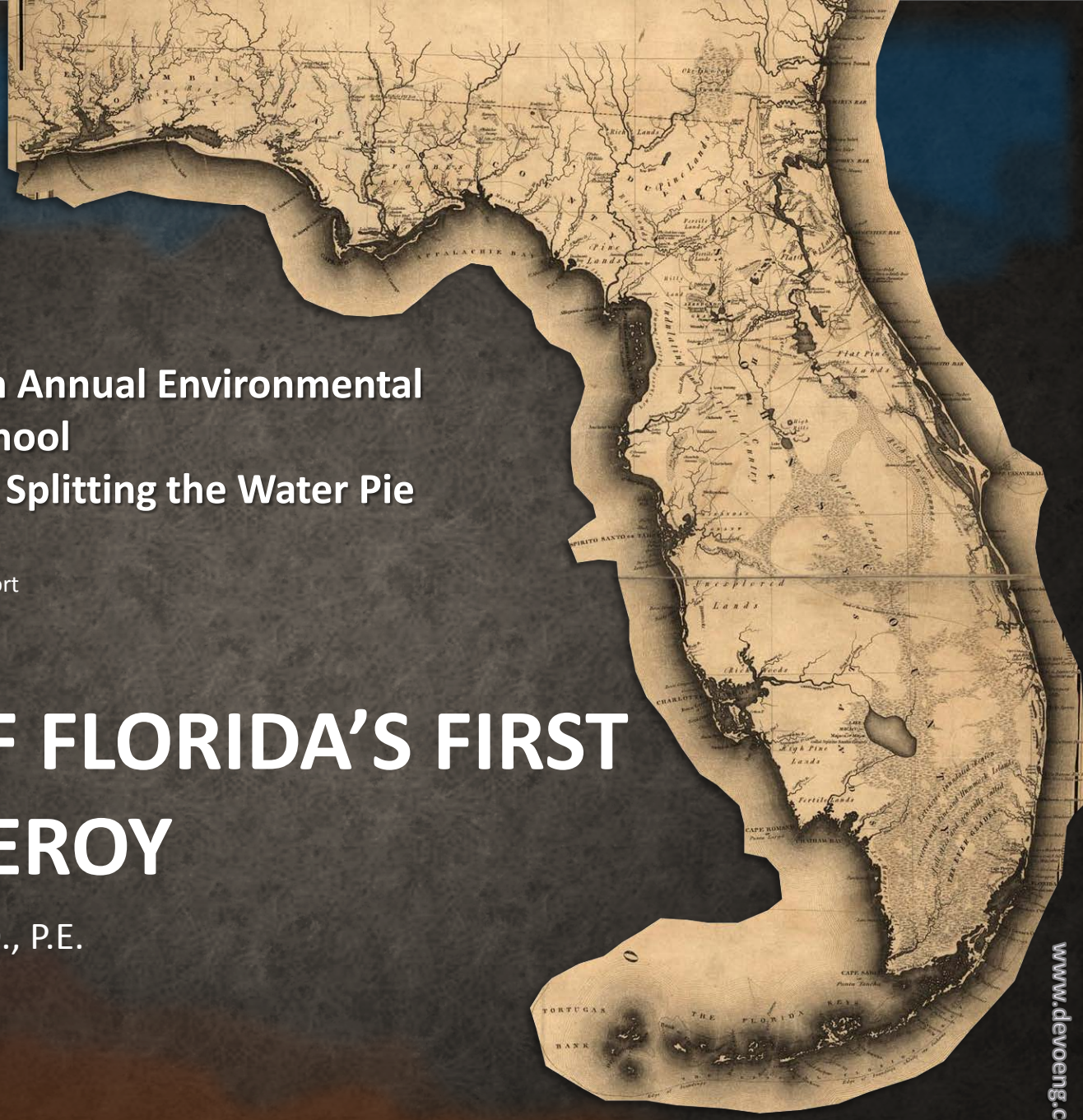
Florida Chamber's 27th Annual Environmental Permitting Summer School
Permitting Workshop - Splitting the Water Pie

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

DREAMS OF FLORIDA'S FIRST WATER VICEROY

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



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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

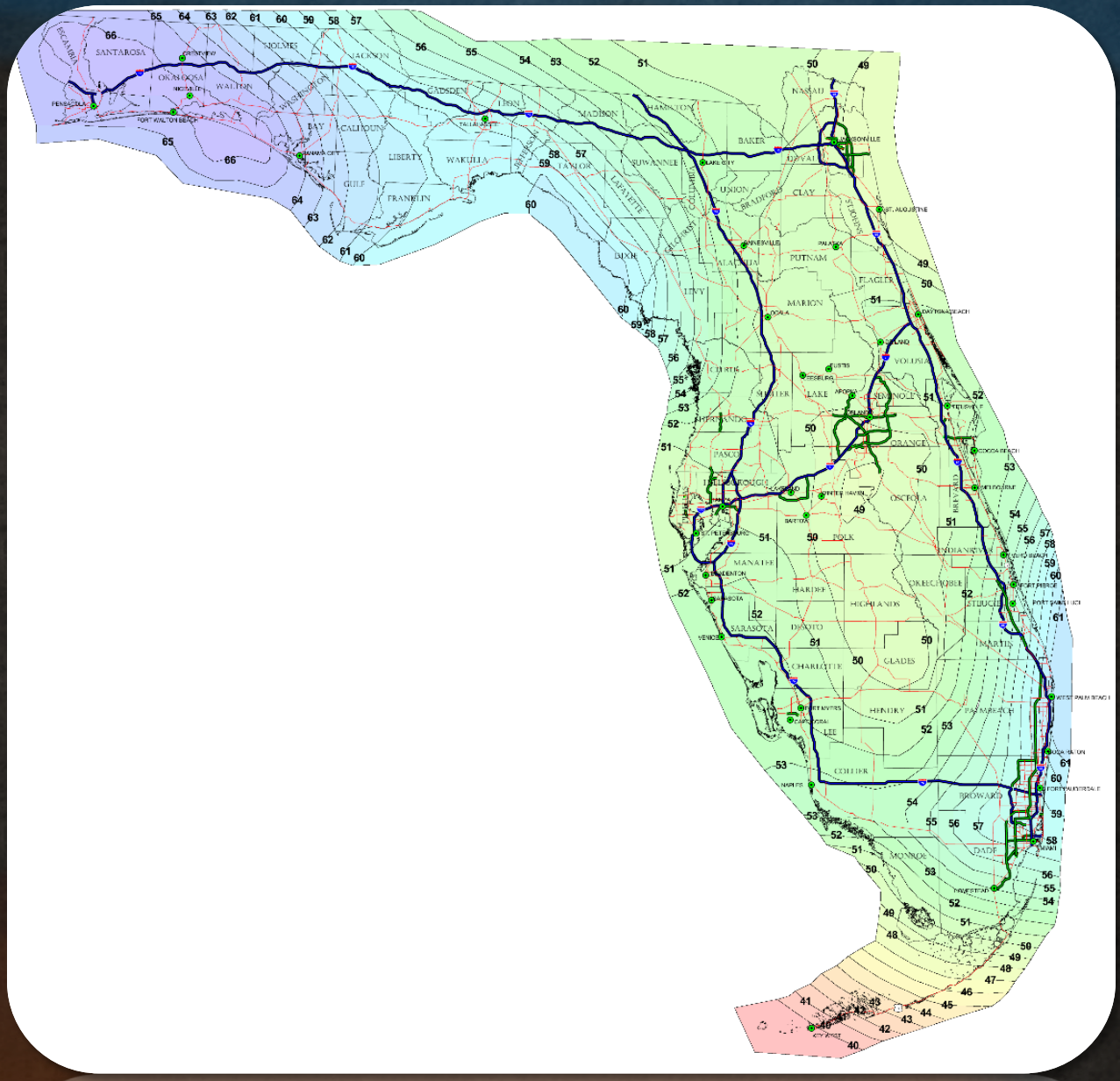
- ***First Step:*** Let us start with a blank canvas; map the parts of the state with the thickest and freshest groundwater and approximate the quantities which can be extracted in a sustainable way. This will be done for the premium groundwater resource areas of the state. For example, in SJRWMD there 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



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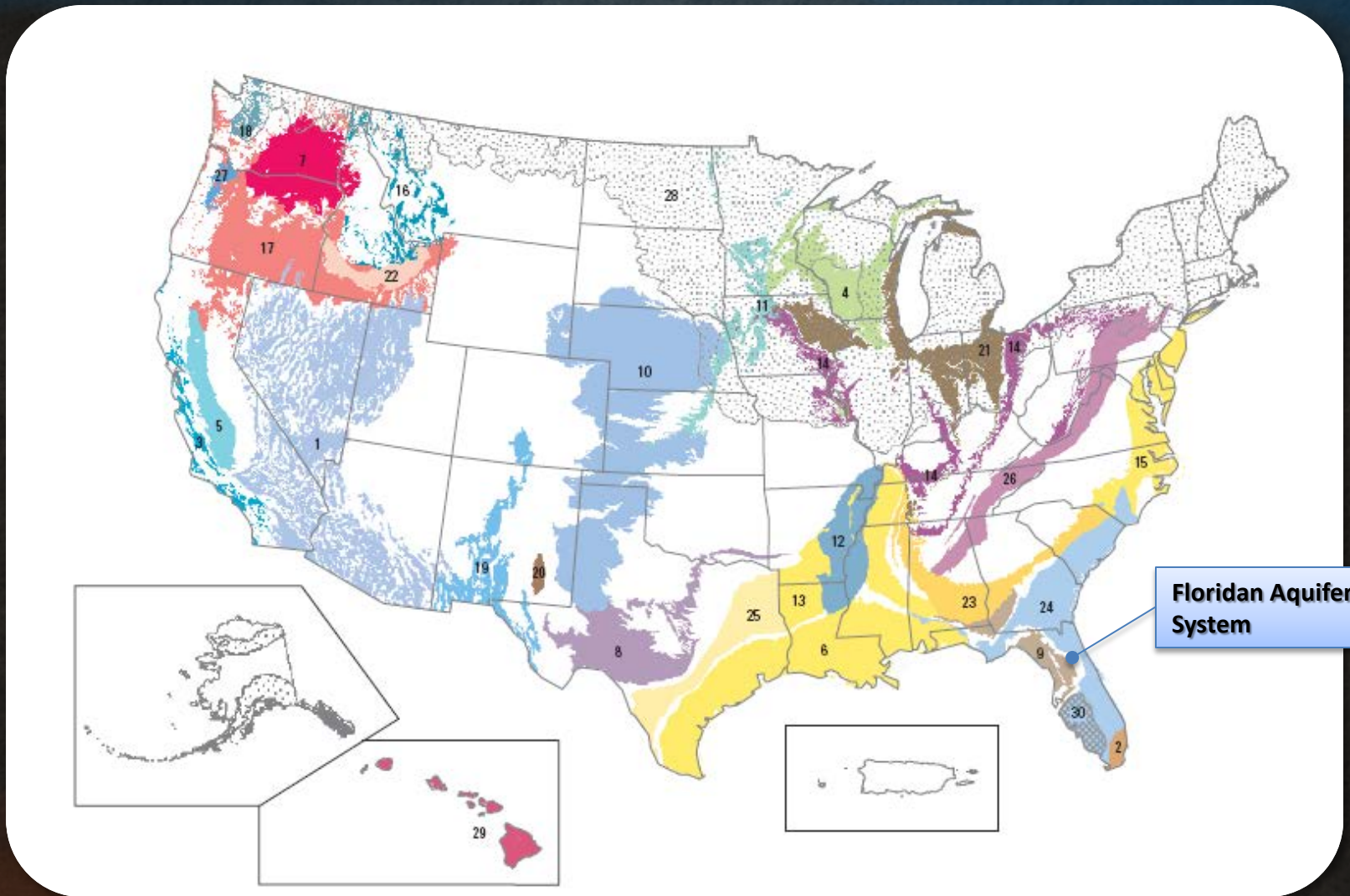
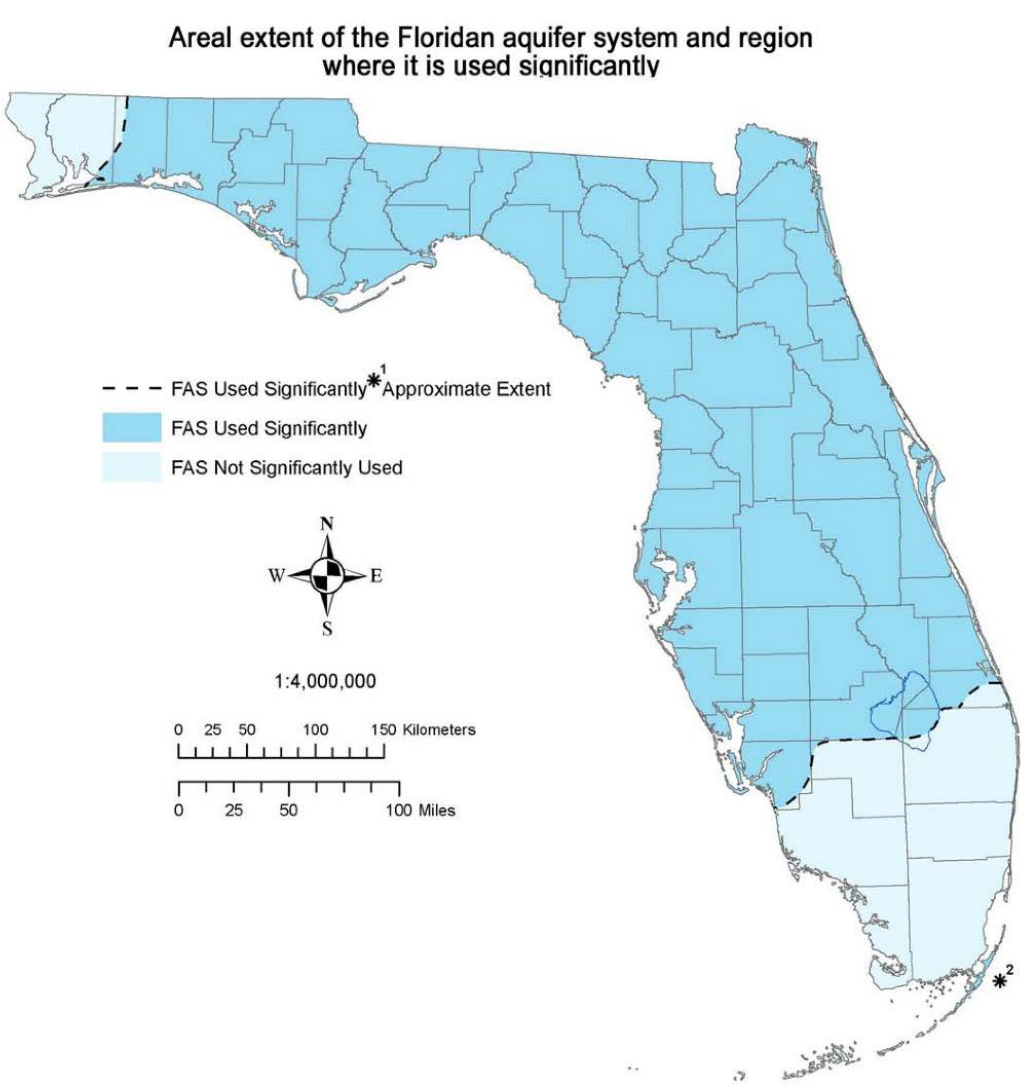
USGS Water Resource Program



Source: USGS

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

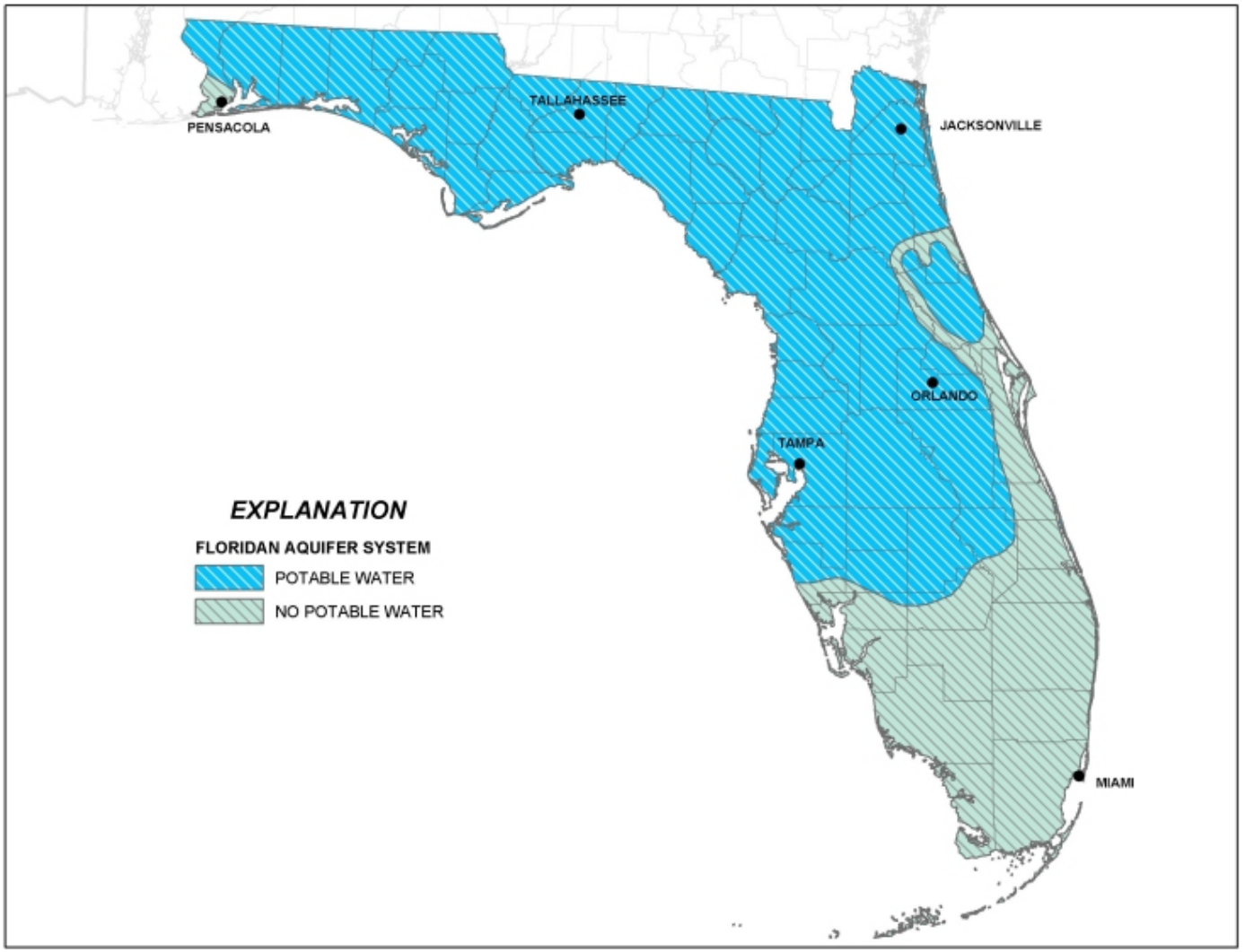
Extent of Floridan Aquifer



*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

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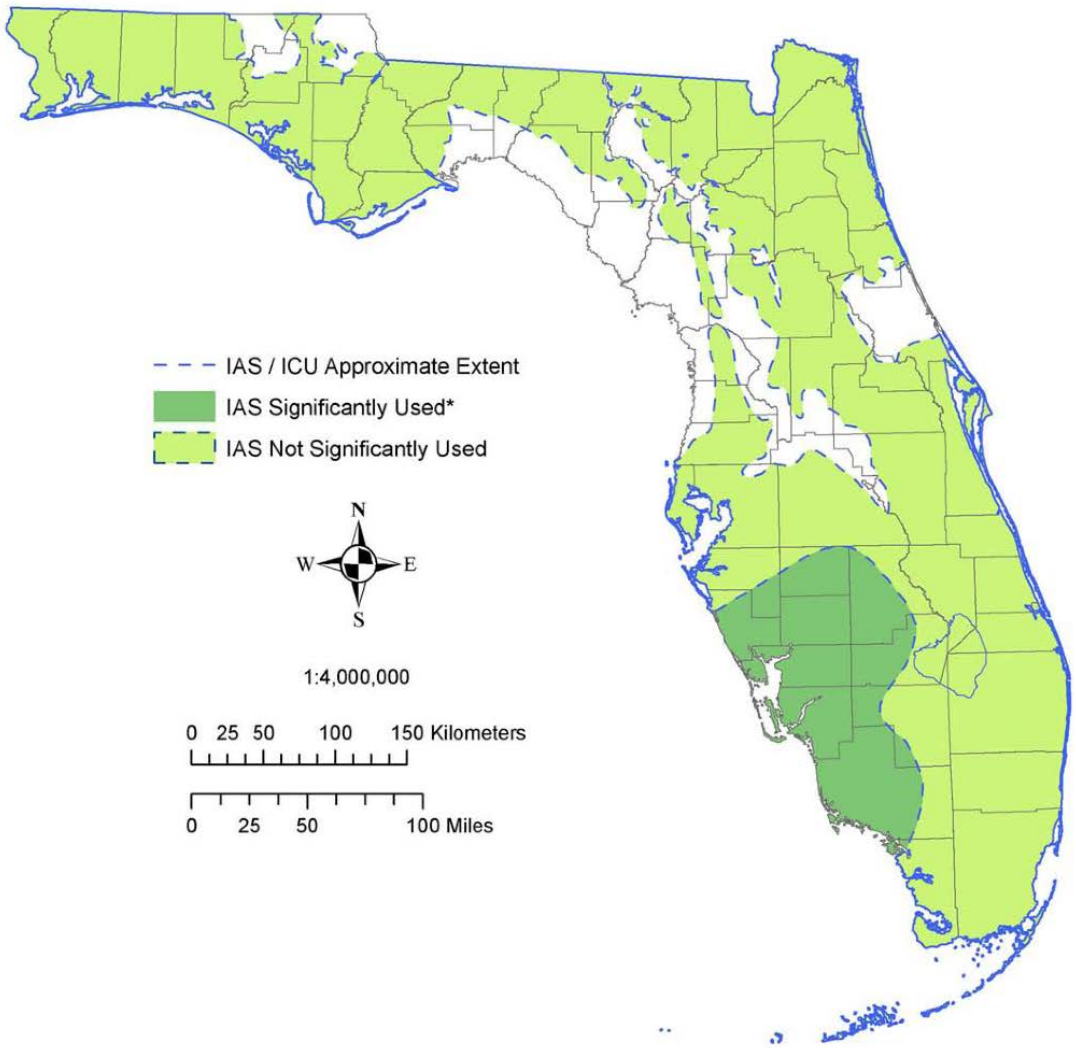
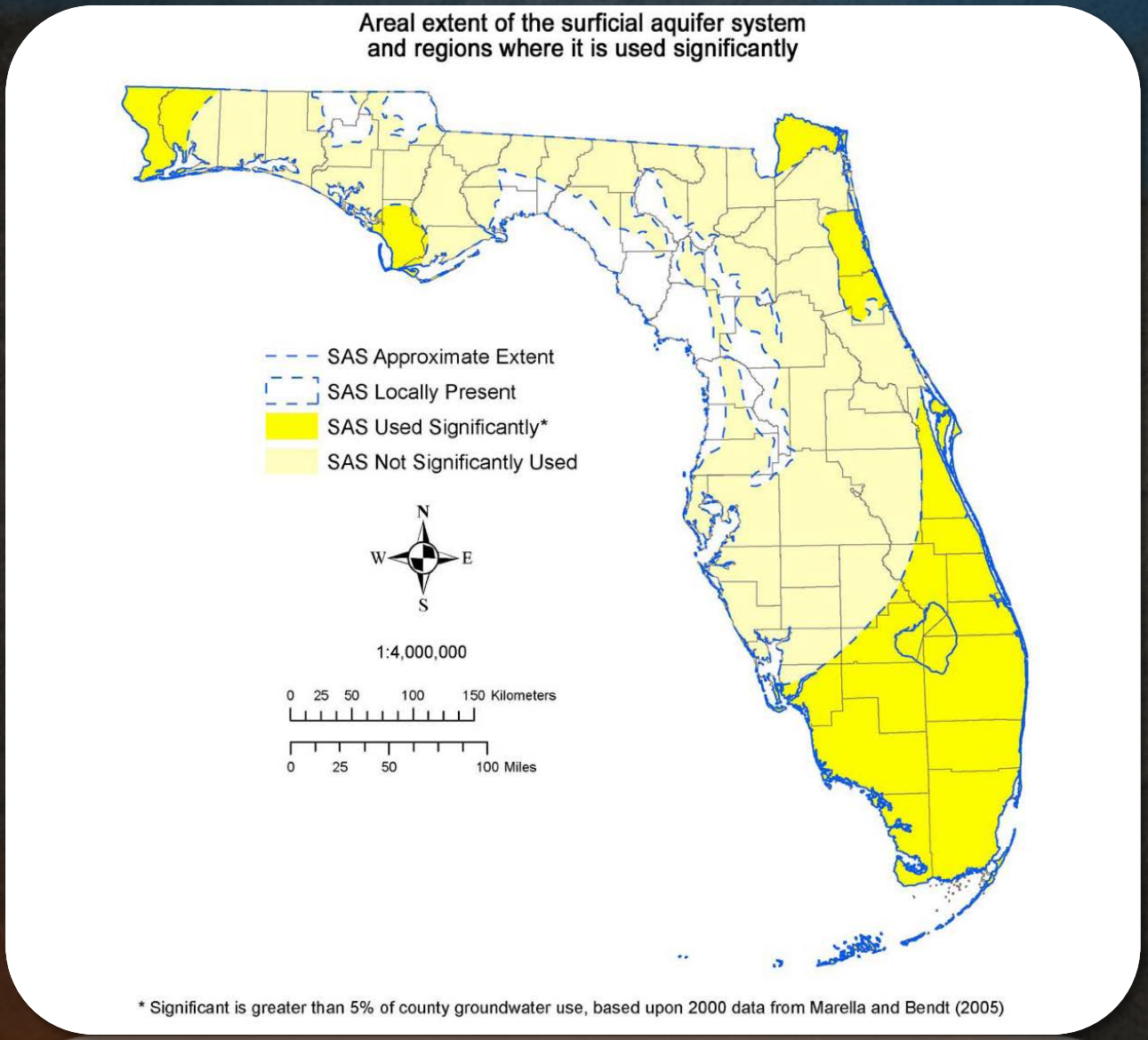
Intermediate Aquifer System



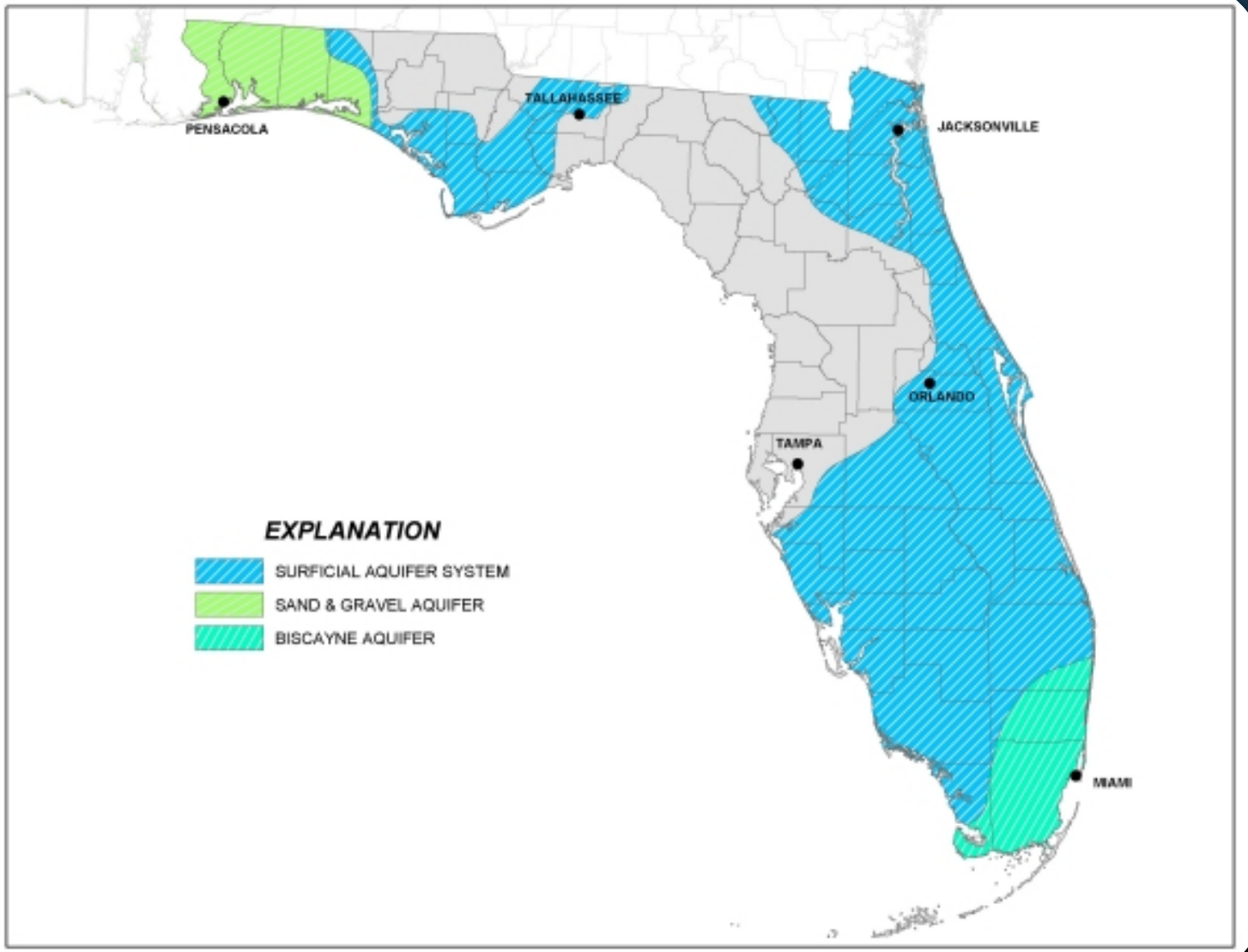
* Significant is greater than 5% of county groundwater use, based upon 2000 data from Marella and Bendt (2005)

Source: USGS

Surficial Aquifer System



Source: USGS



Source: USGS

SURFICIAL AQUIFER SYSTEM MAP

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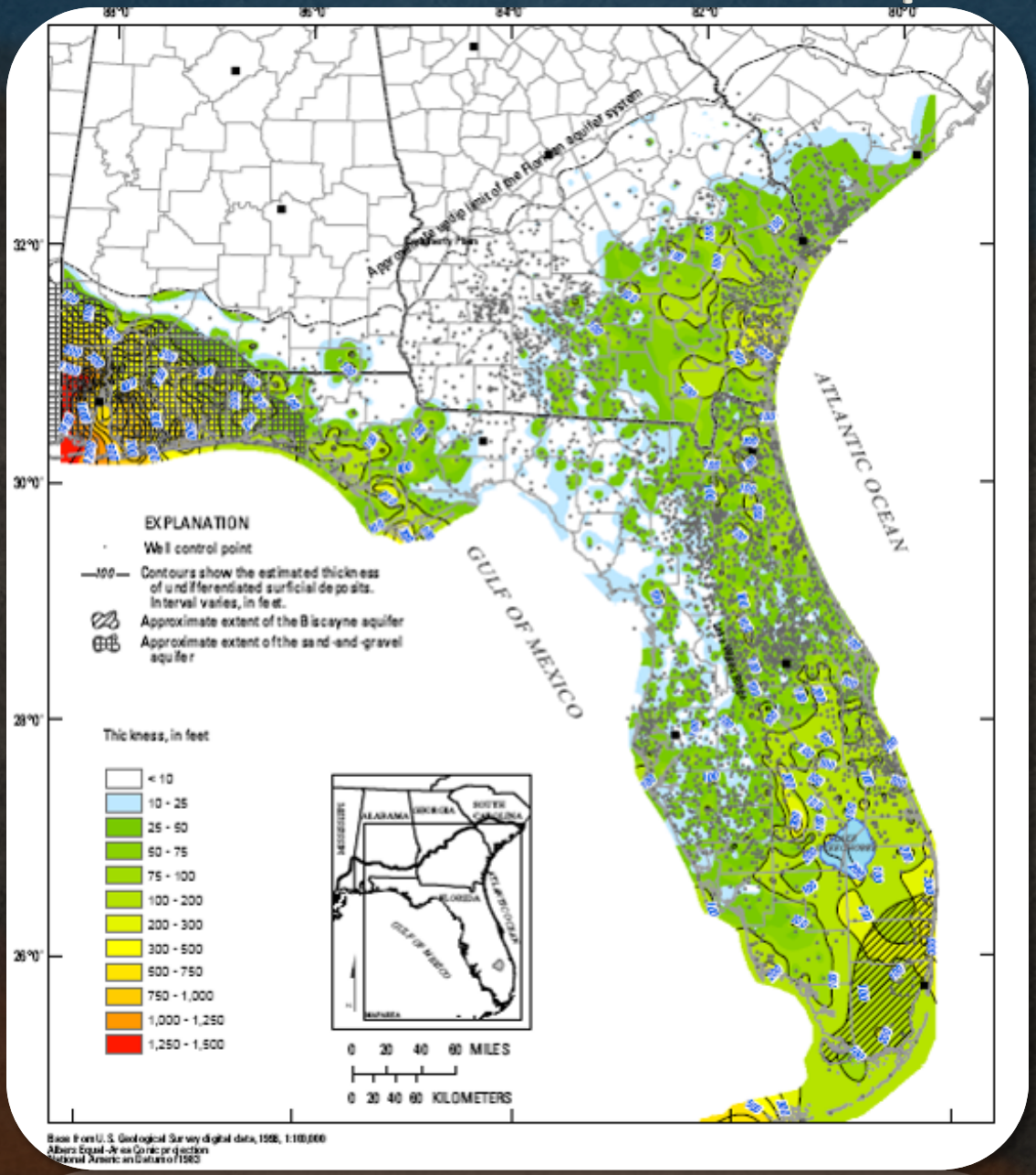
Surficial Aquifer System



Source: USGS

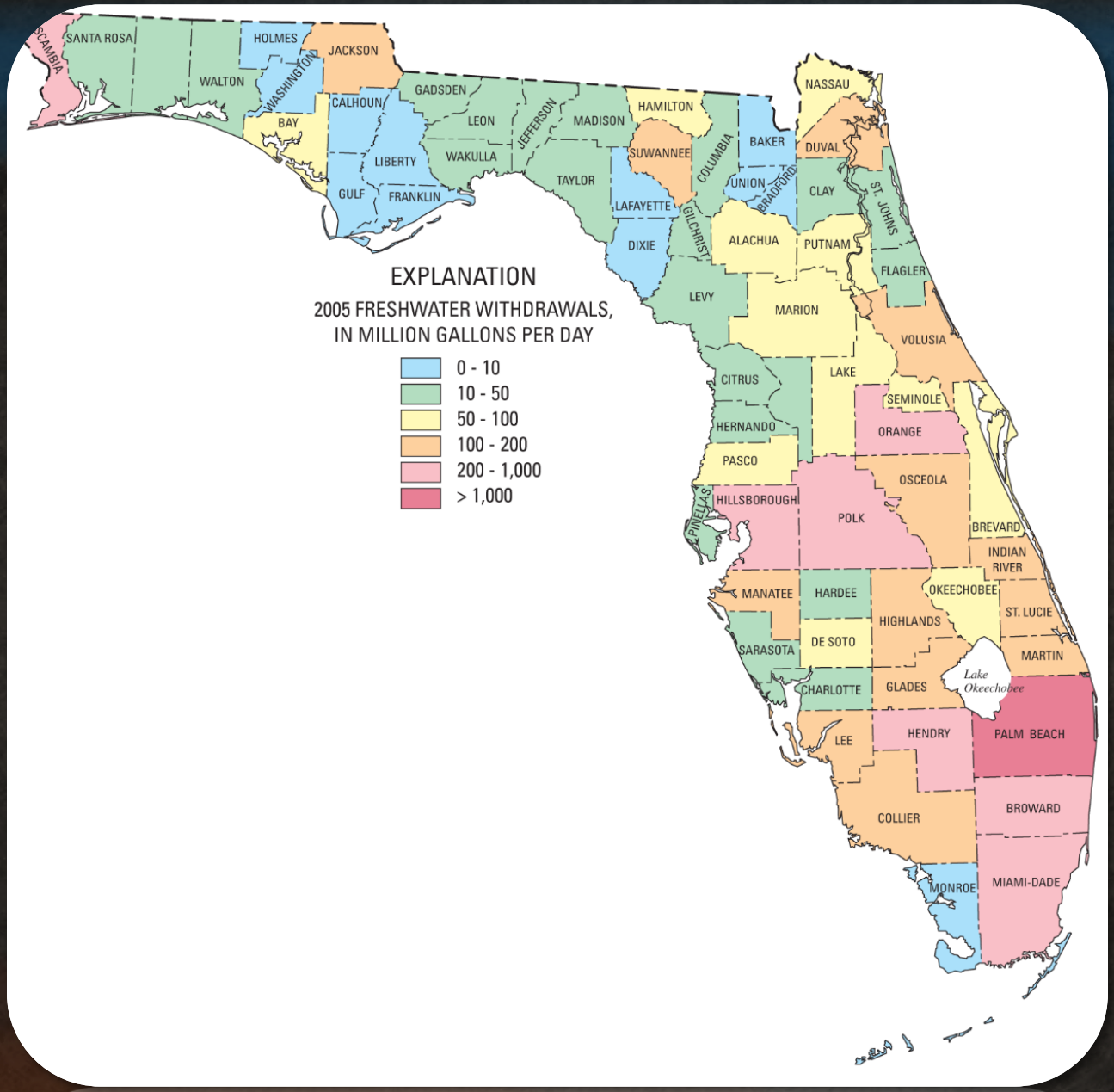


Figure 3. Map showing freshwater withdrawals in Florida by county, 2005.

Source: FDEP

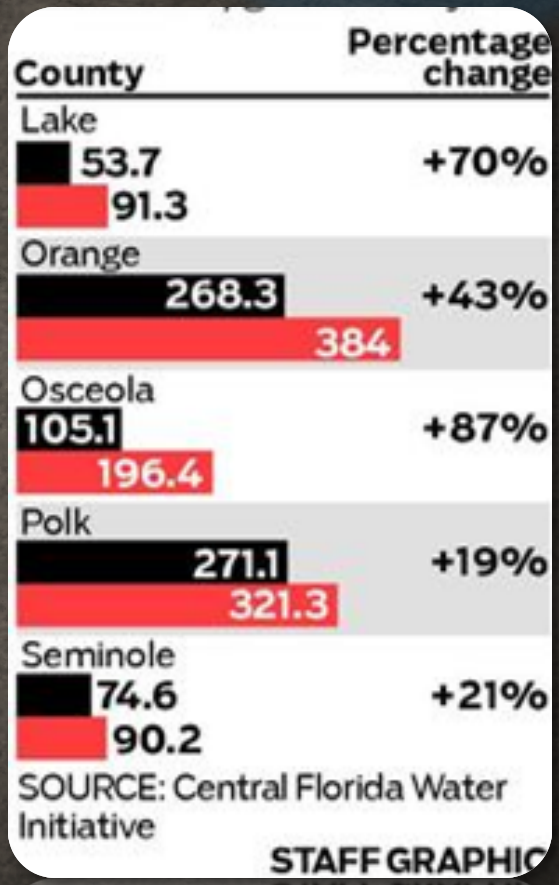
2035 Water Demand for Central Florida

A billion gallons

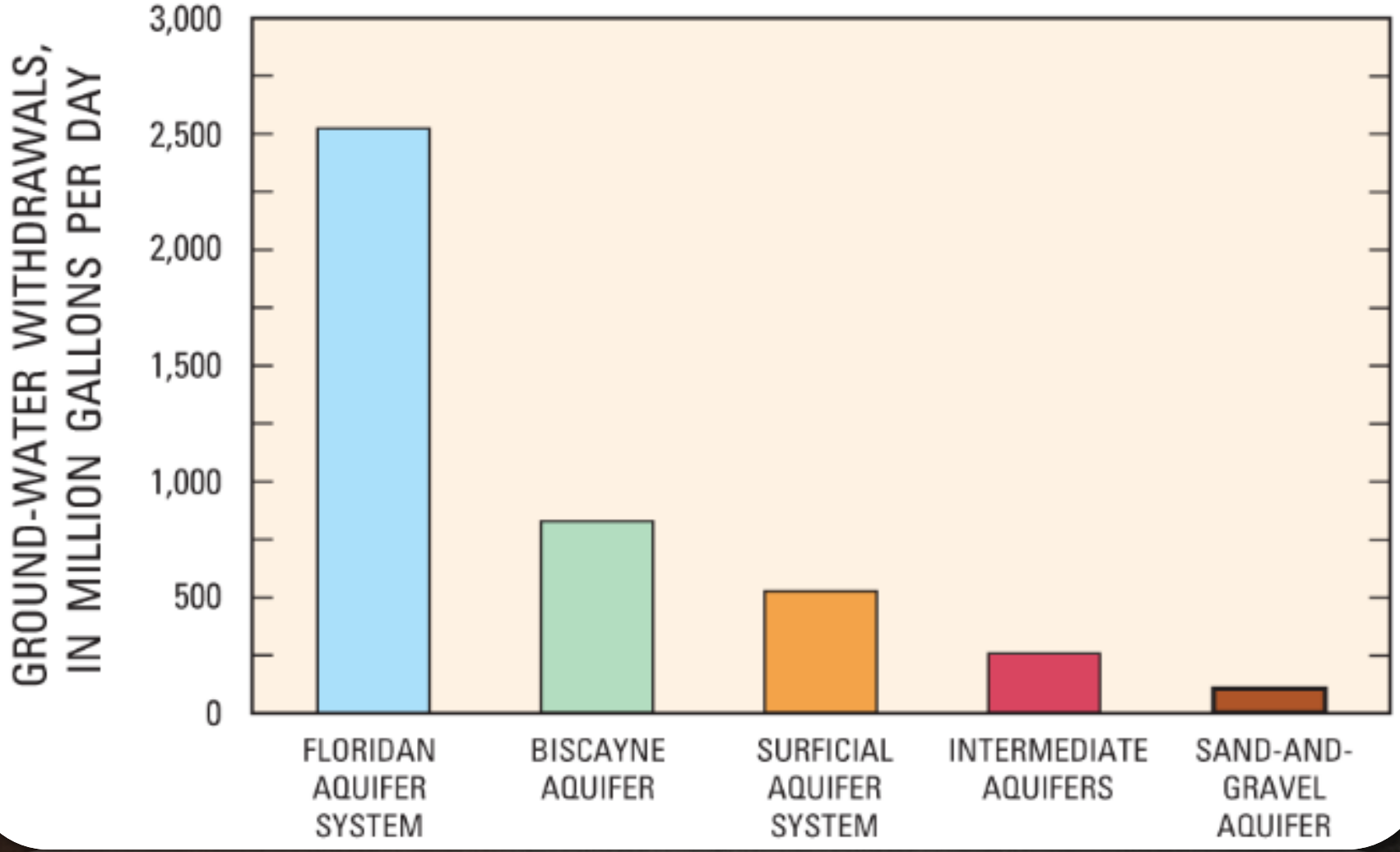
Central Florida will consume a billion gallons of water a day by 2035 and pumping all of it from the Floridan Aquifer would cause widespread environmental harm, according to new predictions.

■ 2010 ■ 2035

In millions of gallons a day

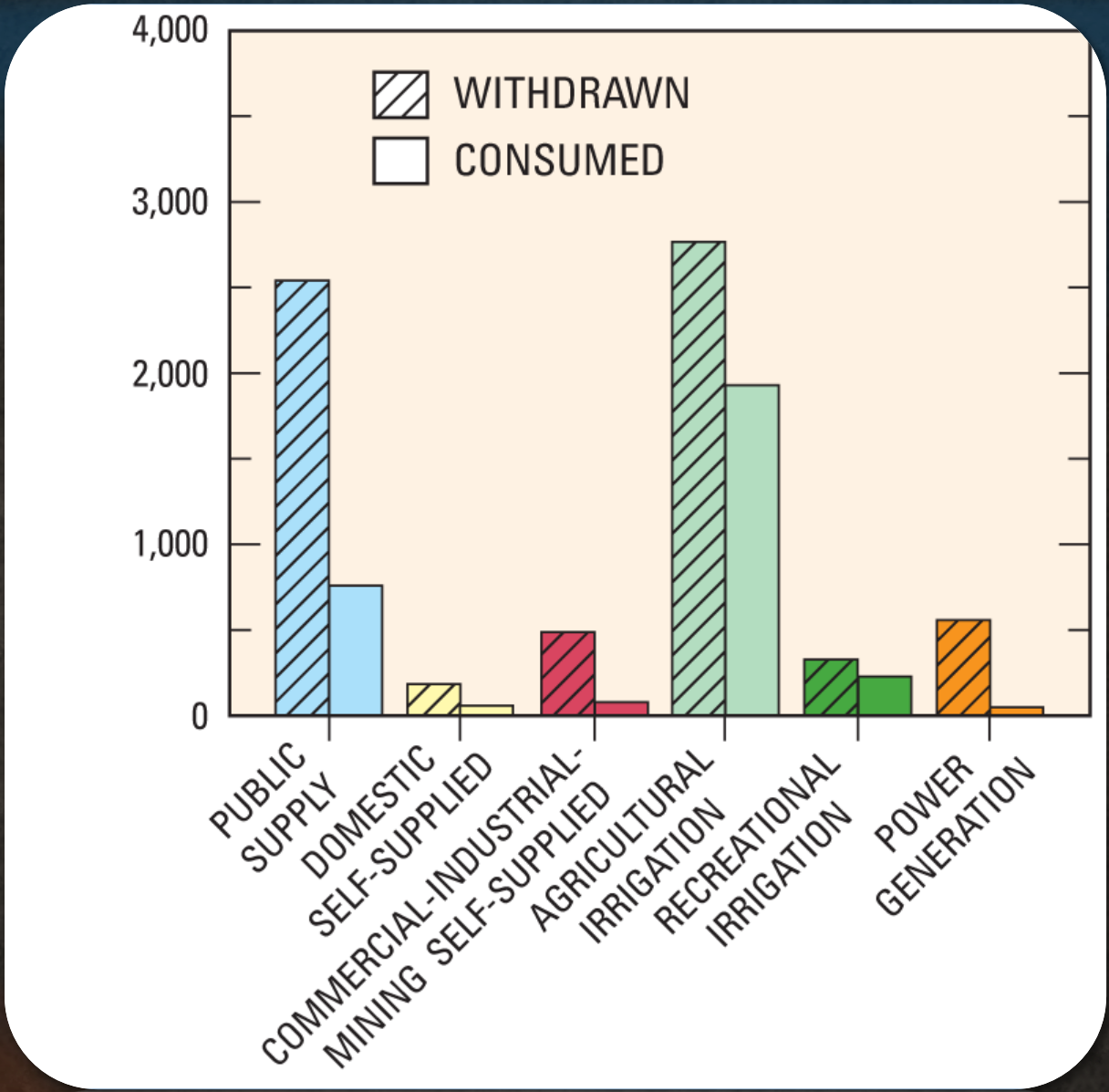


Source: Orlando Sentinel



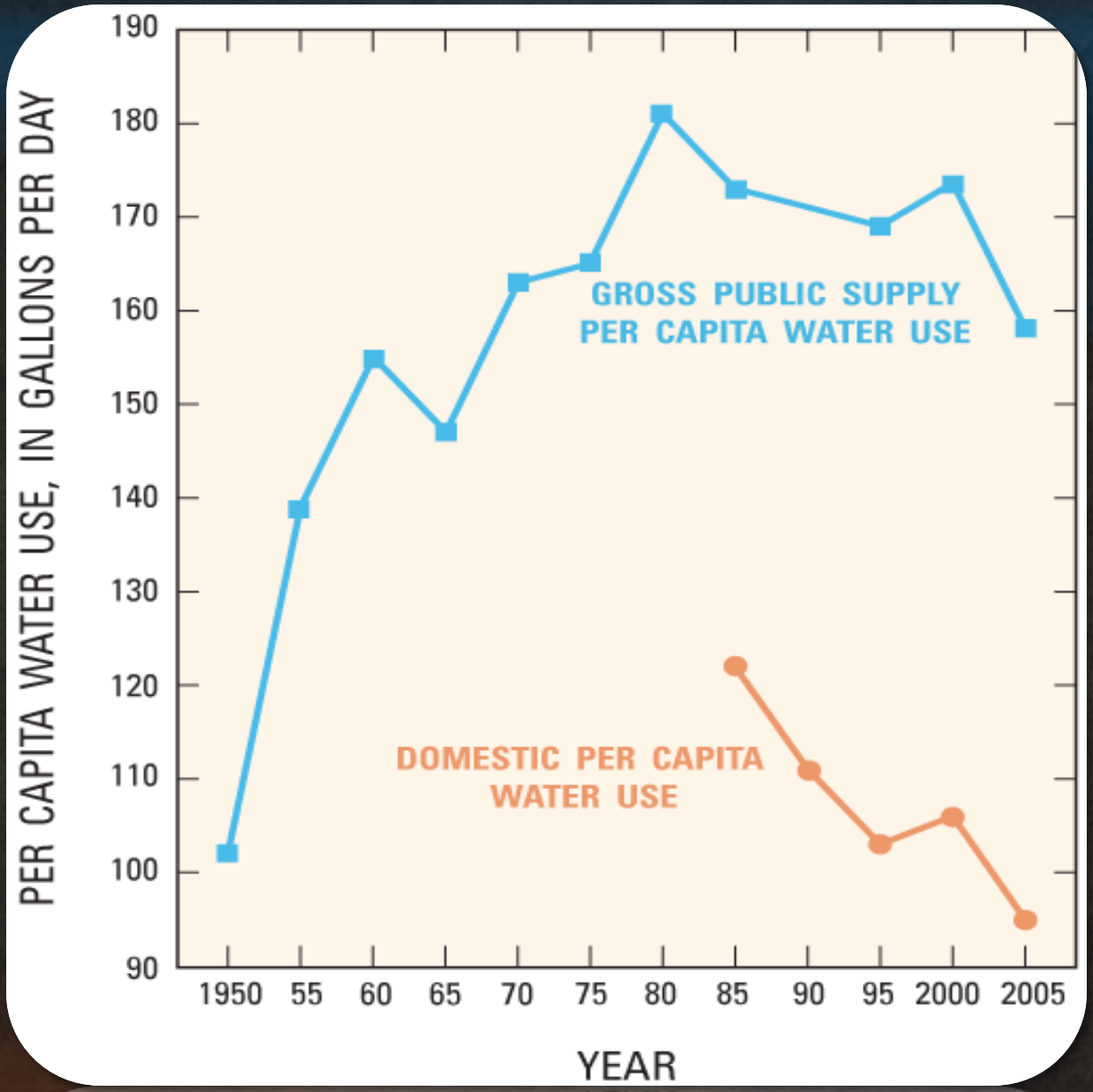
Source: FDEP

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



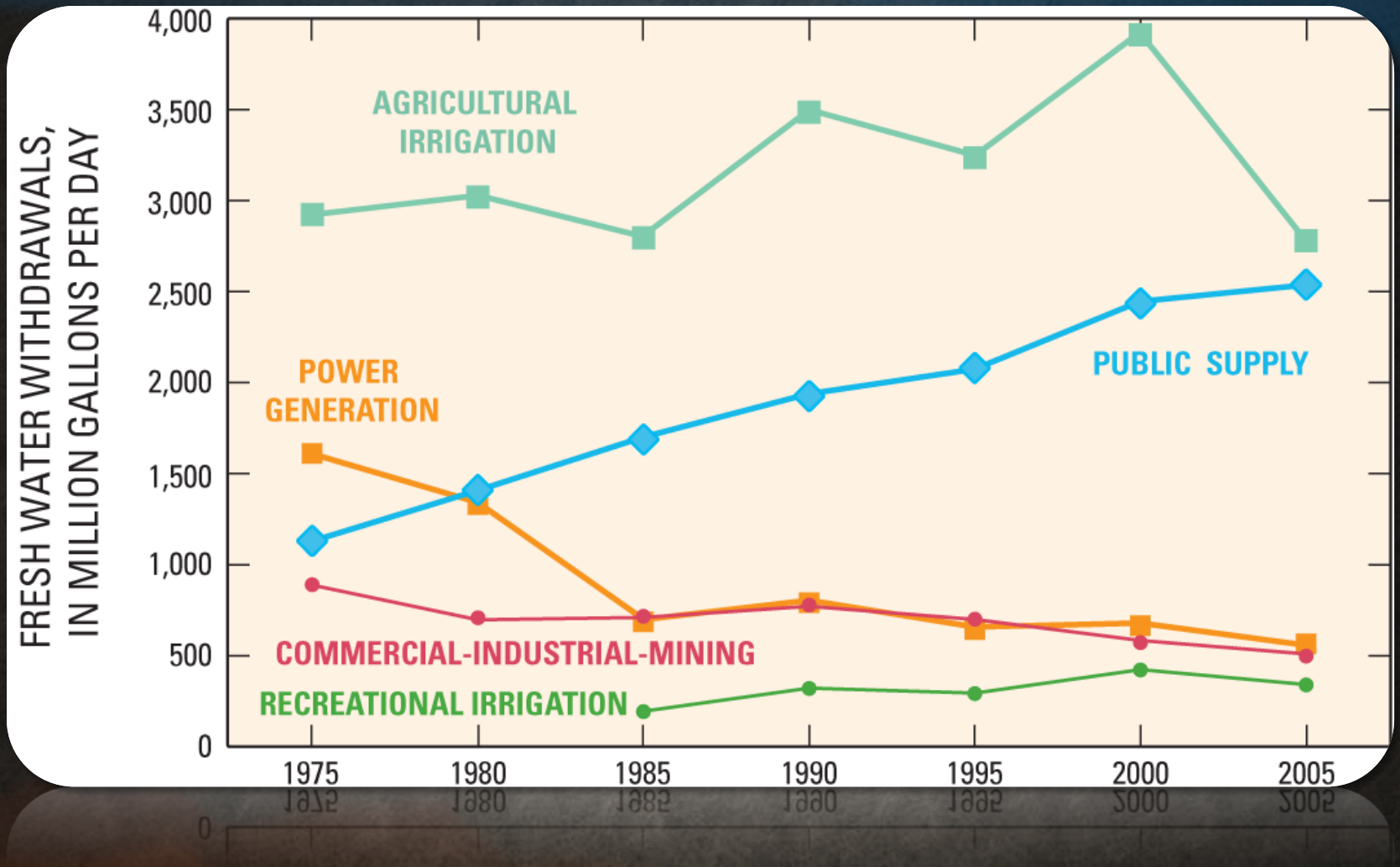
Source: FDEP

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



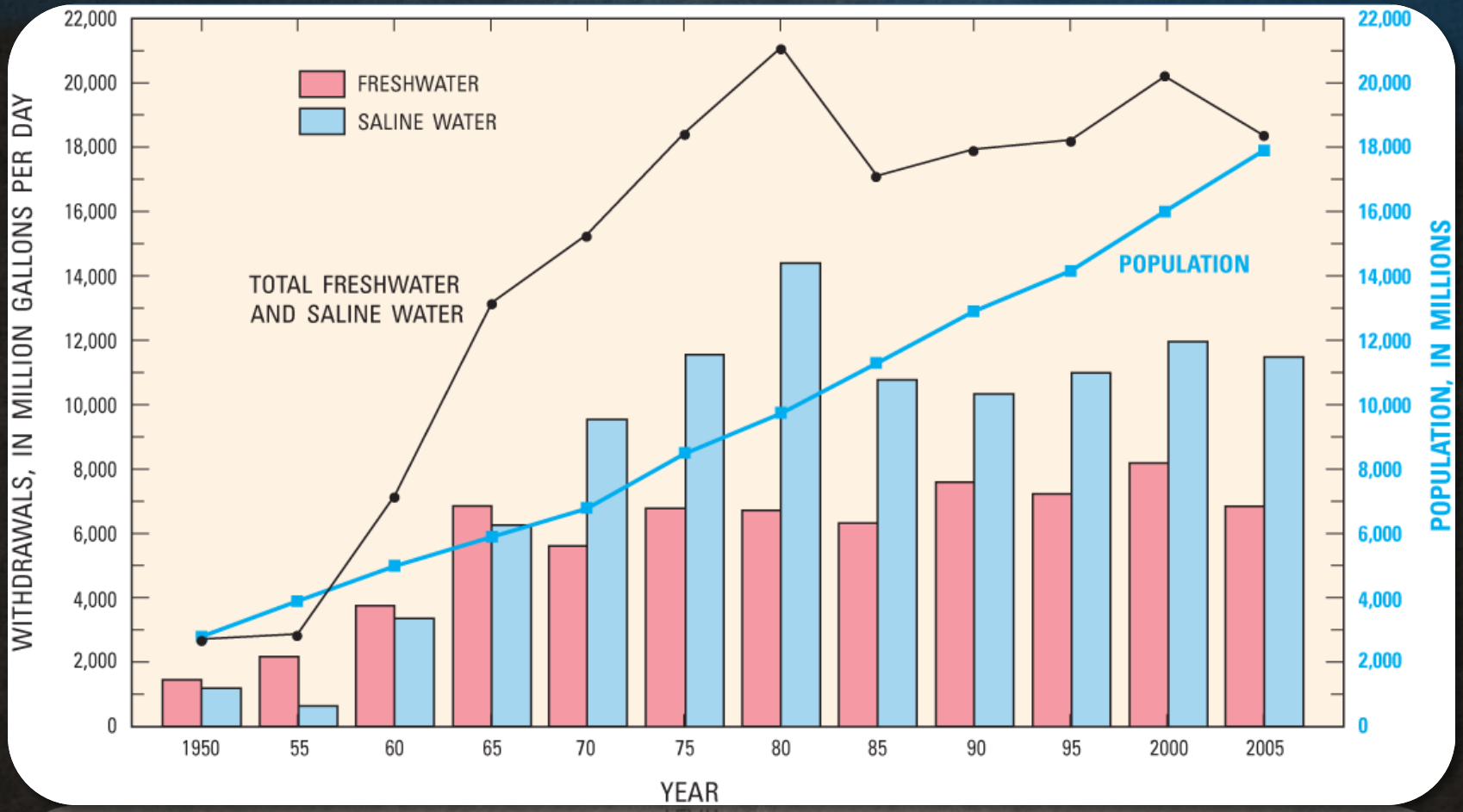
Source: FDEP

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



Source: FDEP

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



Source: FDEP

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

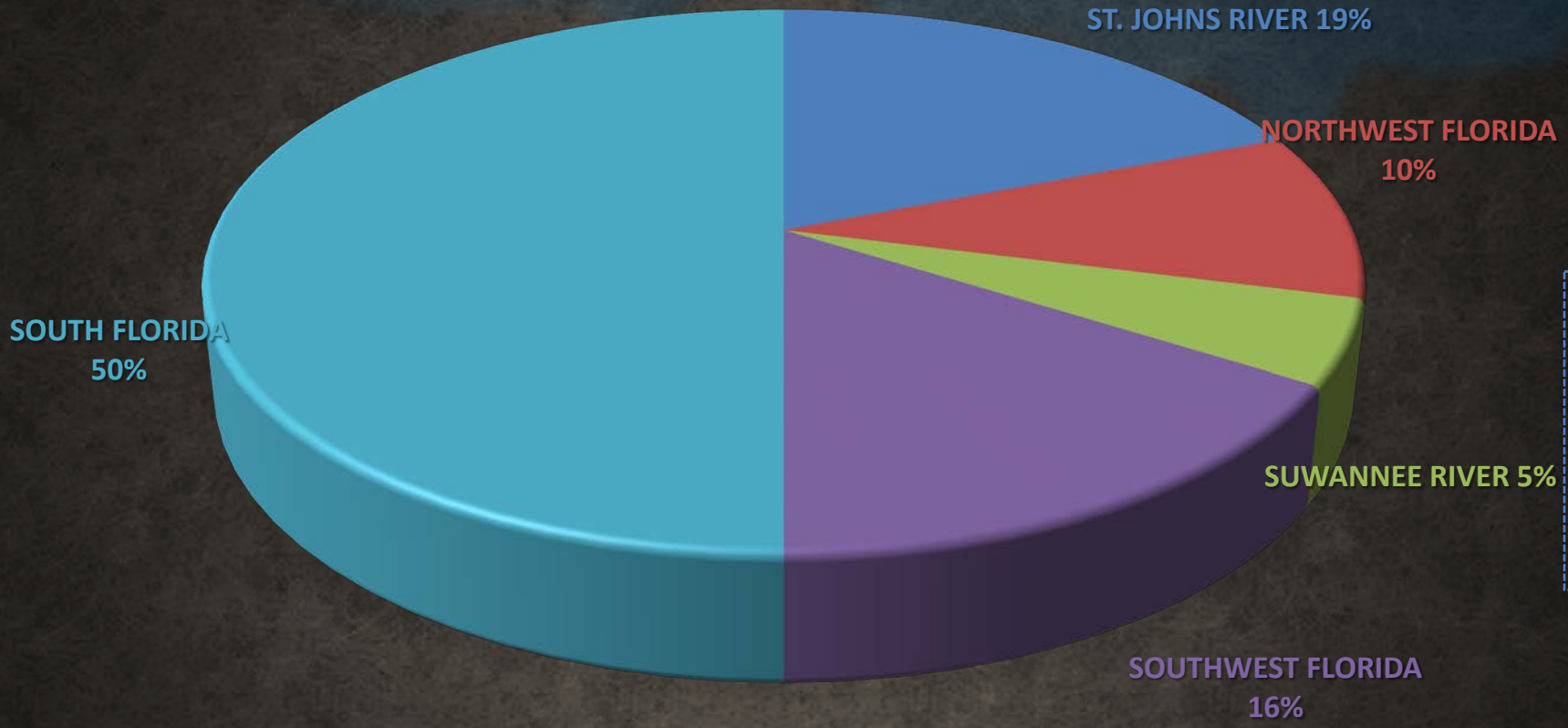
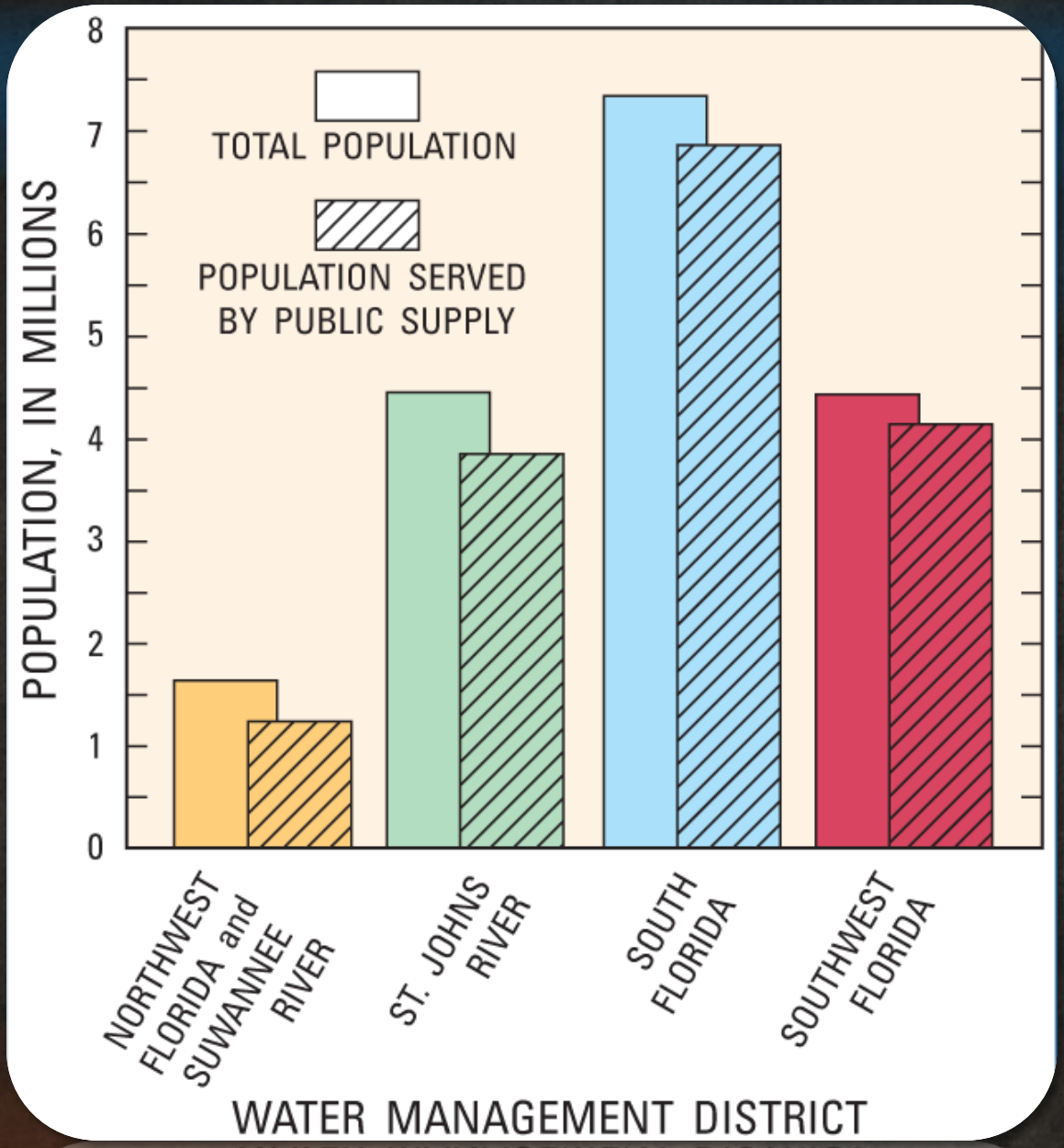


Figure 8. Freshwater withdrawals in Florida by WMD, 2005.



Source: FDEP

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

NOTE: Ground-water withdrawals for power generation accounted for nearly 0.5 percent of the total.

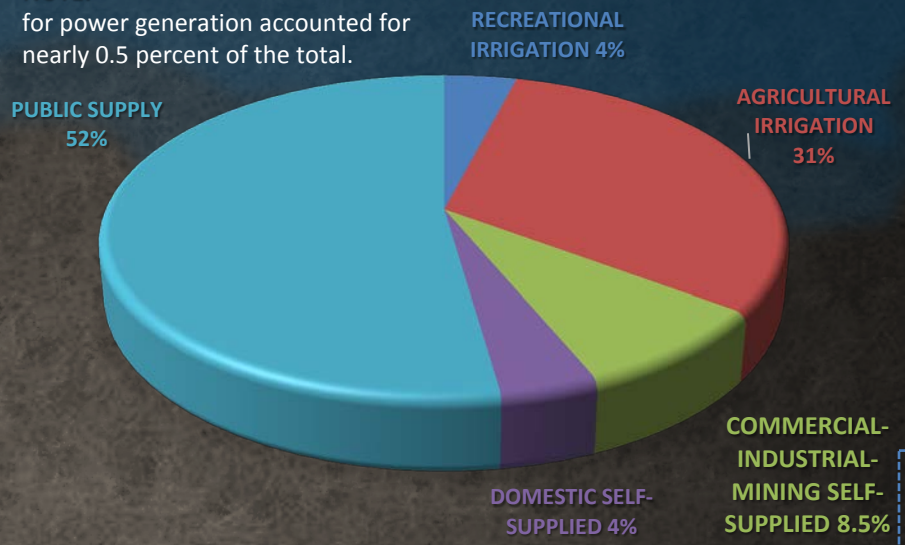


Figure 4. Fresh ground-water withdrawals in Florida by category, 2005.

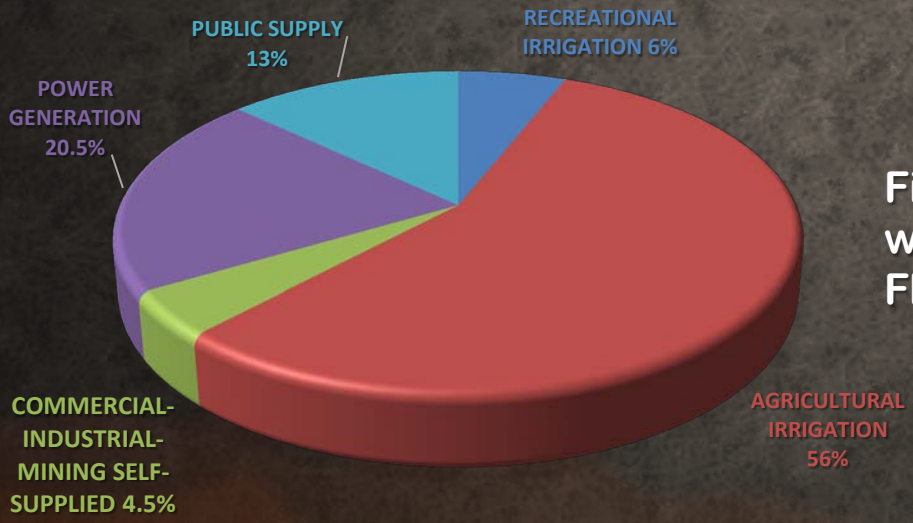
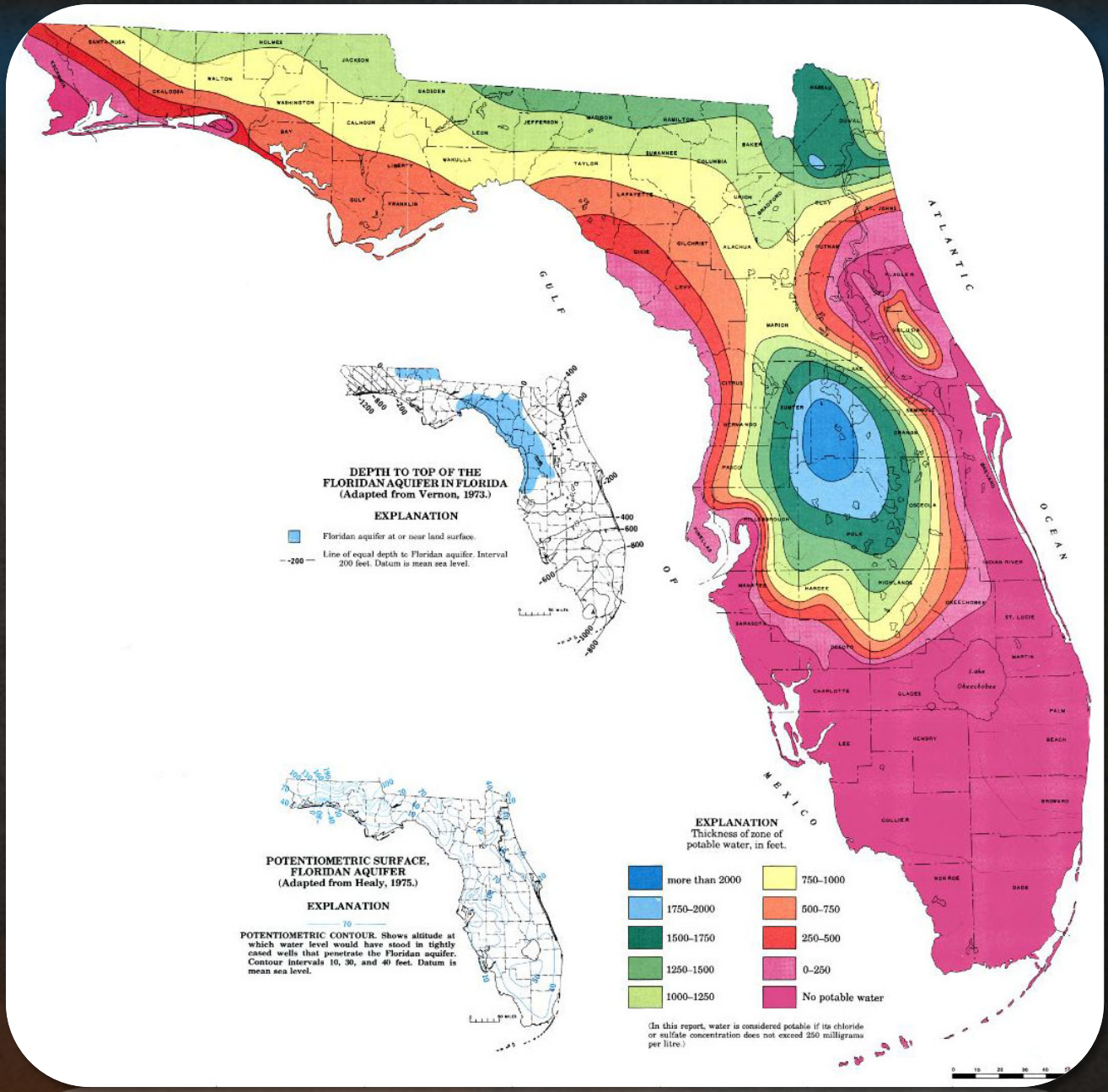


Figure 5. Fresh surface-water withdrawals in Florida by category, 2005.

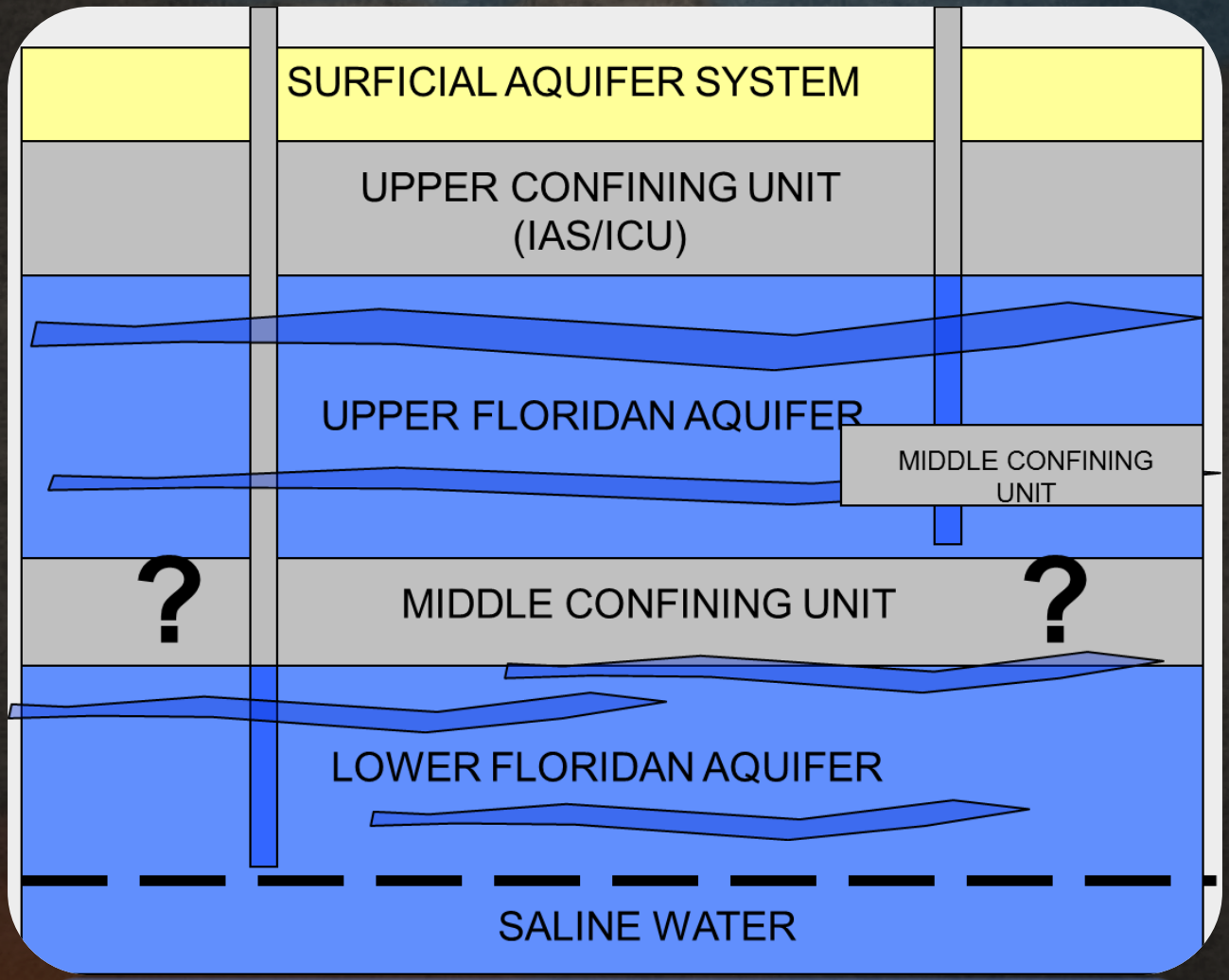
Source: FDEP



Source: USGS

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

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

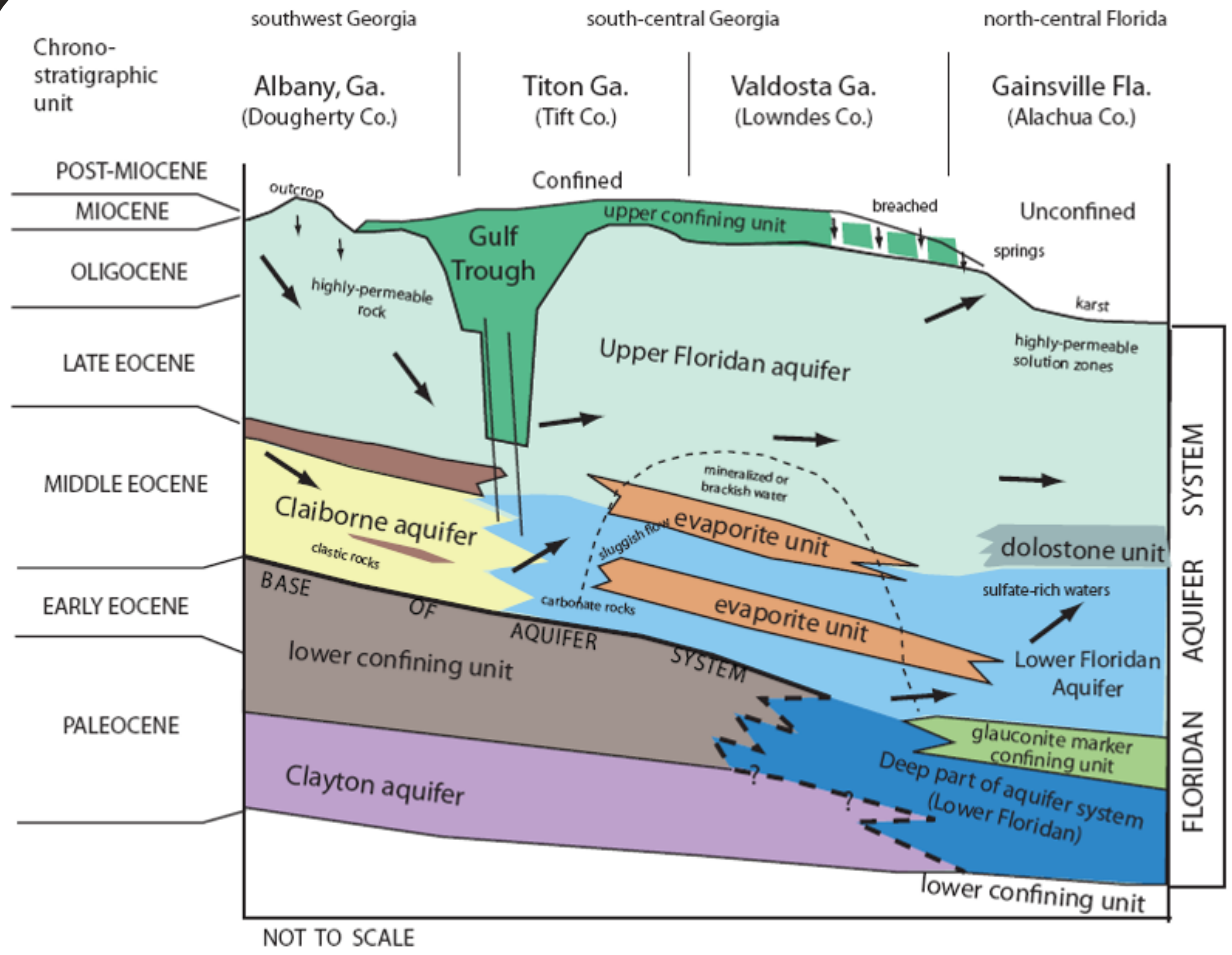
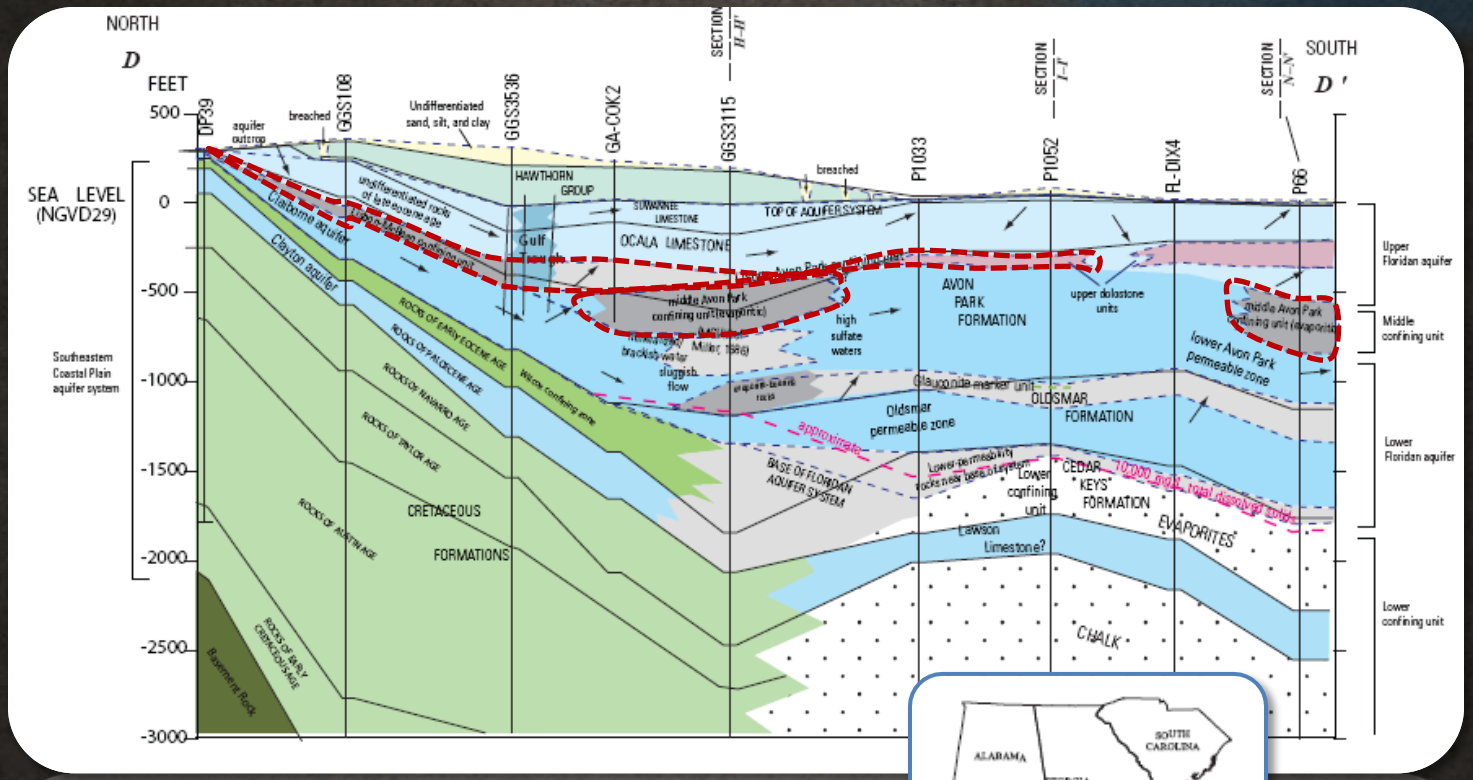
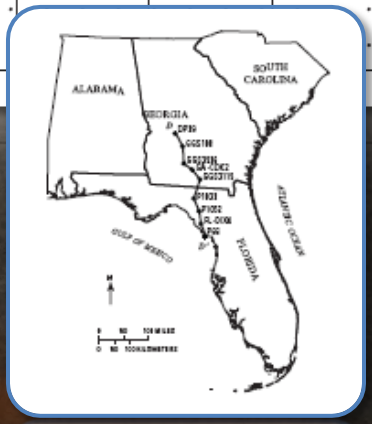


Figure 25. Schematic cross section showing transistion of hydrogeologic units in southwest and south-central Georgia and north-central Florida. Arrows represent direction of groundwater movement.

Source: USGS

Generalized N-S cross section





EXPLANATION

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

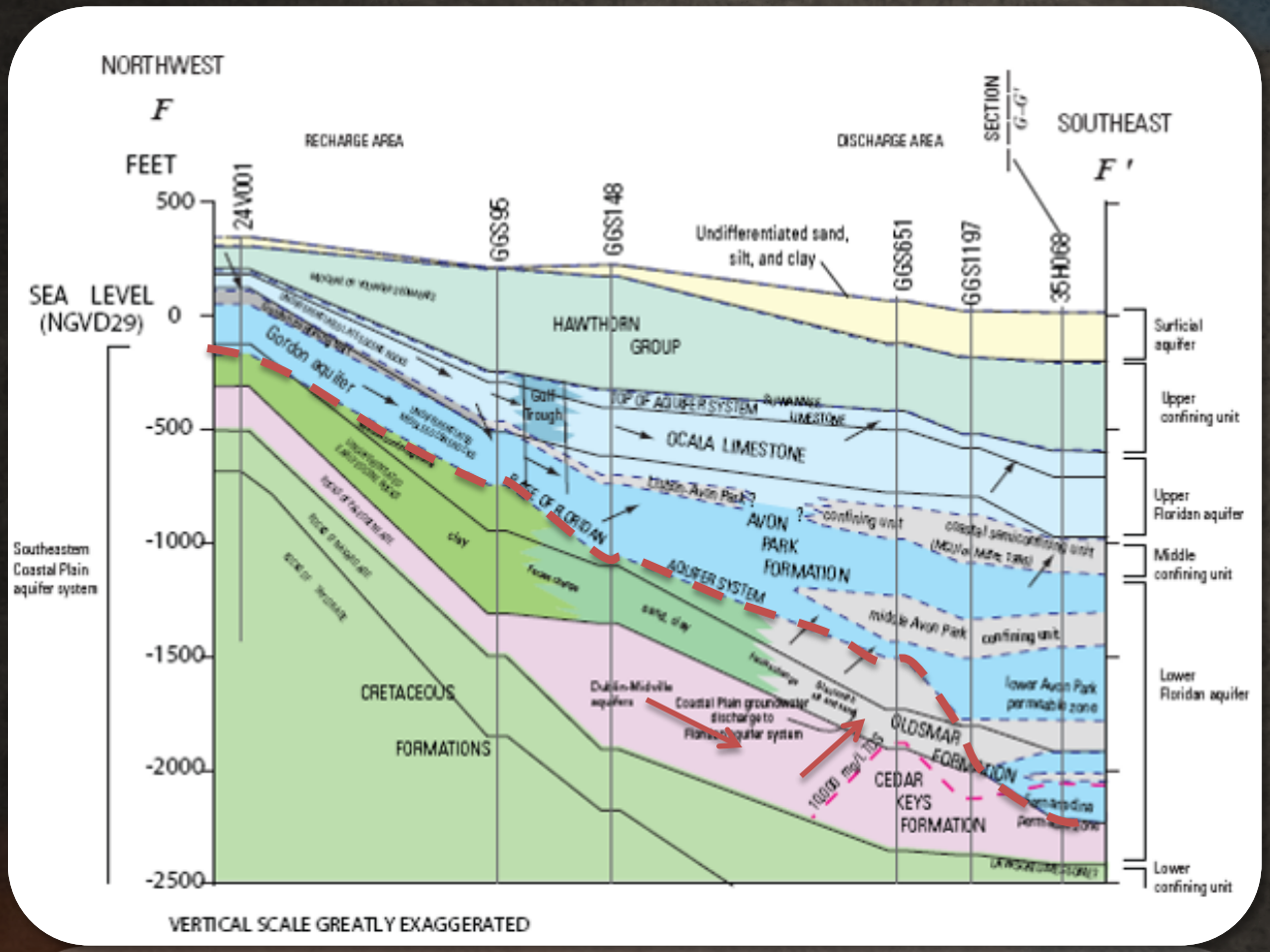
Generalized flow direction

Formation contact

Hydrogeologic boundary

Source: USGS

Southeast Georgia Embayment and coastal plain units



EXPLANATION

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

Generalized flow direction

Formation contact

Hydrogeologic boundary

Source: USGS

Estimated position of salinity zones in Lower Floridan aquifer

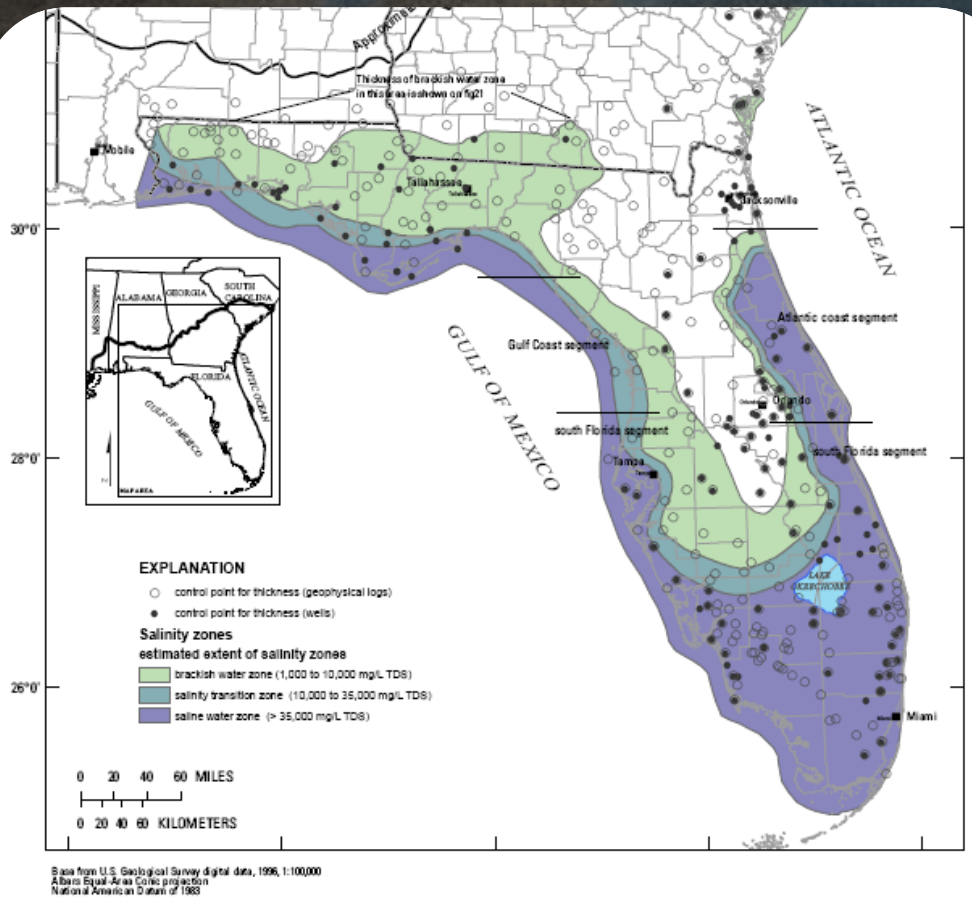
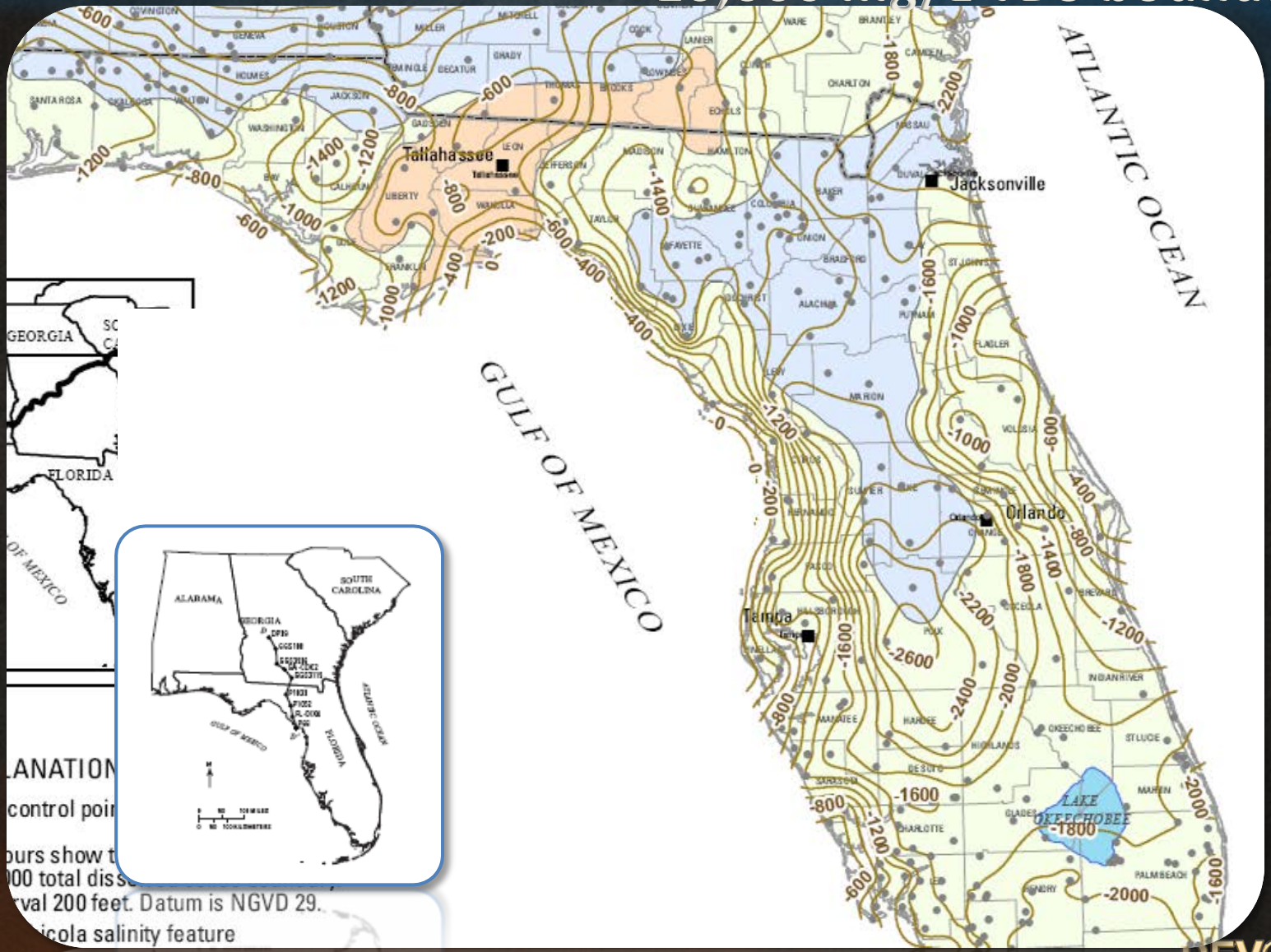


Figure 19. Map showing approximate extents of fresh, brackish, and saline water zones in the Lower Floridan aquifer.

Source: USGS

Elevation of Top of Saltwater in Florida

10,000 mg/L TDS boundary



Source: USGS

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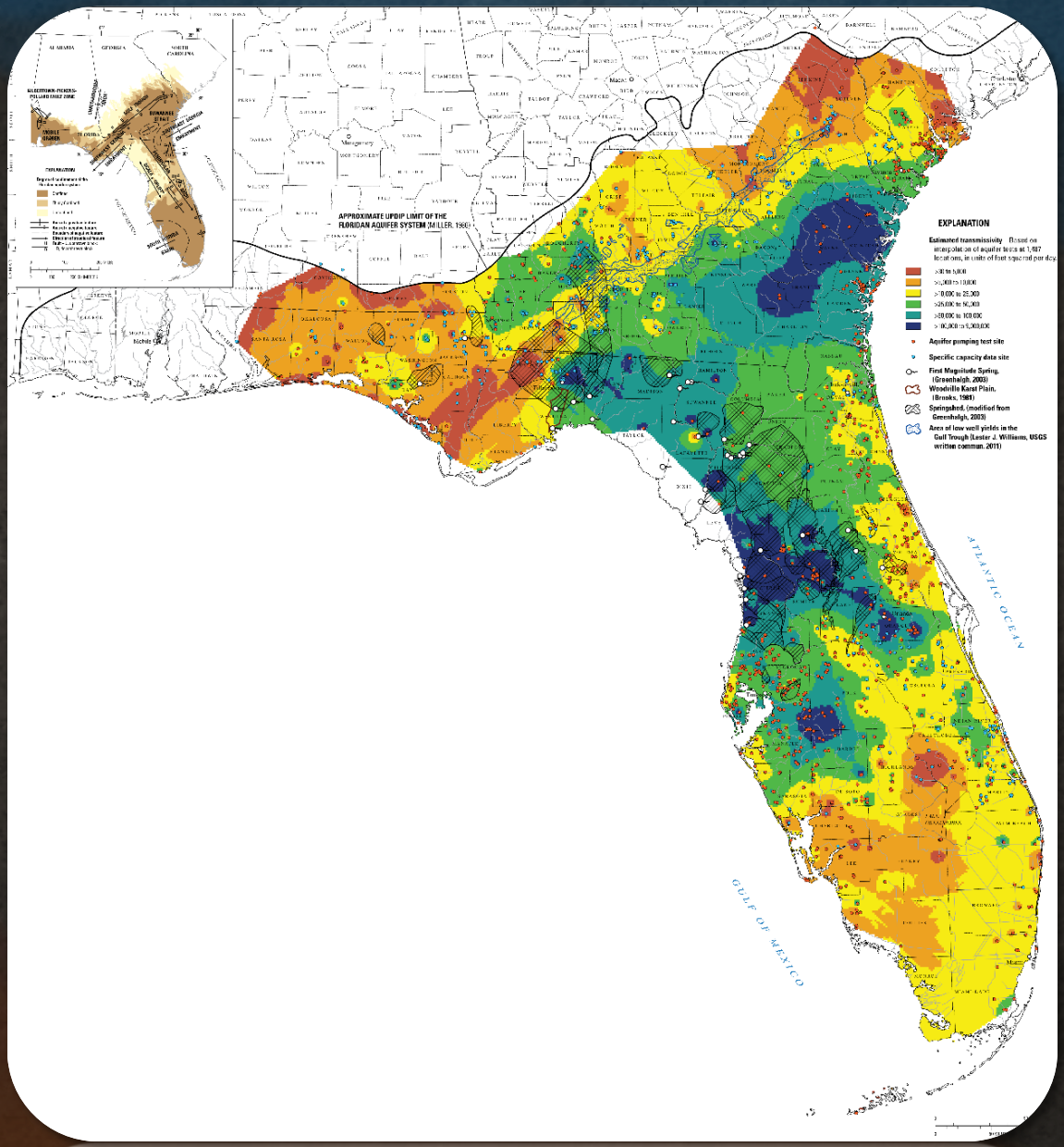
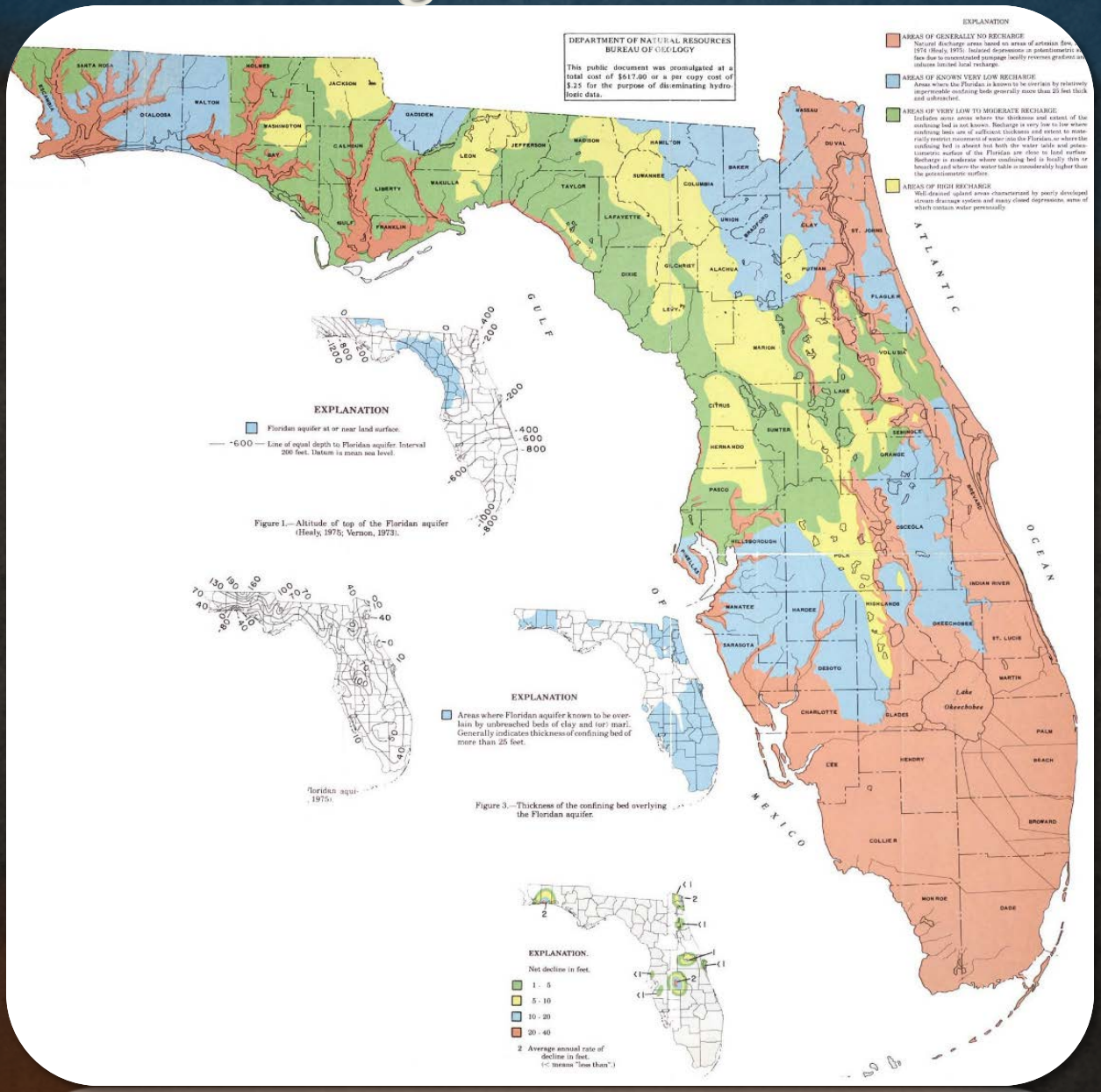
Transmissivity of the Upper Floridan Aquifer

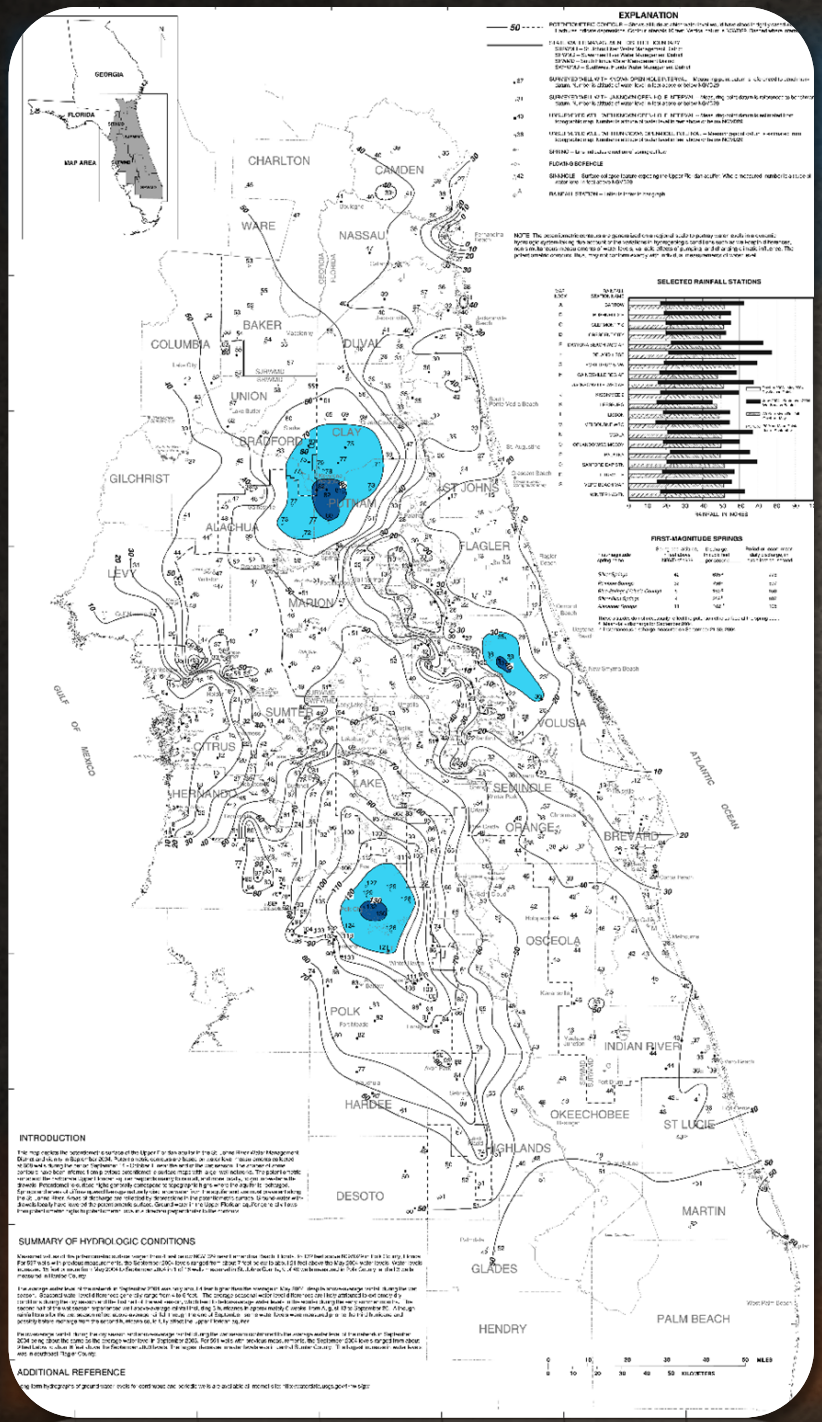


Source: USGS

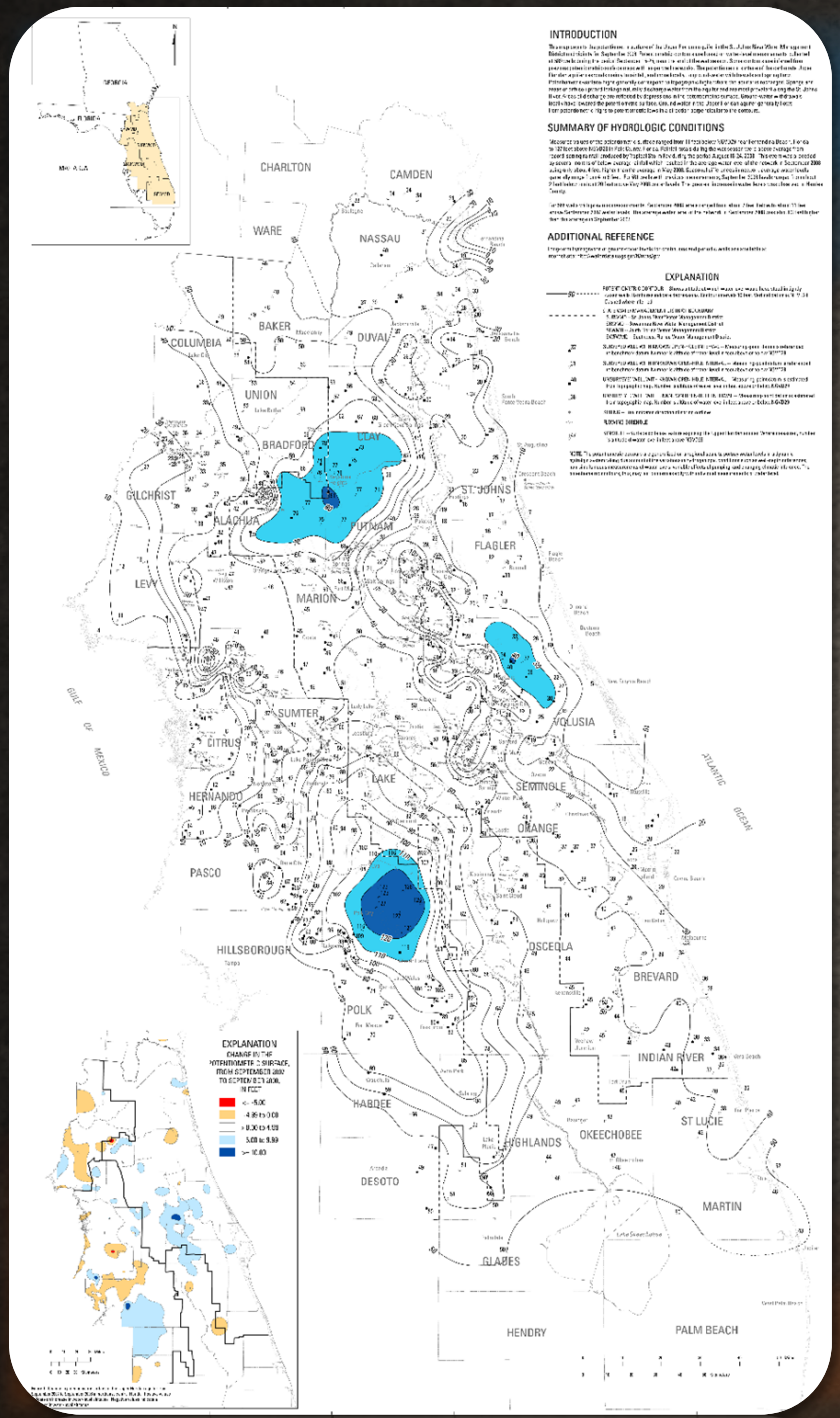
Natural Recharge to the Floridan Aquifer



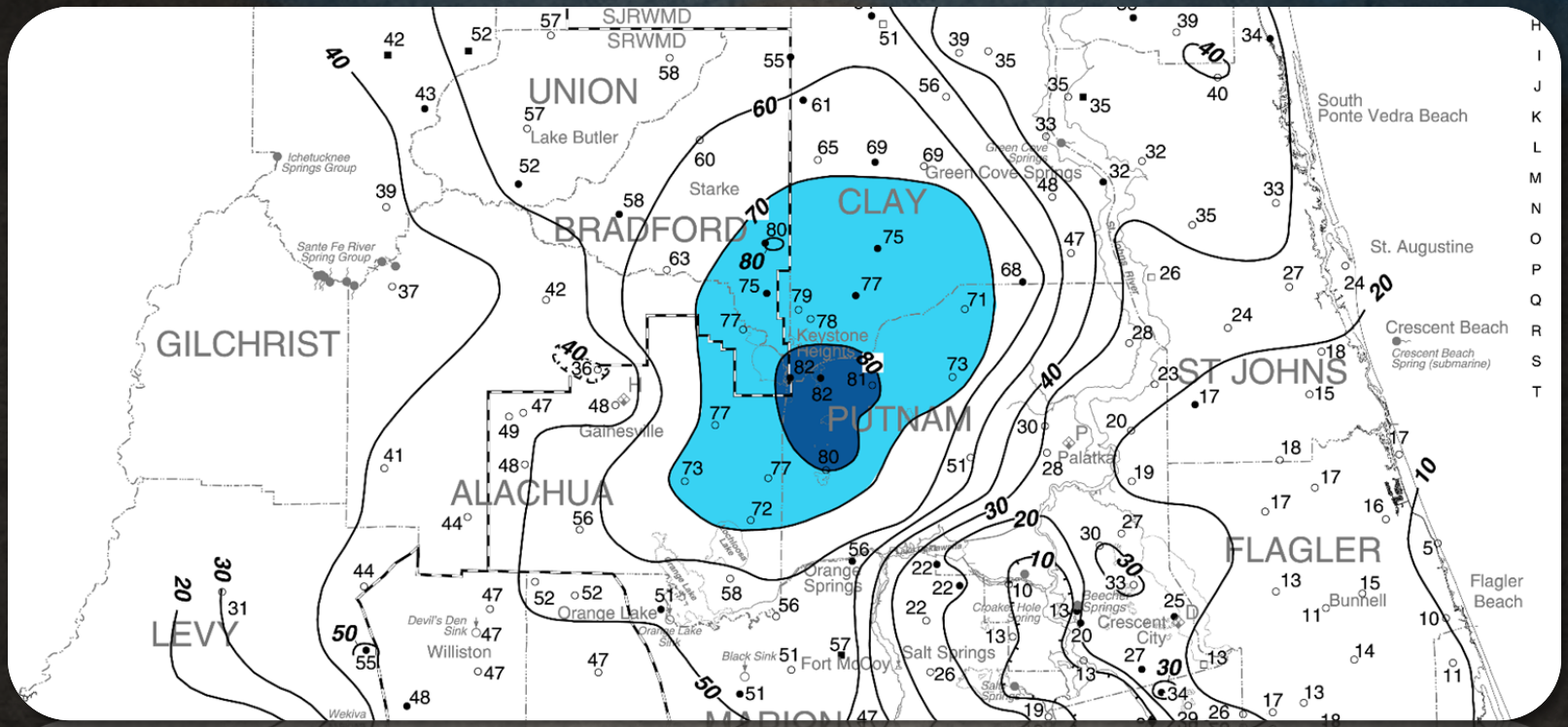
Source: USGS



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

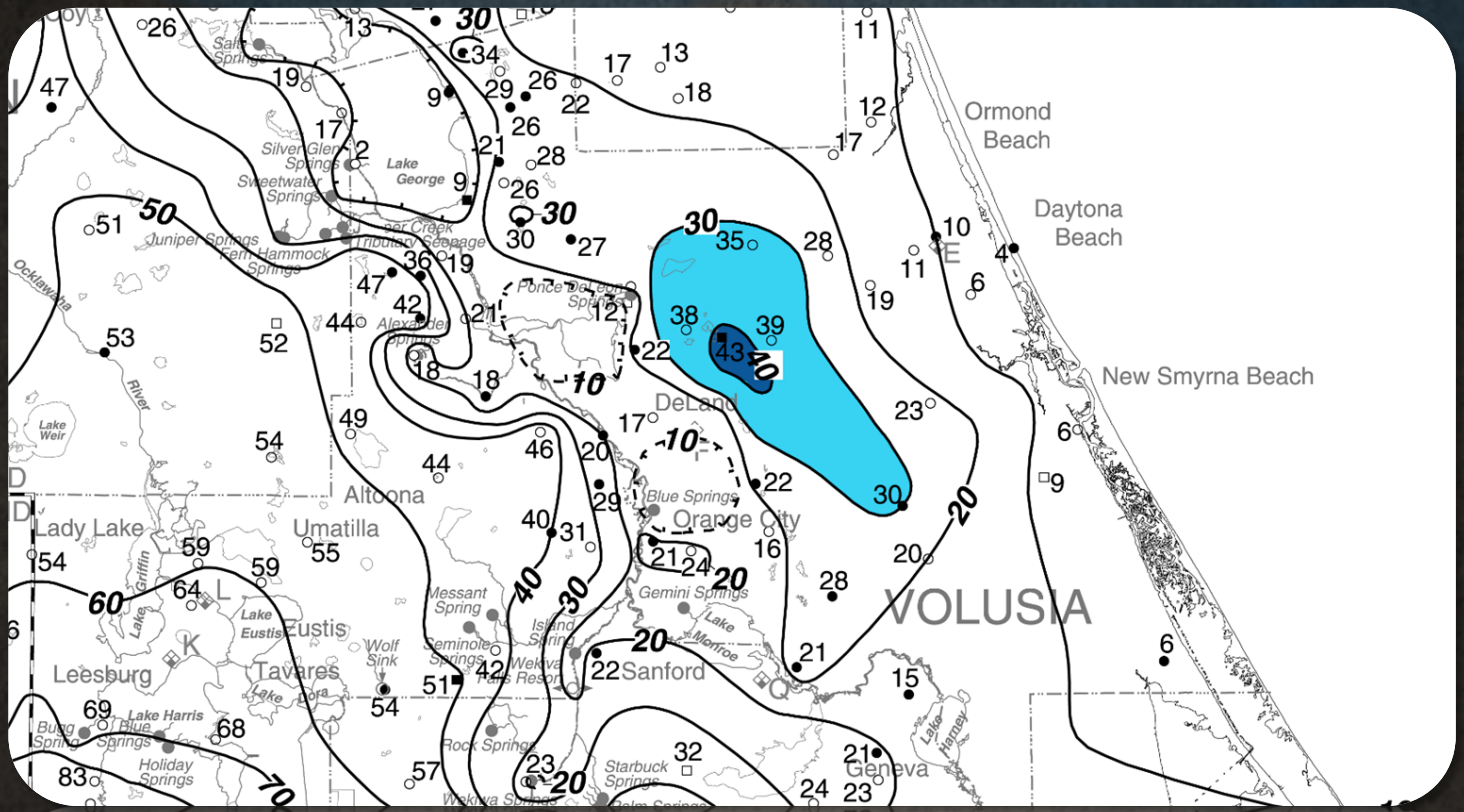


POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 2008



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

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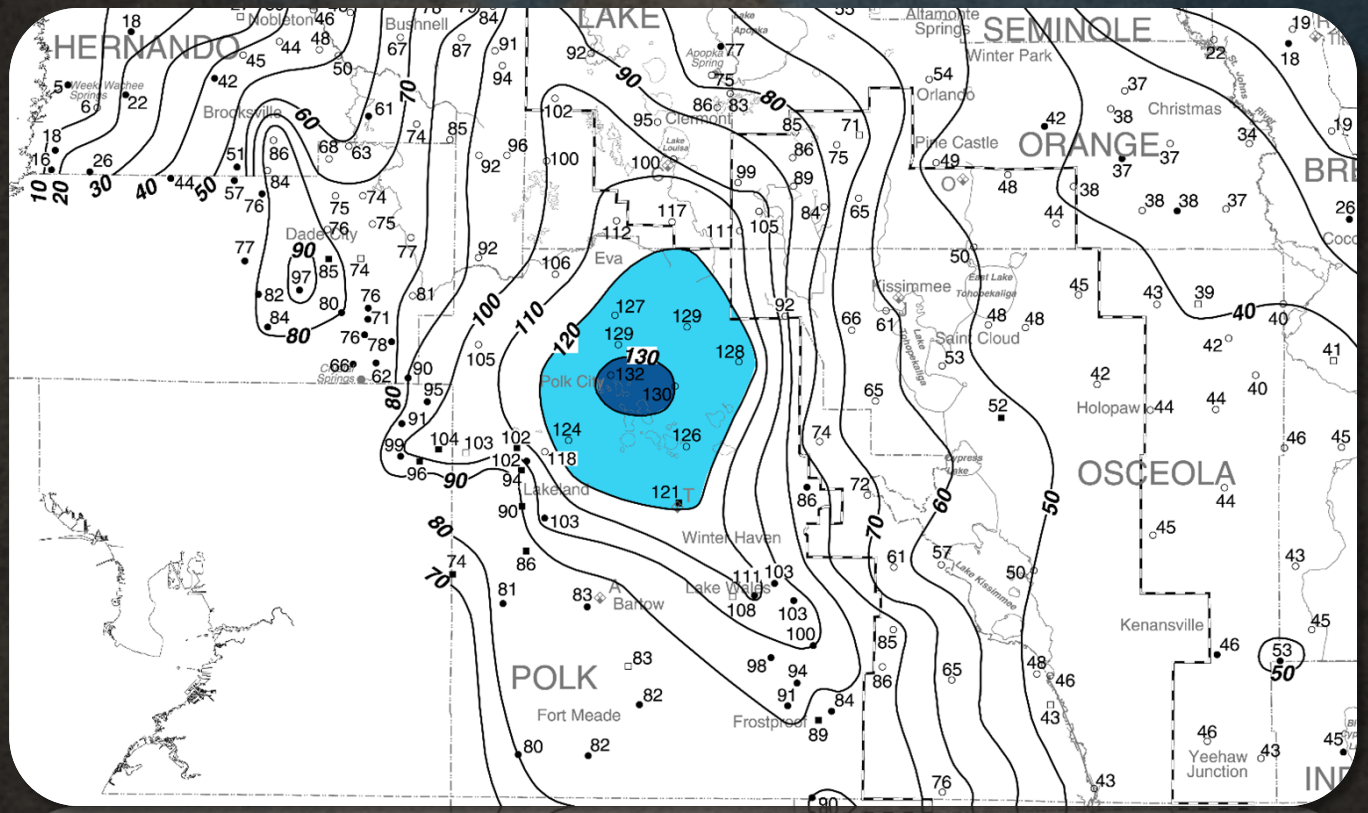

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 2004

Polk City High – Green Swamp Area

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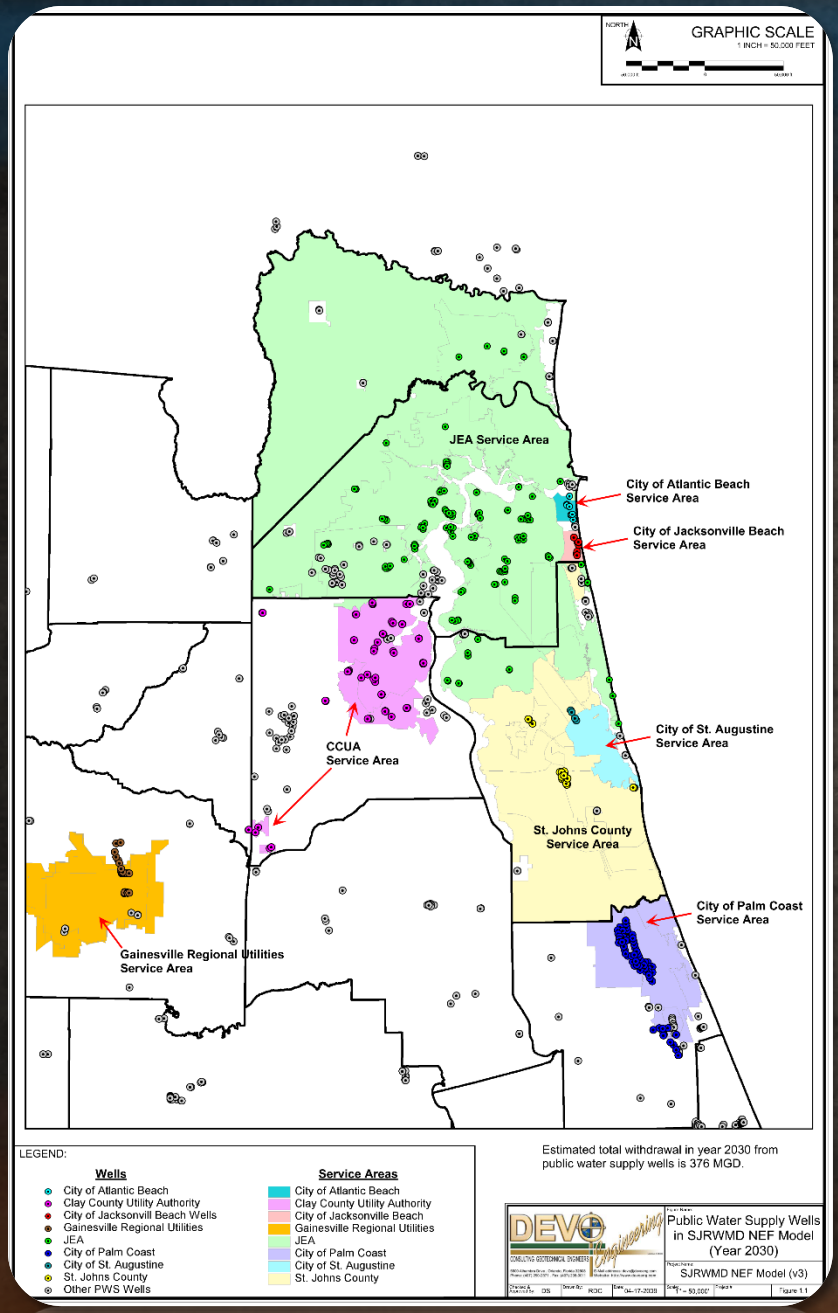
SJRWMD NEF MODEL



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

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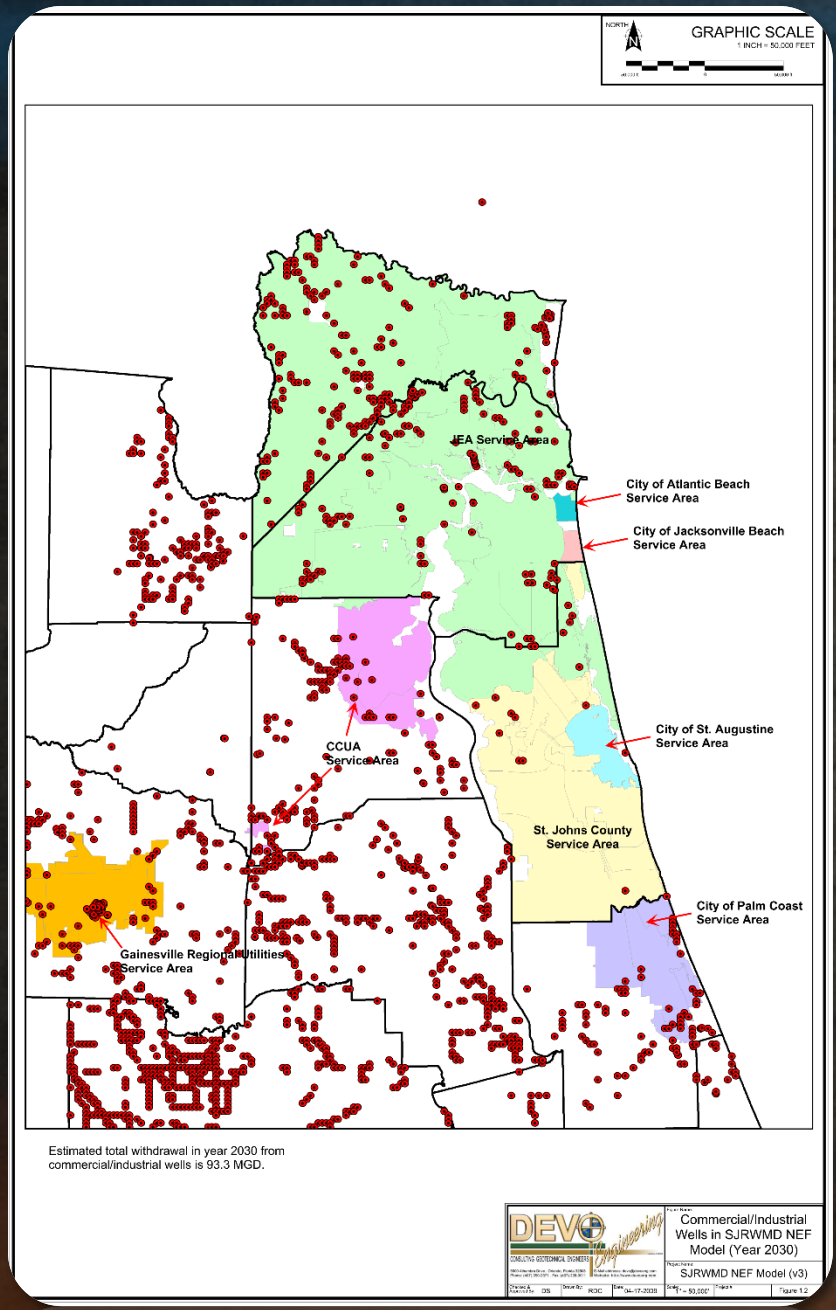
SJRWMD NEF MODEL



COMMERCIAL / INDUSTRIAL WELLS IN SJRWMD NEF MODEL (YEAR 2030

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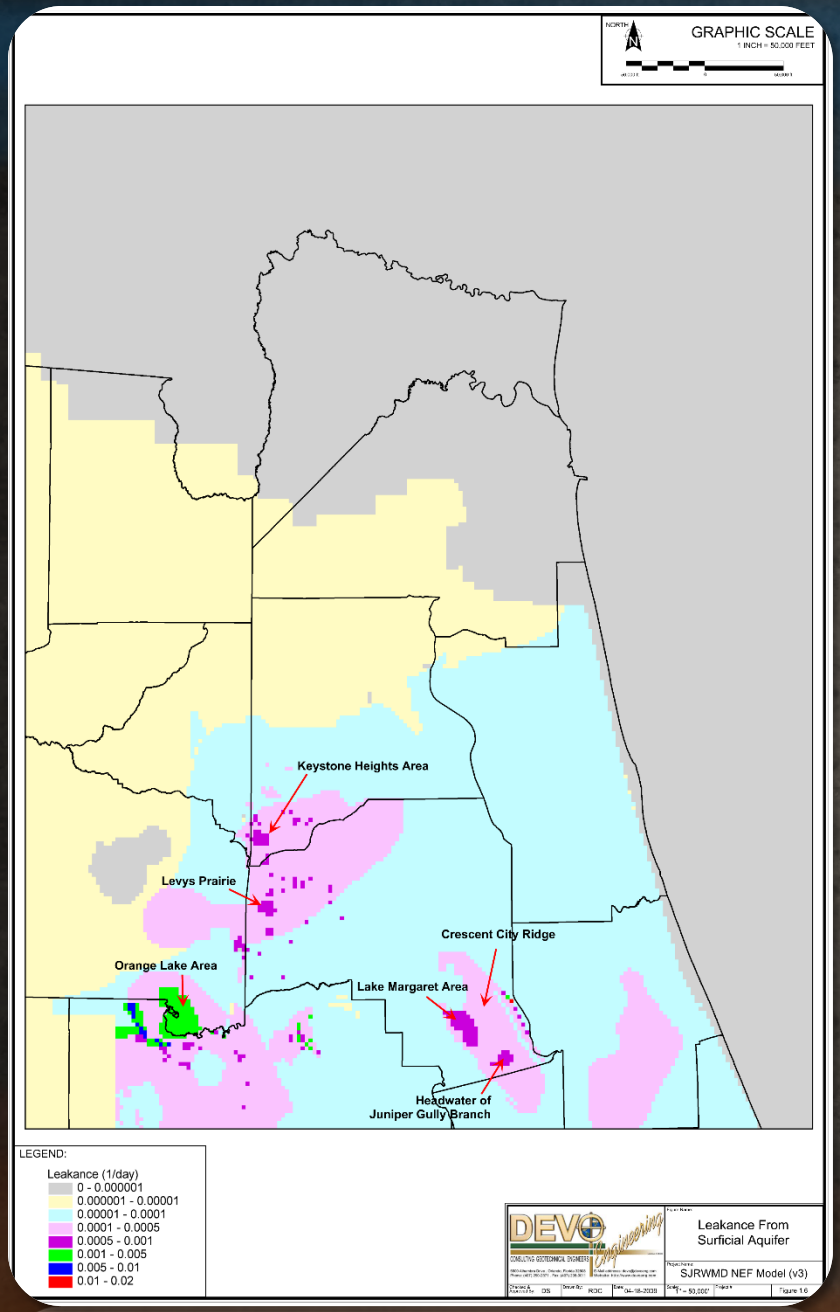
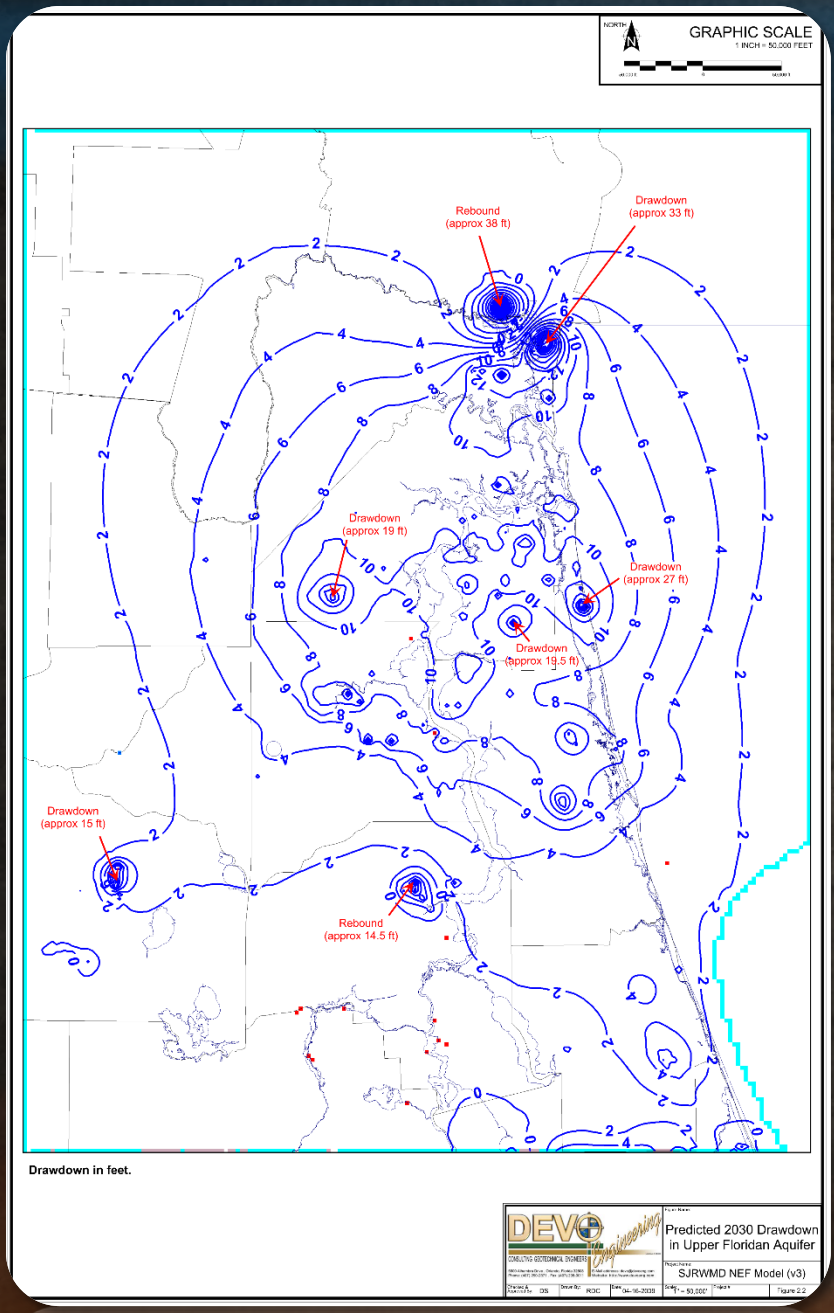
SJRWMD NEF MODEL



LEAKANCE FROM SURFCIAL AQUIFER

SJRWMD NEF MODEL



PREDICTED 2030 DRAWDOWN IN UPPER FLORIDAN AQUIFER

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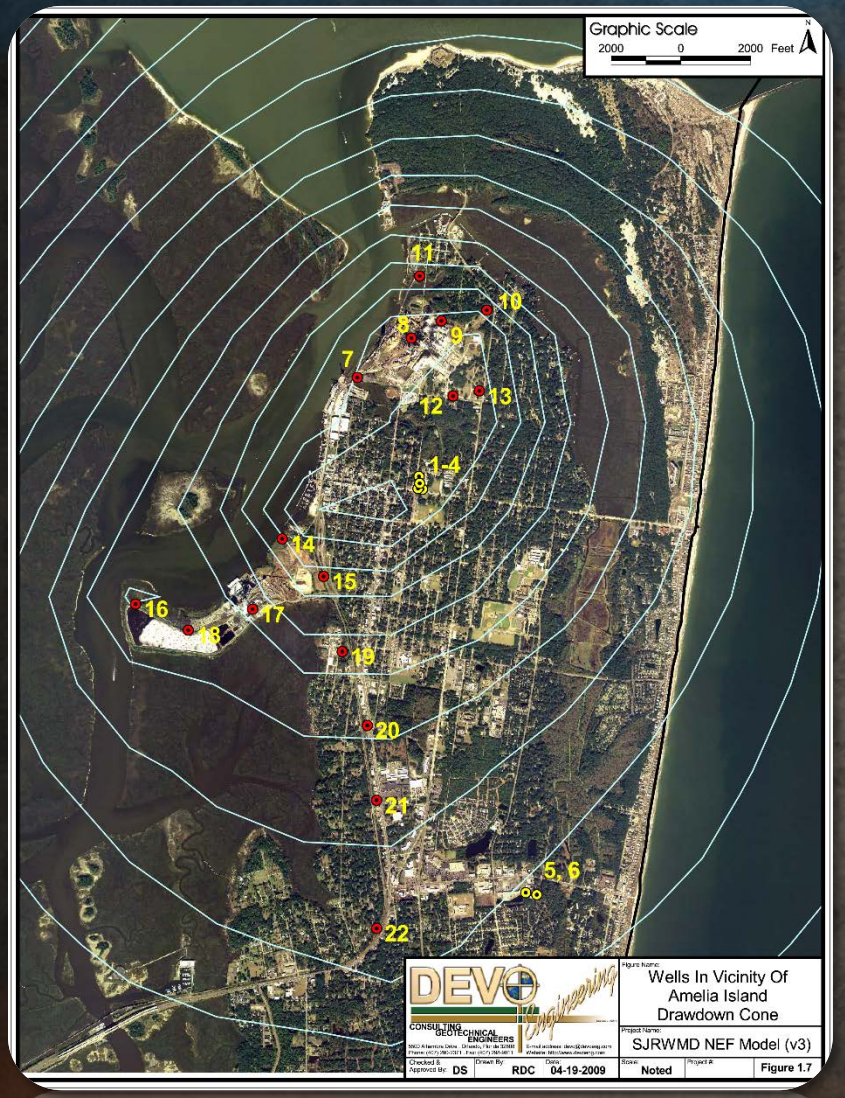
SJRWMD NEF MODEL



WELLS IN VICINITY OF AMELIA ISLAND DRAWDOWN CONE

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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.

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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

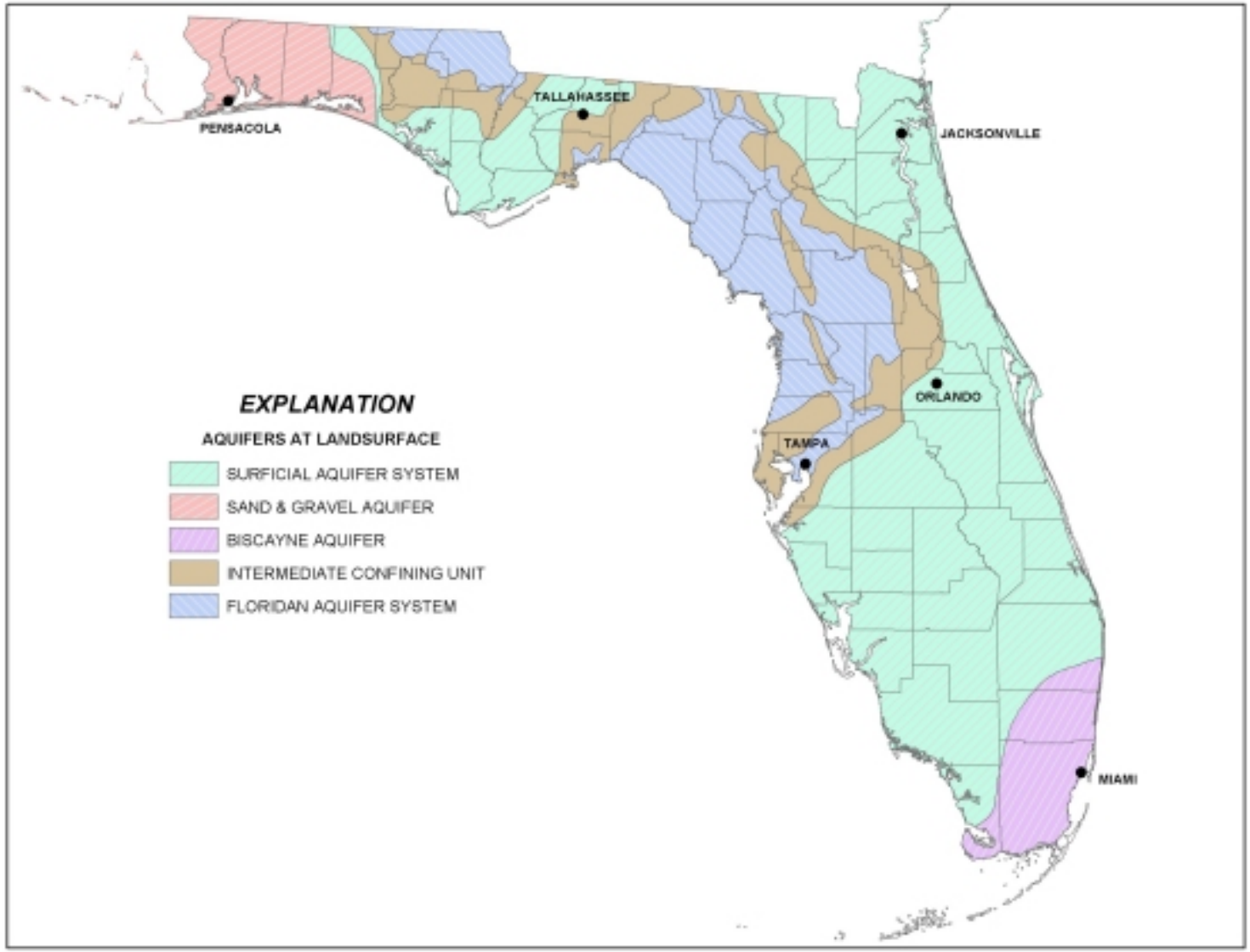
- *LOWER SURFICIAL SOURCE*
  - *Add*
  - *Flooding Mitigation*
    1. Decline of mining dewatering
       a. C.W. Bill Young Reservoir
       b. Back to the Indians
- *MASTER DATABASE FOR STATE*
- *FLOODING*
  - Cranes Roost
    1. hail the reclaimed Deal with Apopka
  - Clermont Chain of Lakes
    1.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

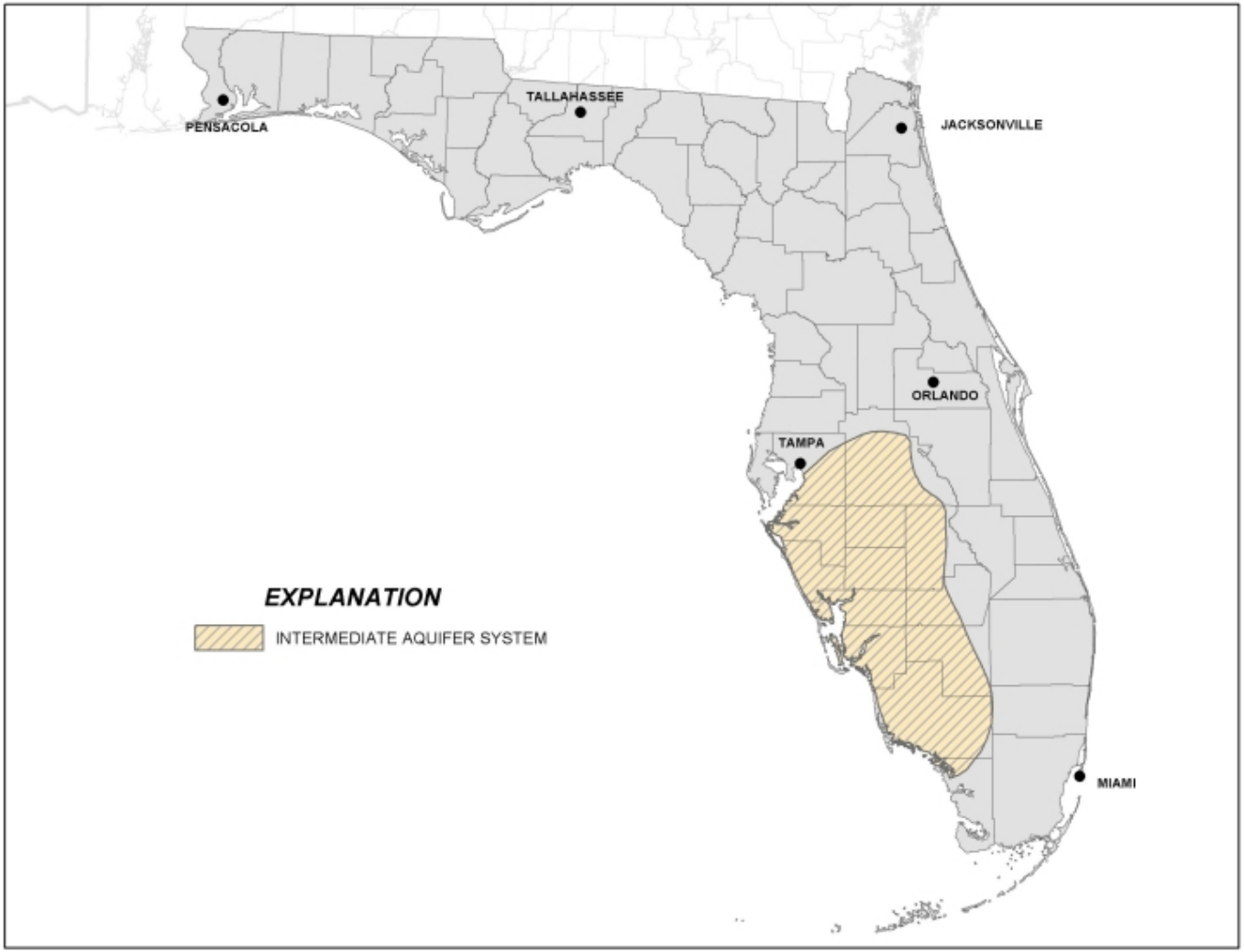


Source: USGS

FLORIDA AQUIFERS MAP

DEVO Engineering

www.devoeng.com



Source: USGS

INTERMEDIATE AQUIFER SYSTEM MAP

DEVO Engineering

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

Hydrostratigraphic units

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

Scale for cross sections

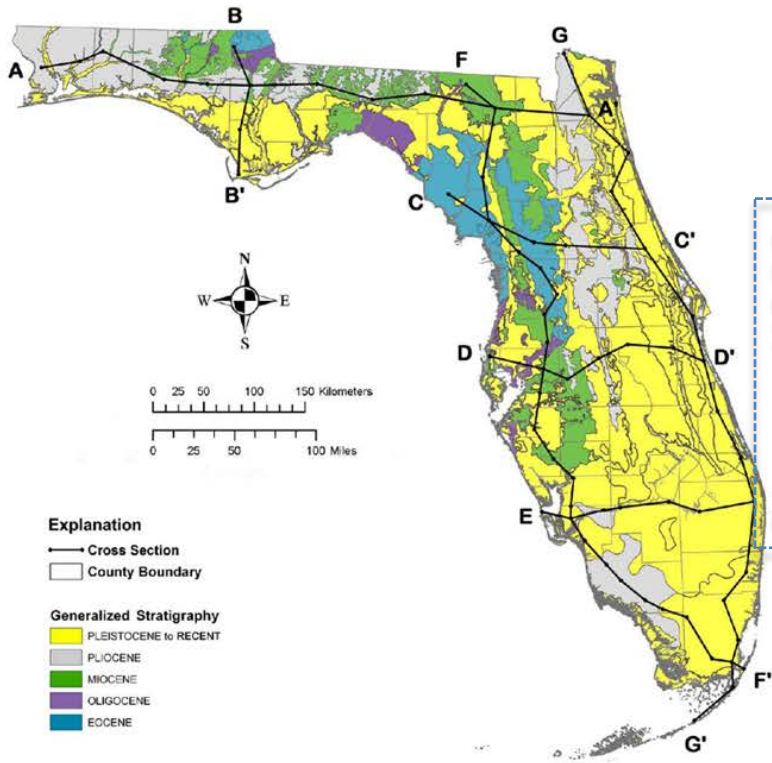
0 25 50 75 Kilometers

0 25 50 Miles

Cross section vertical exaggeration equals 200 times true scale

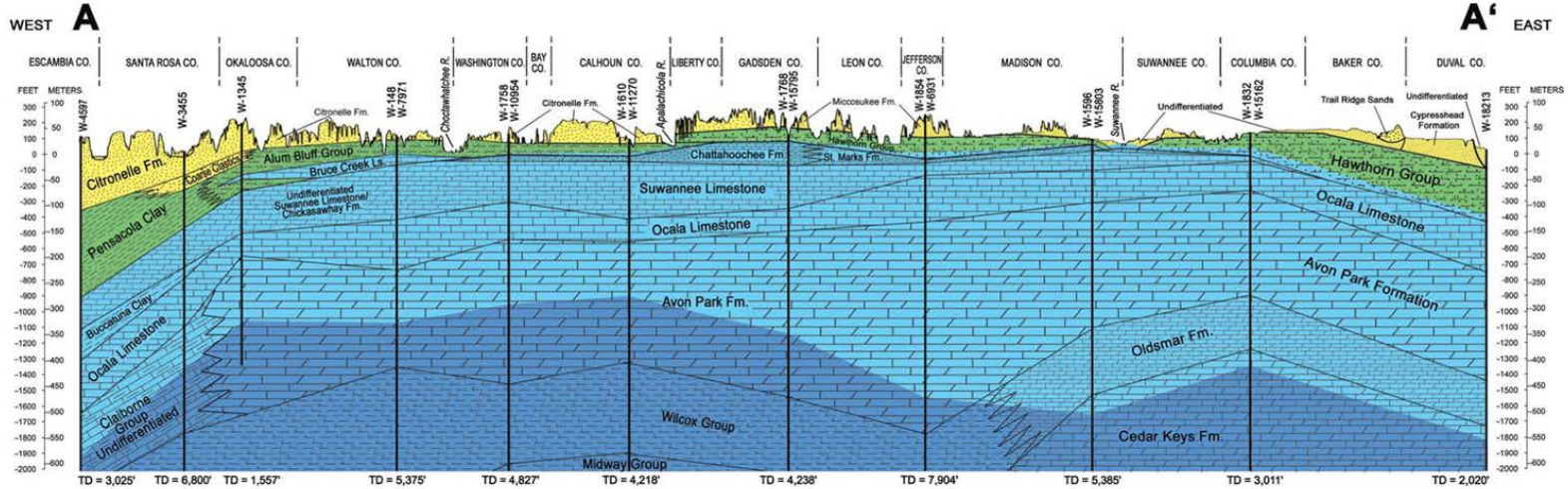
SYSTEM	SERIES	PANHANDLE FLORIDA FORMATION	PANHANDLE FLORIDA HYDROSTRATIGRAPHIC UNIT	NORTHERN FLORIDA FORMATION	NORTHERN FLORIDA HYDROSTRATIGRAPHIC UNIT	SOUTHERN FLORIDA FORMATION	SOUTHERN FLORIDA HYDROSTRATIGRAPHIC UNIT
QUATERNARY	HOLOCENE	Undifferentiated sediments	sand-and-gravel aquifer; surficial aquifer system	Undifferentiated sediments Anastasia Formation	surficial aquifer system	Undifferentiated sediments Miami Limestone Key Largo Limestone Anastasia Formation	surficial aquifer system; Biscayne aquifer
	PLEISTOCENE						
TERTIARY	PLIOCENE	Citronelle Formation Miccosukee Formation Jackson Bluff Formation Intracoastal Formation Alum Bluff Group Coarse Clastics		Undifferentiated sediments Miccosukee Formation Cypresshead Formation		Undifferentiated sediments Tamiami Formation Long Key Formation Hawthorn Group	
	MIOCENE	Coarse Clastics Alum Bluff Group Pensacola Clay Intracoastal Formation Hawthorn Group Chipola Formation Bruce Creek Limestone St. Marks Formation Chattahoochee Formation	intermediate aquifer system or intermediate confining unit	Hawthorn Group	intermediate aquifer system or intermediate confining unit	Hawthorn Group	intermediate aquifer system or intermediate confining unit
				St. Marks Formation			
	OLIGOCENE	Suwannee Limestone Marianna Limestone Suwannee Limestone	Floridan aquifer system	Suwannee Limestone	Floridan aquifer system	Suwannee Limestone	Floridan aquifer system
	EOCENE	Ocala Limestone Avon Park Formation Lisbon Formation Tallahatta Formation Claiborne Group Undiff.		Ocala Limestone Avon Park Formation Oldsmar Formation		Ocala Limestone Avon Park Formation Oldsmar Formation	
	PALEOCENE	Wilcox Group Midway Group	undifferentiated aquifer systems and confining units	Cedar Keys Formation	undifferentiated aquifer systems and confining units	Cedar Keys Formation	undifferentiated aquifer systems and confining units
CRETACEOUS AND OLDER		Undifferentiated		Undifferentiated		Undifferentiated	

Cross section locations and geologic map



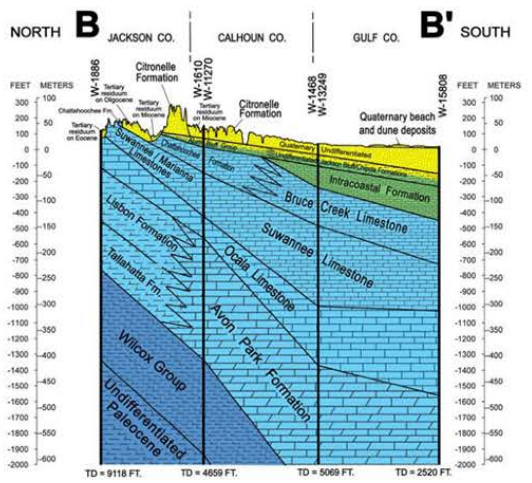
Source: USGS

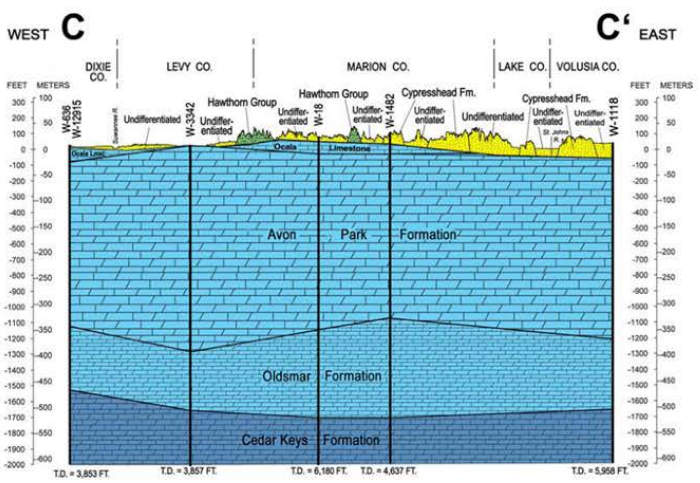
Hydrostratigraphic Units of Florida



Source: USGS

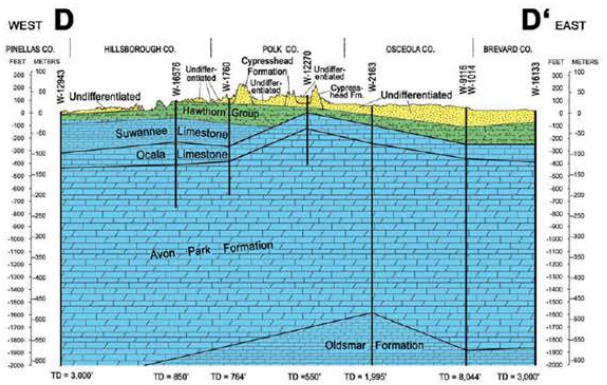
Hydrostratigraphic Units of Florida

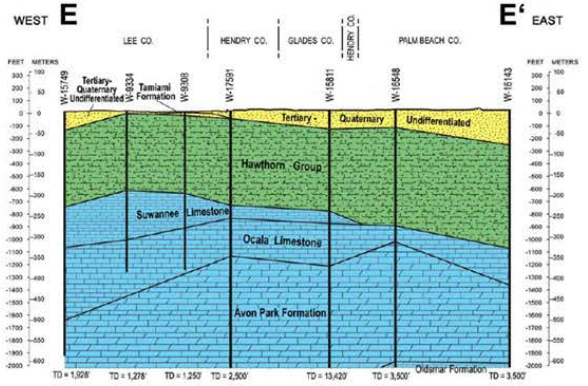




Source: USGS

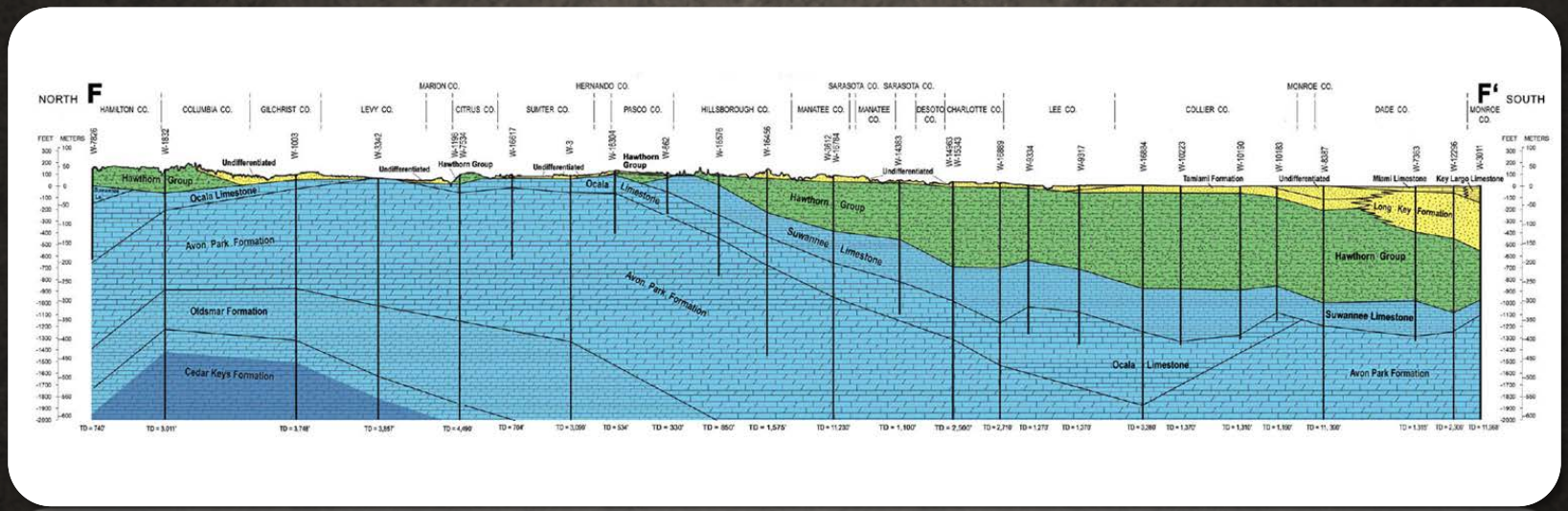
Hydrostratigraphic Units of Florida





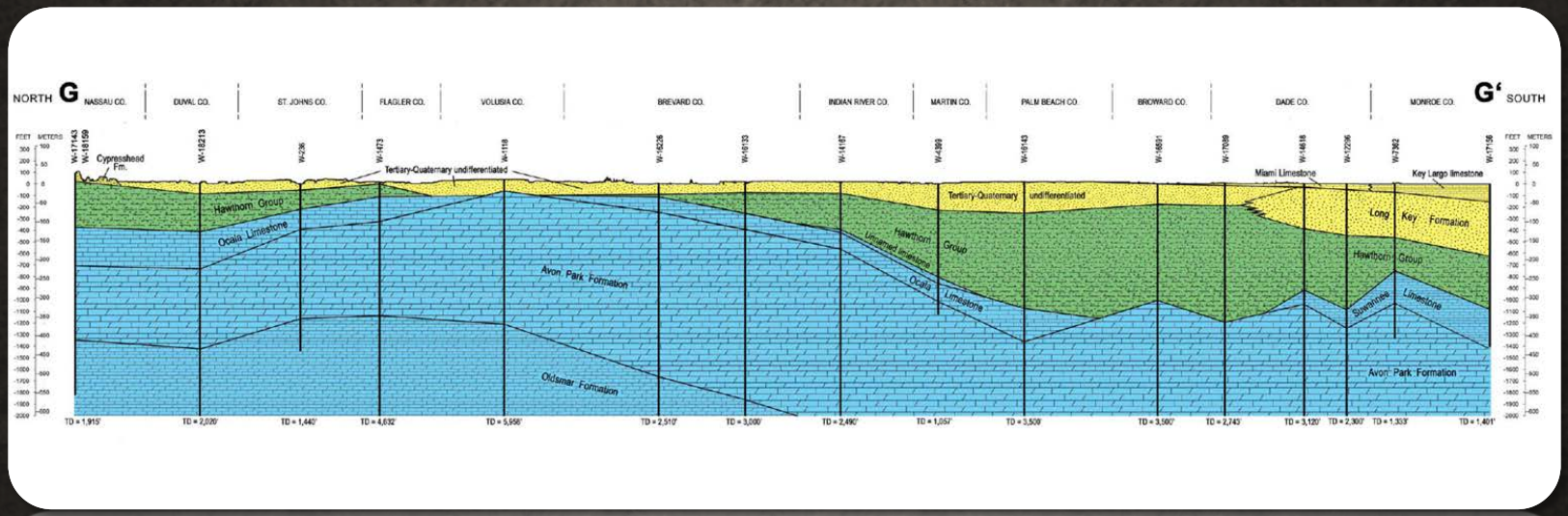
Source: USGS

Hydrostratigraphic Units of Florida



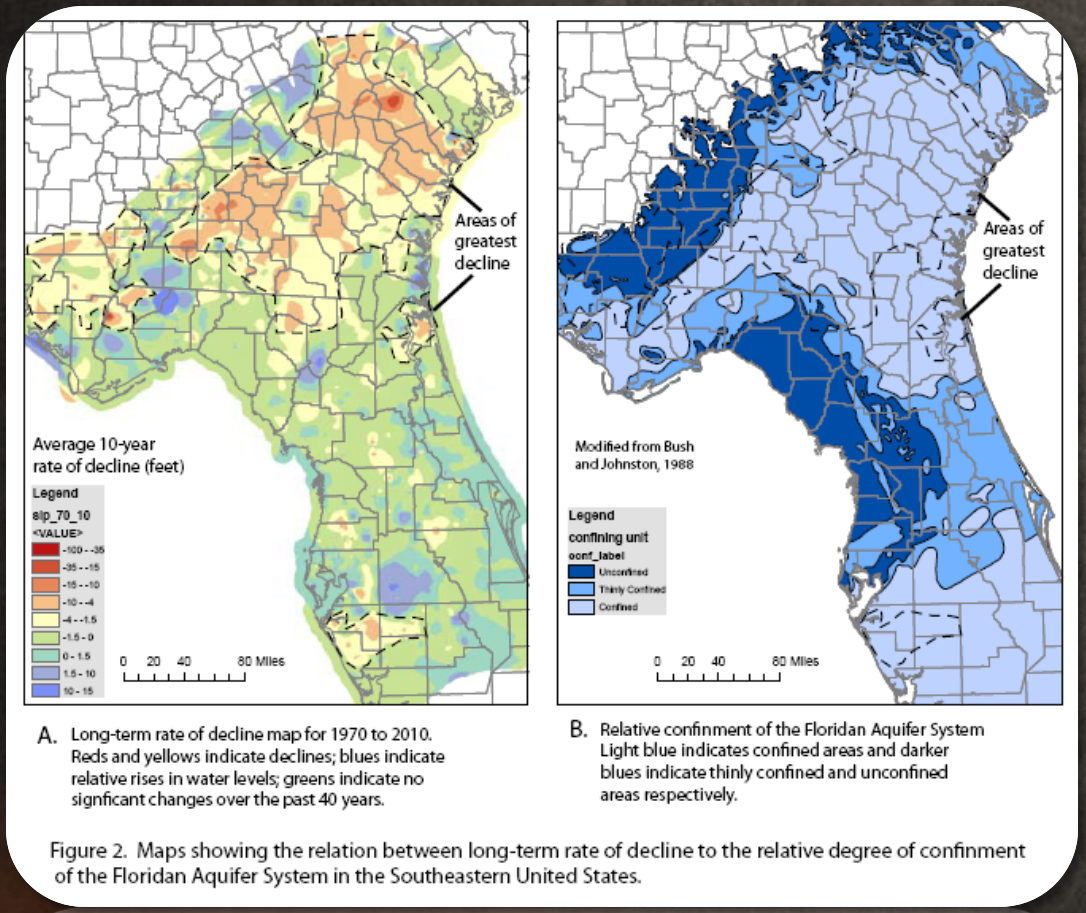
Source: USGS

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 signficant changes over the past 40 years.

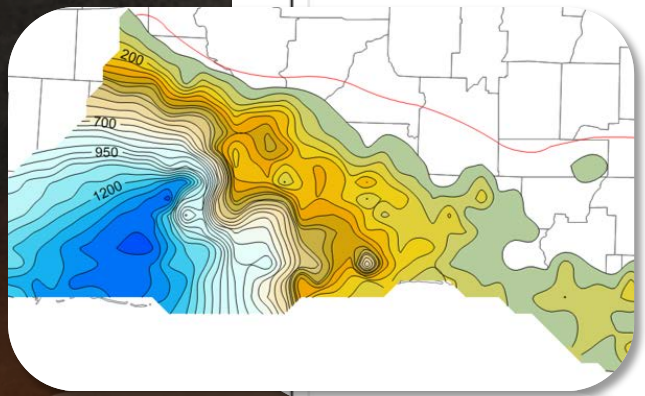
B. Relative confinment of the Floridan Aquifer System Light blue indicates confined areas and darker blues indicate thinly confined and unconfined areas respectively.

Figure 2. Maps showing the relation between long-term rate of decline to the relative degree of confinment 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

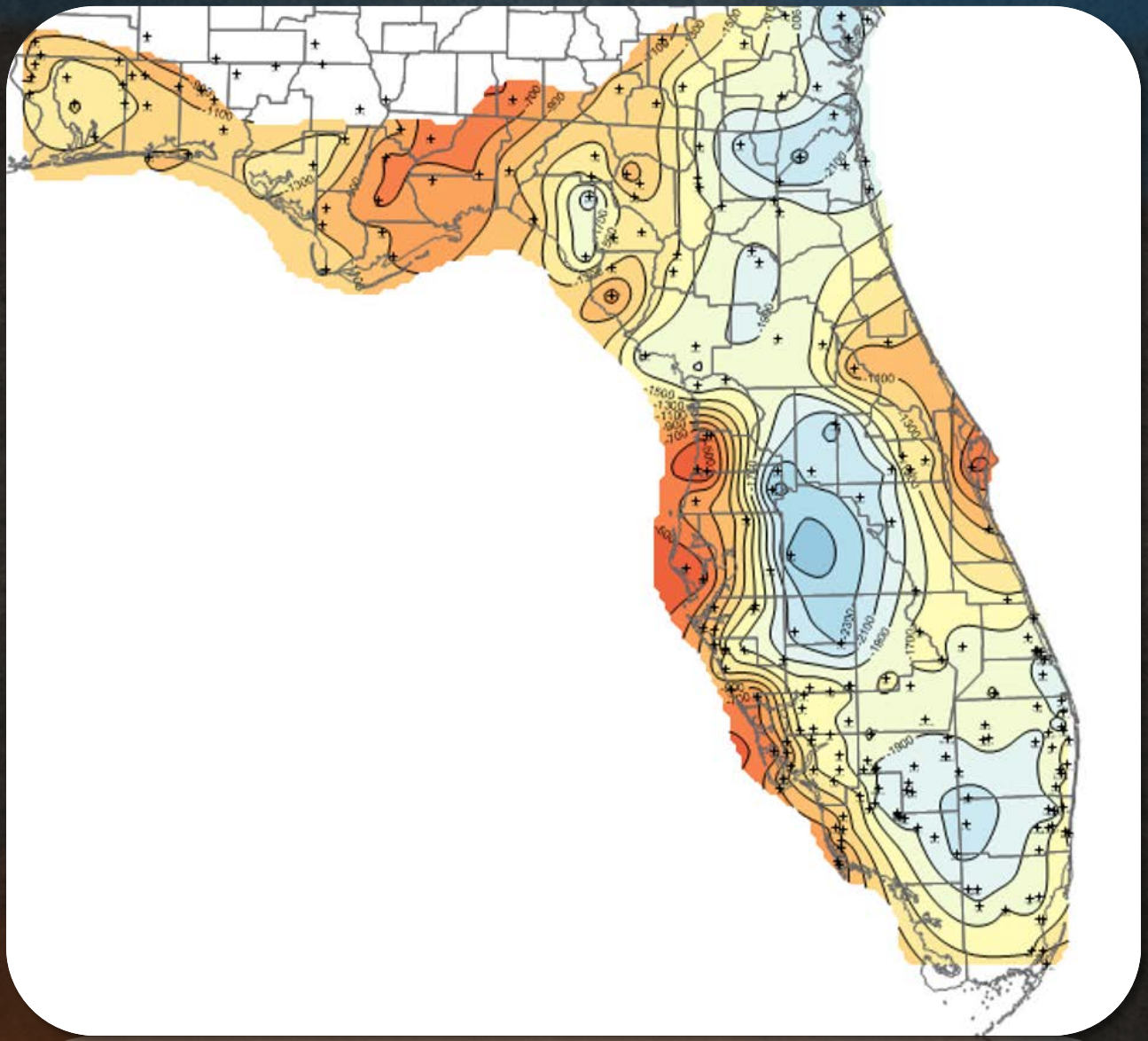
Source: USGS

Thickness of Surficial Aquifer System



Source: USGS

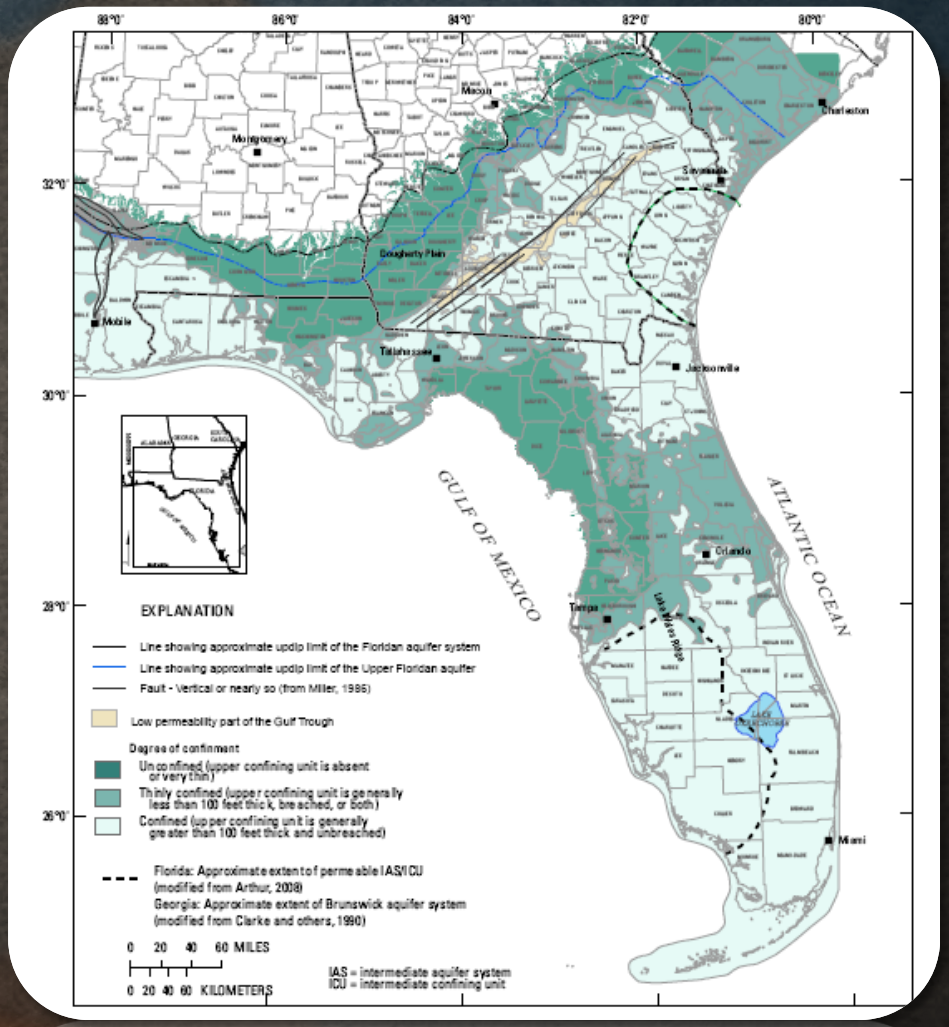
Saline and Brackish Portion of System



Source: USGS

Upper Confining Unit (IAS/ICU)

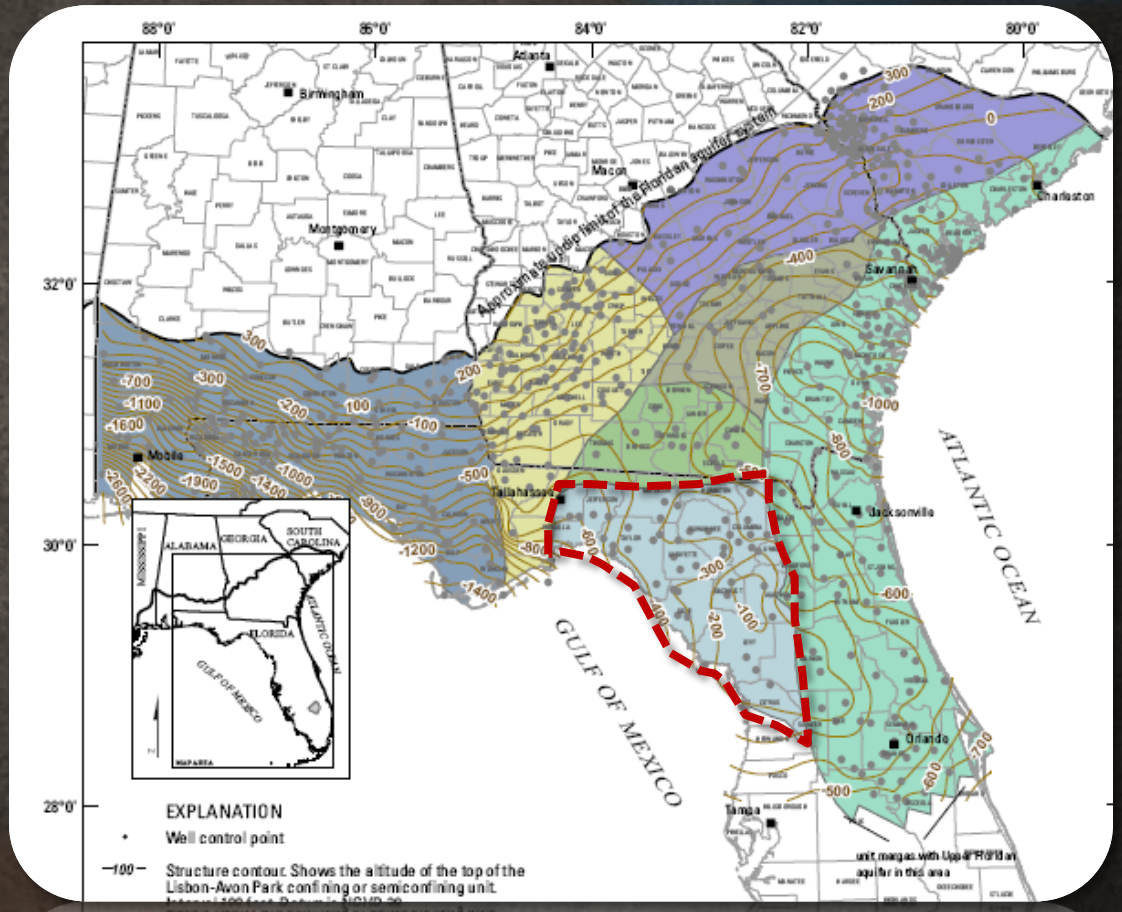
- Generally same sources of data used for constructing this map
- Intermediate aquifer system and Brunswick aquifer system form permeable areas of this unit



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