



**Florida Chamber's 27th Annual Environmental
Permitting Summer School
Permitting Workshop - Splitting the Water Pie**

When: Friday July 19, 2013
Where: Marco Island Marriot Resort

DREAMS OF FLORIDA'S FIRST WATER VICEROY

By: Devo Seereeram, Ph.D., P.E.



The Simple Dream

First, I am allowed to have these
dreams because I am not an
Attorney but an **Engineer**.

The Simple Dream - Continued

- The simple dream is that the Governor of Florida appoints a **Water Viceroy** to have sole decision making powers over the use of the states's water resources (mainly potable supply) without the threat of 120's and other forms of litigation. Well that is really a dream but let us continue anyway.
- The Water Viceroy will make decisions based on the actual occurrence of the resource [below-ground and above-ground (where applicable)] without having to worry about internal political boundaries, and other territorial considerations. The Viceroy also has great powers when it comes to transmission line easements, etc. and he can even develop alternative water supplies.
- To make the powers even more supreme, the Viceroy will also control wastewater and reclaimed water since he can target artificial recharge projects to keep the water cycle healthy. Well, while we are at it, lets add stormwater to his domain as the harvesting projects are also integral to holistic planning.

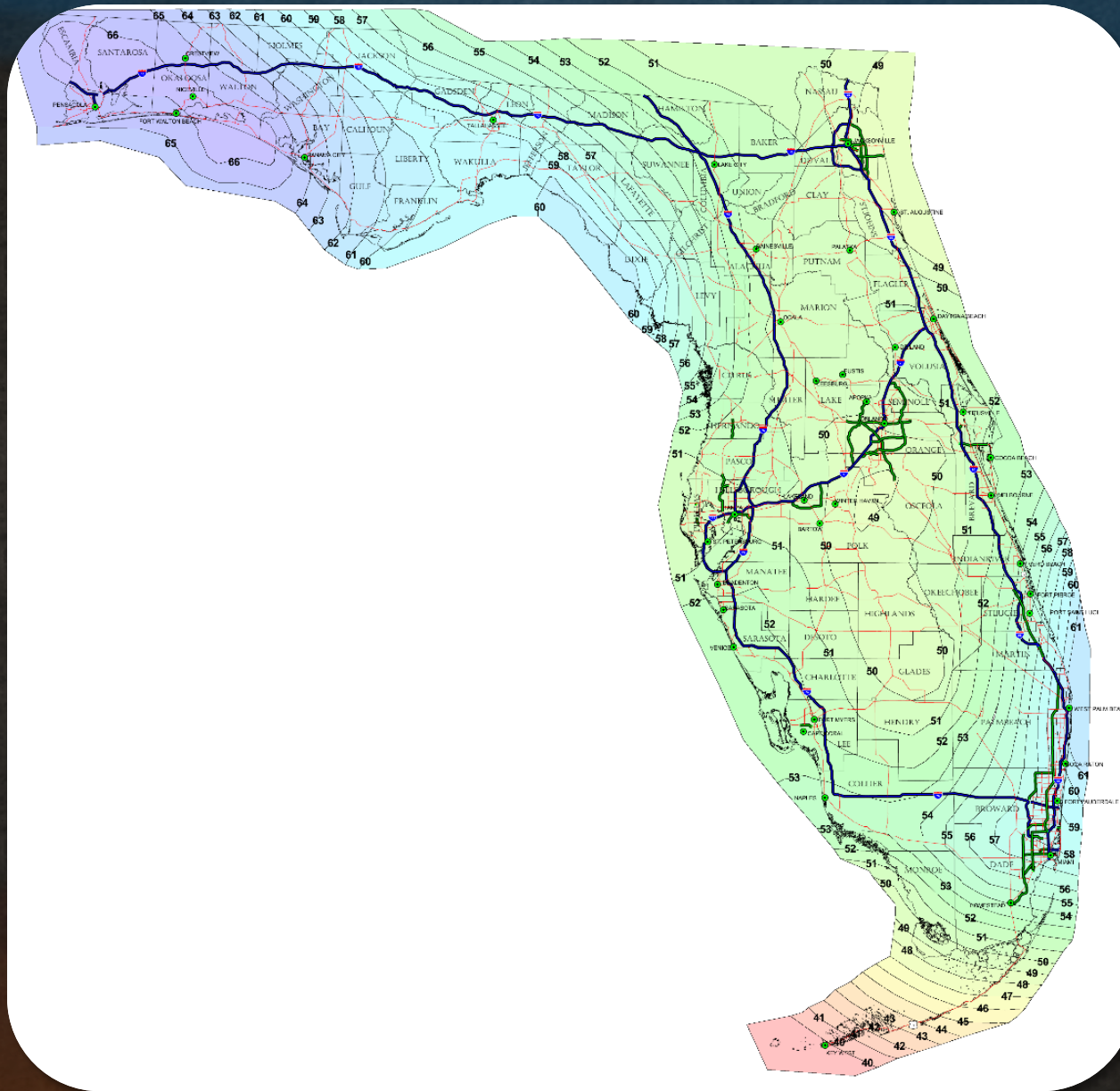
The Simple Dream - Continued

- Even after removing all these constraints, this is a daunting yet exciting task for a water supply professional. Let us go through the exercise, although it might be purely an academic one but maybe remembered 50 years from now “as ahead of its time thinking”.
- Much like some countries have a single water authority, all water bills will come from the Viceroy at a single unified state-wide rate (or maybe not uniform). I guess we tried something similar with Citizens Property Insurance and that seems to be a failed experiment, but water might be a different more predictable animal (without sinkhole claims for every house in Tampa). I am even thinking the Viceroy will control individual wells, taking over from the county health departments.
- Out of this dream, a major constraints map will emerge and locations where alternative water supplies must be pursued post haste. For example, some major industrial withdrawals can switch to reclaimed water. While this may be academic exercise, it will provide an incisive understanding of what might be a theoretical optimum allocation of the resources if the entire state was controlled by a single tribe. Obvious projects will also less likely be ignored.

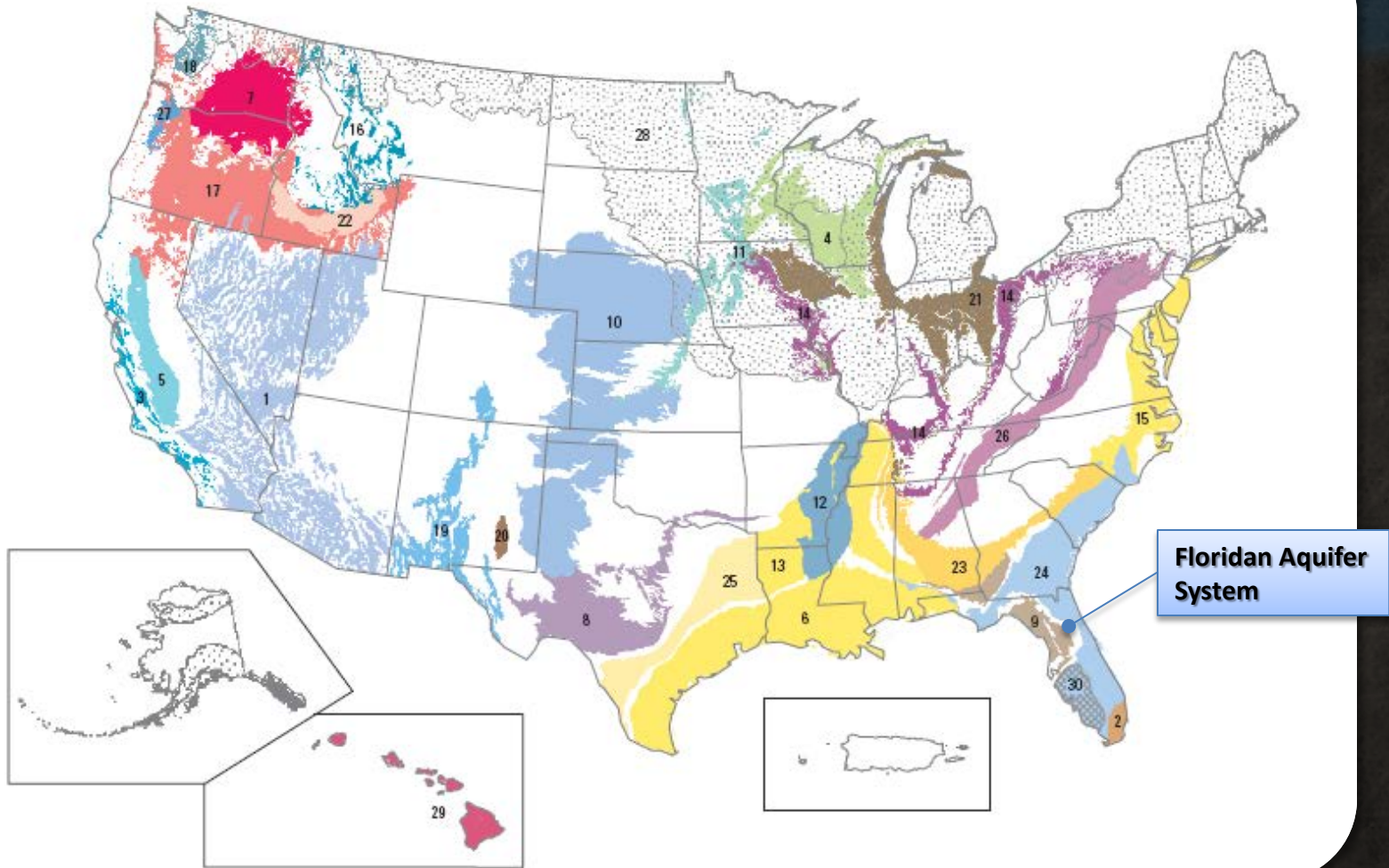
The Steps

- **First Step:** Let us start with a blank canvas; map the parts of the state with the thickest and freshest groundwater and approximate the quantities which can be extracted in a sustainable way. This will be done for the premium groundwater resource areas of the state. For example, in SJRWMD there are 3 primary epicenters (Green Swamp, DeLand Ridge, and Keystone Heights).
- **Second step** is to map the existing demand for potable-grade water based on population distribution and other factors within the state.
- **Third step** is to map the future demand for potable-grade water based on population distribution and other factors within the state.
- **Fourth step** is to overlay the sustainable yield distribution on the demand distribution and make sure these line up numerically and then figure out how to get the water to the demand centers (transmission lines) and reserve enough for the future growth areas.

Rainfall Patterns in Florida – Recharge & Runoff Source



USGS Water Resource Program

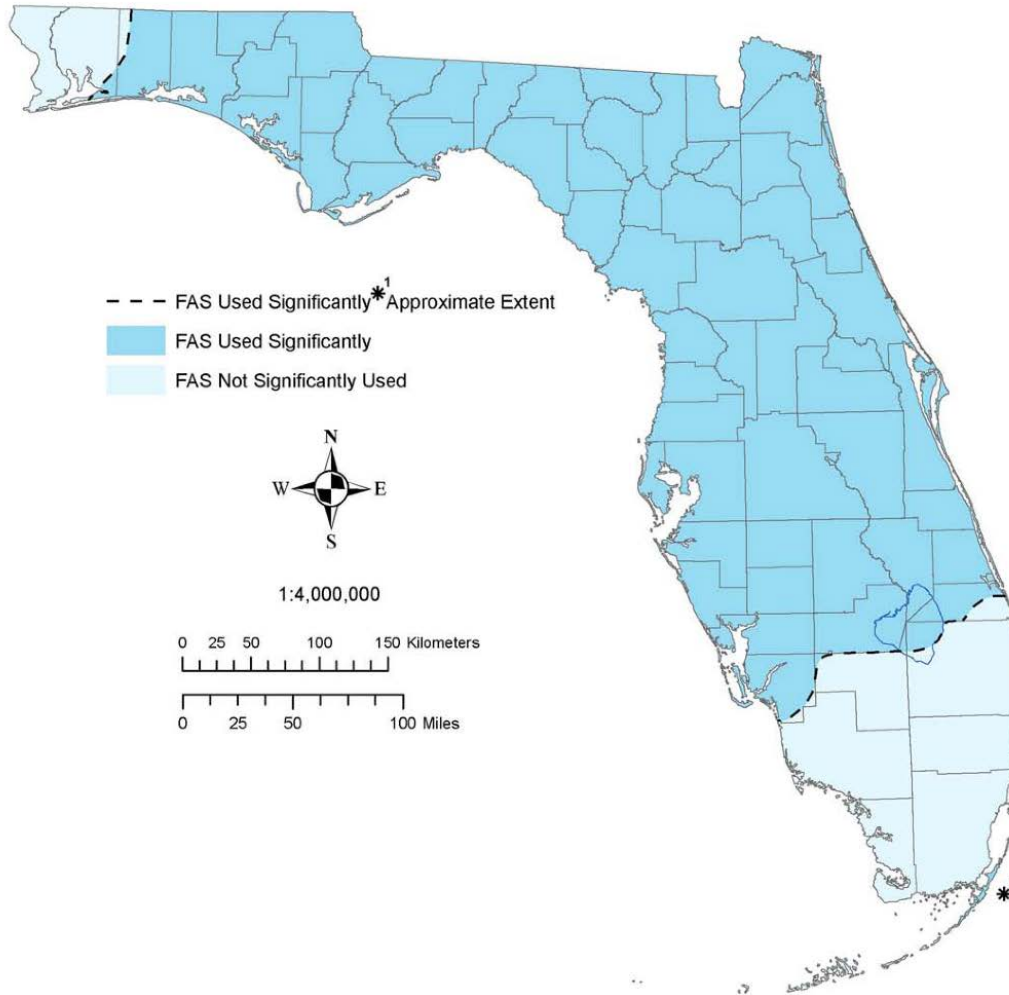


Source: USGS

This 30 principal aquifers account for 94% of total groundwater withdrawals

Extent of Floridan Aquifer

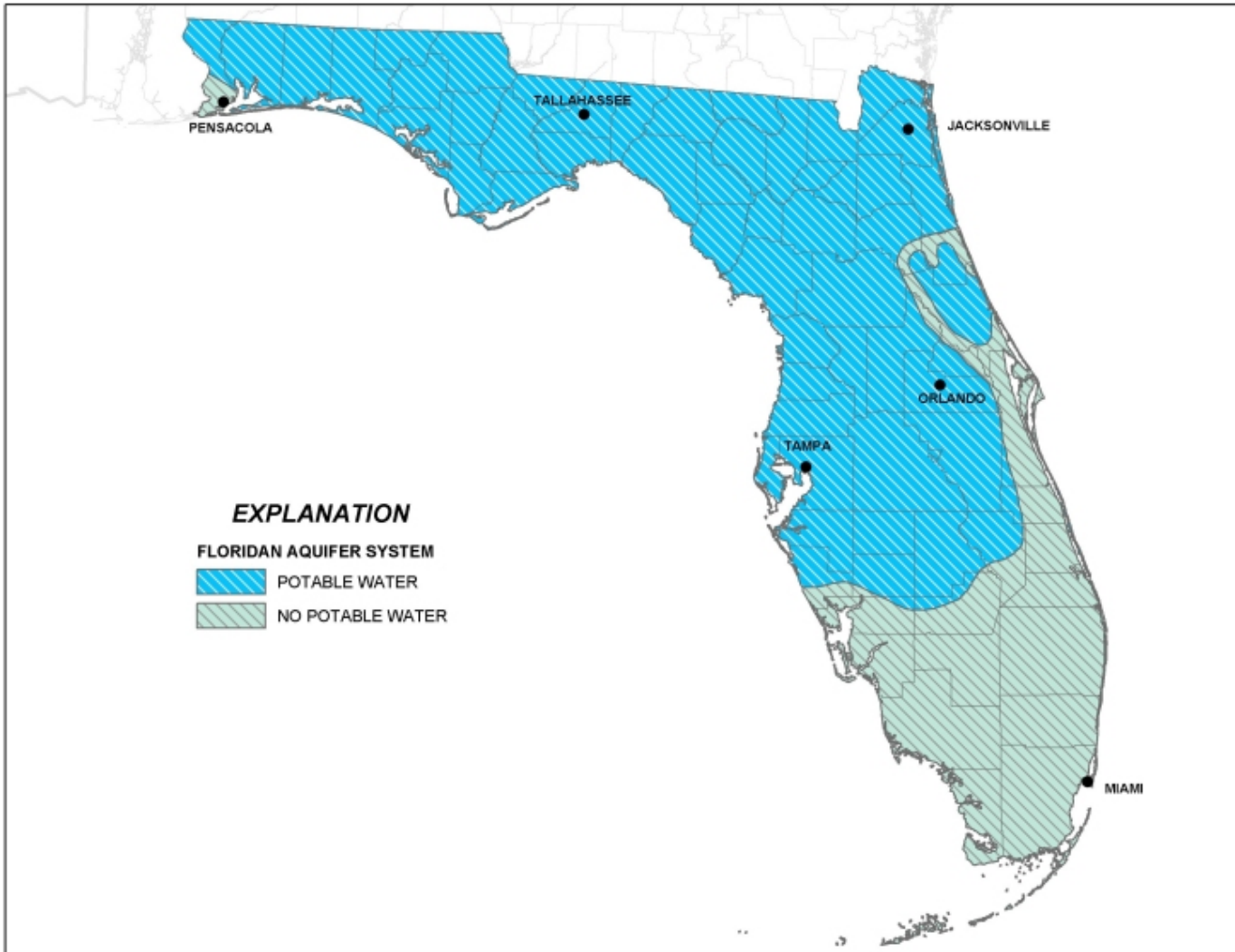
Areal extent of the Floridan aquifer system and region where it is used significantly



*¹ Significant is greater than 5% of county groundwater use based on 2000 data from Marella and Bendt (2005).

*² FAS significantly used in a portion of Key Largo in Monroe County

Source: USGS

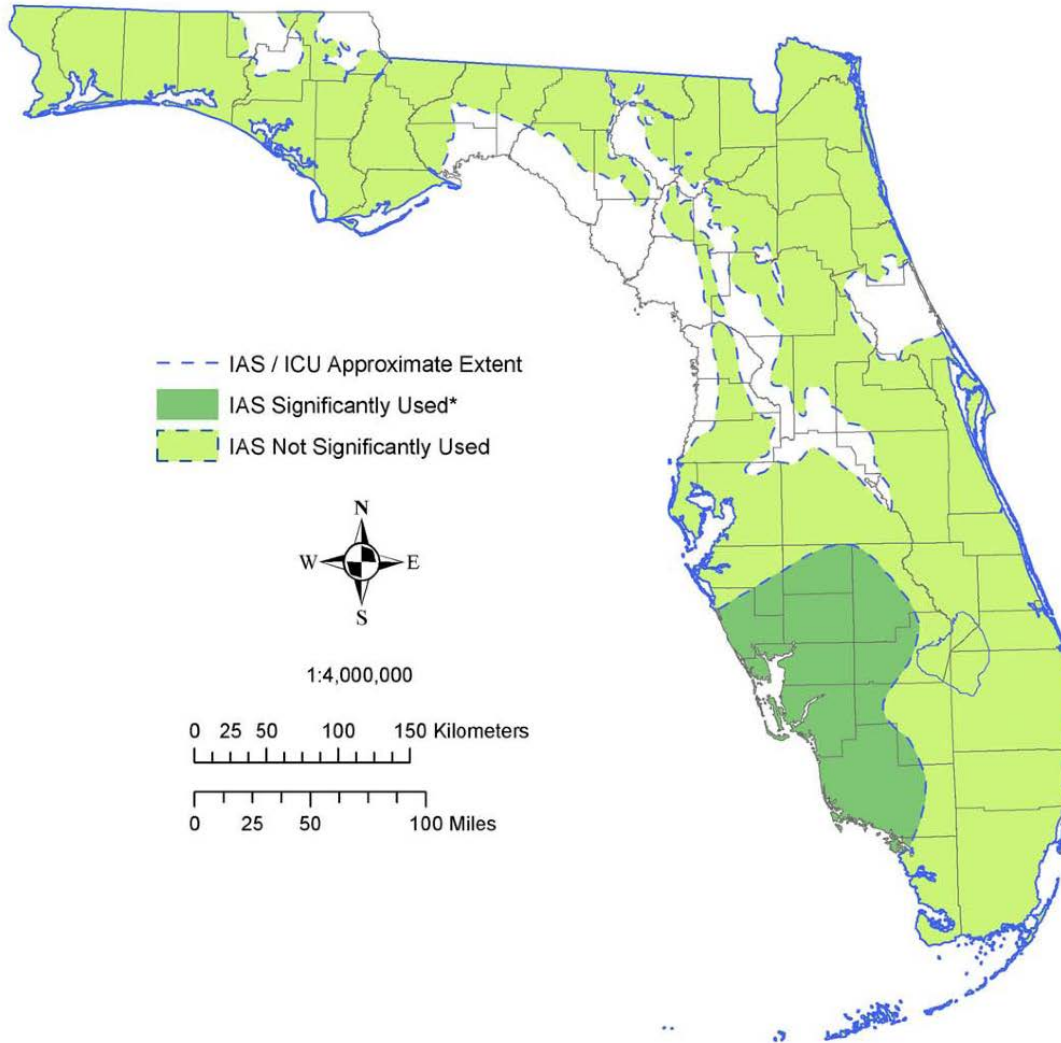


Source: USGS

FLORIDAN AQUIFER, POTABLE & NON-POTABLE ZONATION

Intermediate Aquifer System

Areal extent of the intermediate aquifer system or the intermediate confining unit and region where it is used significantly

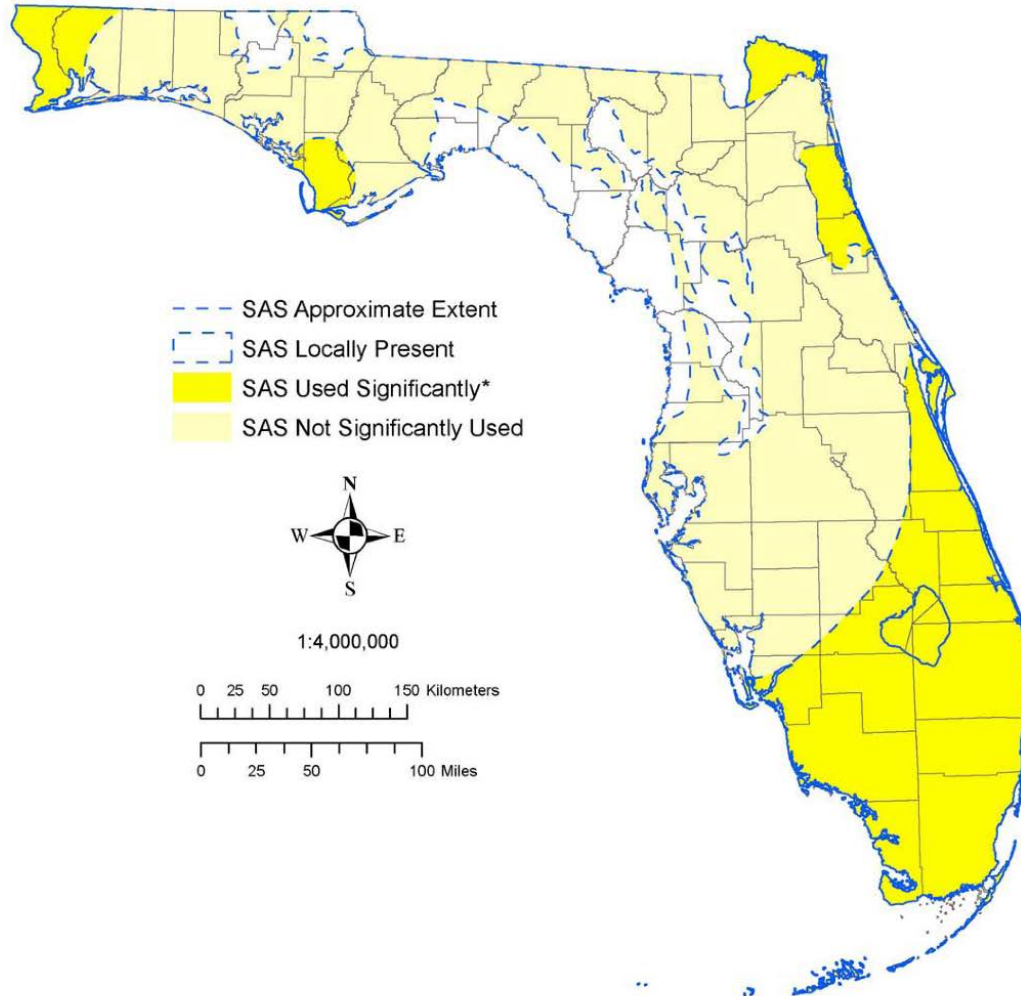


* Significant is greater than 5% of county groundwater use, based upon 2000 data from Marella and Bendt (2005)

Source: USGS

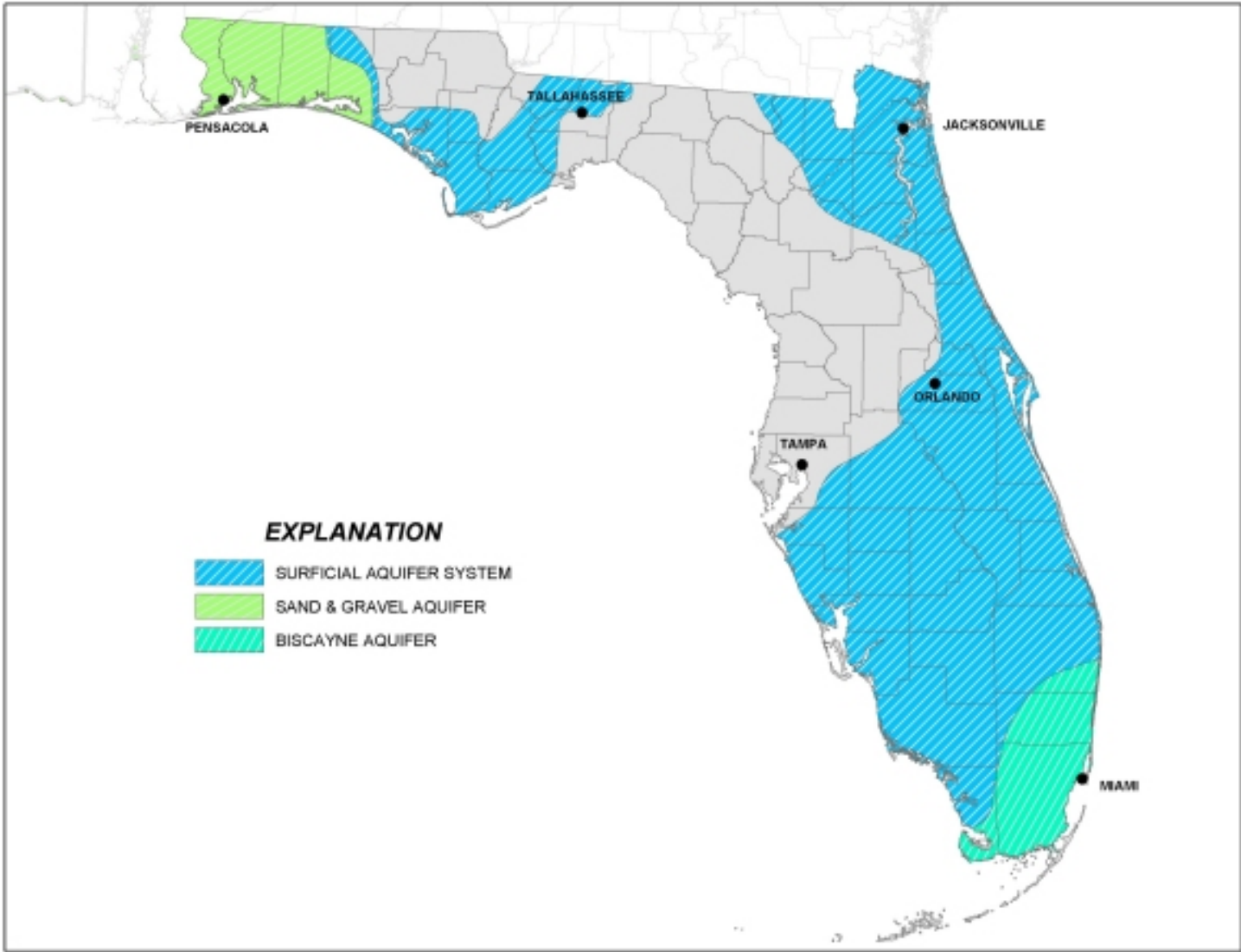
Surficial Aquifer System

Areal extent of the surficial aquifer system and regions where it is used significantly



* Significant is greater than 5% of county groundwater use, based upon 2000 data from Marella and Bendt (2005)

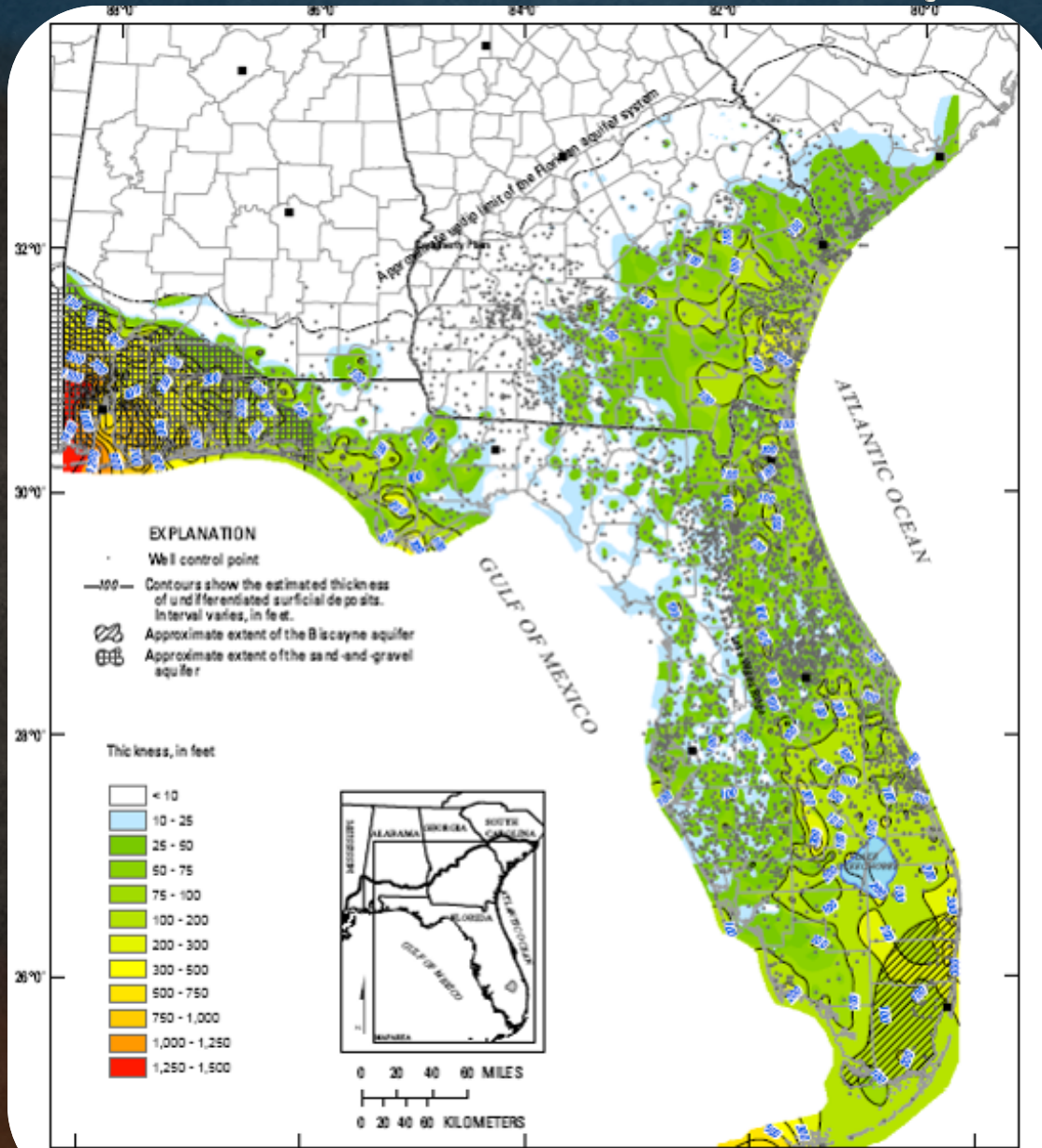
Source: USGS



Source: USGS

SURFICIAL AQUIFER SYSTEM MAP

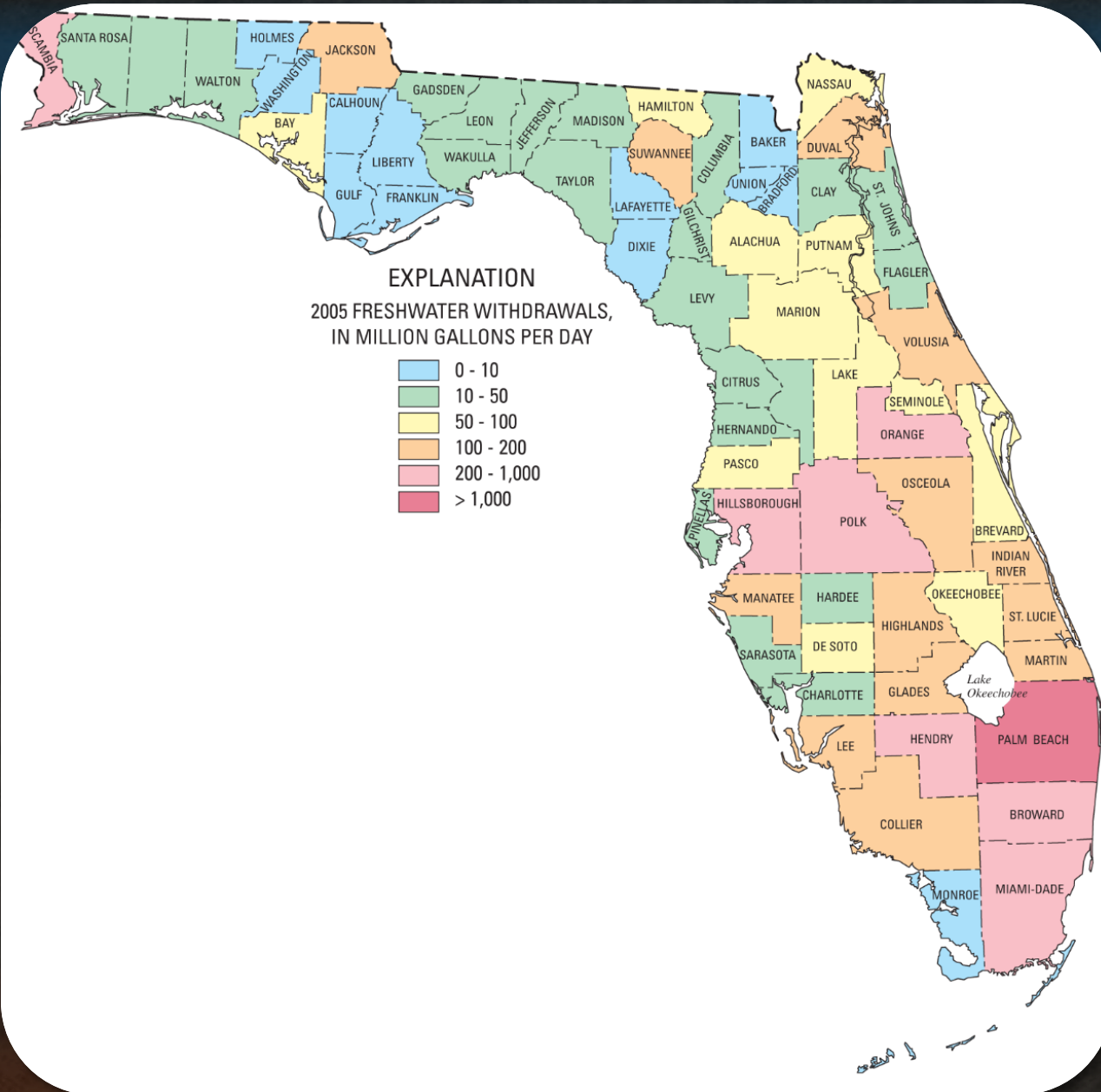
Surficial Aquifer System



Based on U. S. Geological Survey digital data, 1:100,000
 Albers Equal-Area Conic projection
 National datum as of January 1, 1983

Source: USGS

www.devoeng.com



Source: FDEP

Figure 3. Map showing freshwater withdrawals in Florida by county, 2005.

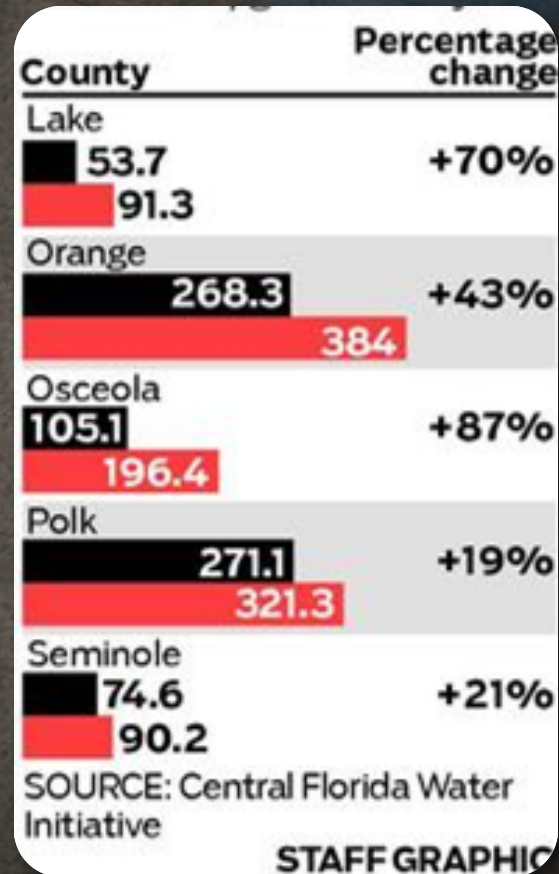
2035 Water Demand for Central Florida

A billion gallons

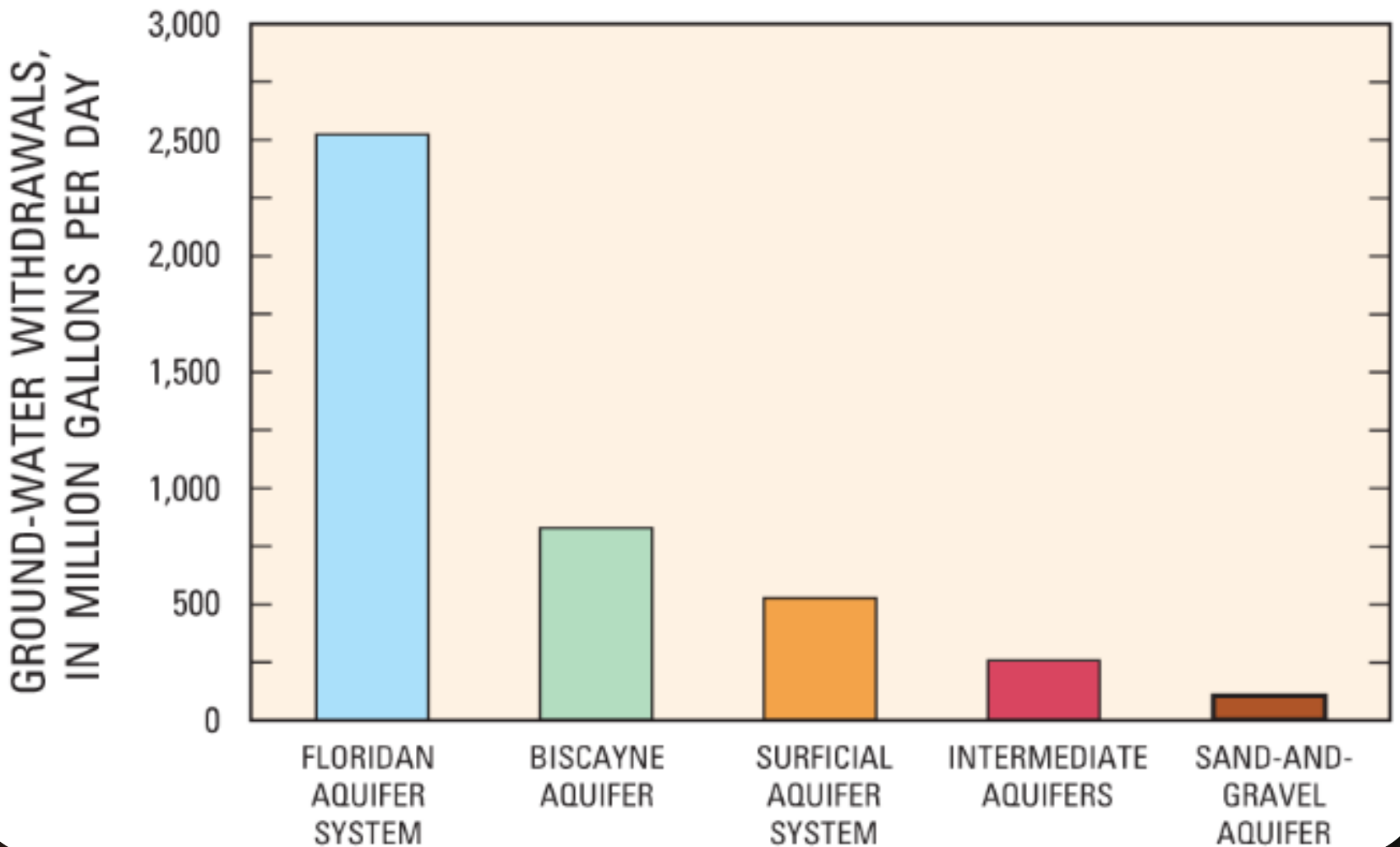
Central Florida will consume a billion gallons of water a day by 2035 and pumping all of it from the Floridan Aquifer would cause widespread environmental harm, according to new predictions.

■ 2010 ■ 2035

In millions of gallons a day

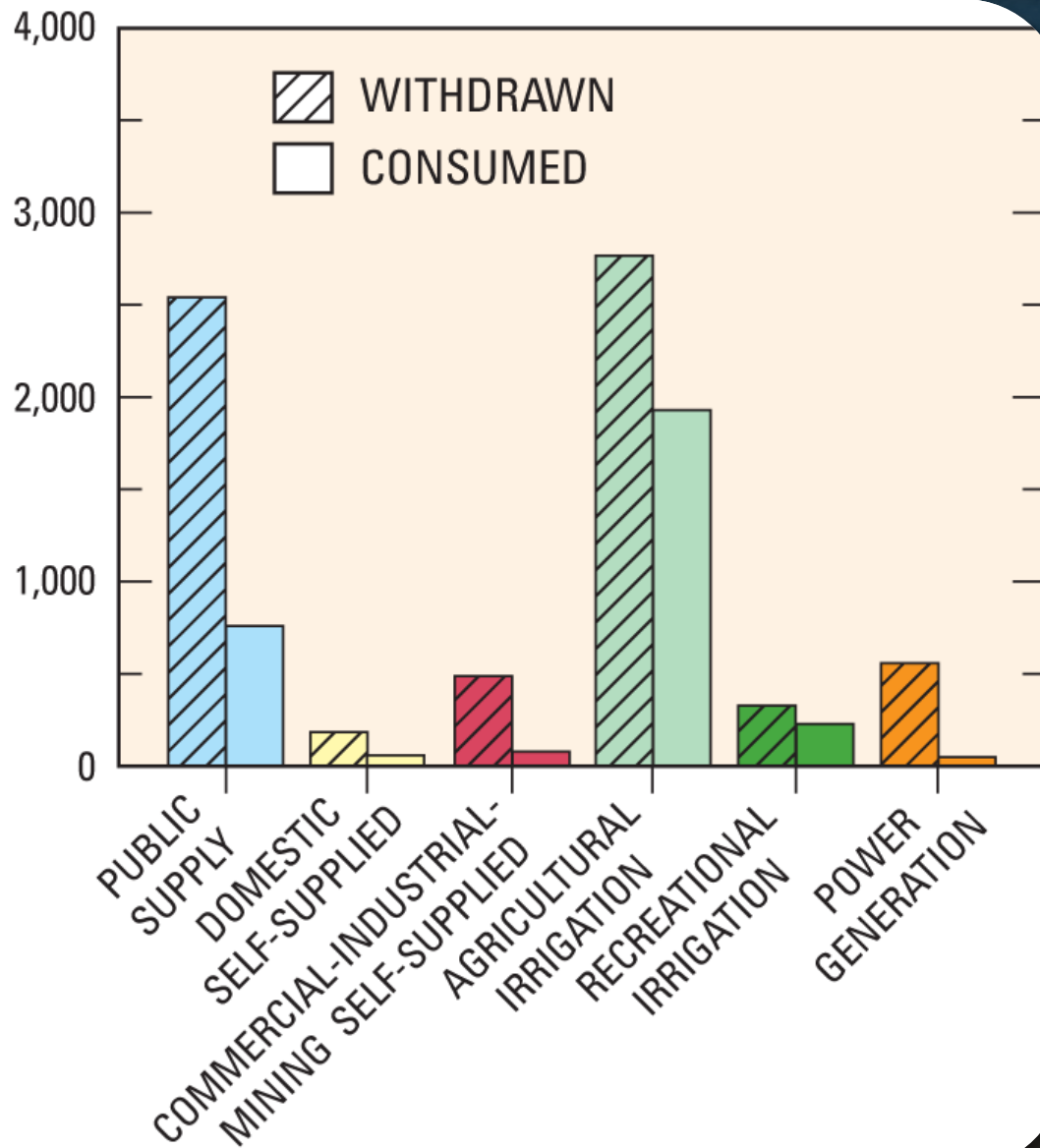


Source: Orlando Sentinel



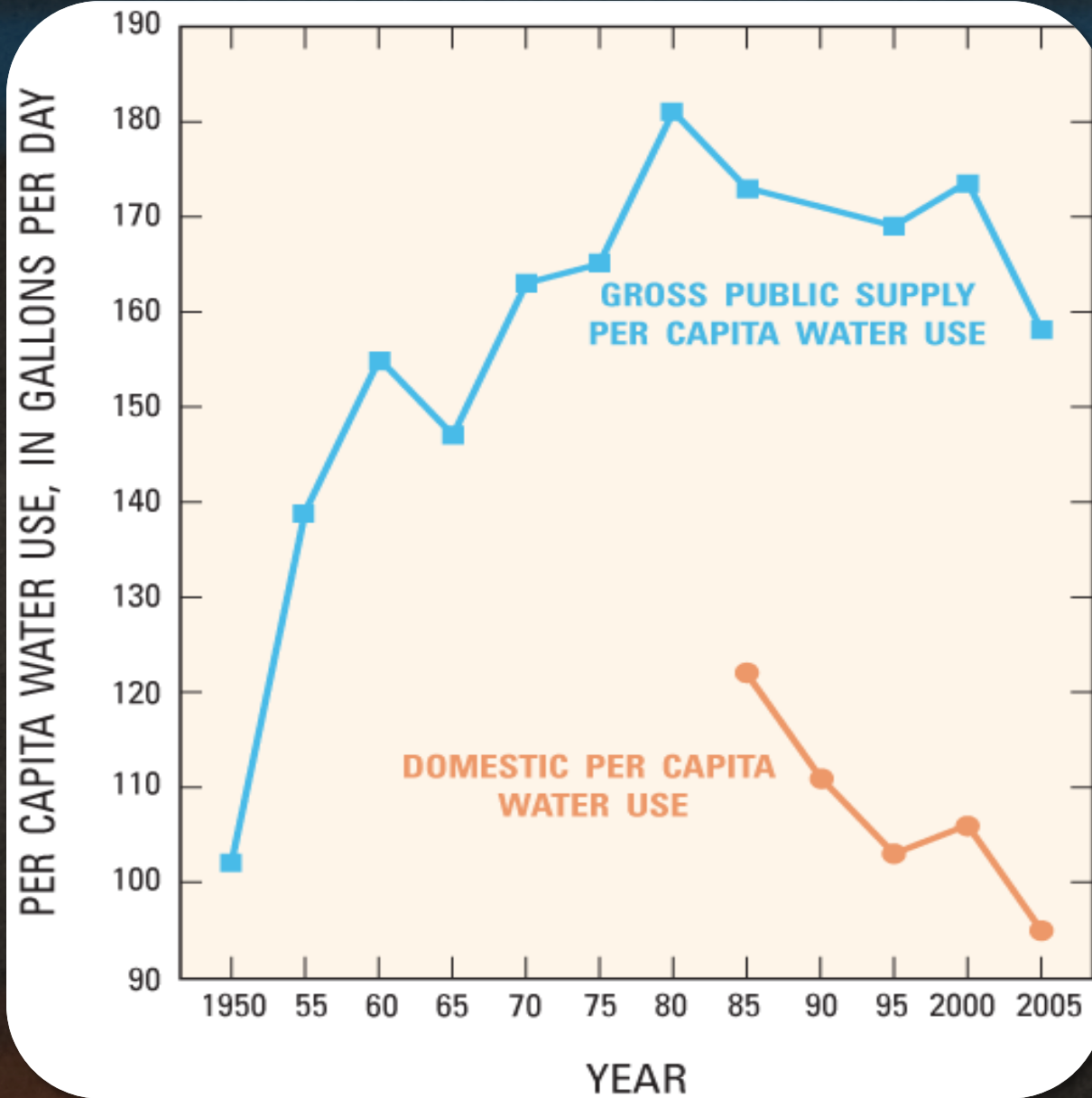
Source: FDEP

Figure 2. Ground-water withdrawals by principal aquifer in Florida, 2005.



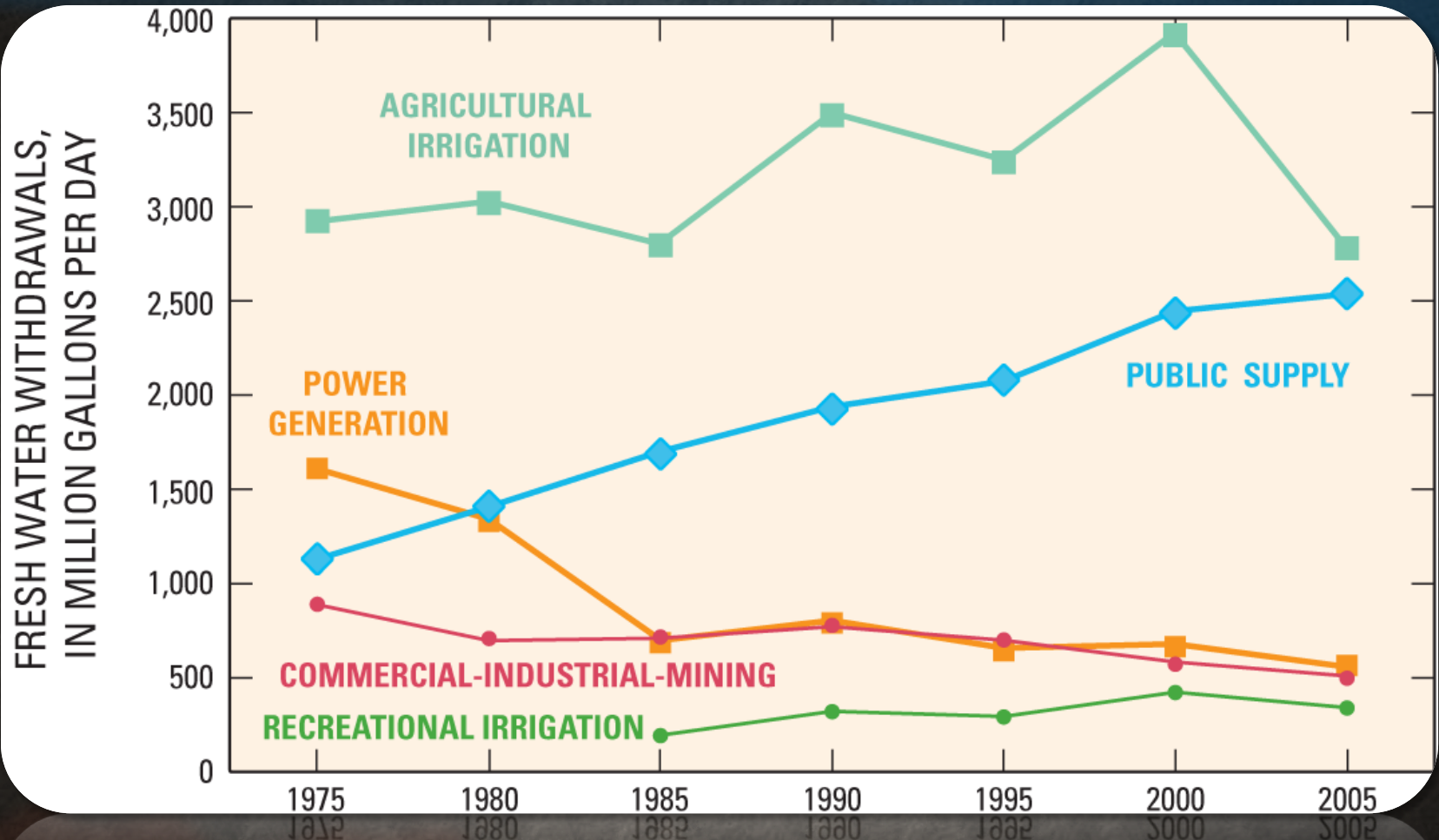
Source: FDEP

Figure 9. Freshwater withdrawals and estimated consumption in Florida by category, 2005.



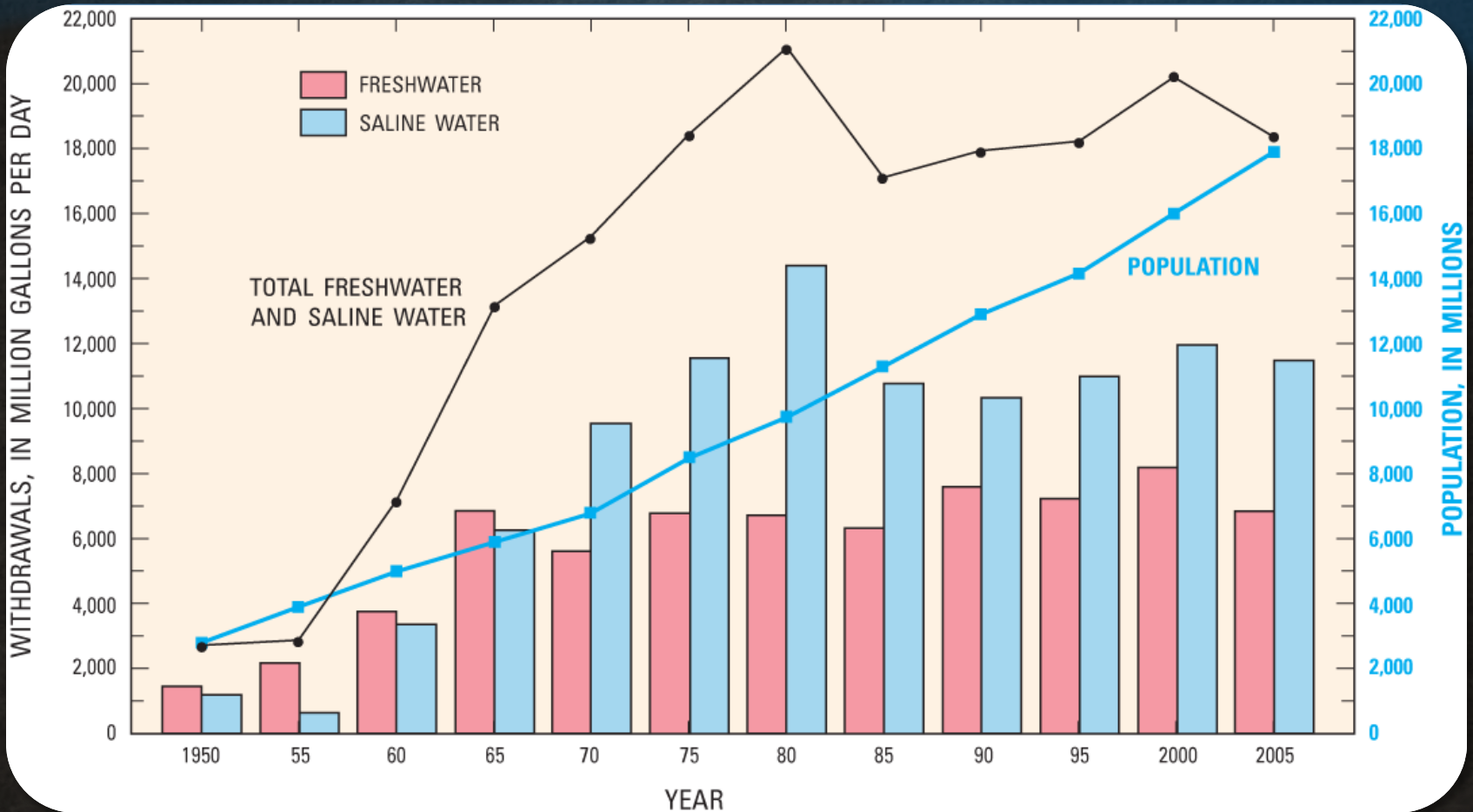
Source: FDEP

Figure 6. Historical gross public supply and domestic per capita water use in Florida, 1950-2005.



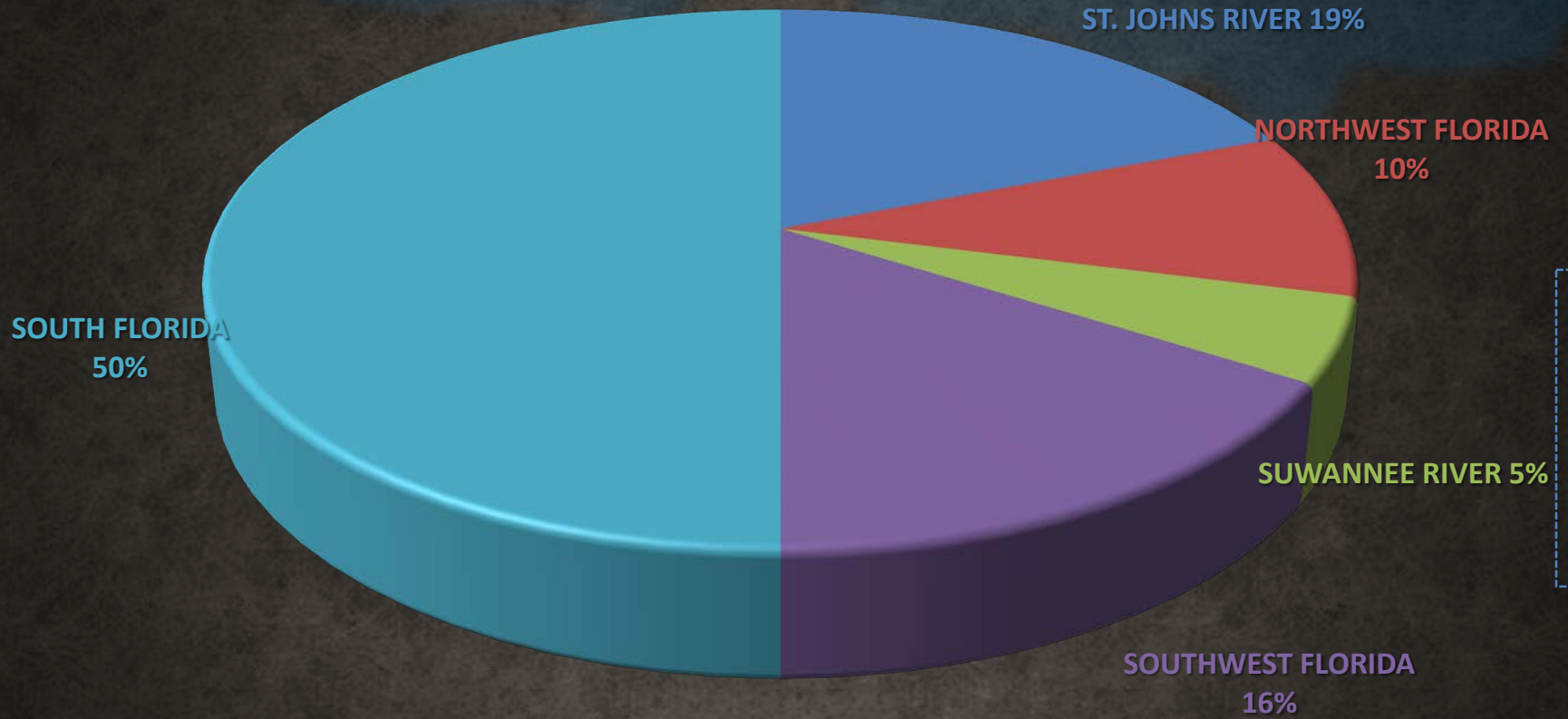
Source: FDEP

Figure 11. Historical freshwater withdrawals in Florida by category, 1975-2005.



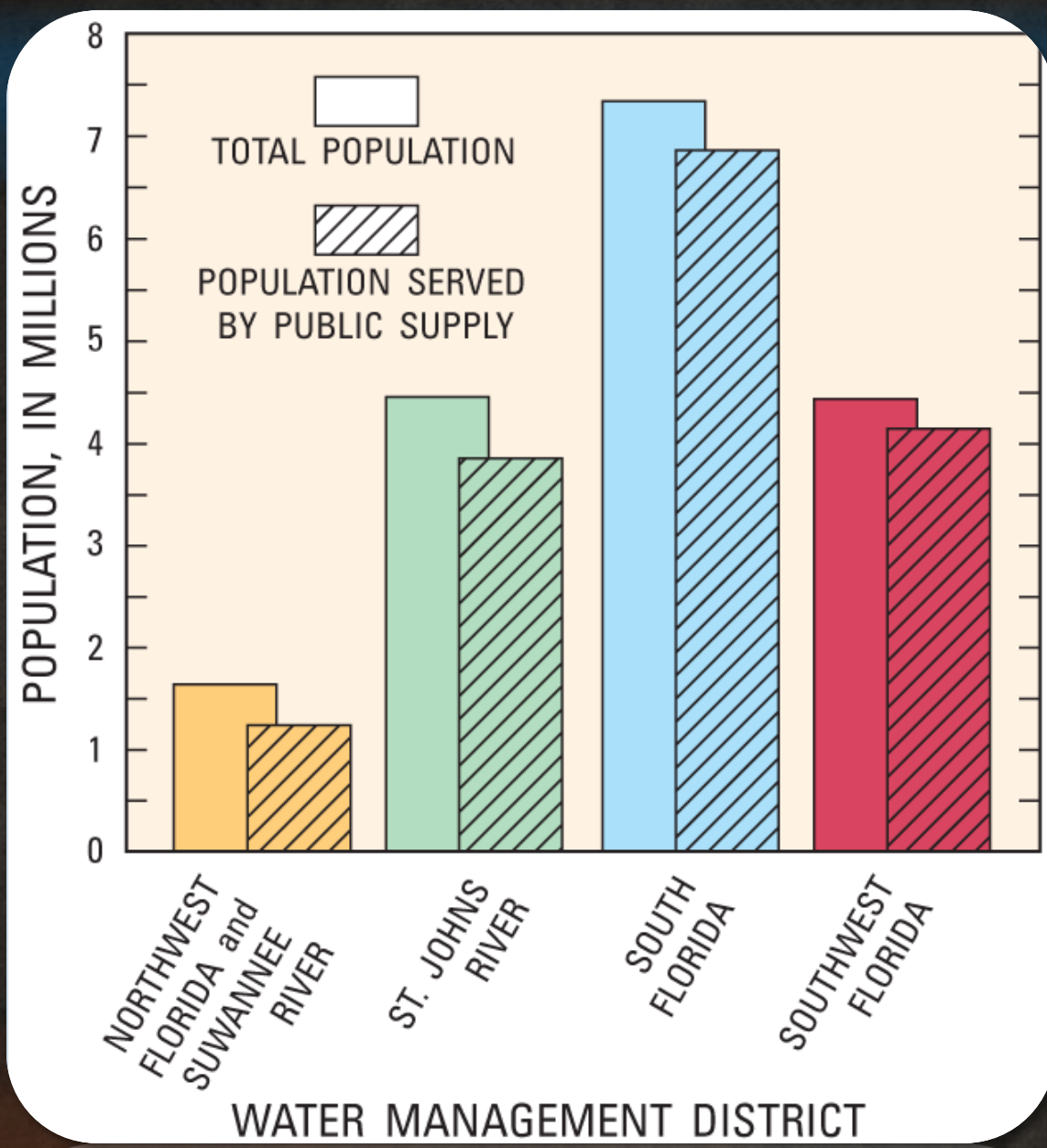
Source: FDEP

Figure 10. Historical population, total fresh, and saline water withdrawals in Florida, 1950-2005.



Source: FDEP

Figure 8. Freshwater withdrawals in Florida by WMD, 2005.



Source: FDEP

Figure 7. Population and population served by public supply in Florida by water management district, 2005.

Figure 4. Fresh ground-water withdrawals in Florida by category, 2005.

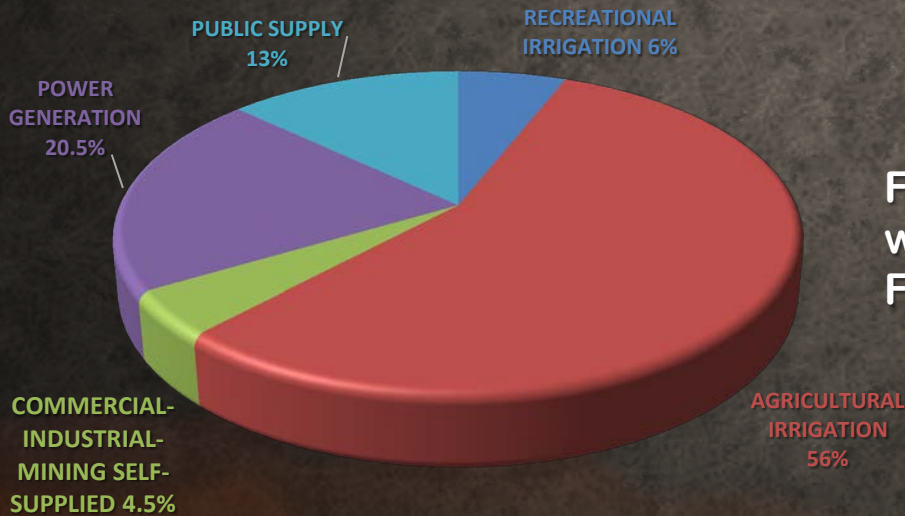
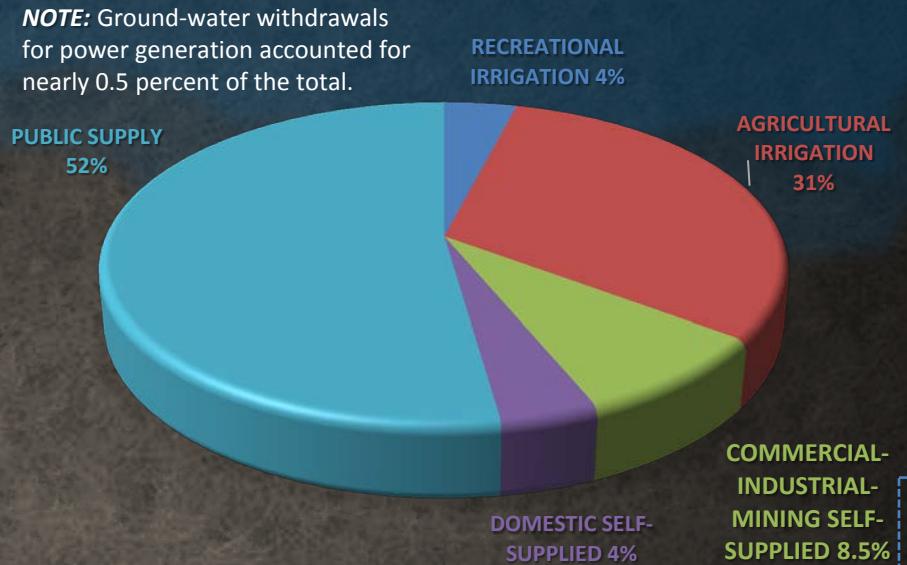
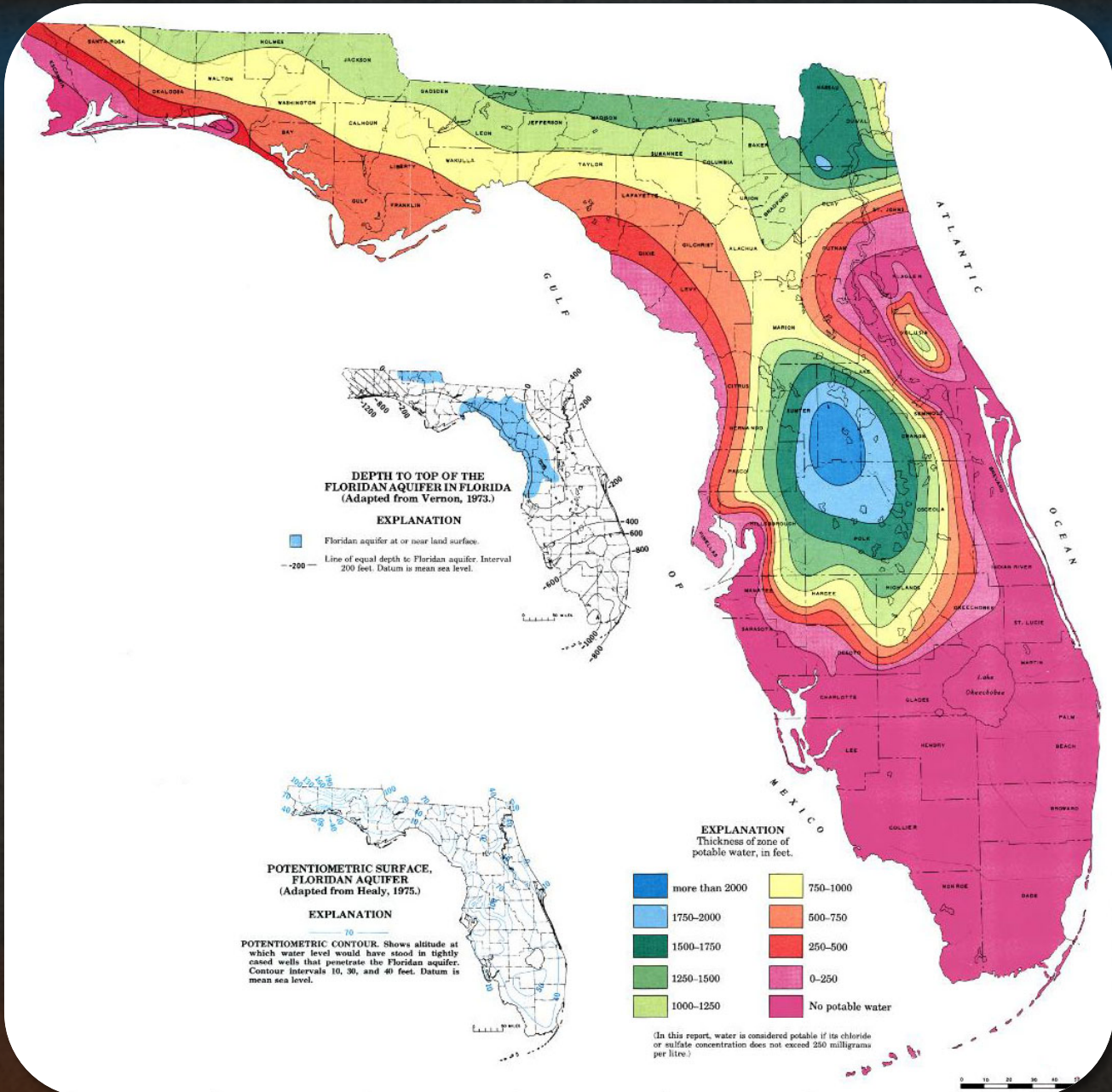


Figure 5. Fresh surface-water withdrawals in Florida by category, 2005.

Source: FDEP



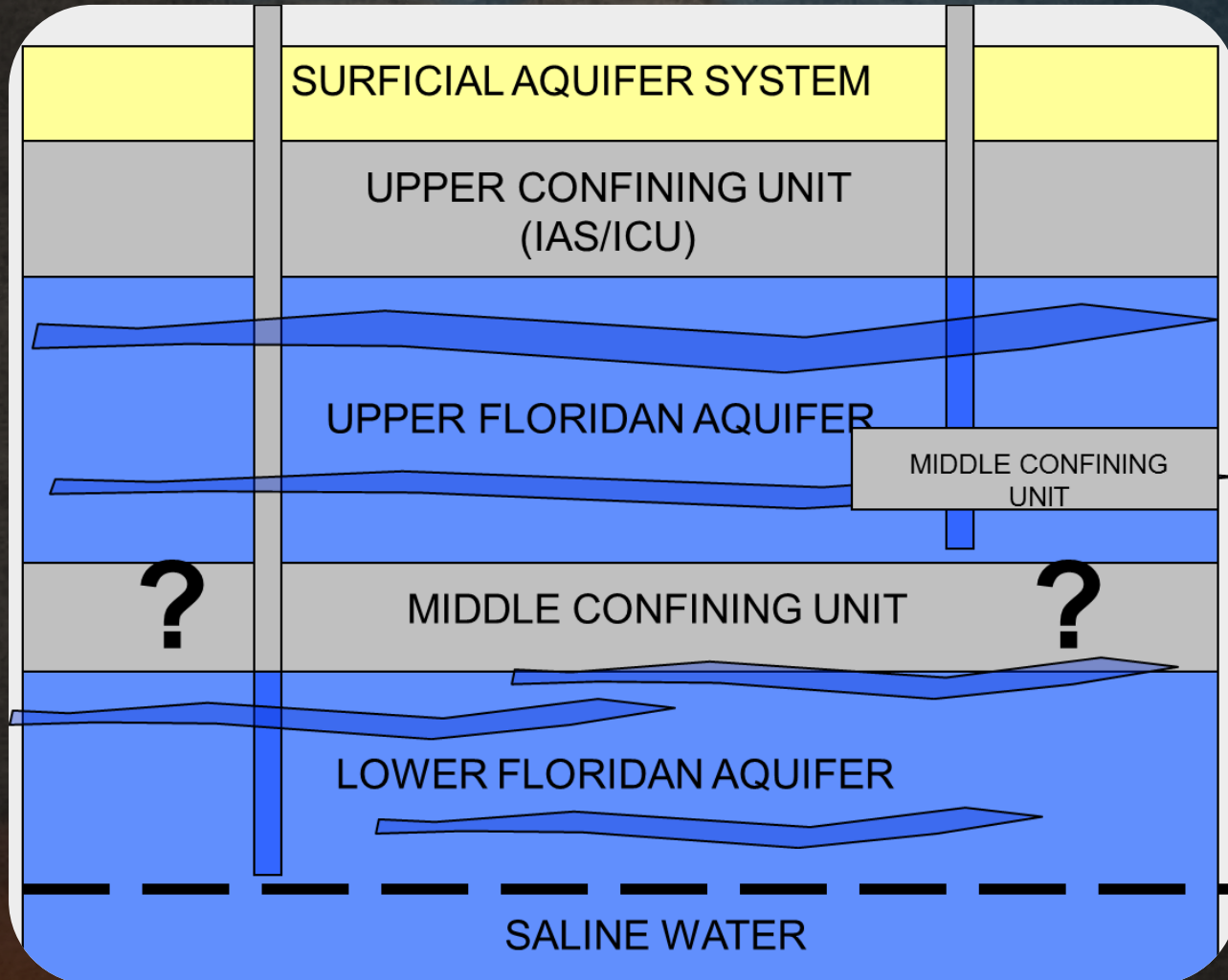
Source: USGS

www.devoeng.com

Thickness of Potable Water Zone in Floridan Aquifer



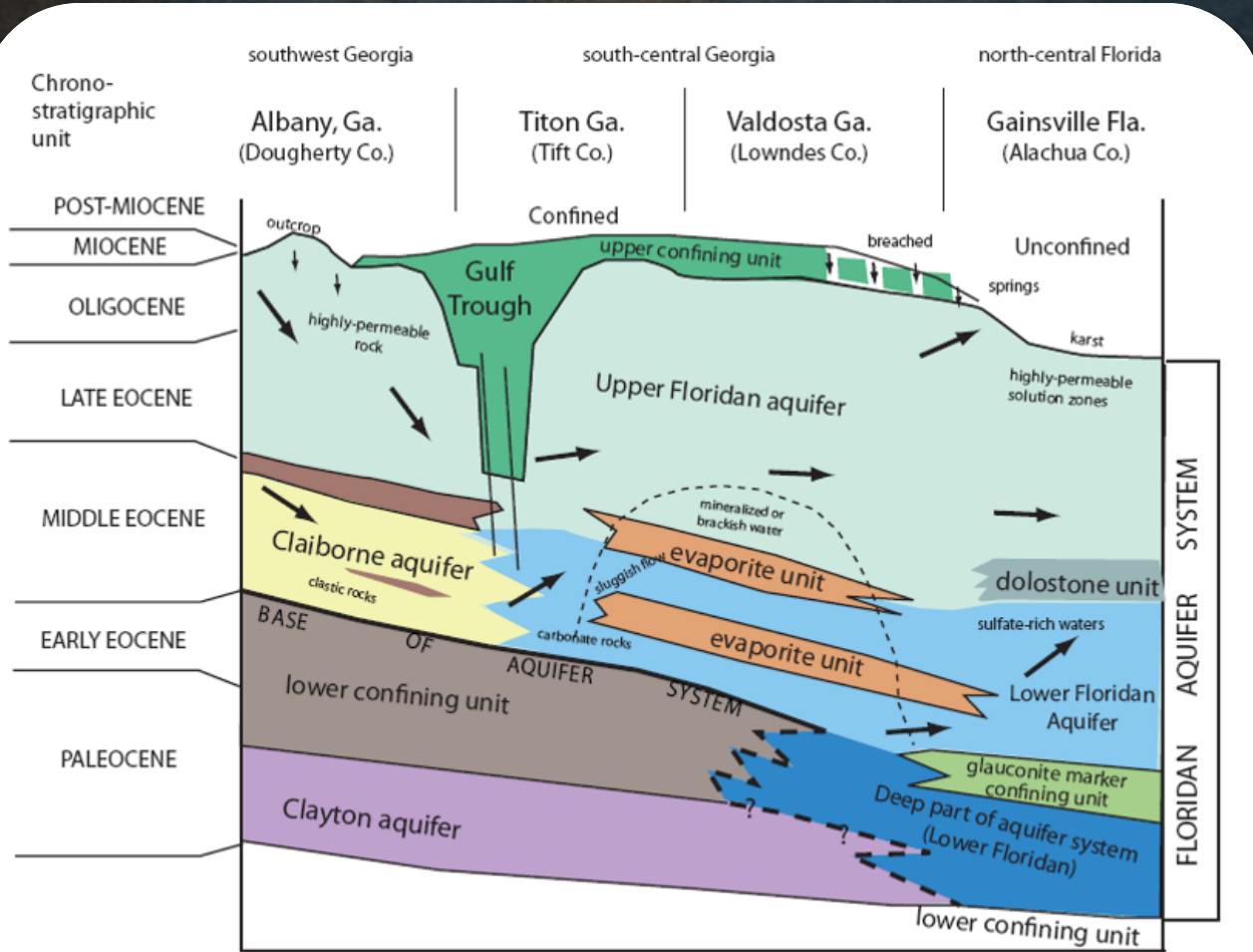
Floridan aquifer system: many ways to split the system into its permeable and less-permeable units



Source: USGS

www.devoeng.com

Conceptual model for southwest and south-central Ga. and going into north-central Florida

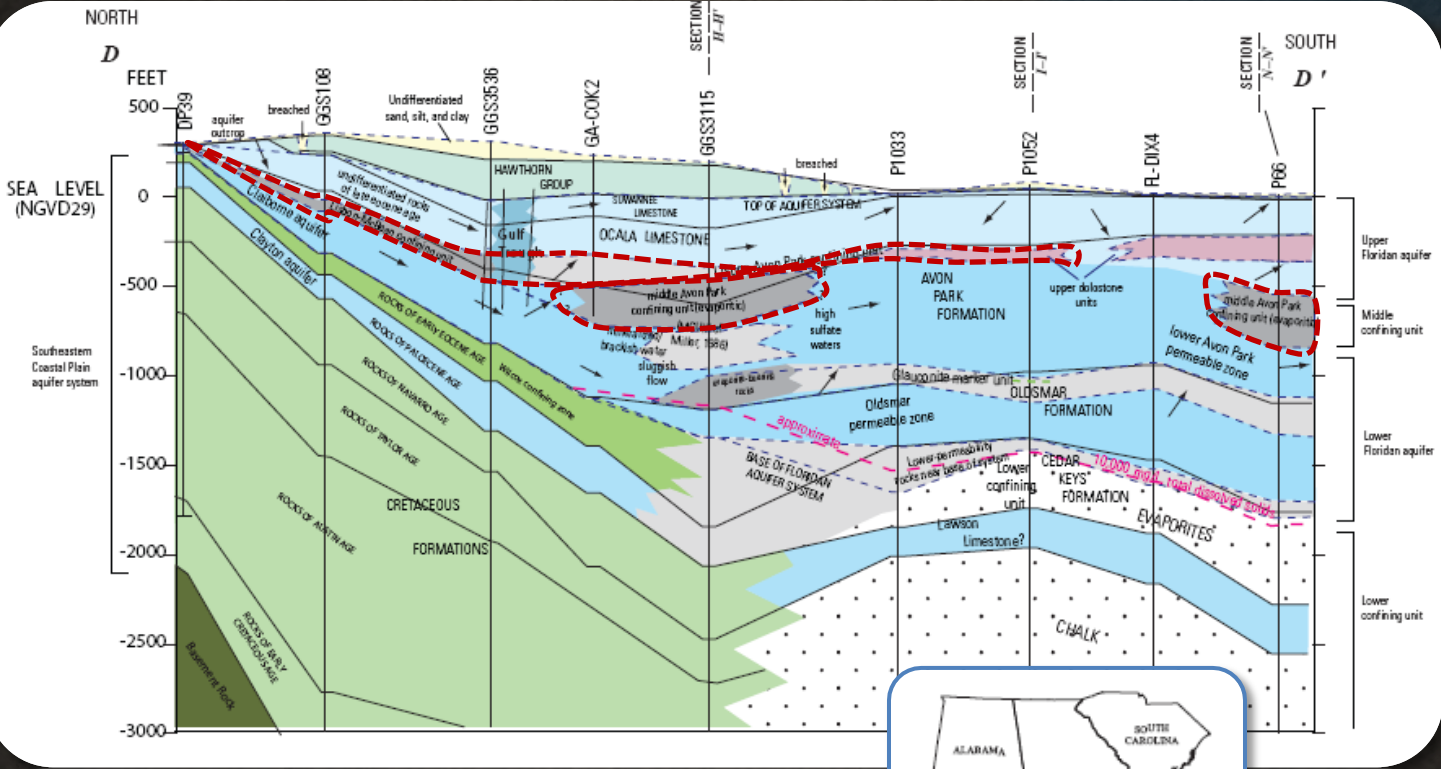


NOT TO SCALE

Figure 25. Schematic cross section showing transiotion of hydrogeologic units in southwest and south-central Georgia and north-central Florida. Arrows represent direction of groundwater movement.

Source: USGS

Generalized N-S cross section



Source: USGS

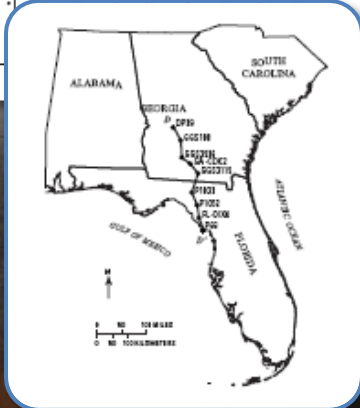
EXPLANATION

P388
 WELL --- Permit number or other unique identifier. See plate 1 for location.

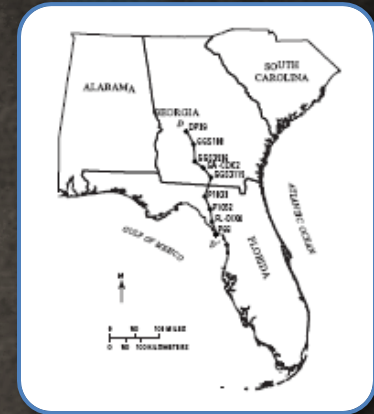
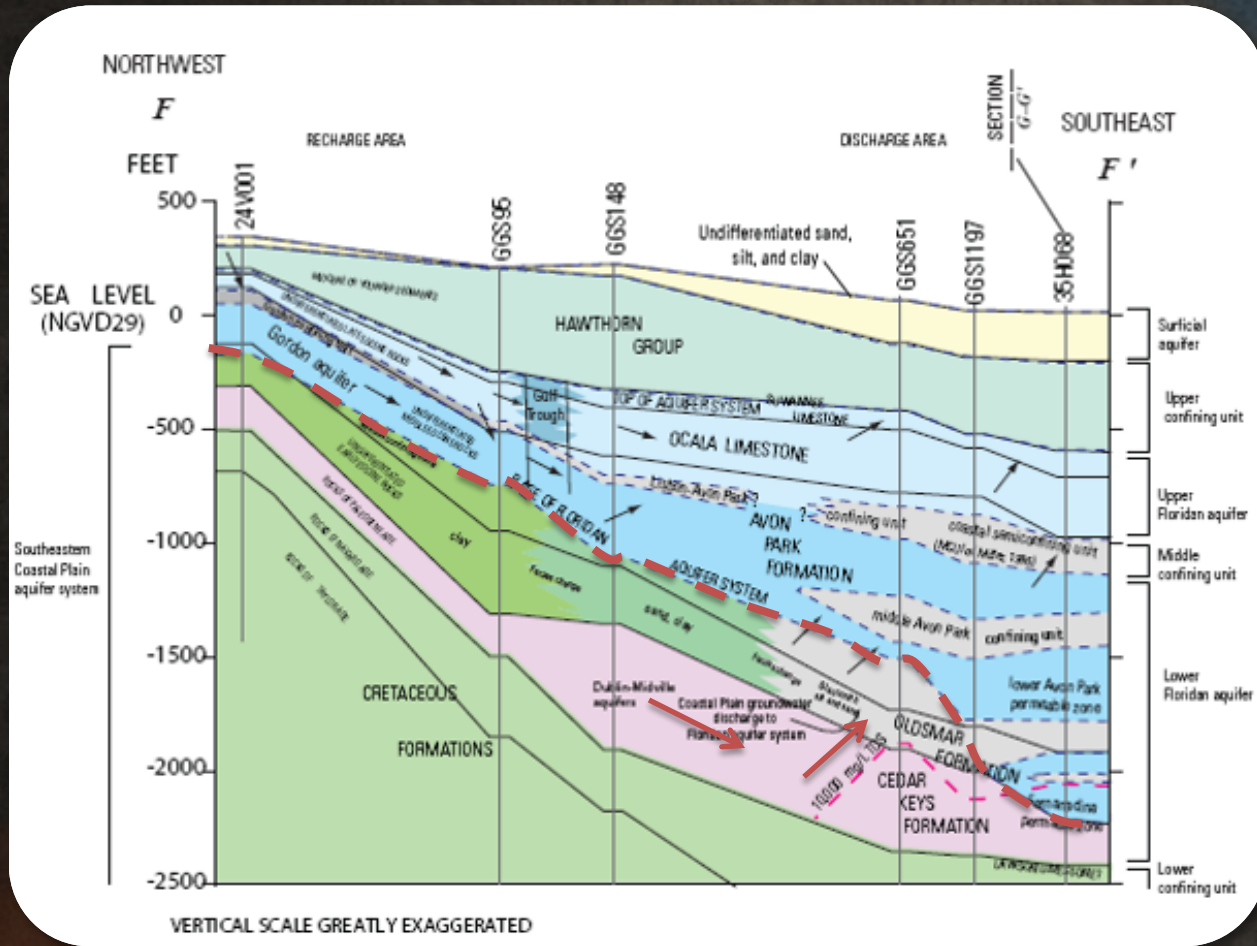
Generalized flow direction

Formation contact

Hydrogeologic boundary



Southeast Georgia Embayment and coastal plain units



Source: USGS

EXPLANATION

- P388 WELL --- Permit number or other unique identifier. See plate 1 for location.
- Generalized flow direction
- Formation contact
- Hydrogeologic boundary

Estimated position of salinity zones in Lower Floridan aquifer

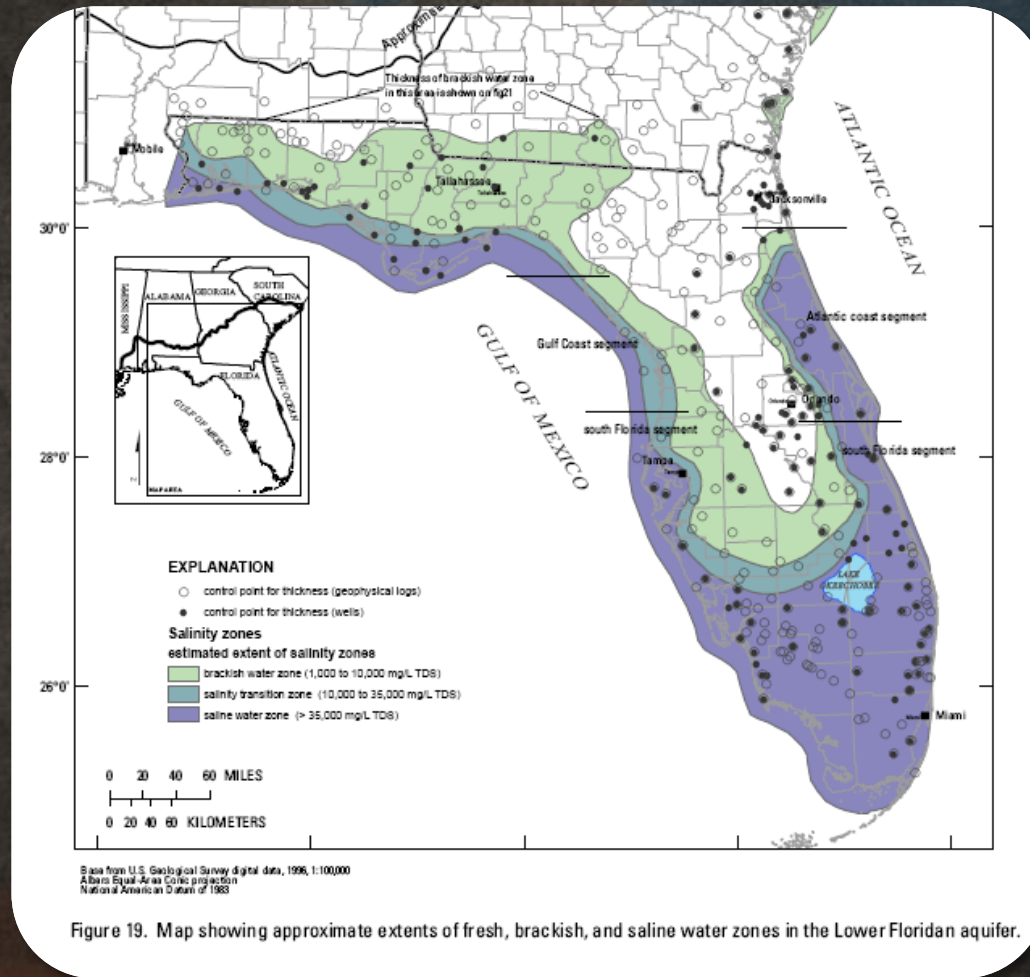
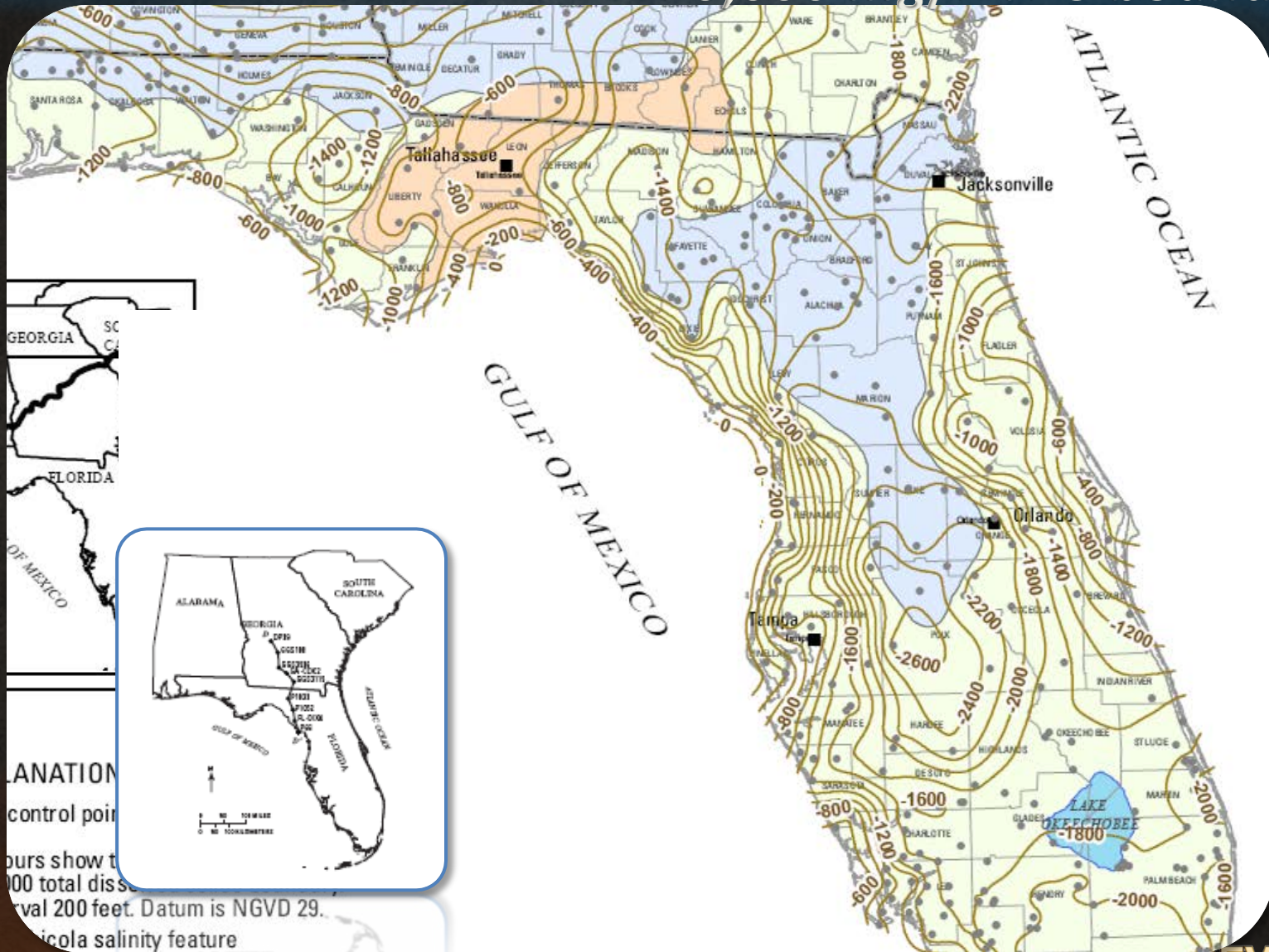


Figure 19. Map showing approximate extents of fresh, brackish, and saline water zones in the Lower Floridan aquifer.

Source: USGS

Elevation of Top of Saltwater in Florida 10,000 mg/L TDS boundary

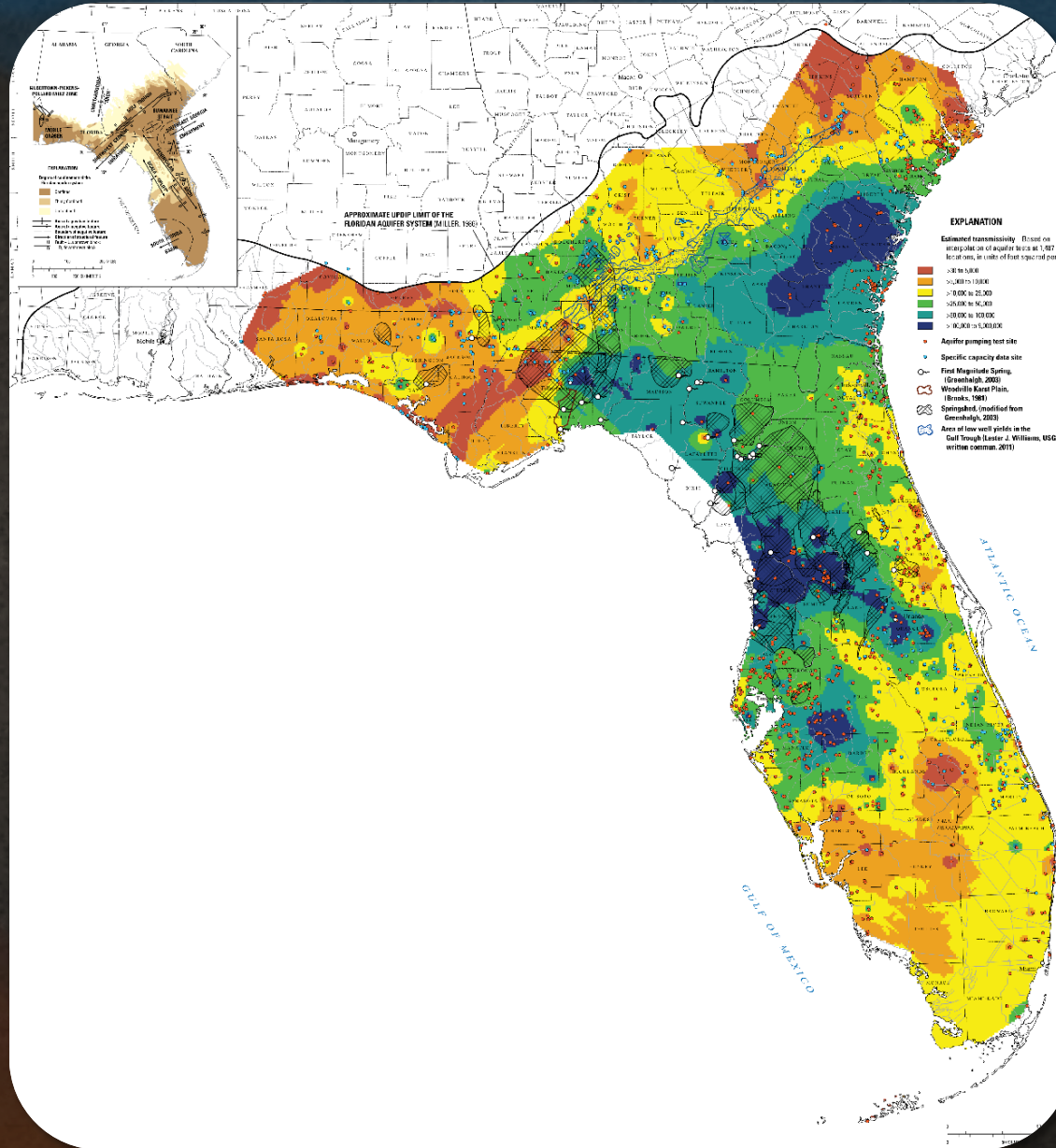


Source: USGS



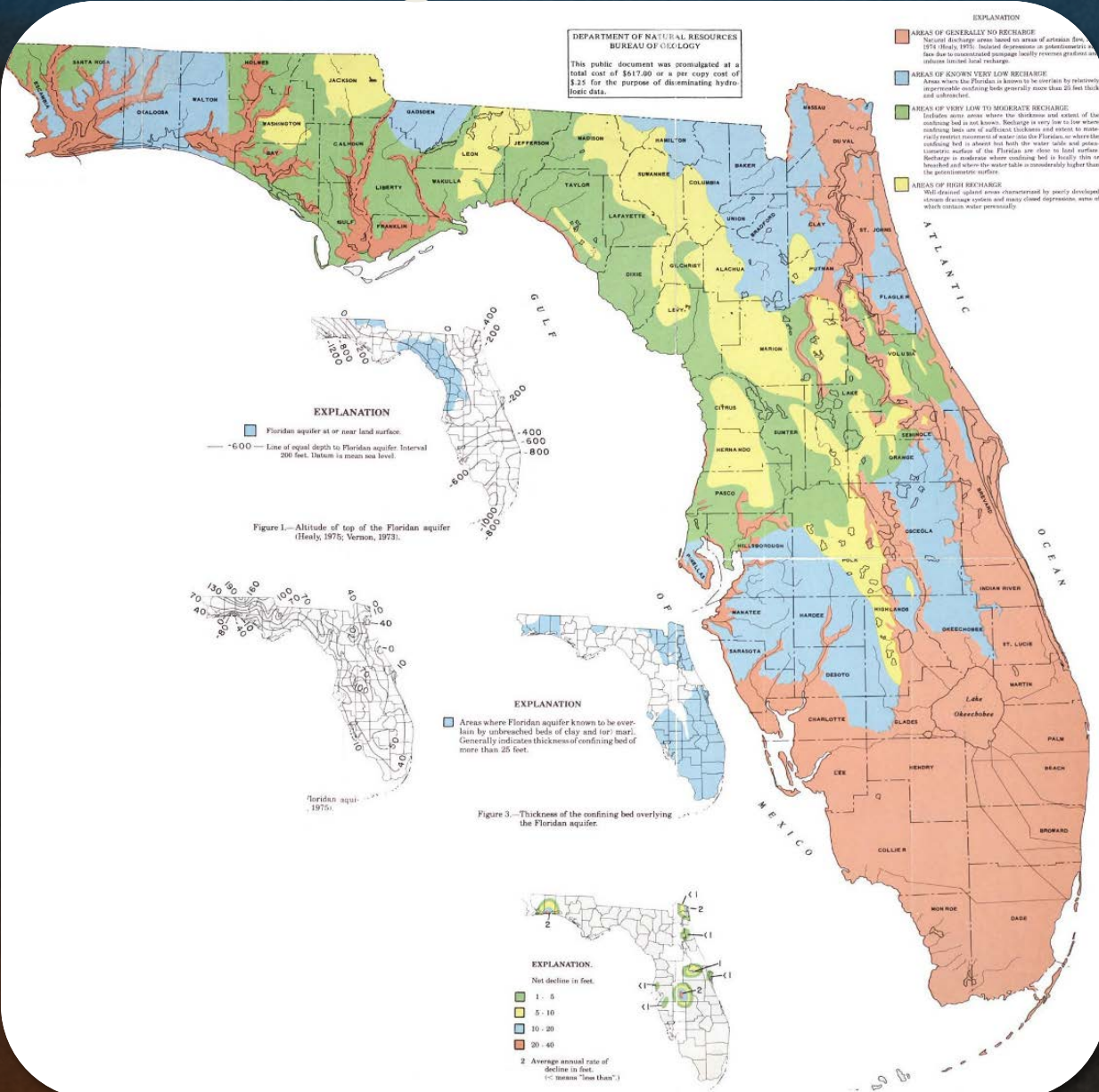
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000 total dis
val 200 feet. Datum is NGVD 29.
nicola salinity feature

Transmissivity of the Upper Floridan Aquifer

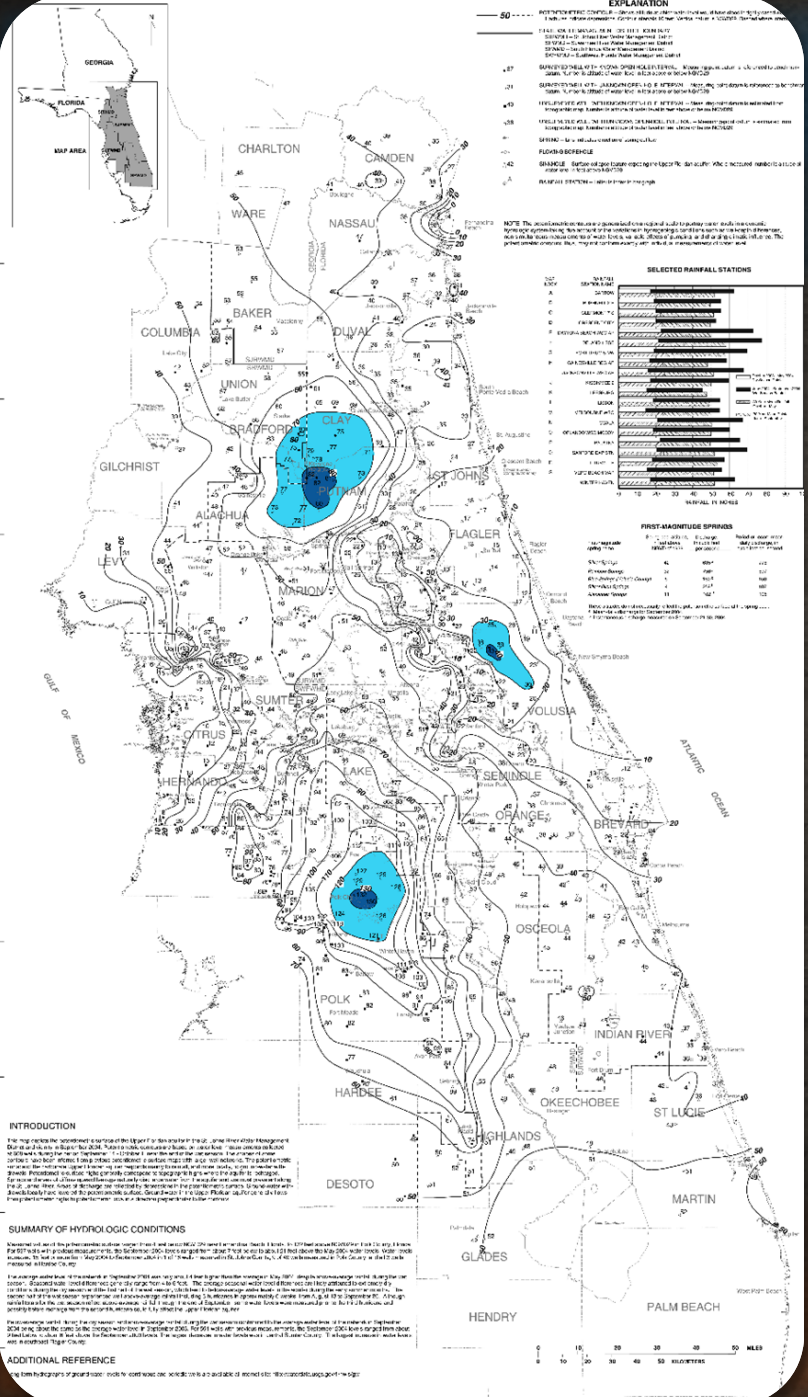


Source: USGS

Natural Recharge to the Floridan Aquifer



Source: USGS



EXPLANATION

1. Contour interval: 1 foot (0.305 m)

2. Contour interval: 2 feet (0.610 m)

3. Contour interval: 3 feet (0.915 m)

4. Contour interval: 4 feet (1.220 m)

5. Contour interval: 5 feet (1.525 m)

6. Contour interval: 6 feet (1.830 m)

7. Contour interval: 7 feet (2.135 m)

8. Contour interval: 8 feet (2.440 m)

9. Contour interval: 9 feet (2.745 m)

10. Contour interval: 10 feet (3.050 m)

11. Contour interval: 11 feet (3.355 m)

12. Contour interval: 12 feet (3.660 m)

13. Contour interval: 13 feet (3.965 m)

14. Contour interval: 14 feet (4.270 m)

15. Contour interval: 15 feet (4.575 m)

16. Contour interval: 16 feet (4.880 m)

17. Contour interval: 17 feet (5.185 m)

18. Contour interval: 18 feet (5.490 m)

19. Contour interval: 19 feet (5.795 m)

20. Contour interval: 20 feet (6.100 m)

21. Contour interval: 21 feet (6.405 m)

22. Contour interval: 22 feet (6.710 m)

23. Contour interval: 23 feet (7.015 m)

24. Contour interval: 24 feet (7.320 m)

25. Contour interval: 25 feet (7.625 m)

26. Contour interval: 26 feet (7.930 m)

27. Contour interval: 27 feet (8.235 m)

28. Contour interval: 28 feet (8.540 m)

29. Contour interval: 29 feet (8.845 m)

30. Contour interval: 30 feet (9.150 m)

31. Contour interval: 31 feet (9.455 m)

32. Contour interval: 32 feet (9.760 m)

33. Contour interval: 33 feet (10.065 m)

34. Contour interval: 34 feet (10.370 m)

35. Contour interval: 35 feet (10.675 m)

36. Contour interval: 36 feet (10.980 m)

37. Contour interval: 37 feet (11.285 m)

38. Contour interval: 38 feet (11.590 m)

39. Contour interval: 39 feet (11.895 m)

40. Contour interval: 40 feet (12.200 m)

41. Contour interval: 41 feet (12.505 m)

42. Contour interval: 42 feet (12.810 m)

43. Contour interval: 43 feet (13.115 m)

44. Contour interval: 44 feet (13.420 m)

45. Contour interval: 45 feet (13.725 m)

46. Contour interval: 46 feet (14.030 m)

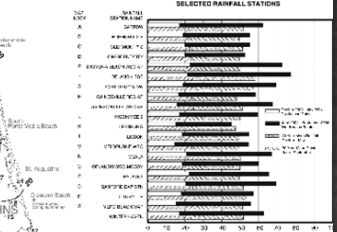
47. Contour interval: 47 feet (14.335 m)

48. Contour interval: 48 feet (14.640 m)

49. Contour interval: 49 feet (14.945 m)

50. Contour interval: 50 feet (15.250 m)

NOTE: The potentiometric surface is shown by contour lines. Contour lines are drawn at 1-foot intervals. Contour lines are labeled with their elevation in feet above mean sea level. Contour lines are drawn at 1-foot intervals. Contour lines are labeled with their elevation in feet above mean sea level. Contour lines are drawn at 1-foot intervals. Contour lines are labeled with their elevation in feet above mean sea level.





INTRODUCTION

The purpose of this report is to provide a potentiometric surface map of the upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, for the month of September 2008. The map shows the potentiometric surface of the upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, for the month of September 2008. The map shows the potentiometric surface of the upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, for the month of September 2008.

SUMMARY OF HYDROLOGIC CONDITIONS

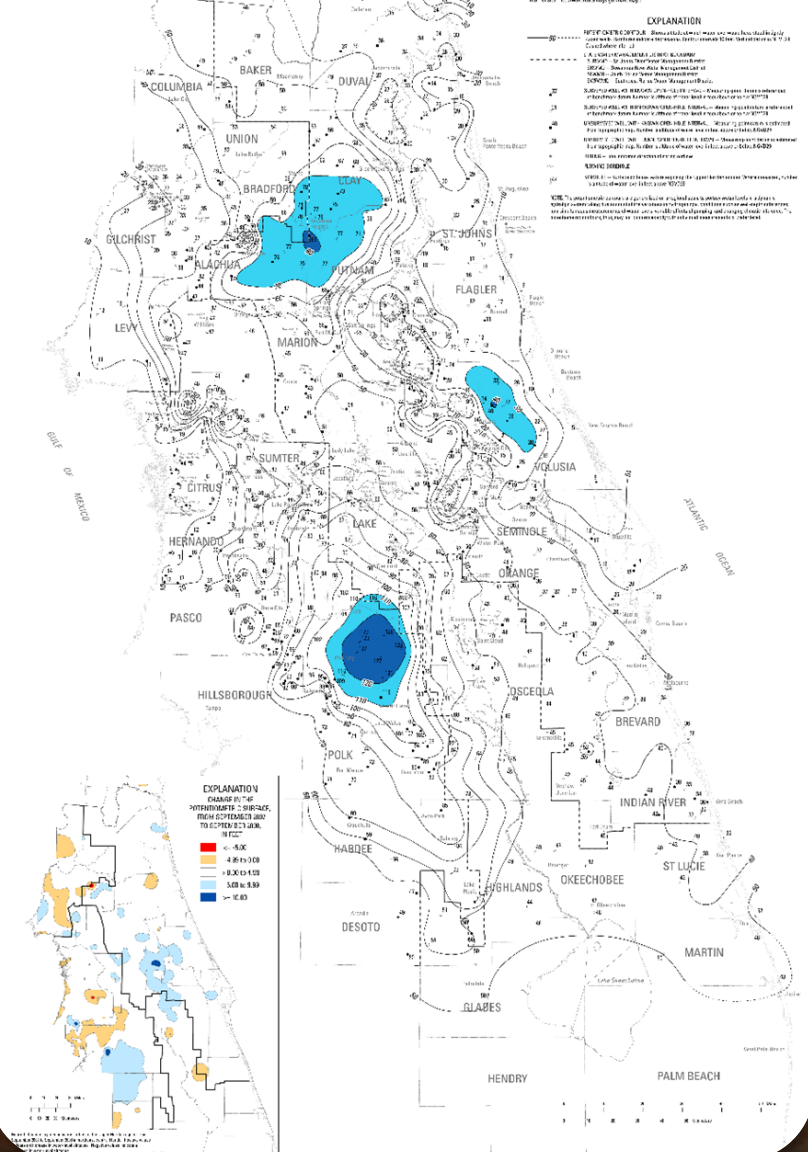
The upper Floridan aquifer is a sandstone and siltstone unit that is part of the Suwannee River Formation. It is a regional aquifer that is recharged by precipitation and discharge to the Gulf of Mexico. The aquifer is generally unconfined and is in hydraulic contact with the underlying lower Floridan aquifer. The potentiometric surface of the upper Floridan aquifer is generally higher than the surface of the land, indicating that the aquifer is overpressured. The potentiometric surface of the upper Floridan aquifer is generally higher than the surface of the land, indicating that the aquifer is overpressured.

ADDITIONAL REFERENCE

Florida Department of Natural Resources, Bureau of Geology, 2008. Potentiometric Surface of the Upper Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 2008.

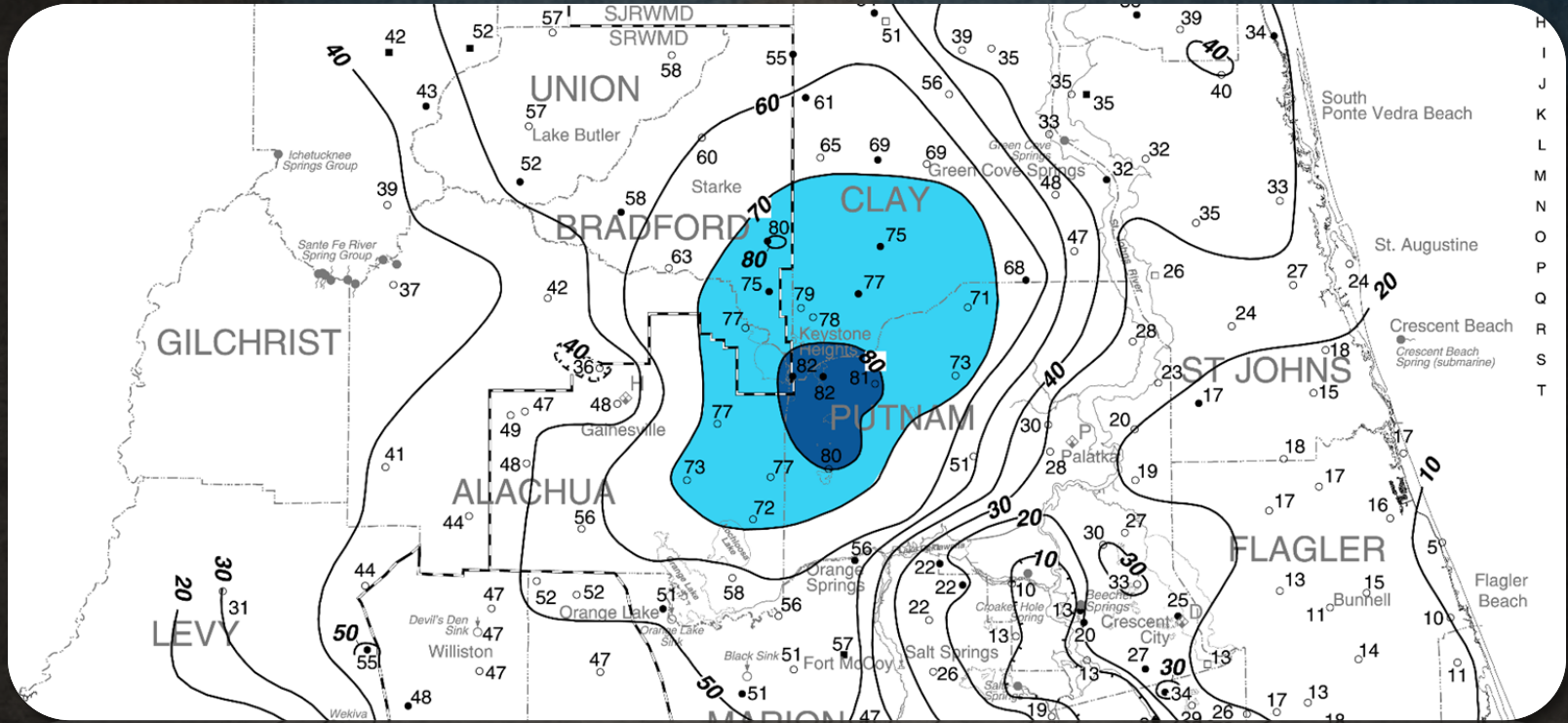
EXPLANATION

- - - - - HYDROLOGIC BOUNDARY
 - - - - - COUNTY BOUNDARY
 - - - - - TOWNSHIP BOUNDARY
 - - - - - SECTION BOUNDARY
 - - - - - RAILROAD BOUNDARY
 - - - - - WATERWAY BOUNDARY
 - - - - - ROAD BOUNDARY
 - - - - - FENCE BOUNDARY
 - - - - - POWERLINE BOUNDARY
 - - - - - TELEPHONE BOUNDARY
 - - - - - FLOODPLAIN BOUNDARY
 - - - - - ELEVATION CONTOUR
 - - - - - POTENTIOMETRIC SURFACE
 - - - - - WATER TABLE
 - - - - - SURFACE WATER
 - - - - - WETLAND
 - - - - - URBAN DEVELOPMENT
 - - - - - AGRICULTURE
 - - - - - FOREST
 - - - - - OPEN SPACE
 - - - - - WETLAND
 - - - - - URBAN DEVELOPMENT
 - - - - - AGRICULTURE
 - - - - - FOREST
 - - - - - OPEN SPACE



POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 2008

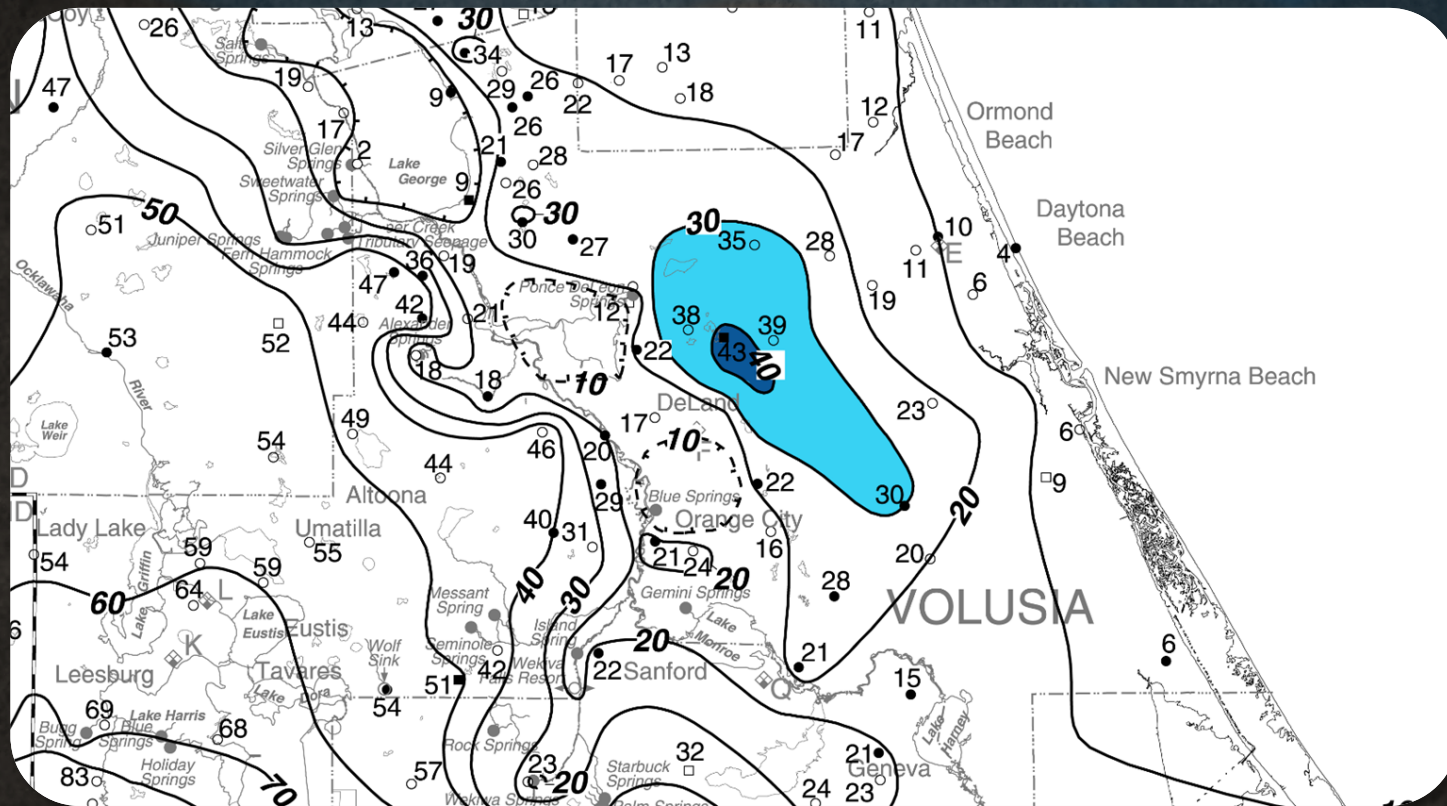




POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 2004

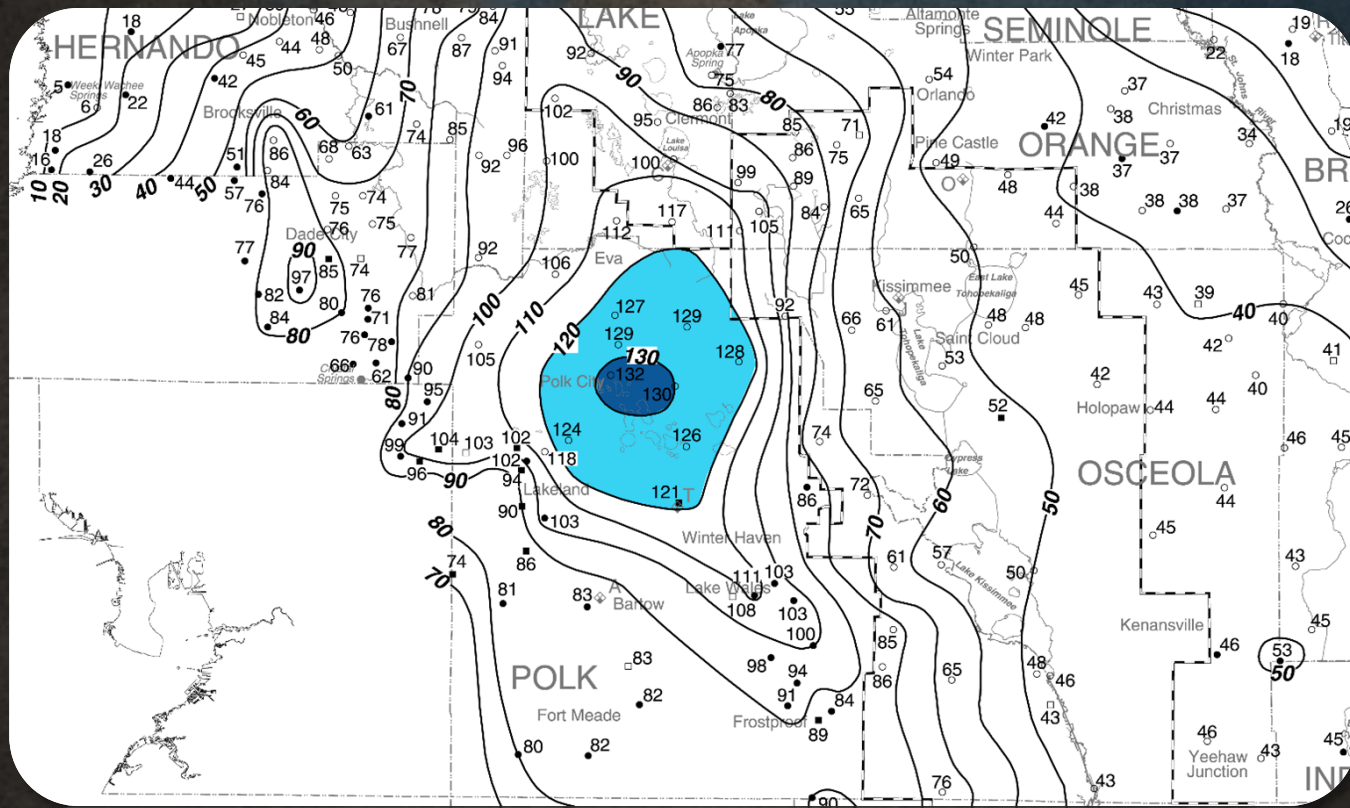
Keystone Heights Area





POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 2004

Deland Ridge Area

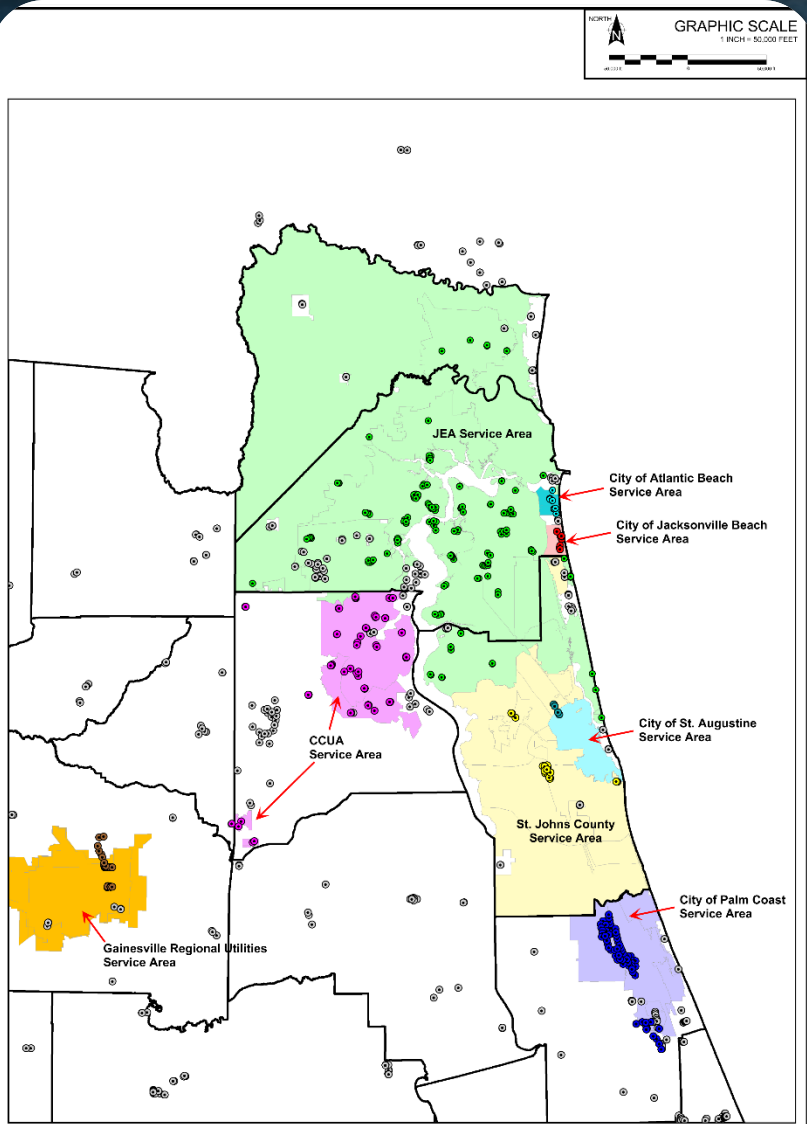


POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 2004

Polk City High – Green Swamp Area



SJRWMD NEF MODEL



PUBLIC WATER SUPPLY WELLS
IN SJRWMD NEF MODEL (YEAR 2030)

LEGEND:

Wells	Service Areas
● City of Atlantic Beach	■ City of Atlantic Beach
● Clay County Utility Authority	■ Clay County Utility Authority
● City of Jacksonville Beach Wells	■ City of Jacksonville Beach
● Gainesville Regional Utilities	■ Gainesville Regional Utilities
● JEA	■ JEA
● City of Palm Coast	■ City of Palm Coast
● City of St. Augustine	■ City of St. Augustine
● St. Johns County	■ St. Johns County
○ Other PWS Wells	

Estimated total withdrawal in year 2030 from public water supply wells is 376 MGD.

DEVO
CONSULTING GEOTECHNICAL ENGINEERS

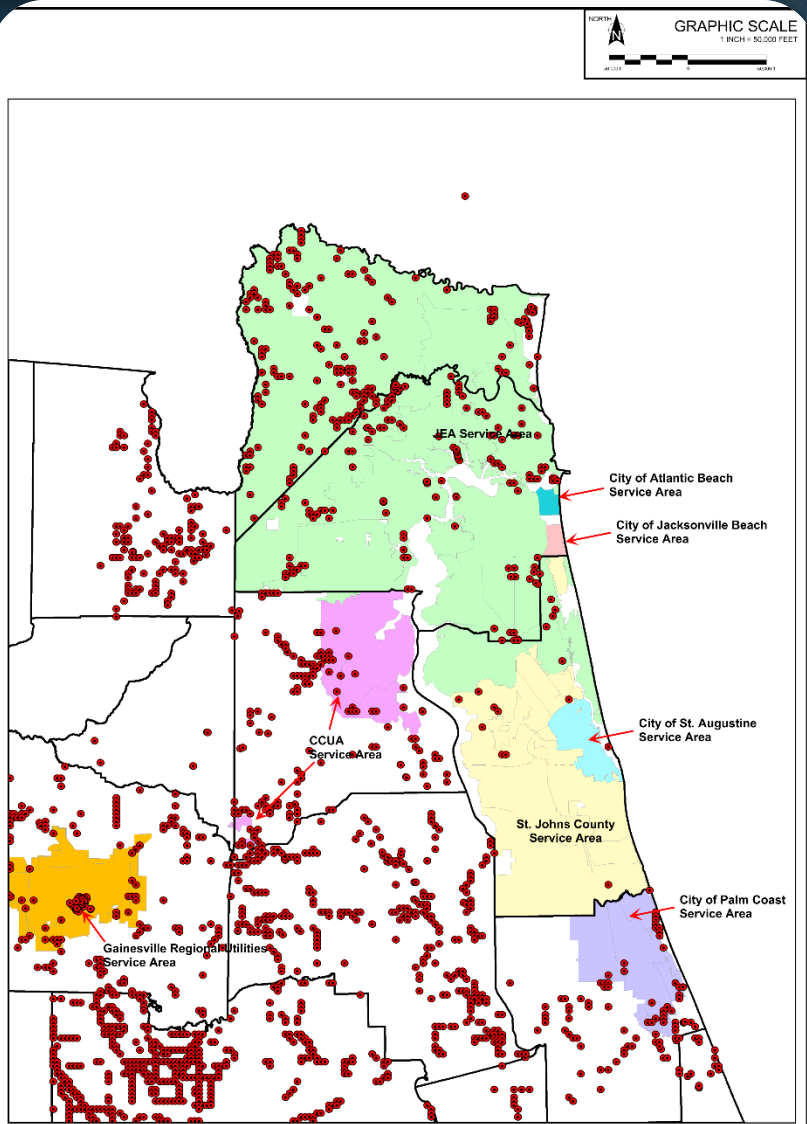
Public Water Supply Wells
in SJRWMD NEF Model
(Year 2030)

SJRWMD NEF Model (v3)

DATE: 06-17-2025

FIGURE 1.1

SJRWMD NEF MODEL

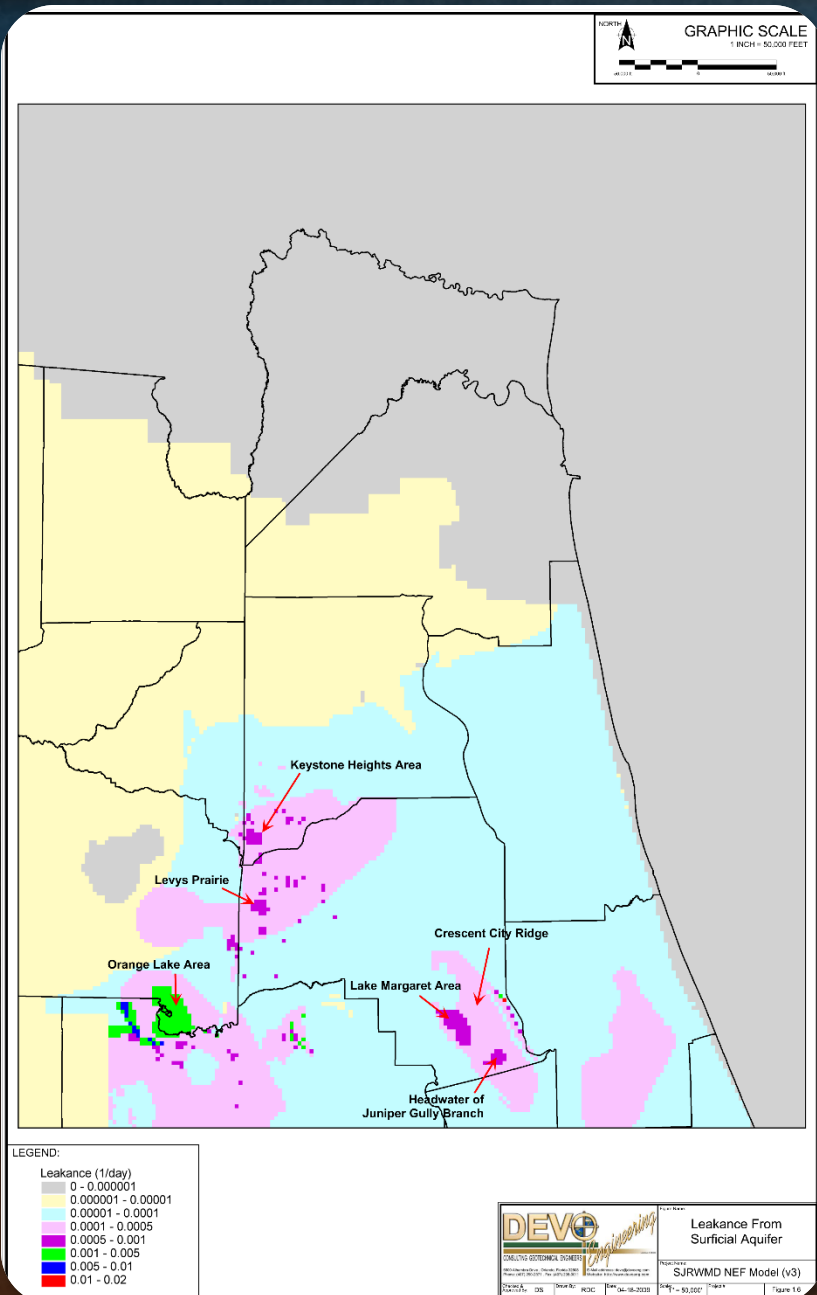


COMMERCIAL / INDUSTRIAL WELLS IN SJRWMD NEF MODEL (YEAR 2030)

Estimated total withdrawal in year 2030 from commercial/industrial wells is 93.3 MGD.

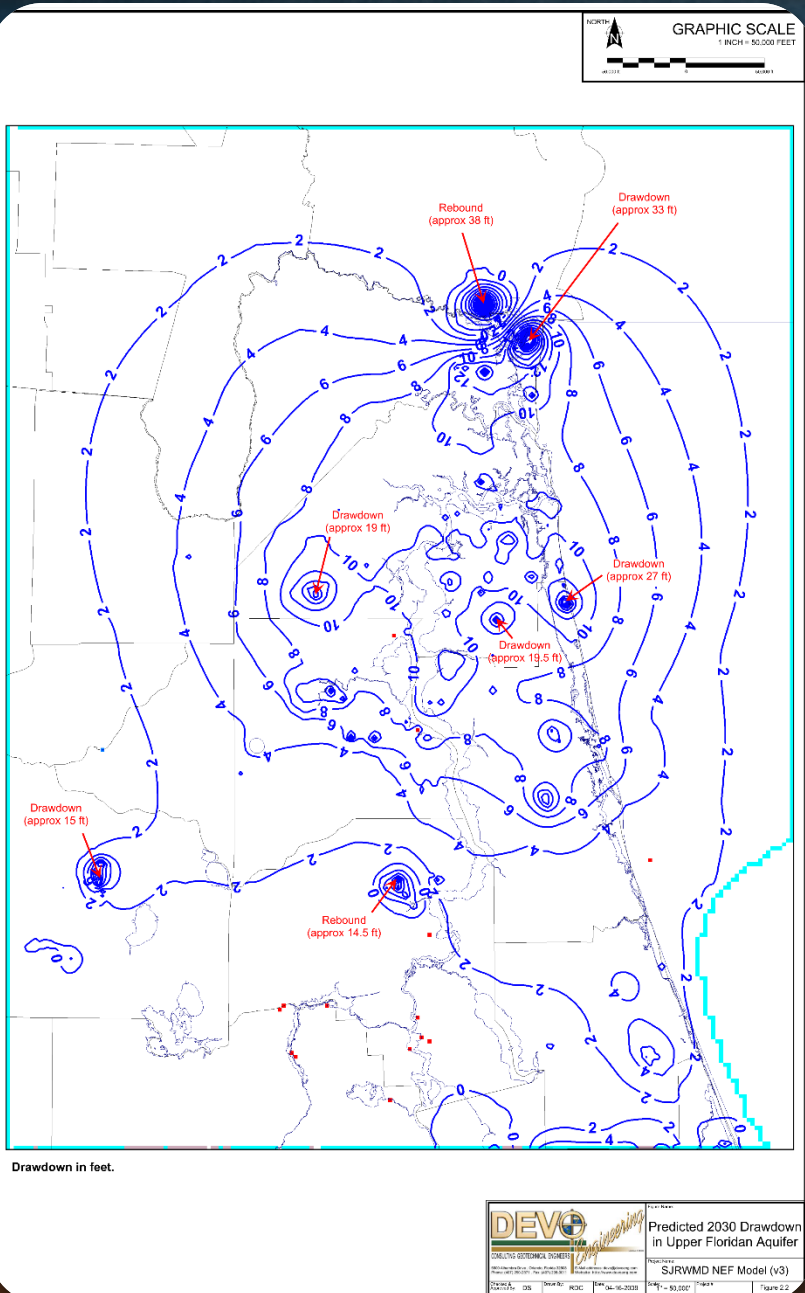
	Commercial/Industrial Wells in SJRWMD NEF Model (Year 2030)
	SJRWMD NEF Model (v3)
DATE: 06-17-2025	SCALE: 1" = 50,000'
PROJECT: 25-0000	FIGURE: 1.2

SJRWMD NEF MODEL



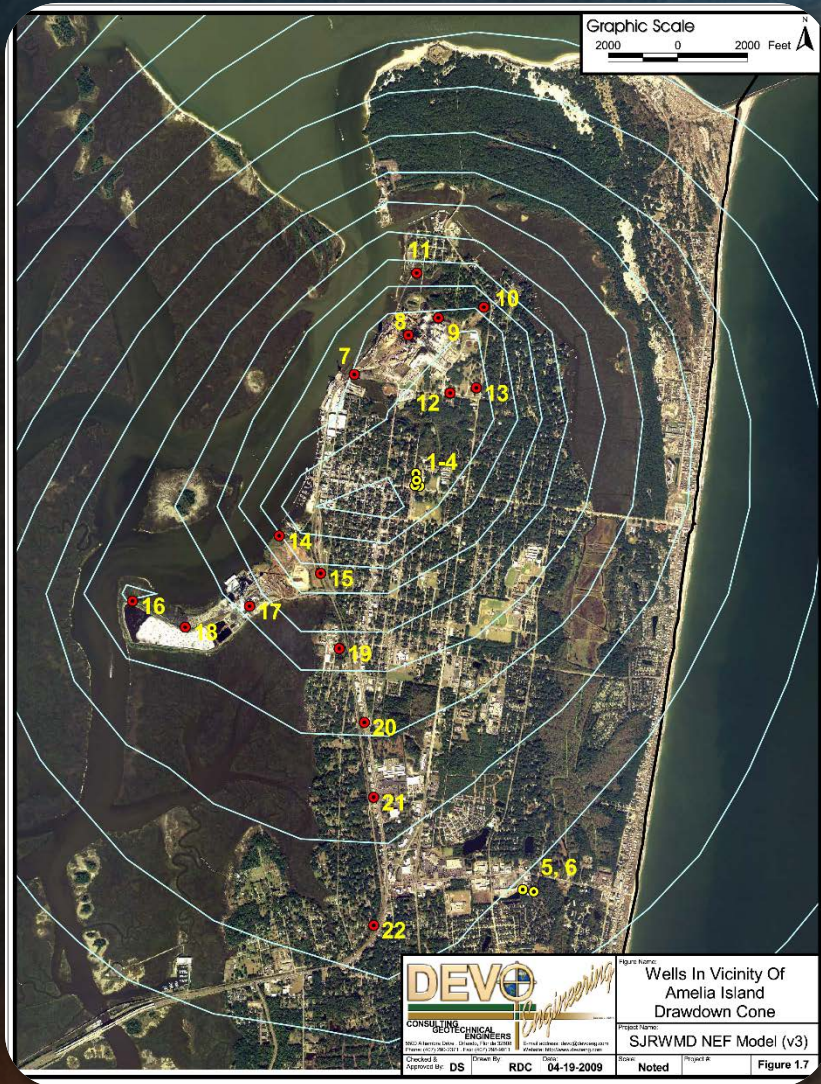
LEAKANCE FROM SURFICIAL
AQUIFER

SJRWMD NEF MODEL



PREDICTED 2030 DRAWDOWN
IN UPPER FLORIDAN AQUIFER

SJRWMD NEF MODEL



WELLS IN VICINITY OF AMELIA ISLAND DRAWDOWN CONE

DEFINITIVE TREATISE ON WATER RESOURCES IN FLORIDA

- *Thickness of fresh water in the Floridan aquifer (both Upper and Lower)*
- *Understanding demand:*
 1. Where people live; where is the water?
 2. Hydro-geologically advantageous areas do not necessarily correspond to the desirability from a residential development standpoint. fresh water is not abundant in coastal areas.
- *What parts of the state receive the most rainfall?*
- *Innovative thinking:*
 1. Thickness of fresh water
 2. Recharge
 3. Transmissivity
 4. Ideal locations for well fields
 5. Ideal locations for artificial recharge
 6. Other tools in toolbox
 - Integrated reclaimed & storm water harvesting system (large scale)
 7. Irrigation is the 800 lb gorilla on the demand side of the equation.
 8. Paper mills/Jacksonville - Switch to reclaimed water.

DEFINITIVE TREATISE ON WATER RESOURCES IN FLORIDA

- *Drawdowns*
 - Mining
- *Special Interest Distortions*
 - Springs
- *Rapid Infiltration Basins*
- *Water Quality*
- *Stormwater Harvesting/Foraging (Altamonte Springs); Surface Water (CW Bill Young)*
- *RECHARGE FROM DRAINAGE WELLS*
 - decline in potentiometric surface for Orlando if all drainwells are closed in Orange County?
- *Lower Floridan Aquifer*

DEFINITIVE TREATISE ON WATER RESOURCES IN FLORIDA

- *Too many intersecting agencies; expectation level needs to be predictable.*
 - FDEP
 - WMD
 - Local Counties
 - 120 FAC - Objectors
 - Interested Parties
- *Groundwater does not recognize these boundaries and intersections.*
- *Water Viceroy (such as the Water & Sewage Authority) - instead of so many disparate and competing entities. Czar should have full controls over:*
 - Surface Water
 - Ground Water
 - Storm Water
 - Reclaimed Water
 - ? water

DEFINITIVE TREATISE ON WATER RESOURCES IN FLORIDA

- *No more water fights*
- *SEPTIC IMPACTS*
 - Septic impacts on residential drinking wells, Fellsmere
- *Need a study*
 - Nitrates
 - Phosphorous Leakage
- *Allocation of Fresh Groundwater*

DEFINITIVE TREATISE ON WATER RESOURCES IN FLORIDA

- *LOWER SURFICIAL SOURCE*
 - *Add*
 - *Flooding Mitigation*
 1. Decline of mining dewatering
 - a. C.W. Bill Young Reservoir
 - b. Back to the Indians
- *MASTER DATABASE FOR STATE*
- *FLOODING*
 - Cranes Roost
 1. hail the reclaimed Deal with Apopka
 - Clermont Chain of Lakes
 1. Show this as a fear factor

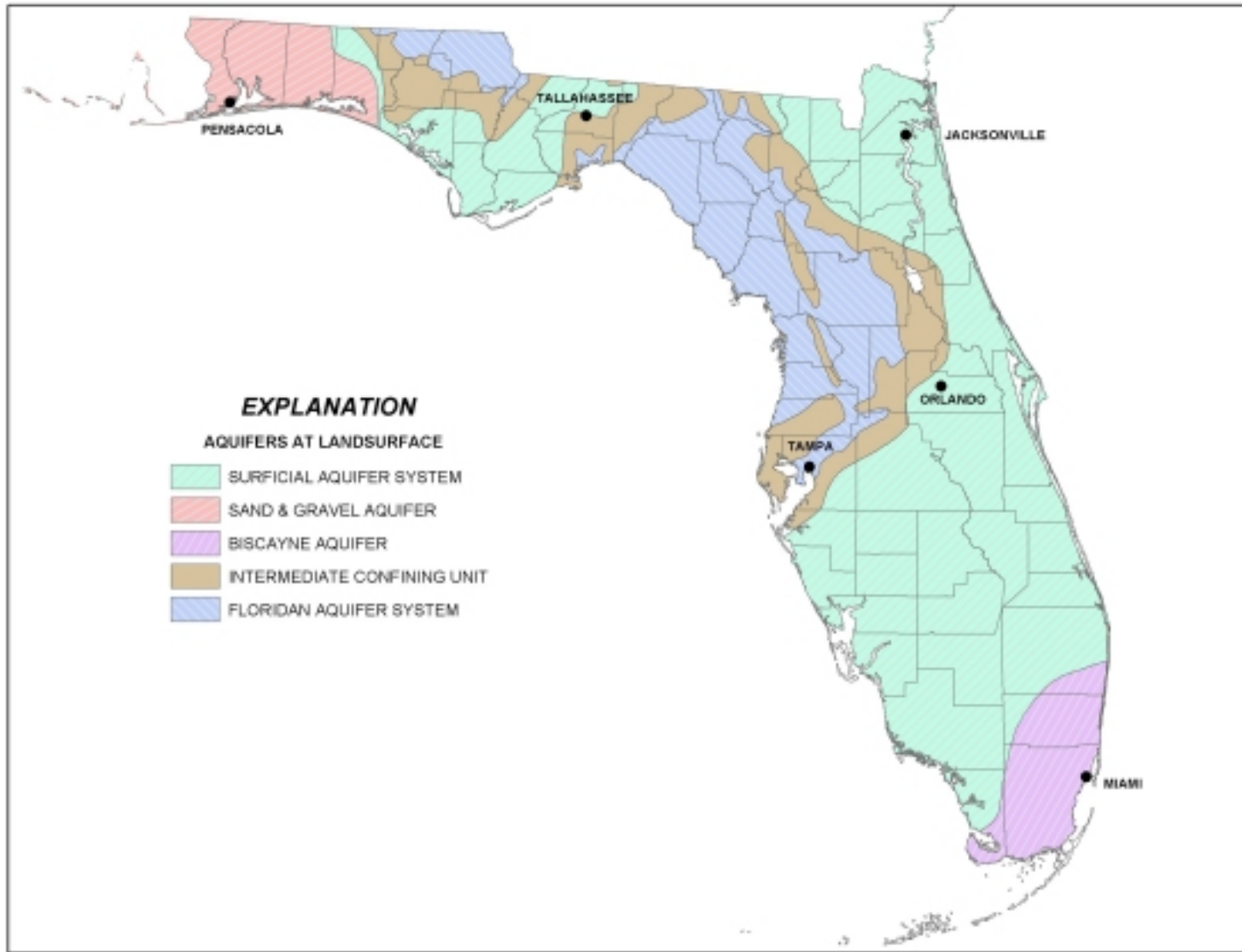
DEFINITIVE TREATISE ON WATER RESOURCES IN FLORIDA

- *SINKHOLES*
 - Sinkholes draining lakes
 1. Pumpage blamed
 - Lack of understanding
 1. Fear
 - a. Keystone Heights
 - Grace Lake
- *UNDERGROUND IMPACTS*
 - Out of Sight
 1. Not like transportation impacts.
 2. Amount of money spent permitting

DEFINITIVE TREATISE ON WATER RESOURCES IN FLORIDA

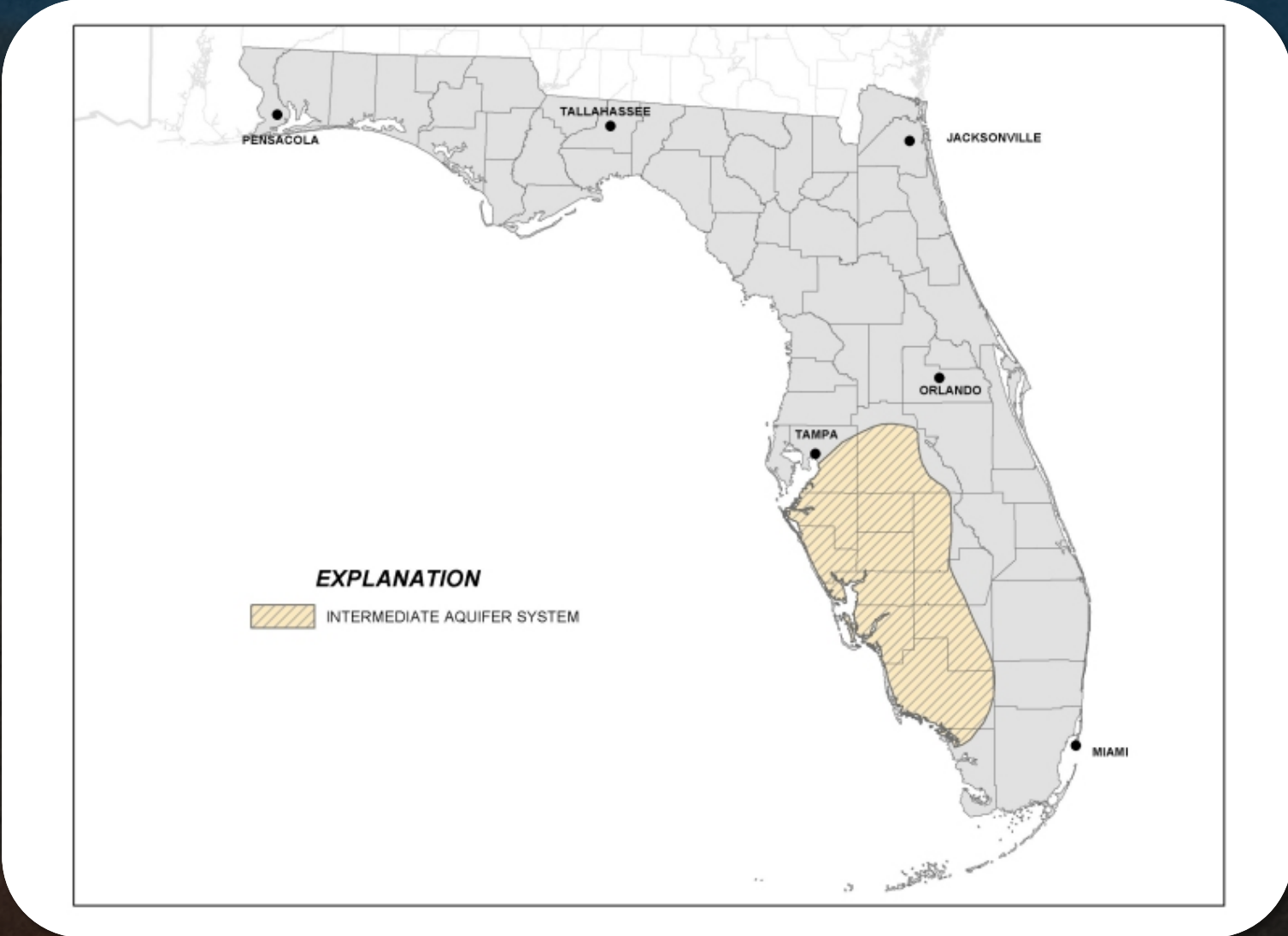
- *WISH LIST*
 - From Deep Underground
 - What is Better Than Rapid Infiltration Basins?
 - Drainage Wells

- *SPLITTING THE WATER PIE*
 - A Simple View Back To The Future
 - Wasting of Water



Source: USGS

FLORIDA AQUIFERS MAP



Source: USGS

INTERMEDIATE AQUIFER SYSTEM MAP

Hydrostratigraphic Units of Florida

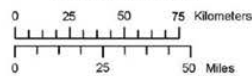
Explanation for Cross Sections

Lithostratigraphic symbols

Predominant lithology indicated. Lithology, mineralogy and fossil content may vary vertically and laterally within a unit.

	Sand		Interbedded or intermixed sand, clay and carbonate
	Clay		Calcareous clay
	Limestone		Argillaceous limestone
	Limestone-dolomite Representing dolomitic limestone, dolostone, and interbedded carbonates.		

Scale for cross sections

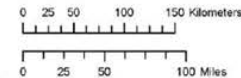
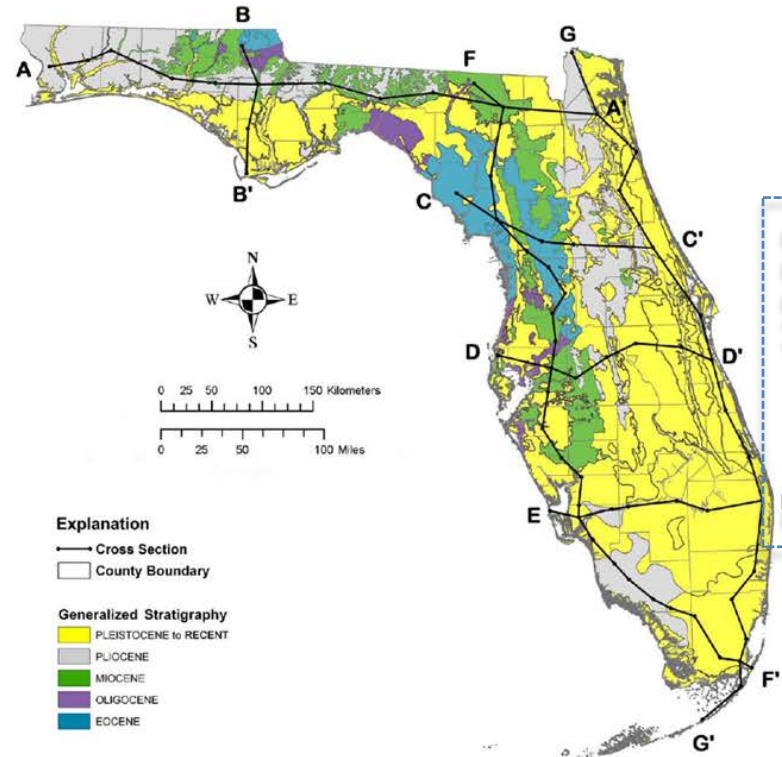


Cross section vertical exaggeration equals 200 times true scale

Hydrostratigraphic units

	surficial aquifer system
	intermediate aquifer system
	Floridan aquifer system
	undifferentiated aquifer systems and confining units

Cross section locations and geologic map



Explanation

- Cross Section
- County Boundary

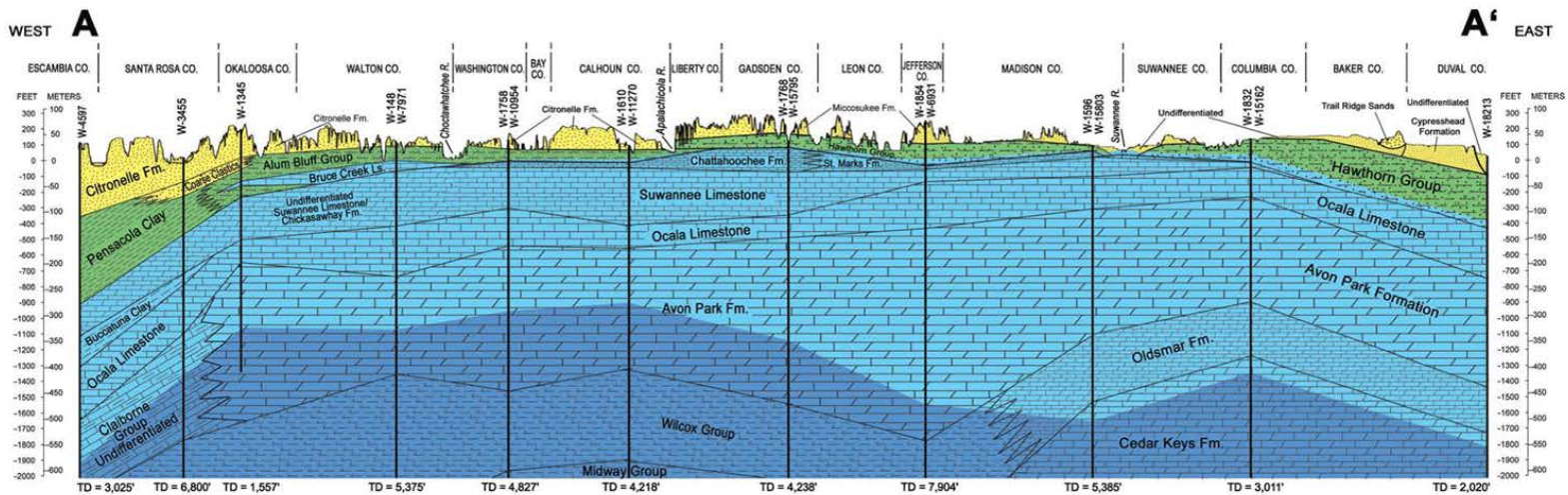
Generalized Stratigraphy

- PLEISTOCENE TO RECENT
- PIOCENE
- MIOCENE
- OLIGOCENE
- EOCENE

SYSTEM	SERIES	PANHANDLE FLORIDA		NORTHERN FLORIDA		SOUTHERN FLORIDA	
		FORMATION	HYDROSTRATIGRAPHIC UNIT	FORMATION	HYDROSTRATIGRAPHIC UNIT	FORMATION	HYDROSTRATIGRAPHIC UNIT
QUATERNARY	HOLOCENE		sand-and-gravel aquifer		surficial aquifer system	Undifferentiated sediments	Biscayne aquifer
	PLEISTOCENE	Undifferentiated sediments		Undifferentiated sediments		Anastasia Formation	
TERTIARY	PLIOCENE	Chionella Formation	intermediate aquifer system or intermediate confining unit	Undifferentiated sediments	surficial aquifer system	Undifferentiated sediments	surficial aquifer system
		Miocosuke Formation		Undifferentiated sediments		Miocosuke Formation	
	Jackson Bluff Formation	Floridan aquifer system		Cypresshead Formation	Tamiami Formation	intermediate aquifer system or intermediate confining unit	
	Intascosia Formation			Hawthorn Group	Long Key Formation		Floridan aquifer system
	Alum Bluff Group	St. Marks Formation		Hawthorn Group	Floridan aquifer system		
	Coarse Clastic	Suwannee Limestone		Suwannee Limestone		Floridan aquifer system	
	MIOCENE	Alum Bluff Group		St. Marks Formation	Ocala Limestone		Floridan aquifer system
	Pensacola Clay	Suwannee Limestone		Ocala Limestone	Floridan aquifer system		
	Intascosia Formation	Floridan aquifer system		Ocala Limestone		Floridan aquifer system	
	Hirshorn Group	Floridan aquifer system		Ocala Limestone	Floridan aquifer system		
Chionella Formation	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				
Chippole Formation	Floridan aquifer system	Ocala Limestone		Floridan aquifer system			
Brook Creek Limestone	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				
St. Marks Formation	Floridan aquifer system	Ocala Limestone		Floridan aquifer system			
Chattahoochee Formation	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				
OLIGOCENE	Bucatanna Clay	Floridan aquifer system		Ocala Limestone	Floridan aquifer system		
Chickensawhay Formation	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				
Mananna Limestone	Floridan aquifer system	Ocala Limestone		Floridan aquifer system			
Suwannee Limestone	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				
EOCENE	Ocala Limestone	Floridan aquifer system		Ocala Limestone	Floridan aquifer system		
Avon Park Formation	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				
Libson Formation	Floridan aquifer system	Ocala Limestone		Floridan aquifer system			
Tallahatta Formation	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				
Clabona Group Unsl.	Floridan aquifer system	Ocala Limestone		Floridan aquifer system			
PALEOCENE	Wicop Group	Floridan aquifer system	Ocala Limestone		Floridan aquifer system		
Micovay Group	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				
Undifferentiated	Floridan aquifer system	Ocala Limestone		Floridan aquifer system			
CRETACEOUS AND OLDER	Undifferentiated	Floridan aquifer system	Ocala Limestone		Floridan aquifer system		
Undifferentiated	Floridan aquifer system	Ocala Limestone	Floridan aquifer system				

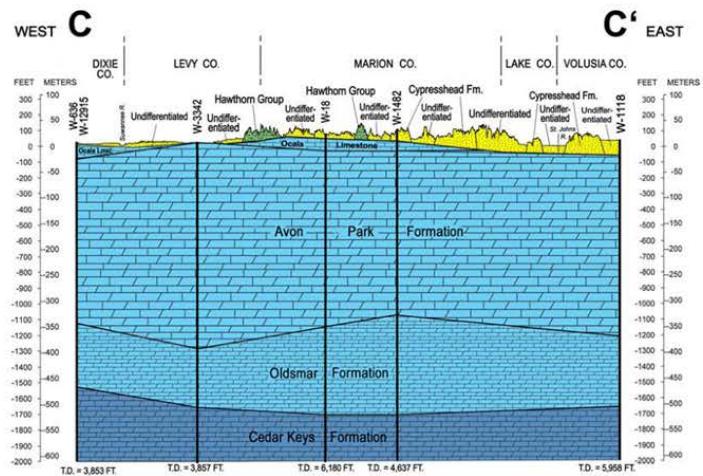
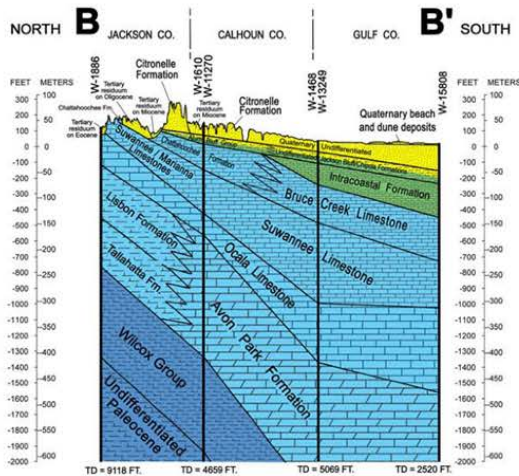
Source: USGS

Hydrostratigraphic Units of Florida



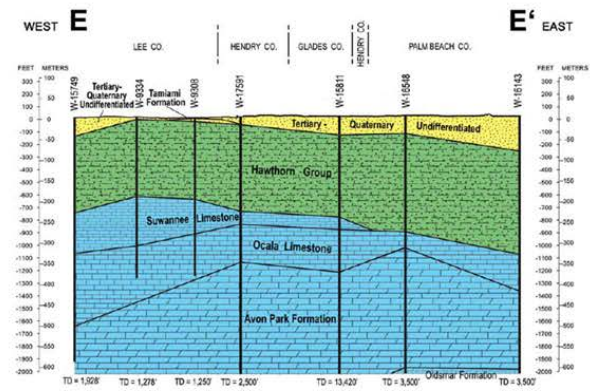
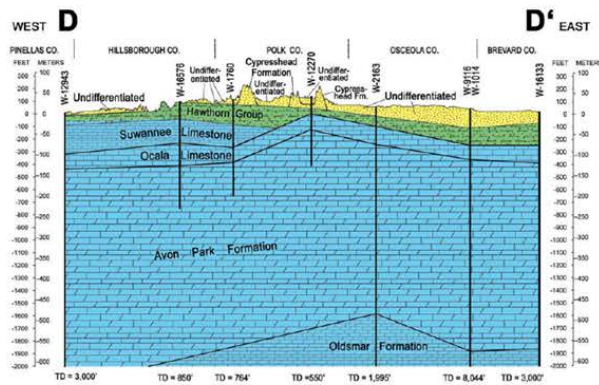
Source: USGS

Hydrostratigraphic Units of Florida



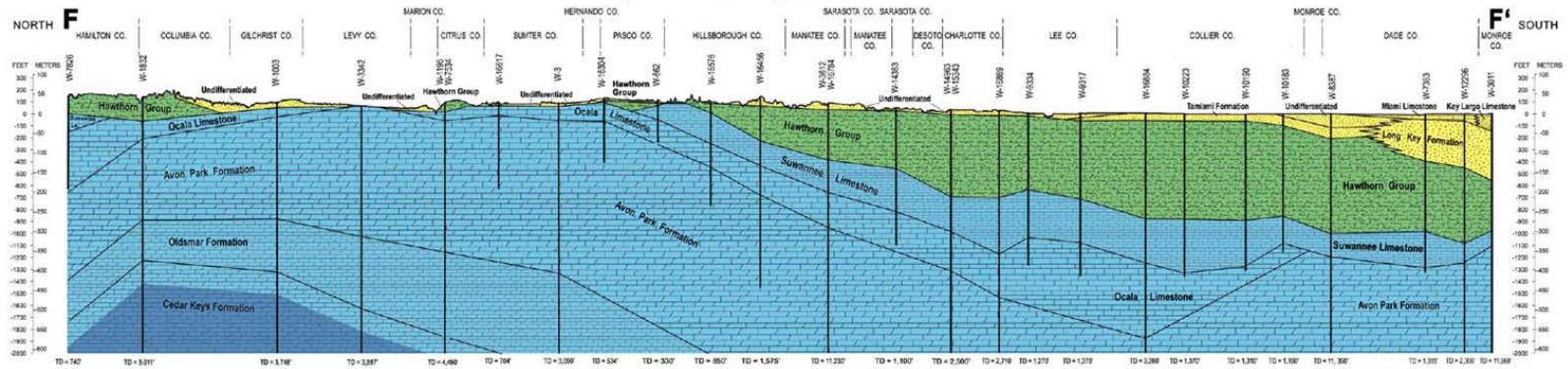
Source: USGS

Hydrostratigraphic Units of Florida



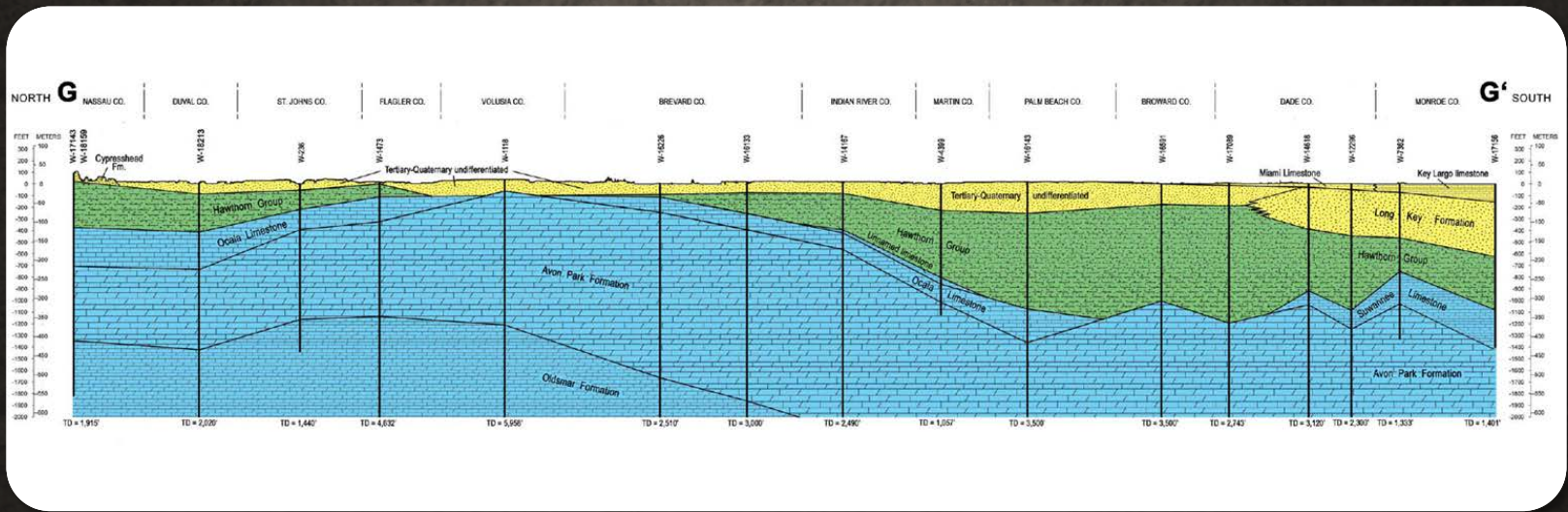
Source: USGS

Hydrostratigraphic Units of Florida



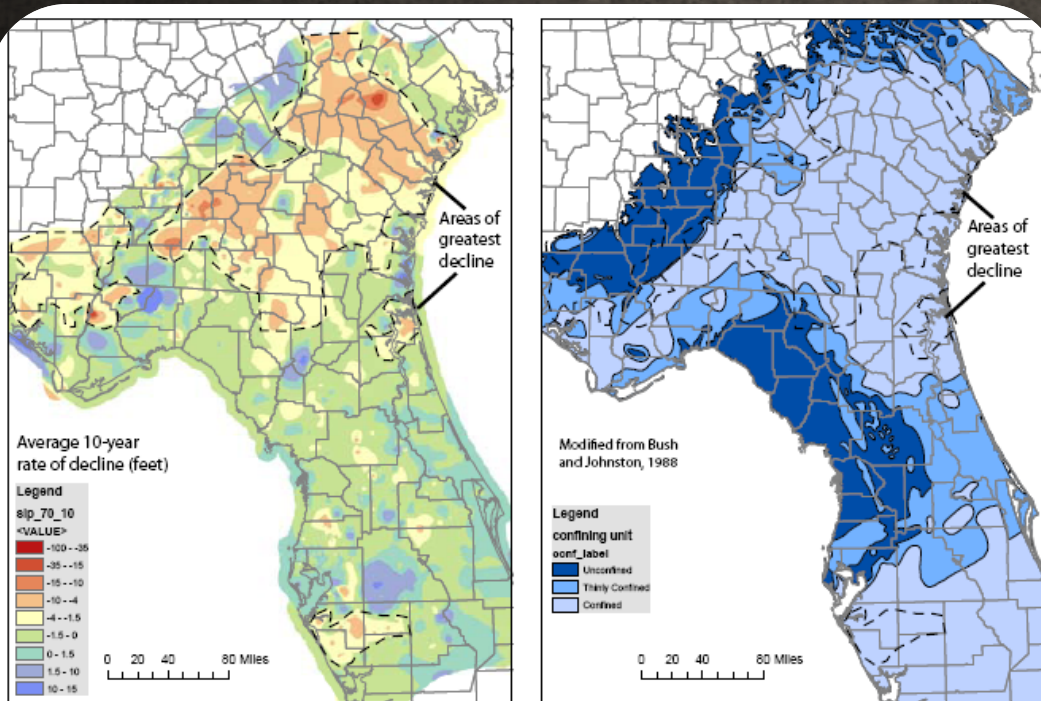
Source: USGS

Hydrostratigraphic Units of Florida



Source: USGS

Relation of Groundwater Level Decline to Confinement in the FAS



A. Long-term rate of decline map for 1970 to 2010. Reds and yellows indicate declines; blues indicate relative rises in water levels; greens indicate no significant changes over the past 40 years.

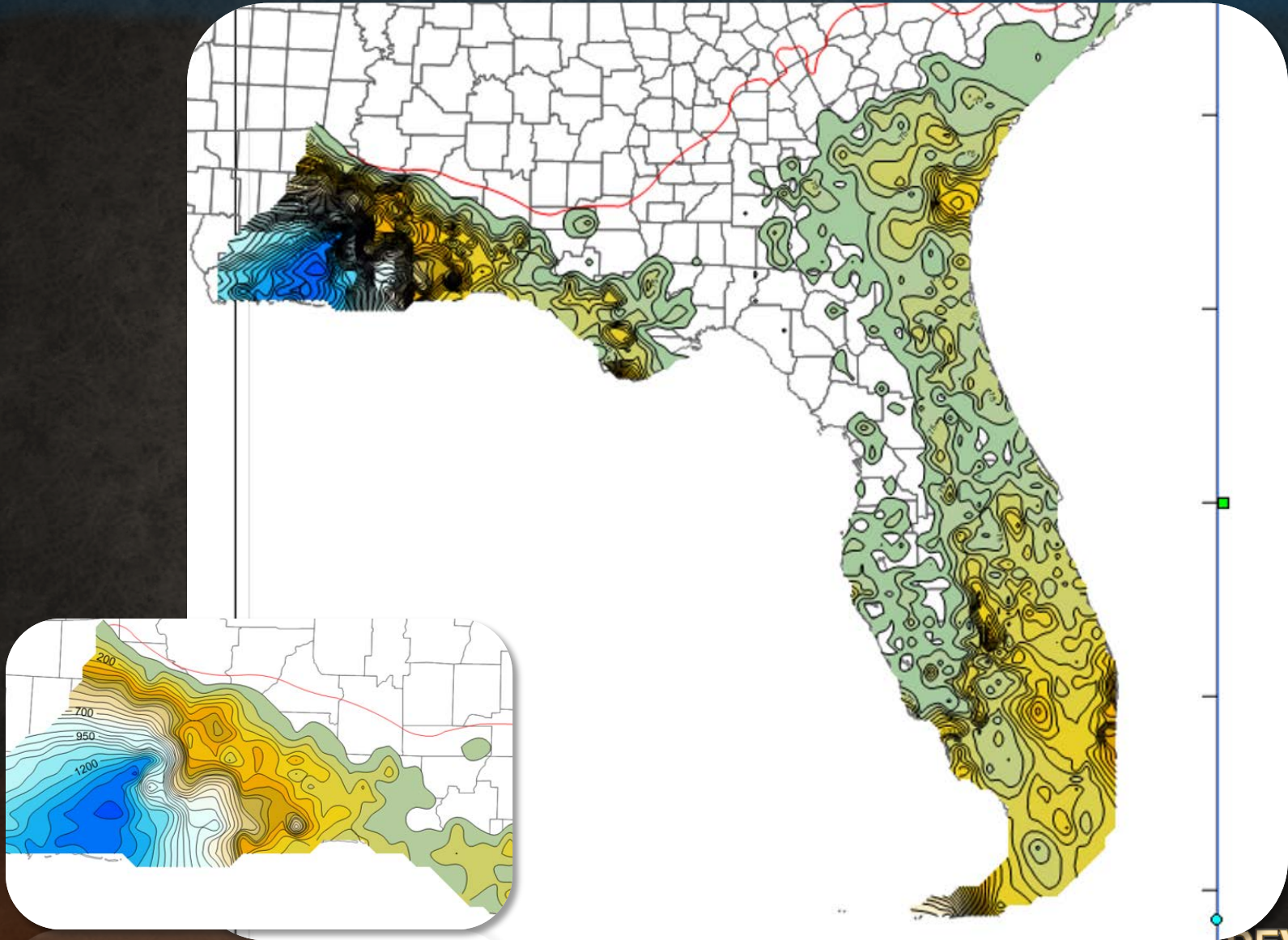
B. Relative confinement of the Floridan Aquifer System. Light blue indicates confined areas and darker blues indicate thinly confined and unconfined areas respectively.

Figure 2. Maps showing the relation between long-term rate of decline to the relative degree of confinement of the Floridan Aquifer System in the Southeastern United States.

- Took the new database of water level data
- Conducted simple trend analysis on wells with > 20 yrs record
- Mapped declines

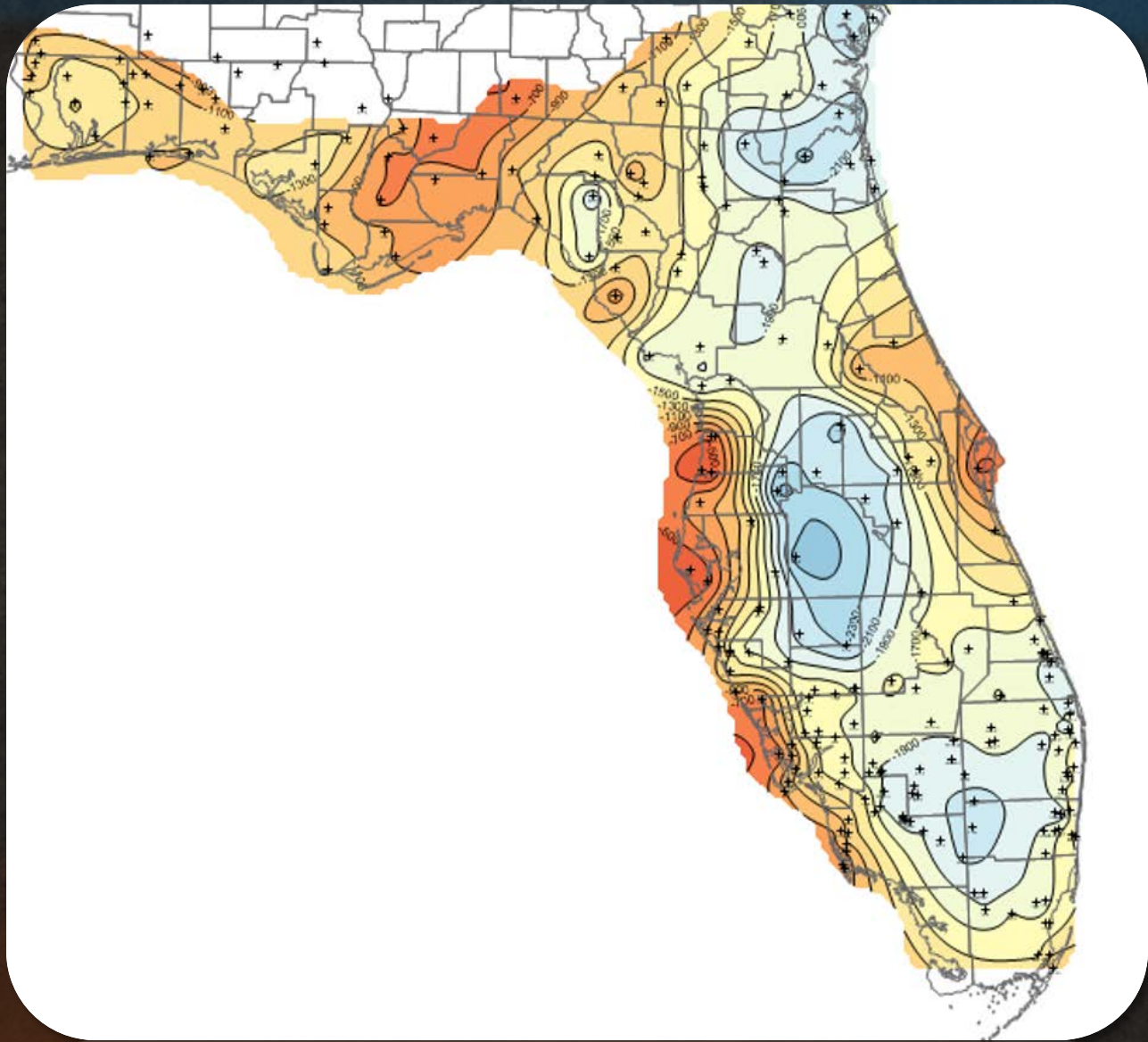
Source: USGS

Thickness of Surficial Aquifer System



Source: USGS

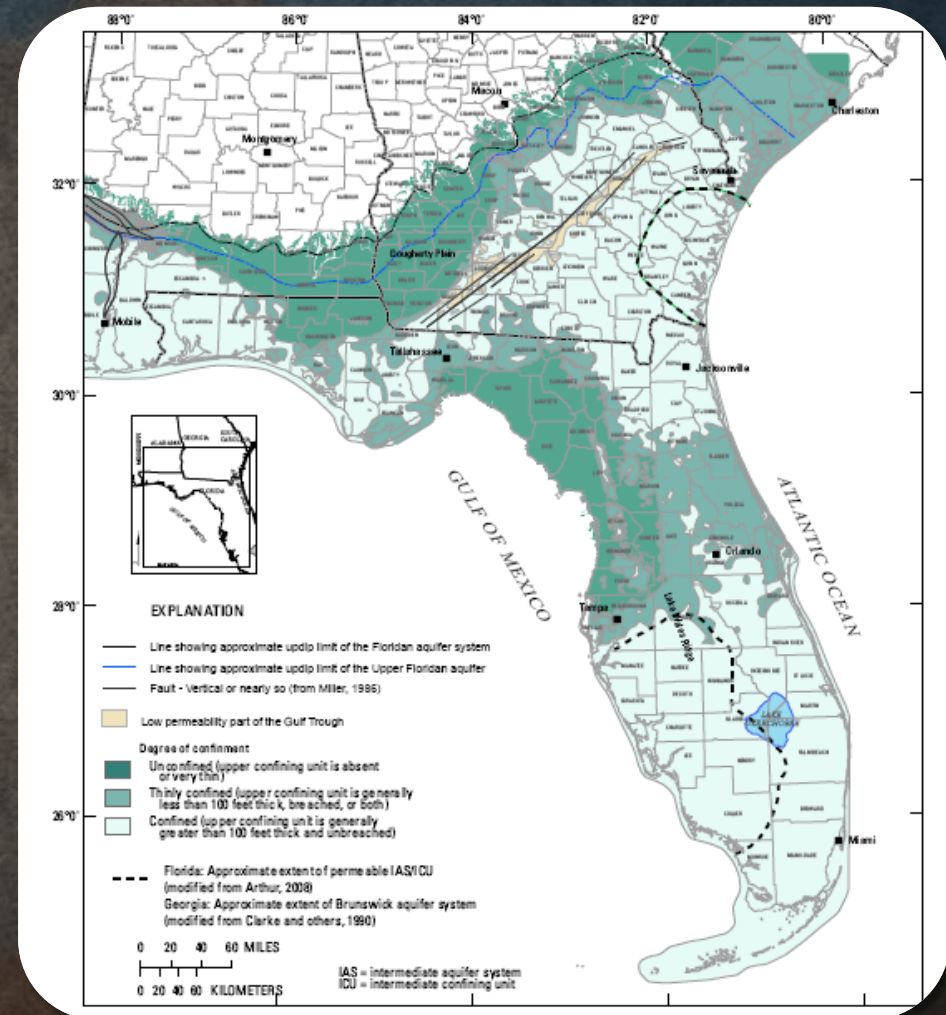
Saline and Brackish Portion of System



Source: USGS

Upper Confining Unit (IAS/ICU)

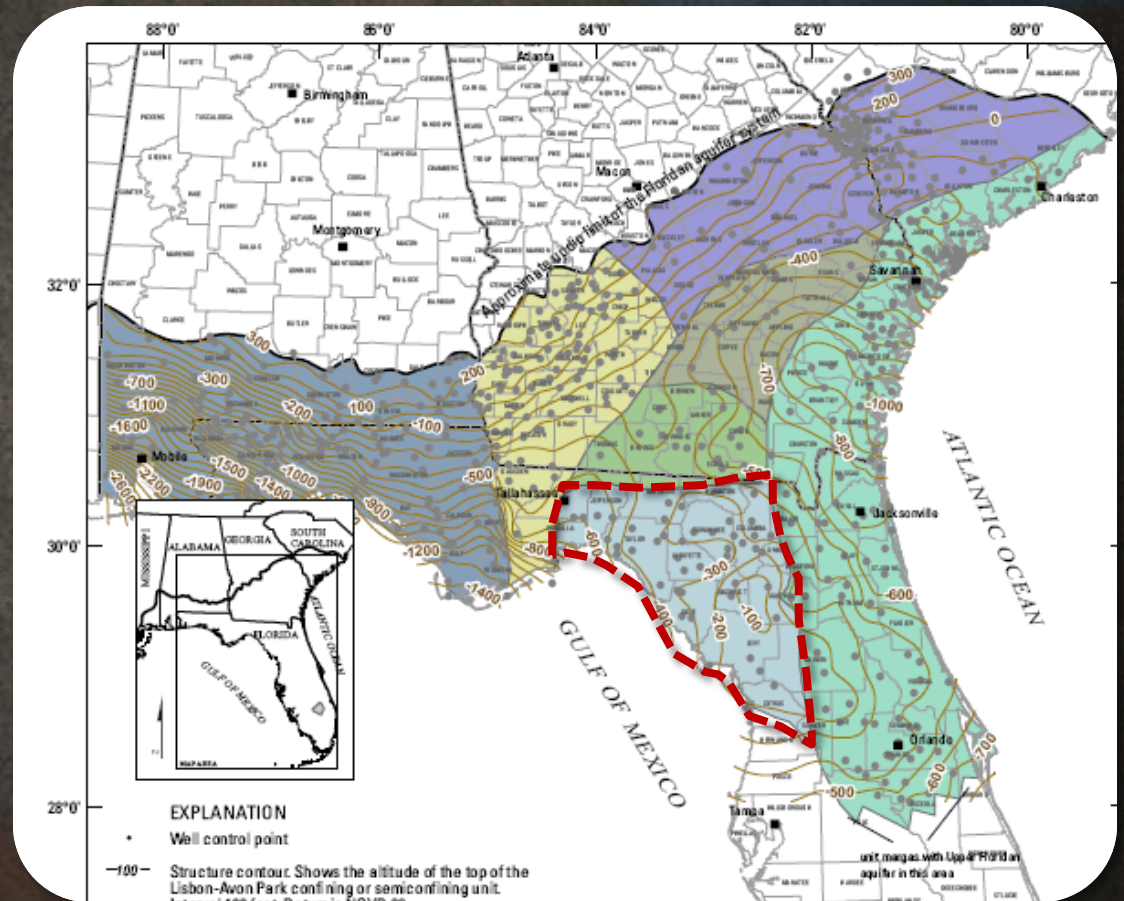
- Generally same sources of data used for constructing this map
- Intermediate aquifer system and Brunswick aquifer system form permeable areas of this unit



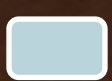
Source: USGS

Middle confining unit “Regions”

- Can hydraulic properties vary across an area?
- Can it have equiv. horizons?



Source: USGS



North-Central Florida Region, Probably leaky
Semi confining unit or part of transmissive system