	69.34	67.70
C-0132	80.86	80.10	81.07	80.25	80.03	79.74	80.18	80.19	79.88	81.12	81.29	81.11	81.29	79.74
C-0436	79.91	80.12	80.13	79.96	79.68	78.95	79.22	79.42	79.89	80.23	80.34	80.23	80.34	78.95
C-0439	77.12	77.37	77.45	77.13	75.92	76.21	76.22	76.46	76.31	77.33	77.43	77.30	77.45	75.92
C-0442	79.32	79.55	79.60	78.50	78.34	78.44	78.57	78.84	78.94	79.67	79.80	79.67	79.80	78.34
C-0451	78.73	79.03	78.36	78.78	78.06	78.07	78.11	78.24	78.74	79.09	79.16	79.05	79.16	78.06
C-0453	77.77	78.08	78.10	77.70	76.96	76.97	76.92	77.14	77.71	78.09	78.18	78.03	78.18	76.92
C-0457	76.56	76.79	76.78	75.78	76.22	75.65	75.53	75.84	76.33	76.80	76.89	76.69	76.89	75.53
D-0018	30.64	31.01	30.45	28.52	26.11	26.41	25.83	26.38	27.85	29.20	29.91	30.29	31.01	25.83
D-0094	32.84	33.31	32.87	32.01	30.20	30.11	29.79	29.95	30.91	31.82	32.37	32.69	33.31	29.79
D-0129	29.52	30.21	29.80	27.80	24.28	24.95	24.85	24.97	26.57	28.78	29.24	29.48	30.21	24.28
D-0145	37.54	37.77	38.00	37.27	35.54	35.14	34.98	35.34	35.79	36.79	37.02	37.40	38.00	34.98
D-0160	38.23	37.19	37.85	36.17	33.68	35.30	33.39	35.40	36.66	37.57	37.60	37.24	38.23	33.39
D-0254	52.85	53.30	53.71	53.18	52.38	51.84	51.61	51.38	51.71	52.15	52.26	52.41	53.71	51.38
D-0262	37.01	37.59	37.39	36.67	35.25	34.81	34.64	34.61	35.13	36.15	36.68	36.82	37.59	34.61
D-0291	45.65	45.63	45.20	43.95	42.75	42.91	42.78	42.98	44.18	44.98	45.28	45.52	45.65	42.75
D-0348	40.75	41.05	41.24	40.76	39.47	38.59	38.40	38.38	38.63	39.72	40.25	40.06	41.24	38.38
D-0667	38.63	39.01	39.02	38.32	36.95	36.57	36.44	36.58	37.21	37.84	38.28	38.74	39.02	36.44
D-425T	35.91	36.34	35.64	34.41	33.53	33.19	33.29	33.55	34.37	35.07	35.69	35.85	36.34	33.19
F-0087	14.32	14.44	14.18	12.94	12.53	12.75	13.21	13.79	13.98	14.49	14.23	14.52	14.52	12.53
F-0158	14.32	14.43	14.28	13.40	12.70	12.77	13.10	13.52	14.04	14.28	14.26	14.21	14.43	12.70
F-0165	15.57	15.63	15.35	14.43	13.80	14.01	14.36	14.73	15.22	15.53	15.51	15.51	15.63	13.80
F-0176	9.68	9.71	8.80	8.38	7.58	7.64	8.18	8.18	8.95	9.78	9.75	9.99	9.99	7.58
F-0182	12.19	12.30	11.26	9.68	9.30	10.57	11.31	11.66	12.10	11.90	11.88	11.89	12.30	9.30
F-0200	15.21	15.16	14.73	13.37	13.18	13.55	13.72	14.36	14.69	15.13	15.26	15.36	15.36	13.18
F-0204	16.17	16.07	15.38	14.16	13.87	14.62	14.96	15.19	15.46	16.38	16.15	16.20	16.38	13.87
F-0251	17.42	17.49	17.95	16.36	15.87	16.33	16.89	17.39	17.44	17.62	17.76	17.47	17.95	15.87
F-0294	17.34	16.75	15.57	14.43	14.35	14.55	15.30	15.82	15.87	17.09	17.59	16.86	17.59	14.35
IR0189	42.64	42.67	42.11	41.25	40.25	41.27	41.76	42.10	42.69	42.86	42.57	41.98	42.86	40.25
IR0312	34.90	34.68	33.72	33.08	31.58	32.98	33.12	34.03	34.99	35.44	36.14	35.58	36.14	31.58
IR0313	35.90	34.29	34.02	35.34	31.87	33.24	33.87	34.54	35.60	36.78	36.52	35.62	36.78	31.87
L-0040	36.93	37.12	37.15	36.81	36.29	36.58	36.94	36.94	37.33	37.36	37.21	37.23	37.36	36.29
L-0043	66.07	66.07	66.04	66.02	64.89	65.48	65.79	65.95	66.21	65.73	65.95	65.54	66.21	64.89
L-0045	13.43	13.33	13.20	13.13	12.77	12.62	13.12	13.43	13.80	13.65	13.27	13.15	13.80	12.62

Table D1–*Continued*

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum	Minimum
L-0051	116.63	116.19	116.72	116.22	115.40	116.09	116.54	116.64	116.86	116.46	116.53	116.45	116.86	115.40
L-0052	83.77	83.51	83.84	83.54	82.62	83.24	83.25	83.68	83.86	84.04	84.01	84.04	84.04	82.62
L-0053	97.17	97.10	97.48	97.38	96.39	97.02	97.33	97.65	97.72	97.54	97.36	97.31	97.72	96.39
L-0059	16.74	16.38	16.35	15.89	15.79	15.74	15.71	15.66	16.25	16.75	17.16	16.81	17.16	15.66
L-0062	100.09	100.14	100.28	99.76	99.12	100.18	100.34	100.65	100.54	100.19	99.92	99.81	100.65	99.12
L-0066	15.89	15.91	16.03	16.05	15.94	15.90	15.94	16.06	16.23	16.30	16.25	16.35	16.35	15.89
L-0095	82.10	82.43	82.73	82.25	81.98	82.80	82.95	83.30	83.16	83.06	82.48	82.12	83.30	81.98
L-0199	73.32	73.25	72.99	73.03	72.65	72.74	73.29	73.58	73.78	73.49	72.92	72.82	73.78	72.65
L-0455	12.46	11.85	11.86	11.45	10.74	11.08	10.85	11.63	12.32	12.42	11.63	12.30	12.46	10.74
LE0002	47.62	47.48	47.95	48.79	48.86	47.88	47.34	48.01	48.96	48.89	48.61	48.07	48.96	47.34
M-0012	47.57	47.40	47.88	47.78	48.33	47.07	47.47	47.65	47.31	47.85	47.12	47.37	48.33	47.07
M-0013	51.25	51.81	51.73	52.19	51.46	52.07	51.46	51.87	51.95	52.13	51.49	52.15	52.19	51.25
M-0021	14.77	14.85	15.04	15.08	15.14	14.94	15.00	15.21	15.48	15.83	15.62	15.02	15.83	14.77
M-0023	19.97	19.77	19.59	19.78	19.73	19.89	19.79	19.41	19.94	20.06	20.12	19.85	20.12	19.41
M-0024	24.37	23.89	23.77	23.92	23.80	24.17	23.80	24.11	23.98	23.94	24.14	23.48	24.37	23.48
M-0025	45.62	45.53	45.81	45.48	45.21	45.48	45.69	45.68	45.97	46.03	45.91	45.69	46.03	45.21
M-0026	41.19	41.20	41.68	41.27	41.34	41.71	41.79	41.79	41.92	41.98	41.70	41.51	41.98	41.19
M-0028	42.27	42.39	42.54	41.78	42.85	42.31	42.63	42.51	44.57	42.64	43.04	42.61	44.57	41.78
M-0031	46.85	45.67	46.15	47.56	46.58	46.83	46.22	48.02	47.51	47.05	47.14	46.40	48.02	45.67
M-0032	41.62	41.84	41.82	42.07	41.70	41.63	42.03	41.91	42.40	42.27	42.05	42.32	42.40	41.62
M-0036	44.06	44.00	44.14	43.74	44.30	43.47	43.87	43.92	44.80	45.13	44.40	44.26	45.13	43.47
M-0037	42.40	42.36	42.86	43.60	43.08	42.36	42.78	43.20	43.68	44.08	43.43	43.40	44.08	42.36
M-0038	42.87	42.49	43.11	42.95	43.18	42.57	43.20	43.59	43.63	44.22	43.76	43.88	44.22	42.49
M-0039	41.81	41.53	42.03	42.24	42.69	41.58	41.74	42.01	42.62	42.77	42.79	42.20	42.79	41.53
M-0040	40.93	40.63	41.09	41.34	41.47	40.78	41.04	41.28	41.64	42.14	41.65	41.54	42.14	40.63
M-0041	44.36	43.99	44.34	44.84	44.79	43.68	44.17	44.56	45.44	45.89	45.05	45.30	45.89	43.68
M-0042	45.65	45.39	45.76	46.41	46.38	45.20	45.41	46.34	46.88	47.28	46.54	46.43	47.28	45.20
M-0044	48.59	48.97	49.21	48.42	48.33	48.77	48.37	49.00	49.24	49.22	49.56	48.89	49.56	48.33
M-0048	48.00	47.93	48.08	48.01	47.74	47.69	47.92	48.46	49.13	49.05	48.70	48.27	49.13	47.69
M-0049	36.42	36.50	36.73	37.01	36.34	36.69	36.75	36.92	37.35	37.59	37.22	36.70	37.59	36.34
M-0052	49.16	49.17	49.63	49.32	49.12	49.08	49.07	49.16	49.18	49.55	49.39	49.22	49.63	49.07
M-0058	45.12	46.28	45.97	44.09	43.45	43.91	43.61	44.82	44.93	45.56	45.51	44.33	46.28	43.45
M-0059	43.77	43.72	43.96	44.56	44.27	44.01	44.44	44.59	44.89	45.14	44.41	44.14	45.14	43.72
M-0063	46.33	46.55	46.96	47.34	47.00	46.61	46.90	46.84	47.45	47.28	47.19	46.45	47.45	46.33
M-0284	49.75	50.01	49.63	49.32	49.00	49.13	47.15	49.29	48.79	49.53	49.72	49.51	50.01	47.15
M-0321	42.95	42.93	42.88	42.96	43.14	42.96	42.95	43.35	43.40	43.63	43.66	43.09	43.66	42.88

Table D1–*Continued*

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum	Minimum
M-0351	52.51	52.91	53.29	53.52	53.09	52.86	52.90	52.84	53.17	53.24	52.82	52.74	53.52	52.51
M-0367	53.29	53.15	55.42	56.26	55.70	55.14	55.23	55.22	55.13	55.09	55.02	54.89	56.26	53.15
N-0002	13.01	14.08	13.46	12.67	12.41	12.73	12.98	14.88	12.89	12.31	12.08	14.21	14.88	12.08
N-0003	-13.65	-16.88	-17.17	-15.84	-17.42	-18.67	-15.00	-17.09	-13.39	-14.95	-15.63	-10.03	-10.03	-18.67
N-0008	30.00	29.30	29.60	28.50	26.23	27.10	27.10	28.20	27.71	29.05	28.30	29.80	30.00	26.23
N-0009	28.09	28.85	27.64	26.38	24.05	23.83	23.69	25.94	26.52	26.17	27.09	29.26	29.26	23.69
N-0035	52.36	54.26	49.77	47.51	45.54	44.87	43.77	46.41	45.90	45.55	45.72	50.22	54.26	43.77
N-0046	30.22	29.69	28.89	28.30	25.44	25.63	25.67	26.53	27.97	27.98	28.95	30.15	30.22	25.44
N-0053	29.14	29.63	29.90	29.50	28.83	28.20	27.55	27.79	27.88	28.43	28.57	29.16	29.90	27.55
N-0120	41.07	41.79	42.20	42.09	41.26	40.31	39.86	39.77	39.92	40.45	40.73	40.86	42.20	39.77
N-0121	30.52	30.67	30.62	31.54	29.79	29.15	28.72	28.50	29.00	29.82	30.12	29.86	31.54	28.50
N-0190	-13.02	-12.43	-13.56	-13.94	-17.53	-16.96	-20.16	-22.17	-14.65	-15.48	-15.46	-11.01	-11.01	-22.17
OK0001	44.52	44.47	44.80	43.48	42.33	43.39	44.10	44.56	44.97	45.45	45.07	44.46	45.45	42.33
OR0007	35.91	35.82	35.56	34.28	33.82	34.45	35.02	35.63	36.17	36.11	36.06	35.84	36.17	33.82
OR0009	50.56	49.51	49.48	47.06	45.38	48.21	48.99	51.41	51.14	50.97	51.80	49.70	51.80	45.38
OR0029	36.27	36.50	36.18	35.05	33.67	34.65	34.87	35.48	36.44	37.12	36.58	36.04	37.12	33.67
OR0030	49.50	48.94	49.03	47.74	45.60	46.93	47.64	48.69	49.56	49.97	49.68	48.79	49.97	45.60
OR0046	47.58	45.57	46.67	48.06	47.08	47.40	48.48	49.36	47.06	47.01	44.95	46.52	49.36	44.95
OR0047	62.79	62.77	62.43	60.89	60.40	61.64	63.20	63.94	64.85	63.67	63.35	63.12	64.85	60.40
OR0064	108.94	108.80	108.86	108.24	107.71	108.48	108.81	109.15	109.12	109.20	109.14	108.88	109.20	107.71
OR0106	53.23	53.29	52.67	52.97	51.69	52.75	52.85	53.91	54.23	53.32	53.46	53.50	54.23	51.69
OR0465	48.57	47.07	46.98	45.91	44.47	45.94	47.28	49.03	49.15	48.41	48.61	47.55	49.15	44.47
OR0467	48.79	47.20	47.21	46.12	44.73	46.47	47.52	49.40	49.52	48.89	48.75	47.74	49.52	44.73
OR0468	48.97	47.42	47.40	46.34	44.91	46.66	47.87	49.61	49.62	49.14	47.67	47.95	49.62	44.91
OR0547	48.79	49.00	48.02	47.32	46.61	47.05	47.36	45.69	48.19	48.51	48.83	48.35	49.00	45.69
OR0548	21.66	21.67	21.42	21.12	21.17	21.16	21.17	24.51	21.74	21.65	21.87	21.58	24.51	21.12
OS0001	44.37	44.28	44.23	43.17	41.53	42.55	43.22	43.94	44.35	44.75	44.61	44.20	44.75	41.53
OS0002	45.13	44.73	44.74	43.89	43.81	43.90	43.93	43.88	45.15	45.61	45.02	44.66	45.61	43.81
OS0004	42.55	43.85	43.24	42.51	41.05	40.82	41.29	41.06	42.28	43.43	43.15	42.96	43.85	40.82
OS0017	43.04	43.54	43.09	41.98	40.84	41.71	39.04	42.20	43.48	43.65	43.63	42.92	43.65	39.04
OS0025	42.59	42.92	42.66	42.17	40.53	41.36	41.60	41.80	42.76	43.36	42.61	42.88	43.36	40.53
P-0001	83.02	83.87	84.09	83.66	83.68	83.20	83.33	83.47	83.58	83.85	84.03	83.38	84.09	83.02
P-0008	80.05	79.77	79.98	80.08	79.29	79.42	79.17	79.76	79.64	80.45	80.26	80.16	80.45	79.17
P-0010	23.64	22.41	21.54	13.43	18.12	22.43	21.85	23.38	22.00	22.78	22.76	22.49	23.64	13.43
P-0016	73.72	73.32	74.12	73.78	73.64	73.49	73.64	73.88	73.75	74.13	74.03	73.60	74.13	73.32
P-0017	68.73	68.76	69.29	69.48	68.25	68.78	69.98	69.52	68.73	69.43	69.73	68.93	69.98	68.25

Table D1–*Continued*

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum	Minimum
P-0054	21.70	22.43	22.62	22.79	22.33	22.47	22.69	22.94	23.08	22.87	23.04	22.48	23.08	21.70
P-0123	29.30	28.98	28.03	27.42	27.05	27.61	27.43	28.43	28.62	28.92	29.12	28.95	29.30	27.05
P-0172	19.44	18.64	16.36	13.20	15.02	17.43	17.99	18.88	18.98	19.47	19.67	19.62	19.67	13.20
P-0242	26.78	27.91	28.38	28.35	28.22	28.42	28.83	28.98	29.63	29.65	29.10	27.95	29.65	26.78
P-0246	29.84	30.26	31.15	32.42	29.62	32.19	31.32	32.29	30.10	32.40	30.49	29.02	32.42	29.02
P-0270	16.42	17.00	17.44	17.09	16.82	17.14	17.41	17.80	18.07	18.27	17.84	17.26	18.27	16.42
P-0306	60.79	60.53	61.00	60.69	60.32	60.41	60.35	60.67	60.70	60.97	60.95	60.65	61.00	60.32
P-0341	24.49	24.61	25.47	26.74	26.47	27.00	28.49	28.07	26.90	27.43	23.92	25.65	28.49	23.92
P-0373	17.16	19.15	20.54	22.94	20.95	23.05	23.18	22.67	22.38	23.80	21.67	20.21	23.80	17.16
P-0408	17.93	18.14	18.40	18.25	17.85	18.12	17.89	18.39	18.60	19.11	19.10	18.38	19.11	17.85
P-0413	38.58	38.18	35.09	39.17	39.22	38.91	38.22	40.77	38.70	40.82	37.38	37.65	40.82	35.09
P-0416	15.96	17.32	18.62	21.30	20.99	21.38	21.07	21.44	21.93	22.25	20.60	19.63	22.25	15.96
P-0417	23.73	25.05	24.49	24.35	22.81	23.40	24.18	24.18	24.19	23.88	23.95	23.35	25.05	22.81
P-0427	9.82	9.79	9.98	9.80	9.79	9.78	9.76	10.00	10.21	10.68	10.58	10.07	10.68	9.76
P-0450	18.83	18.69	18.97	18.88	18.90	19.12	19.12	19.10	19.33	19.54	19.48	19.05	19.54	18.69
P-0469	17.43	17.63	17.69	17.06	16.64	16.86	17.14	17.54	17.66	17.94	17.78	17.44	17.94	16.64
P-0474	17.41	17.33	16.89	14.80	15.01	15.89	16.20	16.70	17.18	17.43	17.76	17.55	17.76	14.80
P-0510	49.39	49.32	49.40	48.50	48.09	48.56	48.50	48.82	49.04	49.36	49.49	49.27	49.49	48.09
P-0517	19.08	17.76	17.67	23.49	24.09	24.58	23.32	24.69	25.23	24.68	21.77	23.00	25.23	17.67
P-0690	30.40	30.42	31.17	30.60	30.27	30.59	30.43	30.31	31.29	31.10	30.90	30.34	31.29	30.27
P-0696	25.46	26.11	25.88	27.23	26.49	27.59	27.51	28.04	27.86	28.60	27.27	26.80	28.60	25.46
P-0705	27.88	28.61	28.32	29.00	28.05	29.00	29.14	29.35	29.16	30.28	28.73	28.91	30.28	27.88
P-0735	11.48	11.91	12.02	11.60	11.26	11.39	11.66	12.20	12.24	13.01	12.79	12.20	13.01	11.26
P-0736	8.15	8.58	8.57	8.23	6.28	7.87	8.12	8.82	8.97	9.54	9.31	9.19	9.54	6.28
P-0744	20.68	20.79	20.47	19.63	19.13	19.59	19.91	20.18	20.71	20.99	20.62	20.27	20.99	19.13
P-0772	74.97	74.38	74.62	74.09	73.57	73.81	73.93	75.32	74.58	74.78	74.62	74.48	75.32	73.57
P-0776	22.27	24.36	24.39	23.73	23.74	23.86	23.87	24.50	25.00	25.11	24.34	24.29	25.11	22.27
P-0817	27.00	26.26	25.90	24.61	24.22	25.05	25.35	25.78	25.21	26.85	27.86	26.99	27.86	24.22
PO0006	127.29	127.21	126.67	125.30	125.45	126.87	127.38	127.85	127.67	127.06	127.00	126.97	127.85	125.30
S-0001	20.28	19.81	20.00	19.30	18.25	18.43	19.25	19.61	19.94	21.45	20.11	20.05	21.45	18.25
S-0026	12.95	13.75	13.89	12.40	12.29	12.40	12.96	12.83	13.76	12.27	12.54	15.34	15.34	12.27
S-0028	19.37	17.66	17.02	18.35	15.71	16.64	17.78	15.86	17.03	17.45	17.01	17.99	19.37	15.71
S-0038	16.72	17.91	17.25	15.31	15.81	15.08	16.90	17.92	16.52	17.82	17.16	17.60	17.92	15.08
S-0086	13.54	12.31	11.86	12.30	11.89	10.81	11.82	11.95	12.76	12.94	11.60	12.25	13.54	10.81
S-0087	11.90	12.30	11.86	10.74	10.64	10.34	10.78	11.99	5.28	12.46	11.58	12.22	12.46	5.28
S-0125	41.85	41.65	41.18	39.59	39.26	40.27	40.89	41.83	42.25	42.24	42.00	41.86	42.25	39.26

Table D1–*Continued*

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum	Minimum
S-0200	8.29	8.28	8.20	7.66	7.56	7.32	7.37	7.52	7.68	8.06	8.31	8.22	8.31	7.32
SJ0005	36.09	36.04	35.41	33.77	32.24	32.23	32.04	32.93	34.01	35.13	35.77	35.67	36.09	32.04
SJ0027	30.29	28.31	25.22	21.90	25.17	27.01	29.04	29.55	30.23	31.07	30.95	30.59	31.07	21.90
SJ0029	40.05	39.81	38.92	38.12	37.13	37.54	38.13	38.04	38.99	39.73	39.75	39.79	40.05	37.13
SJ0076	17.85	19.73	12.90	5.41	11.54	16.30	16.00	17.68	18.24	16.86	15.48	18.46	19.73	5.41
SJ0115	17.10	16.67	16.01	14.80	14.17	15.79	16.00	16.55	16.68	17.47	17.30	17.36	17.47	14.17
SJ0226	15.76	16.56	14.80	7.87	9.54	14.37	15.13	15.73	15.98	15.22	15.55	15.55	16.56	7.87
SJ0263	15.57	13.76	11.50	6.83	9.57	13.93	14.81	15.73	15.86	16.12	15.38	15.85	16.12	6.83
SJ0317	25.25	25.58	16.90	6.27	13.19	21.10	22.82	23.96	23.93	24.11	24.09	24.05	25.58	6.27
SJ0412	32.06	31.77	30.71	28.49	27.99	29.44	29.27	30.14	31.07	31.53	32.09	32.01	32.09	27.99
SJ0413	24.61	24.83	23.18	21.69	20.63	21.42	20.98	22.09	23.42	24.78	25.07	24.50	25.07	20.63
SJ0415	25.14	25.59	24.78	20.56	18.96	22.73	21.41	24.06	21.92	24.66	25.36	24.76	25.59	18.96
SJ0433	36.21	36.21	34.76	34.60	37.02	32.25	34.80	35.35	36.29	37.50	36.90	36.20	37.50	32.25
SJ0436	32.12	32.25	31.19	28.82	27.34	28.32	28.26	28.86	30.44	31.57	32.17	31.98	32.25	27.34
SJ0516	16.60	16.42	15.96	14.49	14.32	14.75	14.79	15.33	15.97	16.32	16.74	16.59	16.74	14.32
SJ0602	16.95	16.93	16.14	15.03	14.98	15.32	15.64	15.97	16.81	17.27	17.09	17.27	17.27	14.98
SU0002	91.25	91.34	91.43	89.89	88.90	90.55	91.53	91.92	91.19	90.46	90.66	90.46	91.92	88.90
SU0013	41.99	42.21	42.88	42.29	41.06	41.73	41.93	42.45	42.49	42.00	41.55	41.26	42.88	41.06
U-0001	54.91	56.21	57.87	57.48	55.68	55.61	55.00	53.85	55.28	54.91	54.43	55.44	57.87	53.85
U-0004	54.48	55.71	56.78	56.71	55.78	55.07	54.83	54.19	55.21	54.85	54.95	55.07	56.78	54.19
V-0008	16.57	16.34	15.48	15.03	13.77	14.12	15.59	14.43	15.15	16.37	16.34	16.45	16.57	13.77
V-0012	32.23	32.43	31.71	31.47	30.56	30.88	32.63	31.50	32.09	32.44	32.39	32.11	32.63	30.56
V-0062	23.98	24.52	24.71	24.56	24.58	24.34	24.69	25.14	25.25	25.59	25.43	24.47	25.59	23.98
V-0064	20.90	22.02	23.39	23.42	23.52	23.62	23.81	24.42	24.33	24.55	24.18	22.25	24.55	20.90
V-0066	15.47	17.90	20.63	21.51	21.27	22.20	22.43	22.99	23.14	23.23	22.49	18.38	23.23	15.47
V-0068	14.01	14.96	16.84	16.80	16.24	16.63	17.40	18.35	18.18	18.30	16.76	15.06	18.35	14.01
V-0080	16.46	16.34	15.27	14.87	13.39	13.92	15.31	13.74	15.00	15.86	15.93	16.20	16.46	13.39
V-0081	37.94	38.27	38.07	37.44	36.50	36.65	37.46	37.26	37.59	38.15	38.05	37.75	38.27	36.50
V-0082	19.33	18.63	18.34	17.97	16.65	16.61	16.49	17.88	18.28	18.84	19.17	18.63	19.33	16.49
V-0083	7.15	6.76	6.63	6.22	5.84	5.88	6.00	6.31	7.16	7.92	7.93	7.89	7.93	5.84
V-0084	11.15	11.48	10.44	10.03	9.12	9.34	9.56	9.97	10.32	10.91	10.85	11.13	11.48	9.12
V-0085	5.32	4.75	4.56	3.16	0.37	2.42	2.75	2.87	3.96	5.11	5.30	5.20	5.32	0.37
V-0086	26.58	26.56	22.35	25.74	24.95	24.04	28.35	25.83	25.60	26.71	27.56	26.97	28.35	22.35
V-0089	23.79	25.84	27.51	31.62	29.63	31.47	31.94	31.87	32.86	33.26	30.13	27.79	33.26	23.79
V-0090	27.20	27.54	27.66	27.09	26.05	25.64	26.35	26.69	27.31	27.51	27.52	27.10	27.66	25.64
V-0094	11.60	12.17	11.70	11.02	7.87	9.39	14.60	10.74	12.49	12.01	12.70	11.70	14.60	7.87

Table D1–*Continued*

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum	Minimum
V-0095	22.05	23.02	22.37	21.87	21.47	21.11	21.61	21.56	21.79	21.64	22.61	21.68	23.02	21.11
V-0096	19.64	19.55	20.16	19.42	18.88	19.15	19.37	20.08	20.07	20.35	20.32	19.64	20.35	18.88
V-0098	3.54	2.98	1.57	0.19	-1.36	-0.74	-0.78	-0.03	1.32	3.08	3.24	2.94	3.54	-1.36
V-0099	6.46	8.19	4.14	2.42	2.21	2.16	3.07	4.29	4.49	6.25	6.95	6.36	8.19	2.16
V-0100	27.74	28.06	27.38	26.81	26.04	26.29	28.47	27.13	27.71	27.84	27.68	27.95	28.47	26.04
V-0101	29.19	29.29	29.17	28.70	27.75	27.36	29.12	29.00	29.32	29.50	29.16	29.02	29.50	27.36
V-0147	16.14	18.93	23.02	31.10	25.93	31.28	27.46	29.51	30.98	32.75	28.04	26.84	32.75	16.14
V-0156	14.03	13.73	14.35	14.88	14.49	14.67	14.59	14.92	15.24	15.07	16.00	14.66	16.00	13.73
V-0157	13.94	13.73	14.36	14.80	14.09	14.59	19.87	13.79	14.46	14.31	15.32	14.45	19.87	13.73
V-0165	13.87	13.46	13.34	13.00	11.56	12.78	13.54	13.29	13.82	14.05	13.25	13.52	14.05	11.56
V-0183	20.43	19.99	19.20	18.54	20.09	17.74	20.29	18.20	19.17	20.12	19.89	19.72	20.43	17.74
V-0184	23.46	24.70	25.23	25.43	24.98	25.62	26.03	26.51	26.52	26.67	25.93	24.58	26.67	23.46
V-0187	6.30	6.71	4.60	3.18	1.75	2.01	4.63	3.09	3.98	5.17	6.21	6.20	6.71	1.75
V-0188	18.26	18.31	16.99	16.18	15.92	15.55	17.21	16.46	16.32	17.74	18.38	17.56	18.38	15.55
V-0196	17.07	17.05	16.82	16.25	16.19	15.51	15.32	17.08	17.21	16.53	17.80	17.04	17.80	15.32
V-0198	16.48	16.79	16.47	14.55	15.46	16.14	17.94	17.08	17.37	17.31	16.94	17.14	17.94	14.55
V-0200	0.75	0.61	0.62	-1.41	-2.42	-1.85	-0.91	-1.82	-0.81	0.40	0.60	0.87	0.87	-2.42
V-0218	26.63	28.61	28.50	27.61	26.56	26.94	27.56	28.16	28.97	29.69	28.21	26.44	29.69	26.44
V-0225	25.04	26.35	27.13	26.16	25.02	24.44	26.21	26.83	27.11	26.11	26.00	24.68	27.13	24.44
V-0435	8.15	7.88	7.39	7.20	5.43	7.32	10.85	8.01	8.69	9.08	8.25	8.47	10.85	5.43
V-0443	9.95	10.13	9.17	8.45	7.67	8.22	11.78	8.89	9.43	10.21	10.14	9.77	11.78	7.67
V-0446	10.59	10.94	9.94	9.04	7.59	8.32	10.98	8.95	10.03	10.30	10.57	9.90	10.98	7.59
V-0449	1.26	0.91	-0.46	-2.51	-4.76	-3.07	-2.75	-2.46	-1.90	-0.56	0.67	0.82	1.26	-4.76
V-0508	4.76	4.53	3.99	3.10	2.15	2.91	2.76	3.77	4.39	4.82	4.91	4.80	4.91	2.15
V-0510	21.37	21.84	22.28	22.47	22.10	22.38	22.64	23.42	23.04	23.66	22.90	22.50	23.66	21.37
V-0520	10.73	10.41	10.47	9.84	8.94	9.38	9.67	10.22	10.66	11.14	10.78	10.34	11.14	8.94
V-0521	11.20	11.35	10.92	10.09	9.39	9.90	10.51	10.52	11.20	11.81	11.50	11.05	11.81	9.39
V-0530	25.71	26.32	26.76	25.96	25.25	26.30	26.14	26.42	27.38	27.71	27.03	26.66	27.71	25.25
V-0531	19.41	21.00	23.90	24.80	23.61	25.78	25.60	25.85	27.47	26.23	23.26	25.05	27.47	19.41
V-0577	23.65	23.09	23.24	24.15	23.65	24.14	23.72	24.72	25.26	25.55	25.16	23.03	25.55	23.03
V-0700	32.22	32.77	32.81	32.21	31.08	30.83	31.50	31.43	31.94	32.68	32.78	31.89	32.81	30.83
V-0742	30.16	30.88	32.44	31.30	32.45	31.02	31.47	31.89	33.09	33.34	33.05	31.44	33.34	30.16
V-0769	25.88	25.96	26.64	26.08	26.20	26.01	26.22	26.63	27.25	27.55	27.34	25.69	27.55	25.69
WN0018	40.94	41.47	42.00	41.84	41.33	40.12	39.75	39.66	40.00	40.17	40.19	40.62	42.00	39.66

APPENDIX E—KRIGING STANDARD DEVIATION MAPS OF THE BASE NETWORK AND THE SIX NETWORK SCENARIOS

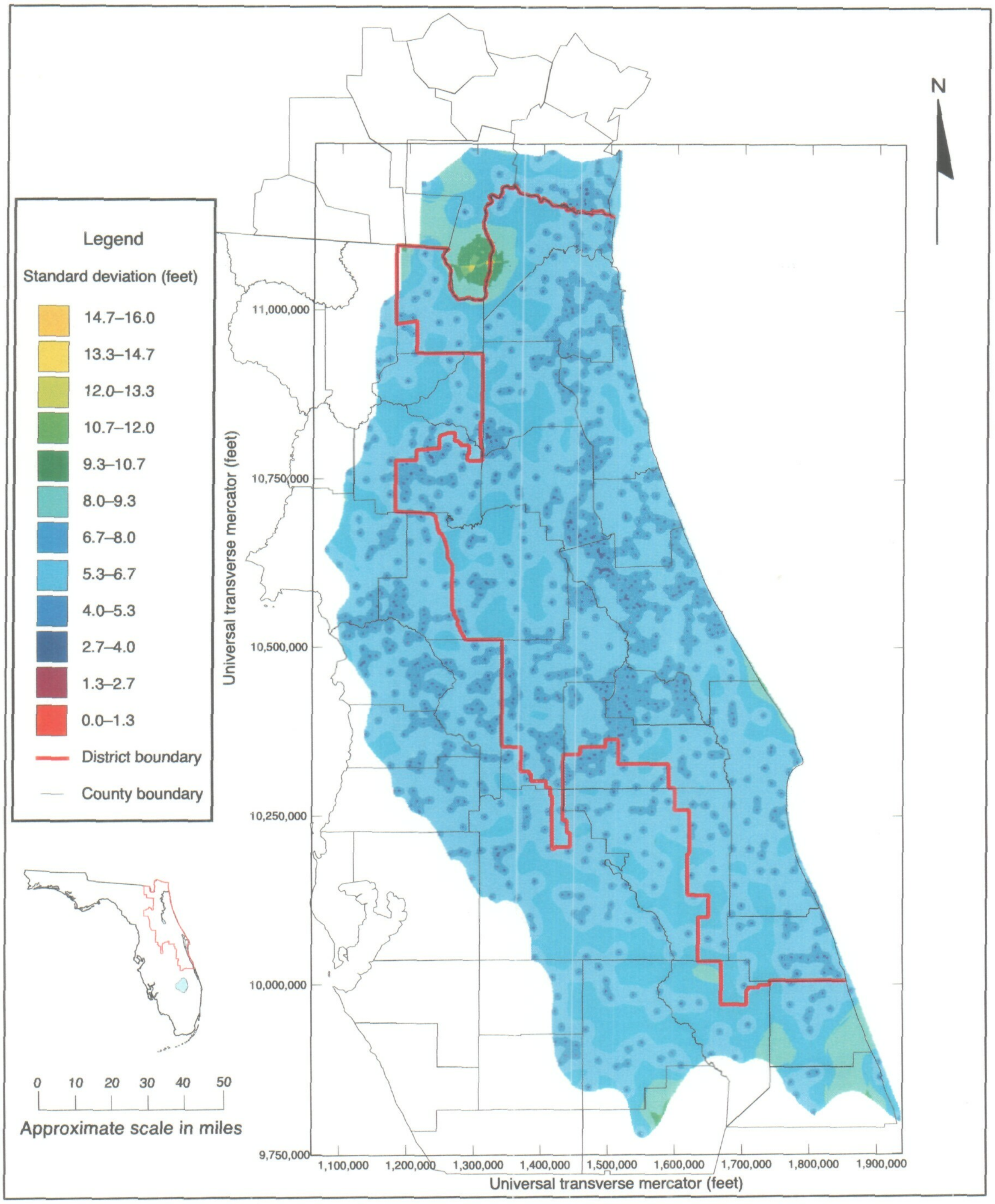

Figure E1. Standard deviation of the base network of 974 sites. *Standard deviations of 1.3 and below are not discernable at this map scale.*

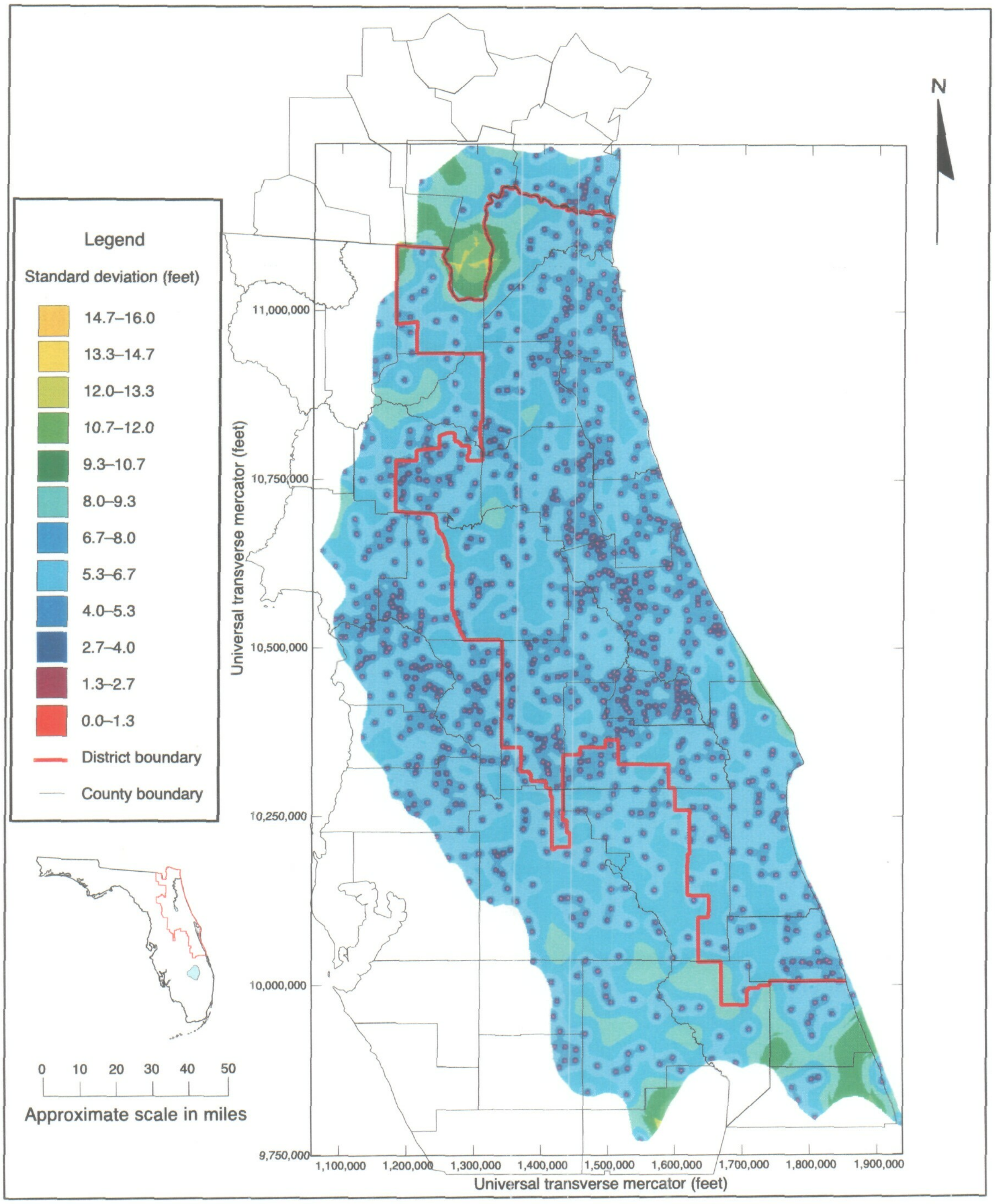

Figure E2. Standard deviation of the water levels estimated by kriging—15,000-foot grid network. *Standard deviations of 1.3 and below are not discernable at this map scale.*

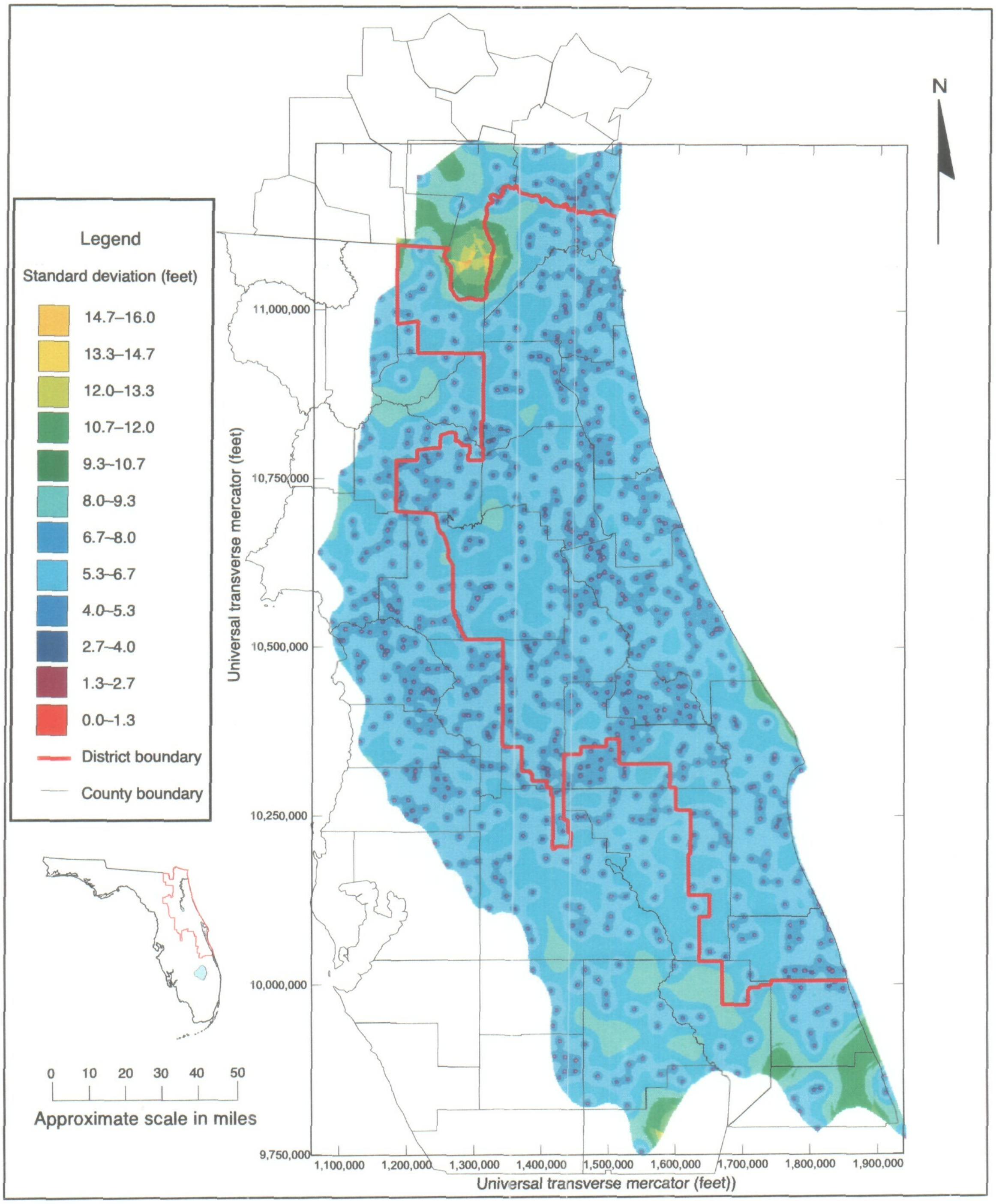

Figure E3. Standard deviation of the water levels estimated by kriging—22,500-foot grid network. *Standard deviations of 1.3 and below are not discernable at this map scale.*

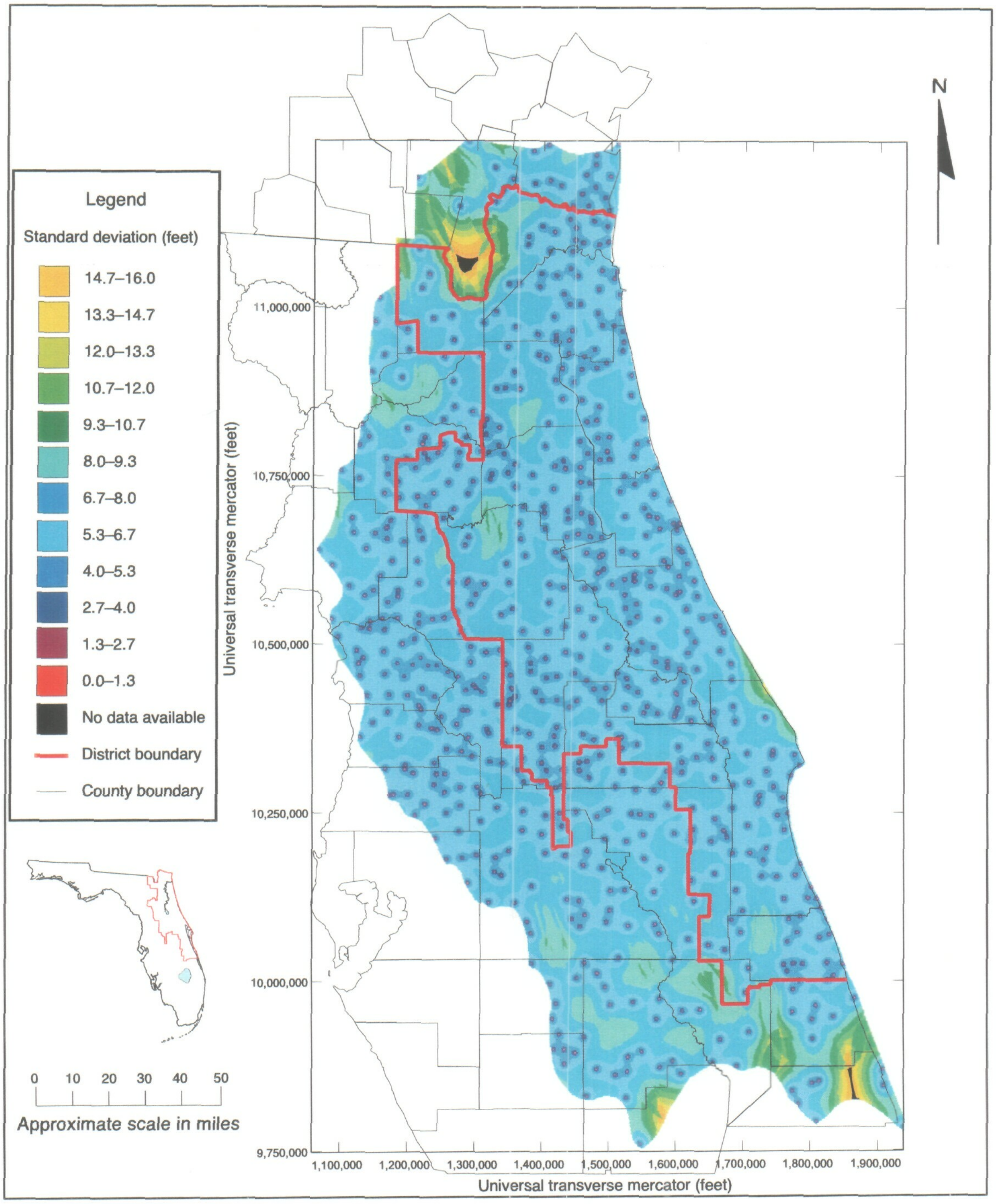

Figure E4. Standard deviation of the water levels estimated by kriging—30,000-foot grid network. *Standard deviations of 1.3 and below are not discernable at this map scale.*

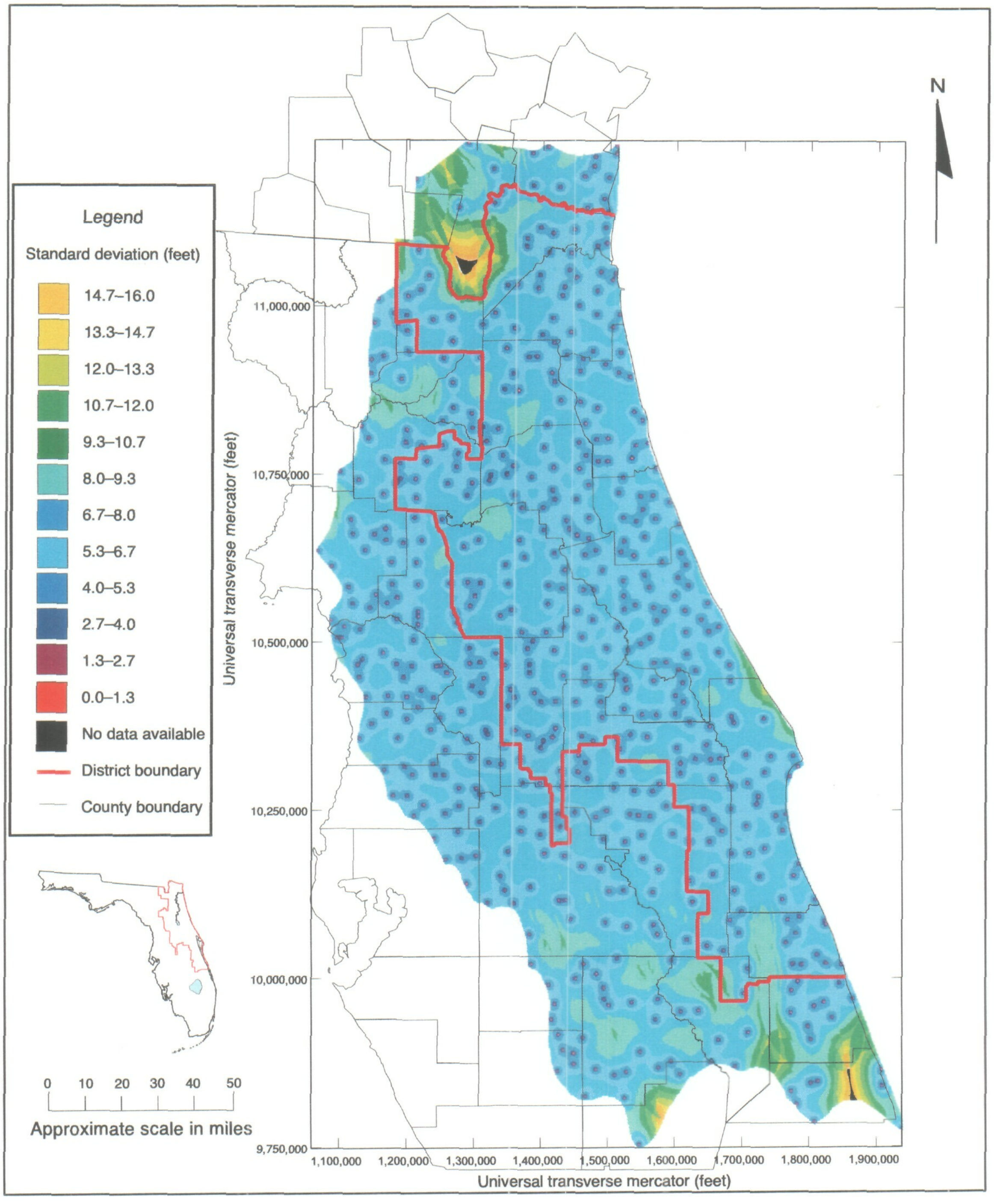

Figure E5. Standard deviation of the water levels estimated by kriging—37,500-foot grid network. *Standard deviations of 1.3 and below are not discernable at this map scale.*

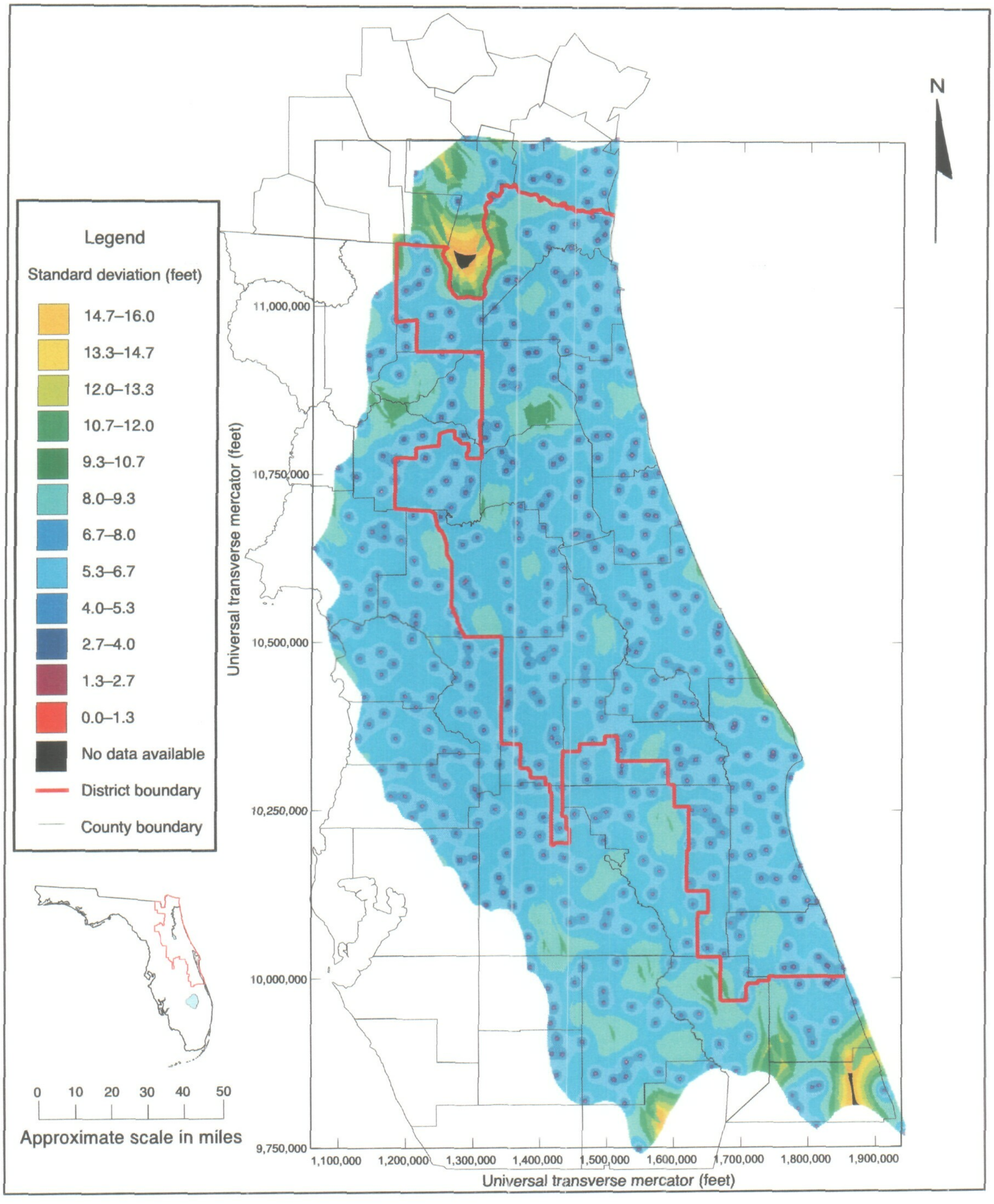

Figure E6. Standard deviation of the water levels estimated by kriging—45,000-foot grid network. *Standard deviations of 1.3 and below are not discernable at this map scale.*

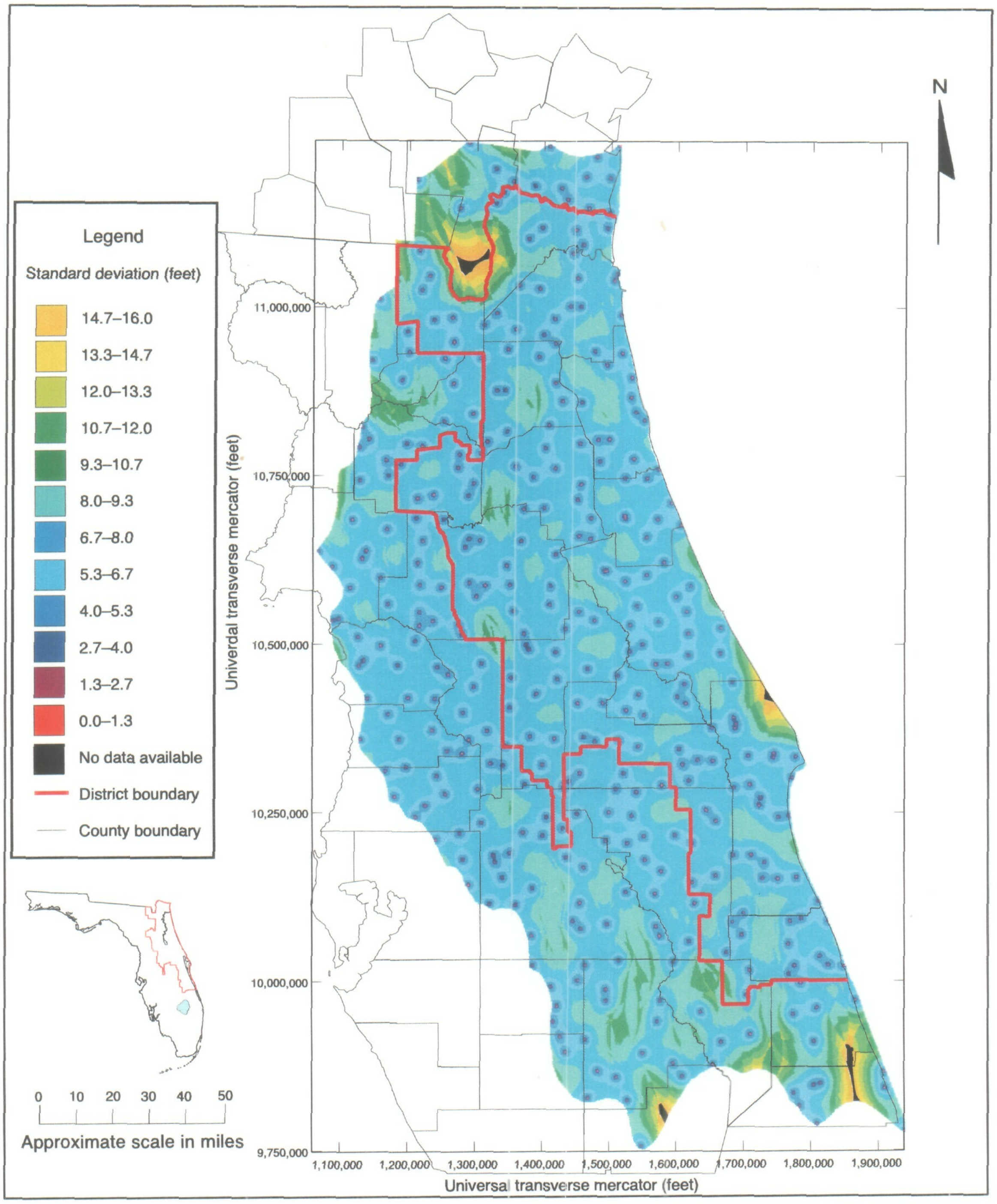

Figure E7. Standard deviation of the water levels estimated by kriging—52,500-foot grid network. *Standard deviations of 1.3 and below are not discernable at this map scale.*