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PROJECTED AQUIFER DRAWDOWNS CITY OF VERO BEACH AND INDIAN RIVER COUNTY WELLFIELDS INDIAN RIVER COUNTY, FLORIDA

by

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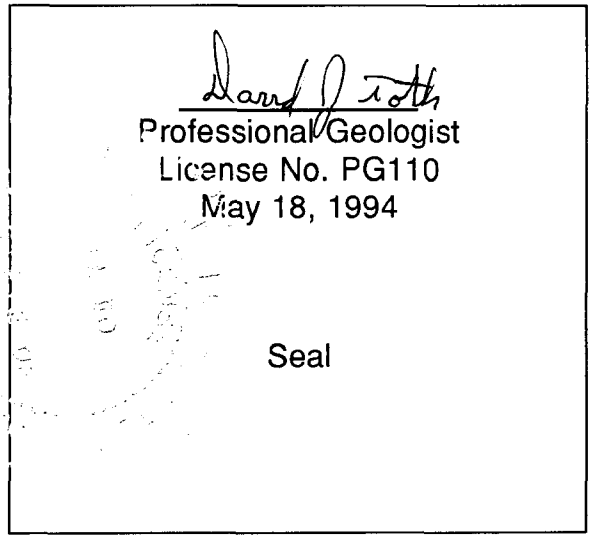

St. Johns River Water Management District
Palatka, Florida

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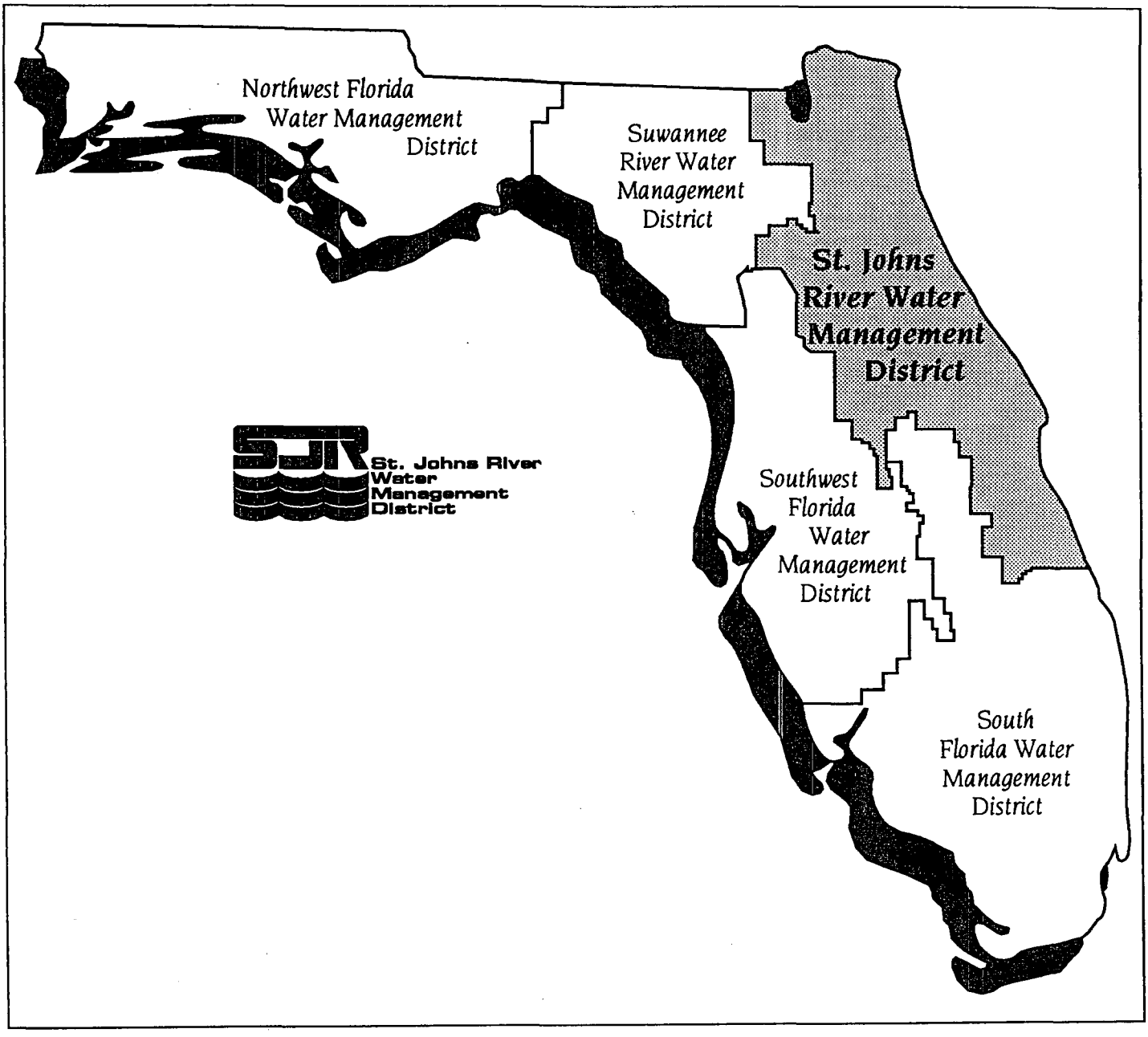

The **St. Johns River Water Management District** (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 19 counties in northeast Florida. The mission of SJRWMD is to manage water resources to ensure their continued 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 acquisition and management.

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ABSTRACT. This paper is part of an assessment of water supply needs and sources, in which the St. Johns River Water Management District has been required to identify areas expected to have inadequate water resources to meet the water supply demand in 2010. An analytical model, MLTLAY, was used to simulate changes in the potentiometric surfaces of the surficial aquifer system (SAS) and the Floridan aquifer system (FAS) based on 2010 projected pumpages at the City of Vero Beach and Indian River County wellfields. The MLTLAY model calculates drawdowns in a multilayered, leaky-artesian aquifer system. The model assumes homogeneous, isotropic, and steady-state conditions. Simulated 1988 drawdowns at the wells ranged from 9.88 to 26.60 feet (ft) for SAS and from 0.78 to 7.14 ft for FAS. Simulated 2010 drawdowns ranged from 13.10 to 37.99 ft for SAS and from 3.45 to 17.94 ft for FAS. The change in drawdown at the wells ranged from 0.97 to 11.39 ft for SAS and from 3.13 to 13.71 ft for FAS. The simulated drawdowns for projected pumpages at these wellfields have a pronounced effect on the elevation of the potentiometric surfaces of SAS and FAS. Water levels increase in SAS in the eastern part of the wellfield. Higher heads in the eastern portion of the model area will act as a buffer and help retard lateral saltwater intrusion in SAS. An additional 16-29 ft of drawdown at the wells for SAS and 3-18 ft of drawdown at the wells for FAS can be expected as a result of the operation of new SAS and FAS wells added to the wellfields.

Section 17-40.501, *Florida Administrative Code,* requires the St. Johns River Water Management District (SJRWMD) to identify "specific geographical areas that have water resource problems which have become critical or are anticipated to become critical within the next 20 years." As part of this identification, SJRWMD is studying water supply needs and sources to determine those areas expected to have inadequate water resources to meet the projected 2010 water supply demand. Regional numerical ground water models and local analytical ground water models are used as part of this overall assessment.

The evaluation discussed here is based on the results of an analytical model, which was used to simulate the impacts associated with ground water withdrawals at the City of Vero Beach and Indian River County wellfields (Figures 1 and 2). The evaluation was used as part of the overall assessment of water supply needs and sources to arrive at the projected 2010 districtwide drawdown in the potentiometric surfaces of the surficial aquifer and Floridan aquifer systems.

Within the area covered by the two wellfields, there are two aquifer systems: the surficial and the Floridan. Two geologic formations occur within the surficial aquifer system. The upper formation consists of water-saturated sand, shell, and clay and exists under unconfined conditions (Gee and Jenson 1979). It is called the Anastasia Formation. The lower formation consists of sand, shell, clay, and limestone and exists under semiconfined to unconfined conditions (Gee and Jenson 1979). It is called the Tamiami Formation. Both formations are hydraulically connected (Gee and Jenson 1979). The City of Vero Beach withdraws water from both formations. In this paper, both formations are treated as a single unit that is referred to as the surficial aquifer system. The Hawthorn Group acts as the upper confining unit, separating the surficial aquifer system and the Floridan aquifer system.

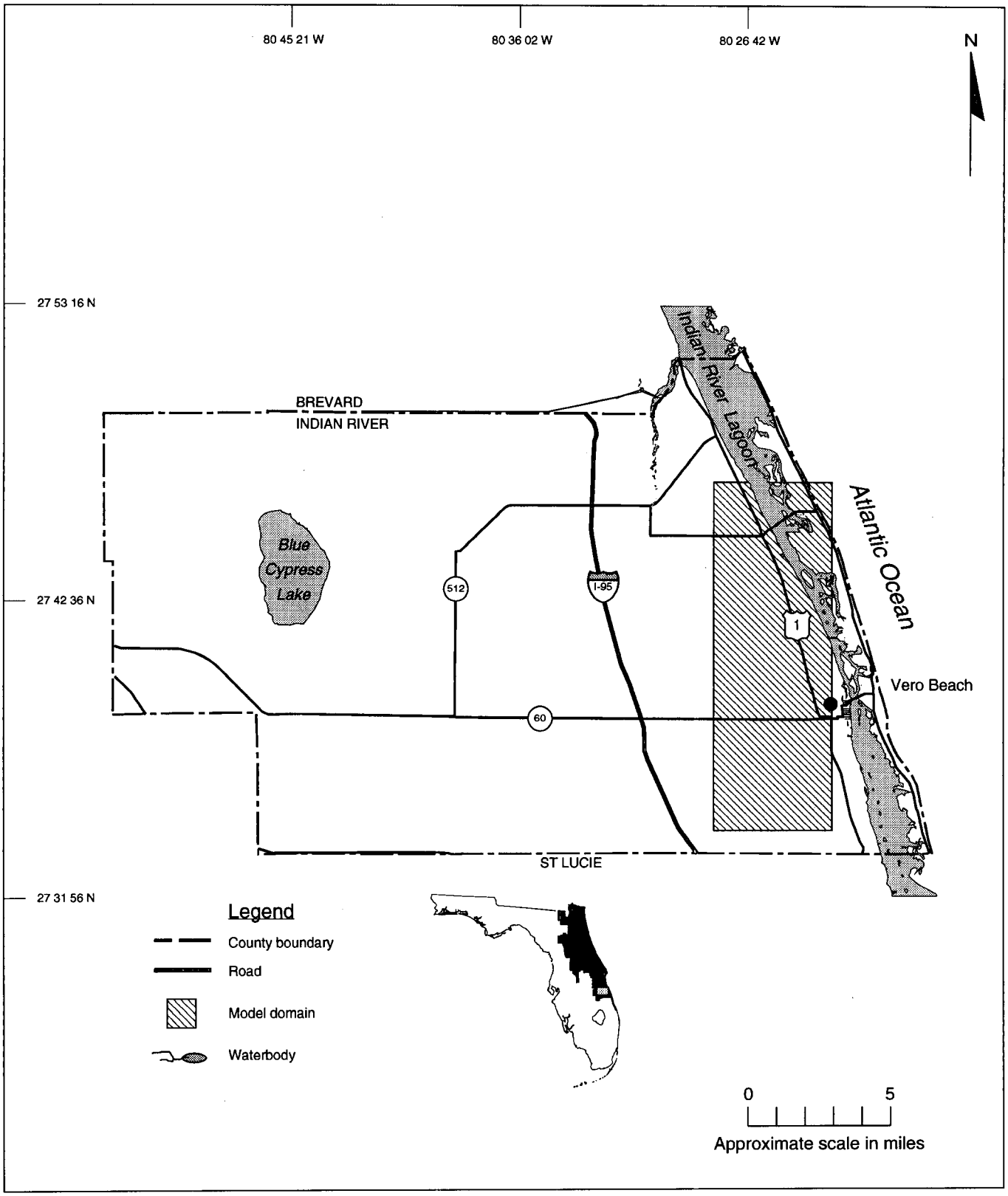

Figure 1. **Location of the model domain, which includes Indian River County wells and City of Vero Beach wells**

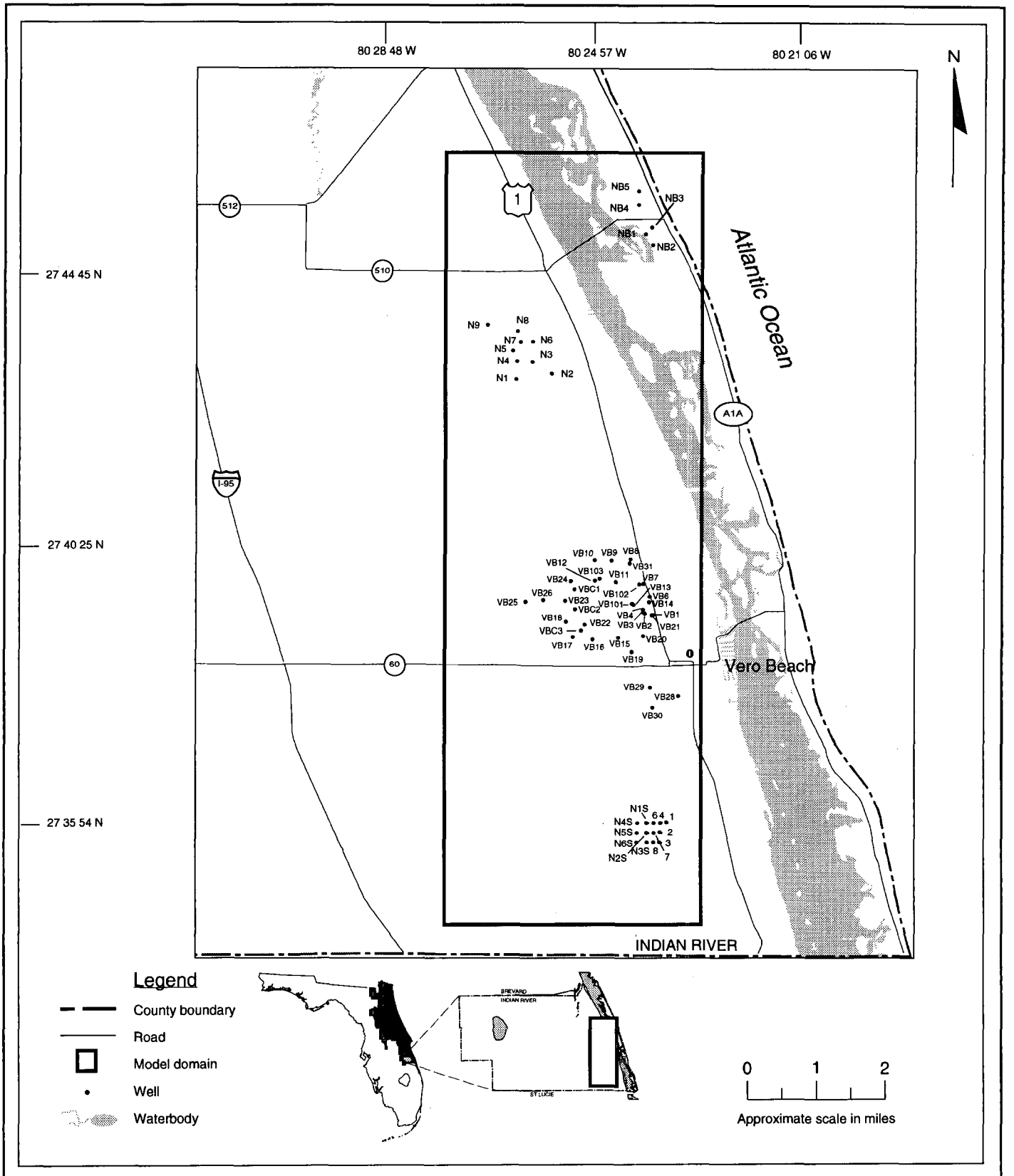

Figure 2. **Model domain and well locations.** *Wells with the "VB" prefix are located in the City of Vero Beach wellfield. All other wells are part of the Indian River County wellfield.*

The City of Vero Beach wellfield lies within the model domain used for the Indian River County wellfield. The City of Vero Beach withdraws water from both the surficial aquifer system and the Floridan aquifer system. Indian River County withdraws water only from the Floridan aquifer system. In 1988, the City of Vero Beach withdrew 9.736 million gallons per day (mgd) from 21 surficial aquifer wells and 3 Floridan aquifer wells (Florence 1990). In 1989, eight additional surficial aquifer wells and three new Floridan aquifer wells were put into service. In 1988, Indian River County withdrew 1.466 mgd from wells at the south reverse osmosis (RO) plant and 0.332 mgd from wells at the North Beach plant (Florence 1990). Each plant had three Floridan aquifer wells. The City of Vero Beach plans to withdraw less water in 2010 than in 1988 because of increased use of reclaimed water, which will replace some of the ground water currently being used. In 2010, the City of Vero Beach plans to withdraw 9.55 mgd from the wellfield using 16 surficial aquifer wells and 3 new Floridan aquifer wells (Ten Eyck 1992, pers. com. 1993); all of these wells were in place in 1992. In 2010, Indian River County plans to withdraw 26.02 mgd from the wellfield using 27 Floridan aquifer wells (Brown and Caldwell 1993); only 10 of these wells were in place in 1992. The locations for the remaining 17 wells are not known precisely; the general locations are based on McCain (1992; pers. com. 1993).

METHODS

Impacts to the ground water flow system resulting from withdrawals at the City of Vero Beach and Indian River County wellfields were evaluated using the MLTLAY model (SJRWMD unpublished). The MLTLAY model uses a linear analytical solution for a multilayered, leaky-artesian aquifer system to calculate the amount of drawdown in the surficial aquifer and the Floridan aquifer systems. The method assumes that homogeneous and isotropic conditions prevail in the surficial aquifer and Floridan aquifer systems. The model simulated steady-state conditions. The model considers the flow of water through multiple aquifers separated by semipervious leaky beds. The model has the capability of simulating the withdrawal of water from either the surficial aquifer system or the Floridan aquifer system or from both simultaneously.

In general, the MLTLAY model calculates drawdowns in the surficial aquifer and Floridan aquifer systems as a result of pumping stresses on each system. Based on available hydraulic and hydrologic parameters (e.g., pumping rates, transmissivity, and leakance coefficient), the model determines the drawdowns in these aquifer systems. Average parameter values are used throughout the entire model domain. Because site-specific elevations of the potentiometric surface of the Floridan aquifer system within the model domain do not exist, the Floridan aquifer drawdowns could not be calibrated or verified. However, an estimated 2010 potentiometric surface map of the Floridan aquifer system can be created by subtracting the 2010 simulated

drawdowns from the measured 1988 elevation of the potentiometric surface for the model domain (Schiner 1988). Such a map would indicate only the impact of increased pumping rates on the elevation of the ground water at the wellfield.

The model domain was chosen to be large enough to include the most significant drawdown in the area around the wellfield. Drawdowns actually occur beyond the extent of the model domain. The dimensions of the model domain are 24,000 feet (ft) wide and 77,000 ft long.

Aquifer characteristics used in the models include transmissivity of the surficial aquifer system and the Upper Floridan aquifer, leakance of the upper confining unit, and evapotranspiration reduction coefficient (Table 1). The transmissivity of the

Table 1. Aquifer characteristics used in the MLTLAY model, City of Vero Beach and Indian River County wellfields

Aquifer Characteristic	Value
Evapotranspiration reduction coefficient	0.00055 (ft/day)/ft
Transmissivity—surficial aquifer system	30,000 gpd/ft
Leakance—upper confining unit	0.0035 (gpd/ft^2)/ft
Transmissivity—Upper Floridan aquifer	408,000 gpd/ft

Note: (ft/day)ft = feet per day per foot
gpd/ft = gallons per day per foot
(gpd/ft^2)/ft = gallons per day per square foot per foot

Source: Gee and Jenson 1980; Geraghty & Miller 1981; Tibbals 1990

surficial aquifer system (Gee and Jenson 1980) and the Upper Floridan aquifer (Geraghty & Miller 1981), measured in gallons per day per foot, came from aquifer performance tests reported by the consulting firms, working for the two local governments. Leakance for the upper confining unit came from Geraghty & Miller (1981). The evapotranspiration reduction coefficient, measured in feet per day per foot, was determined using a graph from Tibbals (1990, p. E10). The evapotranspiration reduction coefficient describes the rate at which evapotranspiration is reduced per unit of water table drawdown. It is based upon a depth to the water table of 5 ft below land surface at the wellfield.

Well pumpage rates for 1988 and 2010, measured in million gallons per day, were used in the model (Tables 2 and 3). Pumpage for each well in the Indian River County wellfield in 1988 was determined by dividing the total metered pumpage (1.466 mgd at the south RO plant and 0.332 mgd at the North Beach plant [Florence

Table 2. Surficial aquifer system pumpage values used in the MLTLAY model, City of Vero Beach and Indian River County wellfields

Well	Latitude	Longitude	1988 Pumpage (mgd)	Projected 2010 Pumpage (mgd)
VB1	273908	802409	0.348	0.504
VB2	273909	802418	0.100	NA
VB3	273912	802421	0.100	NA
VB4	273913	802420	0.179	NA
VB6	273926	802413	0.139	NA
VB7	273939	802415	0.174	NA
VB8	274003	802434	0.199	0.288
VB9	274002	802455	0.418	NA
VB10	274002	802514	0.358	0.518
VB11	273940	802451	0.418	NA
VB12	273942	802514	0.398	NA
VB13	273919	802433	0.179	NA
VB15*	273845	802449	NA	0.504
VB16	273843	802518	0.179	0.259
VB17	273846	802540	0.249	0.115
VB18*	273901	802547	NA	0.518
VB19	273831	802433	0.547	NA
VB20	273847	802421	0.249	NA
VB22*	273958	802526	NA	0.374
VB23*	273922	802548	NA	0.288
VB24*	273941	802541	NA	0.317
VB25	273921	802632	0.547	0.792
VB26	273923	802612	0.249	NA
VB28	273747	802341	0.299	NA
VB29	273756	802413	0.577	0.835
VB30	273735	802410	0.547	0.792
VBC1*	273933	802537	NA	0.216
VBC2*	273913	802537	NA	0.360
VBC3*	273852	802530	NA	0.504

Note: mgd = million gallons per day
NA = not applicable

*Not in service in 1988

Table 3. Floridan aquifer system pumpage values used in the MLTLAY model, City of Vero Beach and Indian River County wellfields

Wellfield	Well	Latitude	Longitude	1988 Pumpage (mgd)	Projected 2010 Pumpage (mgd)
Vero Beach	VB14	273920	802414	0.995	NA
	VB21	273908	802411	0.995	NA
	VB31	273959	802435	1.294	NA
	VB101*	273918	802431	NA	0.787
	VB102*	273938	802424	NA	0.787
	VB103*	273944	802509	NA	0.787
Indian River County	1	273536	802400	0.489	1.090
	2	273526	802407	0.489	1.090
	3	273516	802407	0.489	1.090
	4*	273536	802407	NA	1.090
	6*	273536	802415	NA	1.090
	7*	273526	802415	NA	1.090
	8*	273516	802415	NA	1.090
	N1S*	273536	802422	NA	1.090
	N2S*	273526	802422	NA	1.090
	N3S*	273516	802422	NA	1.090
	N4S*	273536	802433	NA	1.090
	N5S*	273526	802434	NA	1.090
	N6S*	273516	802434	NA	1.090
	N1*	274305	802644	NA	1.113
	N2*	274310	802602	NA	1.113
	N3*	274321	802625	NA	1.113
	N4*	274421	802714	NA	1.113
	N5*	274332	802646	NA	1.113
	N6*	274342	802624	NA	1.113
	N7*	274341	802638	NA	1.113
	N8*	274351	802641	NA	1.113
	N9*	274358	802715	NA	1.113
	NB1	274528	802417	0.111	0.366
	NB2	274517	802409	0.111	0.366
	NB3	274535	802410	0.111	0.366
	NB4*	274557	802424	NA	0.366
	NB5*	274611	802424	NA	0.366

Note: mgd = million gallons per day
NA = not applicable
*Not in service in 1988

1990]) by the number of production wells at each plant to yield an average pumpage of 0.489 mgd for each well at the south RO plant and 0.111 mgd at the North Beach plant. Pumpage for each well in the City of Vero Beach wellfield in 1988 was based on a total metered water use of 9.736 mgd reported by Florence (1990) and was determined from the reported pumping rate of each well and the percentage of time each well was operated (Ten Eyck 1992).

Pumping conditions for August 1988 at the City of Vero Beach wellfield were used to compare model results of the drawdown in the surficial aquifer system to measured drawdowns at the wellfield (Table 4; Ten Eyck 1994). Drawdowns were

Table 4. Comparison of measured and calculated drawdowns at several surficial aquifer monitor wells for the City of Vero Beach, August 1988

Monitor Well Number	Approximate Drawdowns (feet)	
	Measured*	Calculated
2	1	1
5	2	2
6	6	4
9	14	9
10.2	4	7
11.4	12	9
12	2	3
13	1	2
14	5	2
15.2	9	6
15.3	4	4
16	15	10
17	5	5
18.2	2	2
19.1	7	4

*Source: Ten Eyck 1994

assumed to be the difference between a static water level in the wellfield of 5 ft below land surface and the measured water level in the monitor wells while the

wellfield was in operation. The difference between measured and calculated drawdowns was less than 3 ft at most monitor wells. The comparison illustrates that the aquifer characteristics used are a reasonable representation of the hydrogeologic setting because of the good agreement between the measured and calculated results. Therefore, the aquifer characteristics were used to predict the 2010 impact on the ground water flow system. Site-specific elevations of the potentiometric surface of the Floridan aquifer system are not available for a similar comparison.

Since 1992, water has been withdrawn from three of the Floridan aquifer wells at the City of Vero Beach wellfield (well numbers VB101–VB103) for use in the RO treatment process. Pumpage rates are not expected to change by the year 2010. The total projected estimate for RO is 2.36 mgd (Ten Eyck 1992), or 0.787 mgd per well.

The 2010 total projected pumpage at the City of Vero Beach wellfield is estimated to be 9.55 mgd (Ten Eyck 1992). This is based on 16 surficial aquifer wells and 3 Floridan aquifer wells (Ten Eyck, pers. com. 1993). Thirteen surficial and three Floridan aquifer wells will not routinely be used in 2010.

The 2010 total projected pumpage at the Indian River County wellfield is estimated to be 26.02 mgd (Brown and Caldwell 1993). This is based on withdrawals from 27 Floridan aquifer wells (Brown and Caldwell 1993). Projected pumpages for individual wells at this wellfield were obtained by dividing the projected withdrawals for each RO plant by the number of wells. Since 1992, water has been withdrawn from seven Floridan aquifer wells at the south RO plant (well numbers 1–4 and 6–8) and three Floridan aquifer wells at the North Beach plant (well numbers NB1–NB3). The six wells used in 1988 are in the domain of the south RO plant and the North Beach plant (three wells at each plant). Indian River County expects to have a north RO plant by 2010. The north plant will have nine wells and withdraw a total of 10.02 mgd from the Floridan aquifer system (Brown and Caldwell 1993). The south plant will have 13 wells and withdraw a total of 14.17 mgd from the Floridan aquifer system (Brown and Caldwell 1993). The North Beach plant will have five wells and withdraw a total of 1.83 mgd from the Floridan aquifer system (Brown and Caldwell 1993).

RESULTS

Drawdowns calculated by the model are based on the assumption that all wells were pumping 100 percent of the time; however, the wells are actually pumped on a rotated basis. The wells in the model were allowed to pump 100 percent of the time because the purpose of using the model was to examine the long-term regional impacts of the wellfield. Consequently, site-specific results, which would be sensitive to the number of wells pumping and the amount of time each well was pumped, were not necessary.

The change in simulated drawdowns in the potentiometric surface from 1988 to 2010 at the wells ranged from 0.97 to 11.39 ft for the surficial aquifer system and from 3.13 to 13.71 ft for the Floridan aquifer system (Tables 5 and 6). However, an additional 16–29 ft of drawdown at the wells for the surficial aquifer system and 3–18 ft of drawdown at the wells for the Floridan aquifer system can be expected as a result of new surficial aquifer and Floridan aquifer wells added to each wellfield. Simulated 1988 drawdowns ranged from 9.88 to 26.60 ft for the surficial aquifer system and from 0.78 to 7.14 ft for the Floridan aquifer system. Simulated 2010 drawdowns ranged from 13.10 to 37.99 ft for the surficial aquifer system and from 3.45 to 17.94 ft for the Floridan aquifer system.

Simulated drawdowns at the City of Vero Beach and Indian River County wellfields were contoured for 1988 and 2010 for the surficial aquifer and the Floridan aquifer systems (Figures 3–6). Differences between the drawdowns in 1988 and 2010 were contoured for the surficial aquifer and the Floridan aquifer systems (Figures 7–8). Figures 3–6 show the localized effect that pumping of these wells has on the aquifer. In reality, the effect of the pumping extends beyond the model domain.

DISCUSSION

The difference in drawdowns between 1988 and 2010 for the surficial aquifer system at the City of Vero Beach wellfield are greatest in the western part of the modeled area and least in the eastern part (Figure 7). This is because more wells are pumped in the western part of the wellfield in 2010 compared to 1988. Pumpage at the City of Vero Beach wellfield in 2010 includes eight more surficial aquifer wells and three new Floridan aquifer wells than in 1988. The three Floridan aquifer wells that were used in 1988 will not be in service in 2010. The incorporation of additional surficial aquifer wells and reduced pumpage from existing wells produces higher heads in the surficial aquifer system in the eastern portion of the modeled area—more than 4 ft higher—in 2010 compared to 1988. Higher heads in the eastern portion of the modeled area will act as a buffer and help retard lateral saltwater intrusion in the surficial aquifer system.

The difference in drawdowns between 1988 and 2010 for the surficial aquifer system are less than 12 ft (Table 5, Figure 7). In the areas of the north and south RO plants, the difference in drawdowns between 1988 and 2010 is about 2 and 4 ft, respectively (see Figures 2 and 7). Because of the relatively high leakance of the upper confining unit, drawdowns occur in these areas even though neither RO plant withdraws water from the surficial aquifer. The leakance enables the surficial aquifer system to recharge the underlying Floridan aquifer system when large drawdowns occur. As water discharges from the surficial aquifer system, drawdowns occur in that system.

Table 5. Surficial aquifer system simulated drawdowns for the City of Vero Beach wellfield

Well	Simulated 1988 Drawdown (ft)	Simulated 2010 Drawdown (ft)	Drawdown Difference (ft)
VB1	19.48	23.10	3.62
VB2	12.71	NA	NA
VB3	13.56	NA	NA
VB4	15.54	NA	NA
VB6	11.30	NA	NA
VB7	11.48	NA	NA
VB8	12.14	14.26	2.12
VB9	21.63	NA	NA
VB10	18.71	24.17	5.46
VB11	21.86	NA	NA
VB12	20.41	NA	NA
VB13	13.01	NA	NA
VB15*	NA	24.49	NA
VB16	9.88	17.52	7.64
VB17	12.13	13.10	0.97
VB18*	NA	28.43	NA
VB19	25.39	NA	NA
VB20	14.78	NA	NA
VB22*	NA	24.89	NA
VB23*	NA	19.17	NA
VB24*	NA	18.50	NA
VB25	23.91	34.76	10.85
VB26	12.77	NA	NA
VB28	14.57	NA	NA
VB29	26.60	37.99	11.39
VB30	25.01	36.30	11.29
VBC1*	NA	16.01	NA
VBC2*	NA	23.04	NA
VBC3*	NA	29.42	NA

Note: ft = foot
NA = not applicable

*Not in service in 1988

Table 6. Floridan aquifer system simulated drawdowns for the City of Vero Beach and Indian River County wellfields

Wellfield	Well	Simulated 1988 Drawdown (ft)	Simulated 2010 Drawdown (ft)	Drawdown Difference (ft)
Vero Beach	VB14	6.84	NA	NA
	VB21	6.74	NA	NA
	VB31	7.14	NA	NA
	VB101*	NA	6.90	NA
	VB102*	NA	6.69	NA
	VB103*	NA	6.72	NA
Indian River County	1	3.28	15.53	12.25
	2	3.37	17.08	13.71
	3	3.22	16.08	12.86
	4*	NA	16.59	NA
	6*	NA	17.21	NA
	7*	NA	17.94	NA
	8*	NA	16.85	NA
	N1S*	NA	17.00	NA
	N2S*	NA	17.76	NA
	N3S*	NA	16.73	NA
	N4S*	NA	15.56	NA
	N5S*	NA	16.15	NA
	N6S*	NA	15.38	NA
	N1*	NA	9.84	NA
	N2*	NA	9.46	NA
	N3*	NA	10.79	NA
	N4*	NA	8.69	NA
	N5*	NA	11.14	NA
	N6*	NA	10.99	NA
	N7*	NA	11.54	NA
	N8*	NA	10.96	NA
	N9*	NA	9.48	NA
	NB1	0.81	4.06	3.25
	NB2	0.79	3.92	3.13
	NB3	0.78	3.94	3.16
	NB4*	NA	3.70	NA
	NB5*	NA	3.45	NA

Note: ft = foot
NA = not applicable
*Not in service in 1988

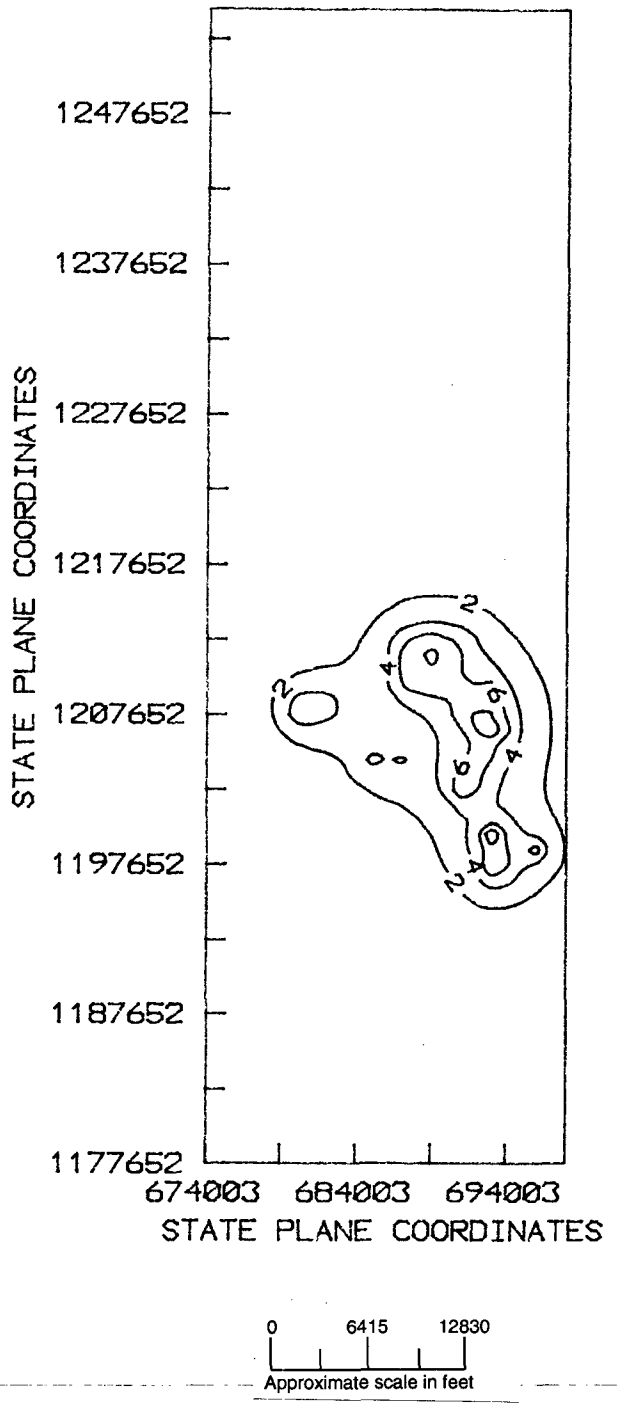

Figure 3. **Simulated 1988 drawdowns in the surficial aquifer system at the City of Vero Beach and Indian River County wellfields (measured in feet)**

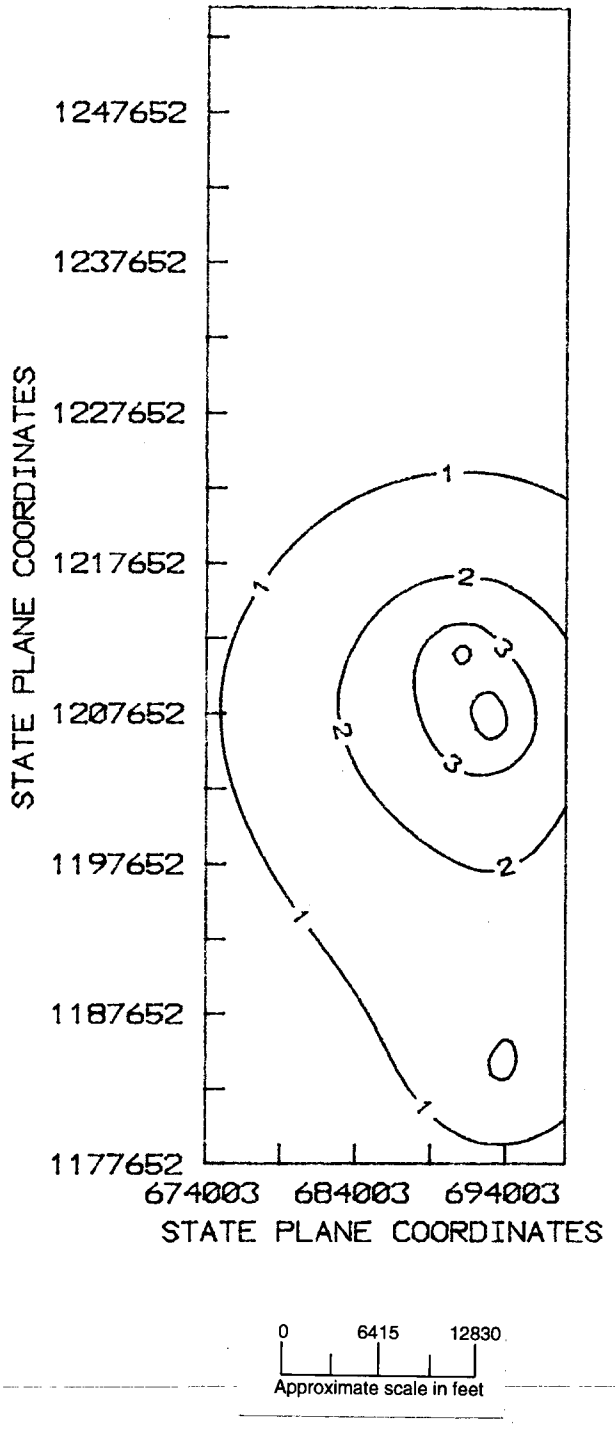

Figure 4. **Simulated 1988 drawdowns in the Floridan aquifer system at the City of Vero Beach and Indian River County wellfields (measured in feet)**

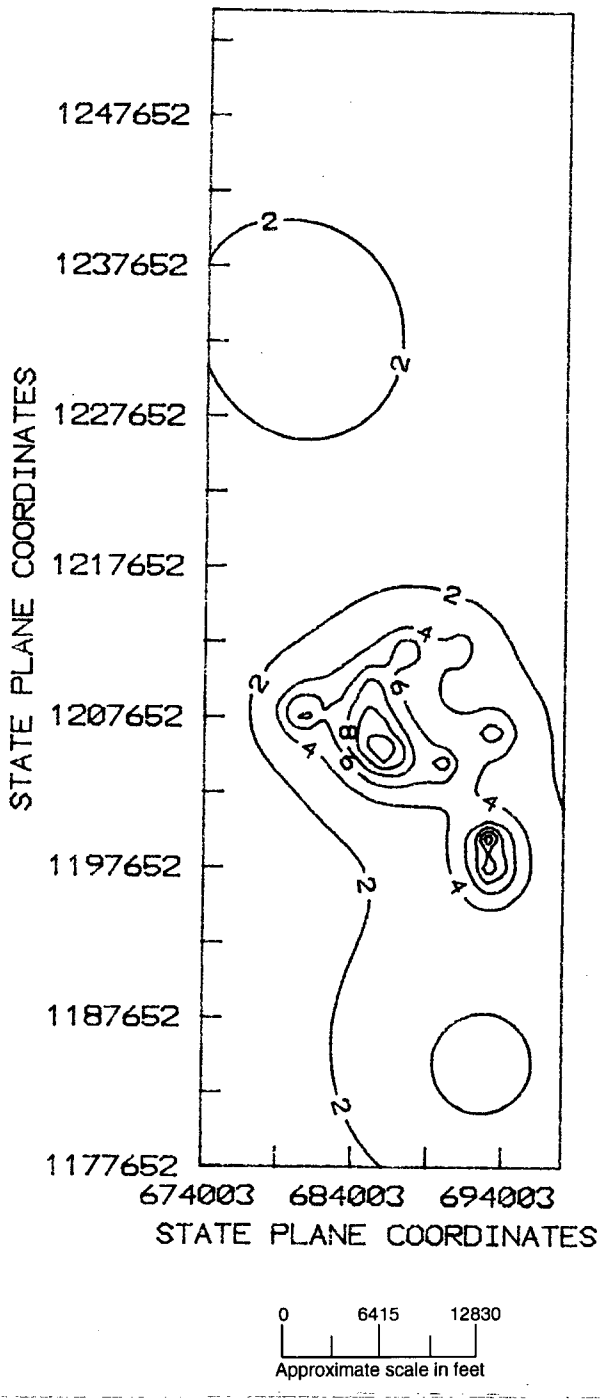

Figure 5. **Simulated 2010 drawdowns in the surficial aquifer system at the City of Vero Beach and Indian River County wellfields (measured in feet)**

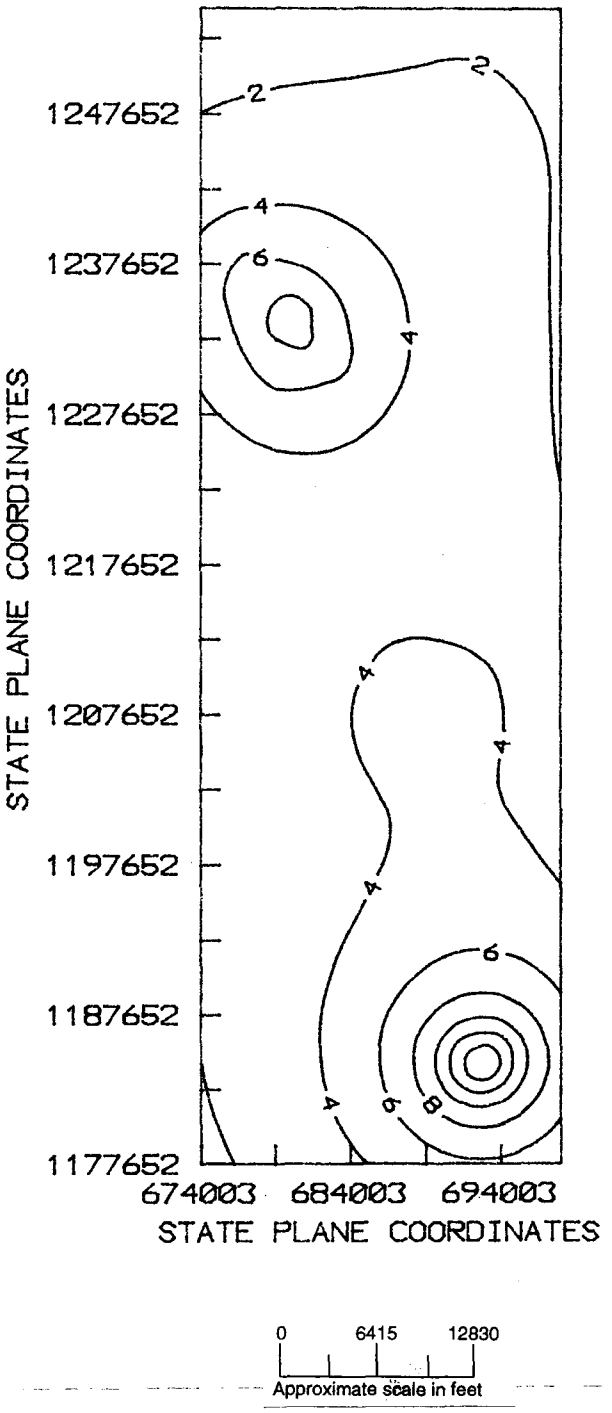

Figure 6. **Simulated 2010 drawdowns in the Floridan aquifer system at the City of Vero Beach and Indian River County wellfields (measured in feet)**

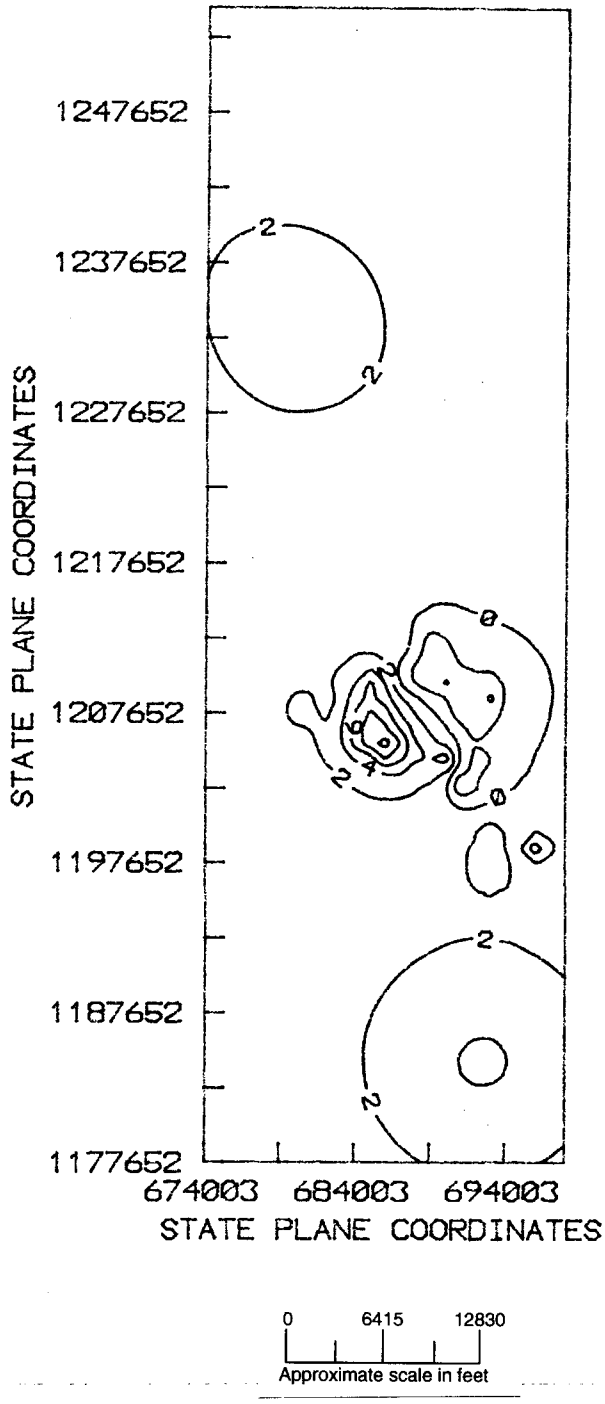

Figure 7. **Difference in simulated drawdowns between 1988 and 2010 for the surficial aquifer system at the City of Vero Beach and Indian River County wellfields (measured in feet)**

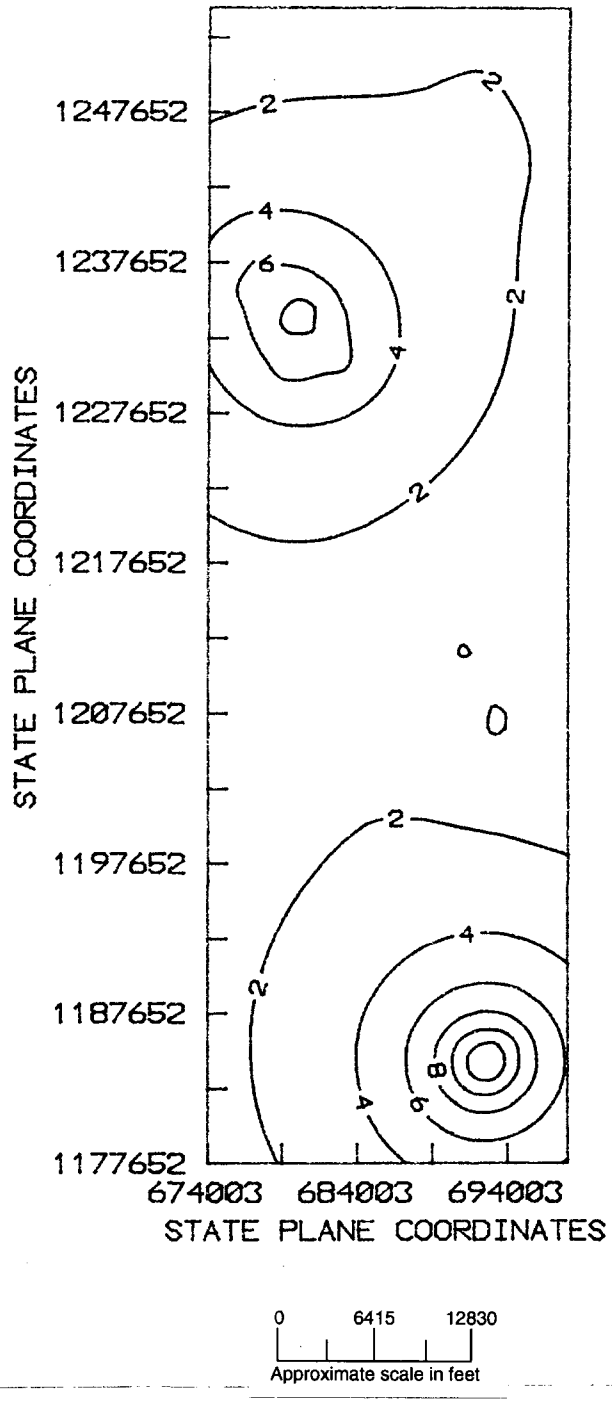

Figure 8. **Difference in simulated drawdowns between 1988 and 2010 in the Floridan aquifer system at the City of Vero Beach and Indian River County wellfields (measured in feet)**

The difference in drawdowns between 1988 and 2010 for the Floridan aquifer system are greater than 8 and 12 ft in the areas of the north (proposed) and south RO plants, respectively, for Indian River County wellfield and approximately 3 ft in the area of Indian River County's North Beach plant (Figure 8). Wells at the south RO plant are numbered 1–8 (there is no well number 5) and N1S–N6S (Table 6). Wells at the proposed north RO plant are numbered N1–N9 (Table 6). Wells at the North Beach plant are numbered NB1–NB5 (Table 6). For comparison, the elevation of the potentiometric surface of the Floridan aquifer system was approximately 33 ft above mean sea level in the area of both the north (proposed) and south RO plants for Indian River County and approximately 31 ft above mean sea level in the area of Indian River County's North Beach plant in May 1988 (Schiner 1988). Projected pumpage in 2010 at Indian River County's north and south RO plants will lower the elevation of the potentiometric surface to about 25 and 21 ft above mean sea level, respectively.

CONCLUSIONS

Based on the results of the model, increased pumpage at the Indian River County wellfield and decreased pumpage at the City of Vero Beach wellfield between 1988 and 2010 will cause about 10 ft of additional drawdown in the surficial aquifer system. This change in pumpage also will cause about 13 ft of additional drawdown in the elevation of the potentiometric surface of the Floridan aquifer system at the wells. The simulated drawdowns for projected pumpages at the City of Vero Beach and Indian River County wellfields have a pronounced effect on the elevation of the potentiometric surface of both the surficial aquifer and Floridan aquifer systems. Decreased pumpage at the City of Vero Beach wellfield between 1988 and 2010 will cause an approximate 2-ft rise in the elevation of the surficial aquifer system in the eastern part of the wellfield. More wells are pumped in the western part of the City of Vero Beach wellfield in 2010 compared to 1988. Higher heads in the eastern portion of the model area will act as a buffer and help retard lateral saltwater intrusion in the surficial aquifer system.

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CONVERSION TABLE

Multiply	By	To Obtain
foot (ft)	0.3048	meter (m)
million gallons per day (mgd)	3.785×10^{3}	cubic meters per day (m^3/d)
gallons per day per foot (gpd/ft)	1.242×10^{-2}	square meters per day (m^2/d)
gallons per day per square foot (gpd/ft^2)	4.075×10^{-2}	meters per day (m/d)
gallons per day per square foot per foot ($[gpd/ft^2]/ft$)	0.1337	meters per day per meter ([m/d]/m)
feet per day per foot ([ft/d]/ft)	1.0	meters per day per meter ([m/d]/m)