



GeoView

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services company*



Geophysical and Hydrogeological Study of Big Pine Key

- **Non-Intrusive Geophysical Methods Were Used to Delineate the Vertical and Horizontal Extent of the Freshwater Aquifers**
- **Investigation was Performed During the Wet and Dry Seasons**
- **Results were Calibrated to Data Obtained From Available Monitor Wells**
- **Effectiveness of the Electrical Resistivity Imaging Technique in Profiling the Freshwater Aquifers was Demonstrated**
- **Work was Compared to Previous Work in 1980 and 1987 in an Attempt to Document Changes Over That Time Period**

Work was conducted under the supervision and guidance of the Nature Conservancy and Key Deer National Wildlife Refuge

Big Pine Key

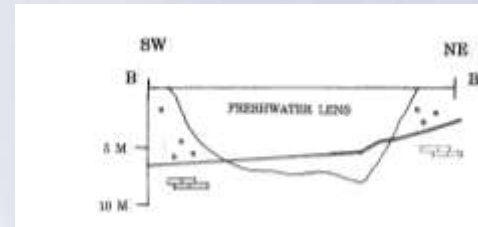
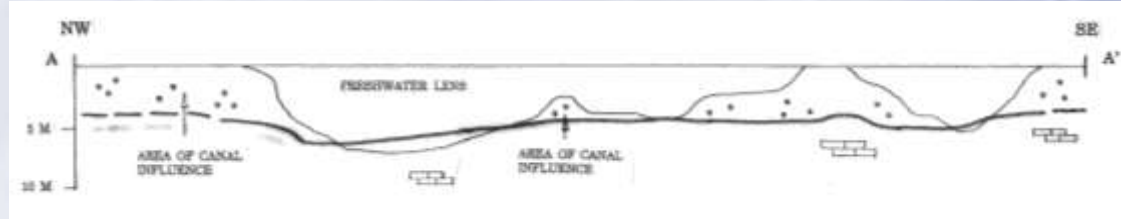
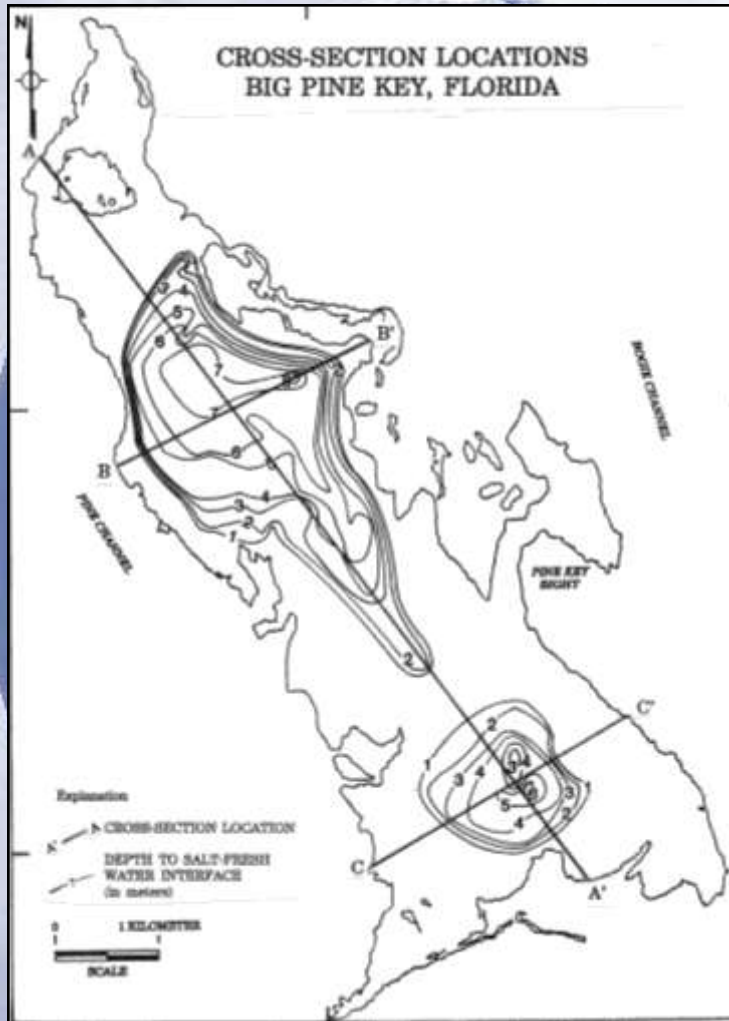
The freshwater aquifers of Big Pine Key have been assessed 3 times:

1980 (USGS): Network of 20 monitor wells was tested for 1 year to determine the lateral and vertical extent of the freshwater lenses (wells abandoned after study). Basic lens geometry, geological control on maximum depth of lens established, wet/dry season dynamics of lens geometry.

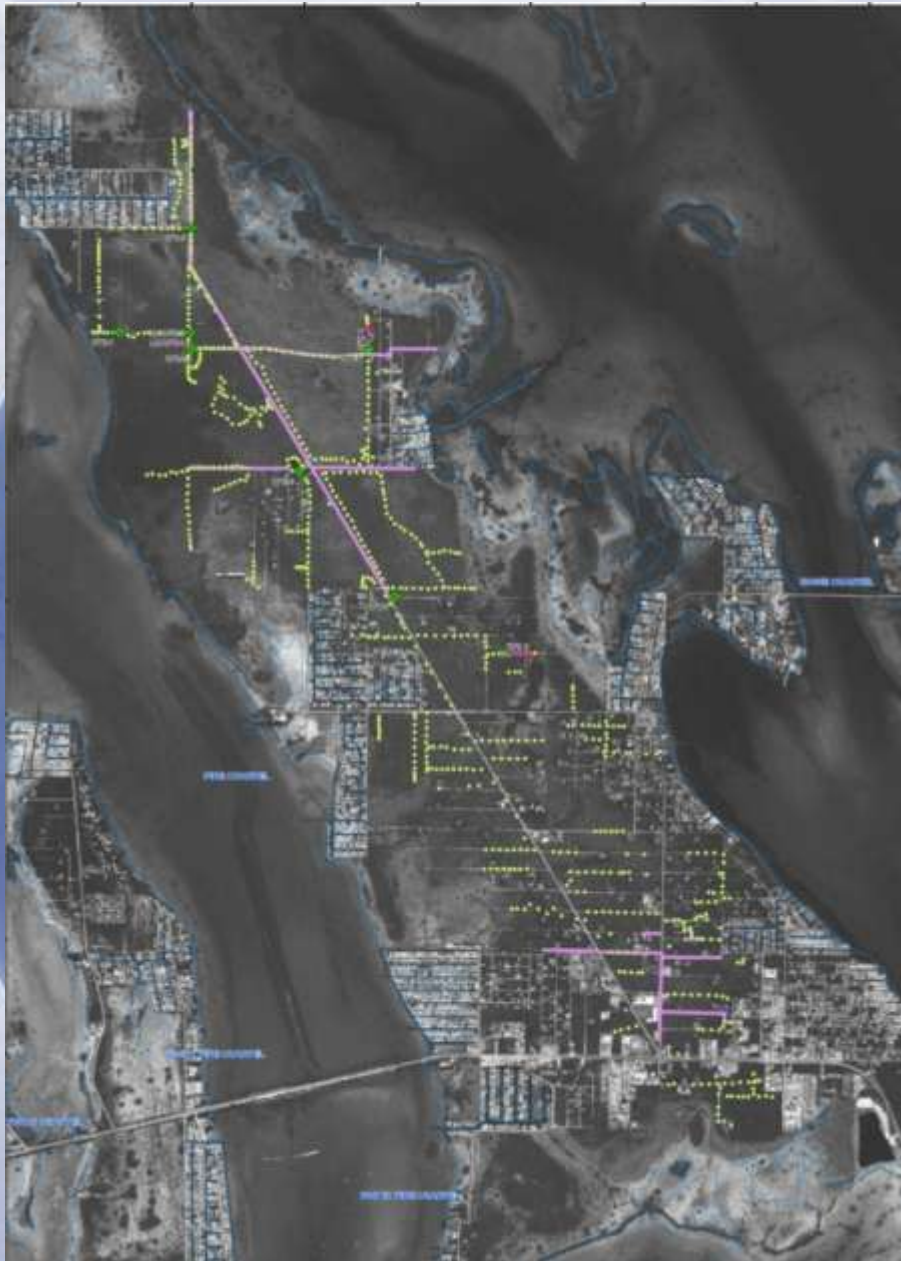
1987 (Wightman, Masters Thesis, University of South Florida): Electromagnetic (EM) mapping of lens during wet and dry season. Hydrogeological controls on lens geometry confirmed. Wet/Dry season changes in Lens Geometry documented.

2009-2010 (GeoView [Geophysical Consulting Firm]) : EM mapping of Wet/Dry Season greatly expanded using GPS technology, salinity profiling of existing monitor wells, demonstration of electrical resistivity imaging technology.

Big Pine Key-Why Is It So Interesting and Important?



The freshwater aquifer on BPK is truncated at the lithological contact between the Miami Limestone (low transmissivity) and Key Largo Limestone (high transmissivity). The saltwater interface occurs within 1-1.5 meters of the contact. If not for this geological contact the aquifer would be 50 percent thicker.



EM Profiling
Solid Lines from
1987 Survey

Circles from 2010
Study

EM Profiling

EM Profiling: The EM method is a geophysical method where the bulk conductance (resistivity) of the earth is measured. The depth of investigation can be controlled by varying the coil spacing. For this study a 20-m coil spacing with vertical coils was used. Position control was obtained using differentially corrected GPS.



Converting Terrain Conductivity to Freshwater Lens Thickness

T1 (fixed)

R1 (fixed)

T2 (calculated)

R2 (fixed)

T3 (infinite)

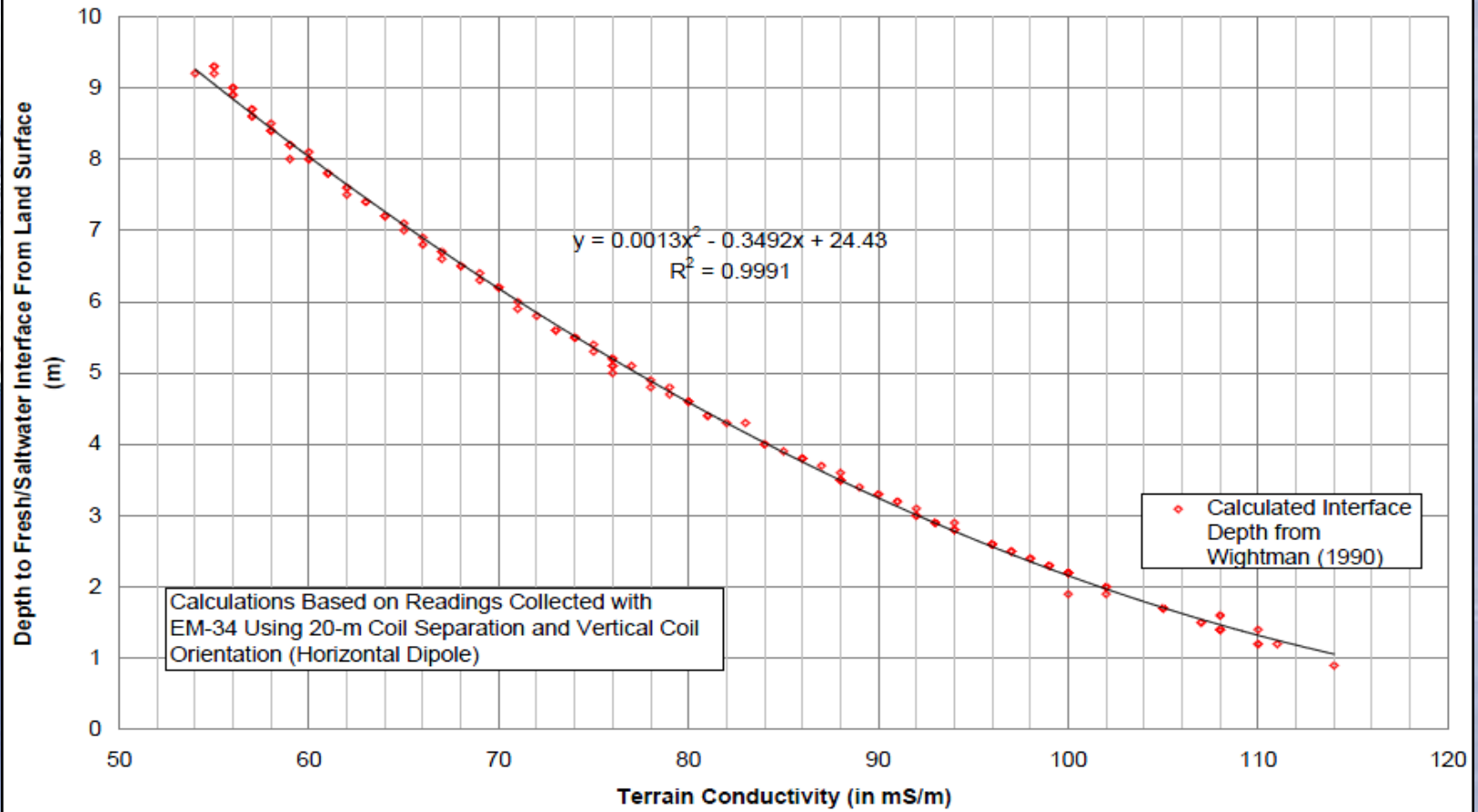
R3 (fixed)

The Terrain
Conductivity is a
Function of 7
Variables.

The Terrain
Conductivity is
Measured

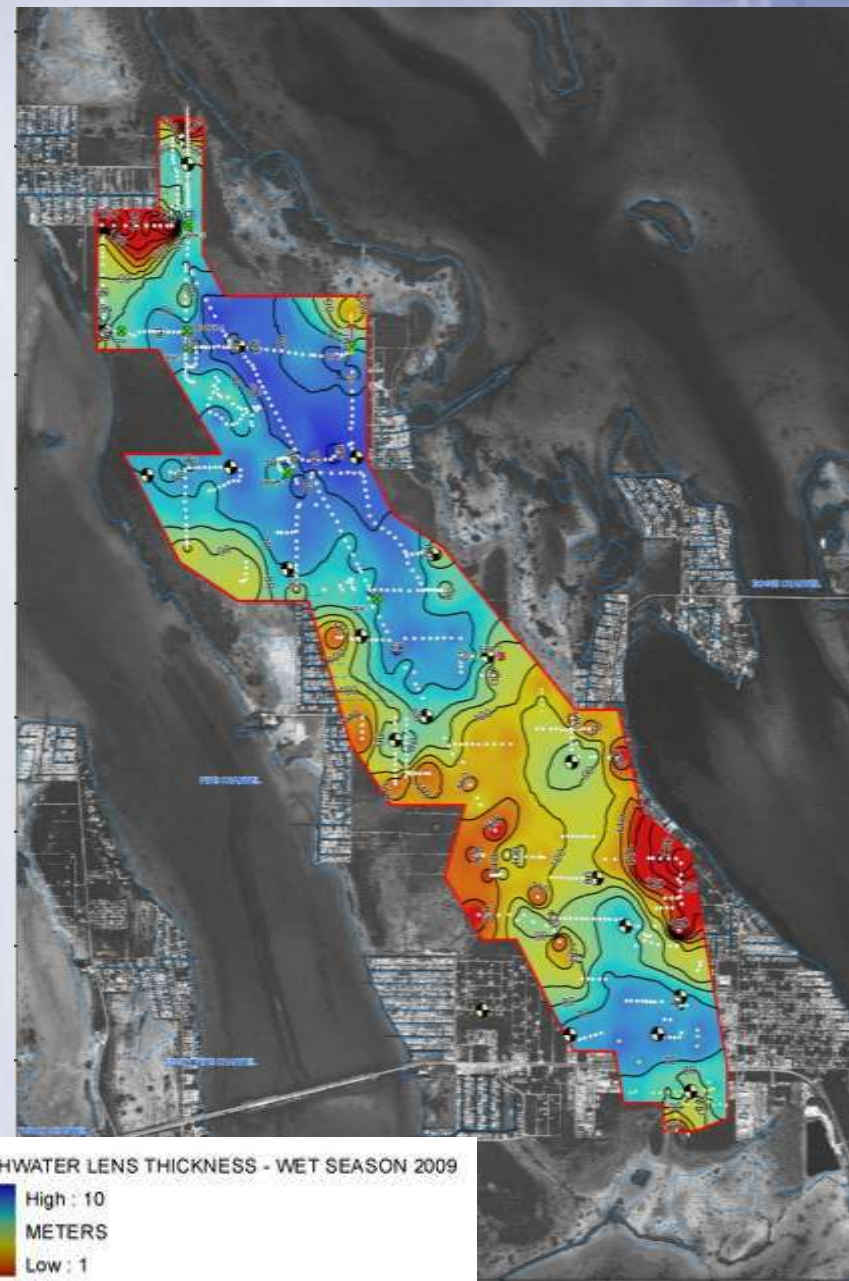
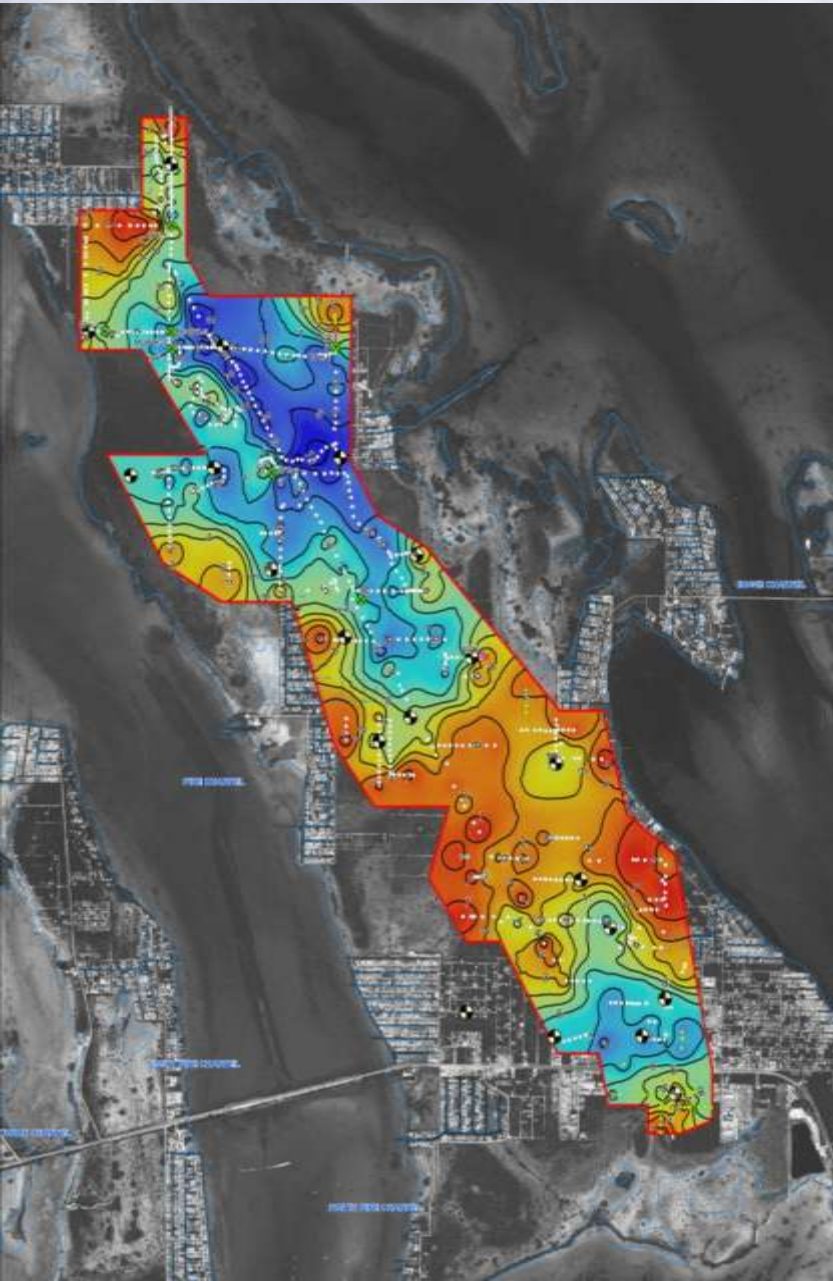
With Six of The
Seven Variables
Known, You Can
Solve for T2

Conversion of Terrain Conductivity Values Into
Estimated Depth to Fresh/Saltwater Interface
Big Pine Key, FL

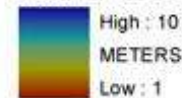


EM values are directly converted to depth to saltwater using determined empirical relationships

Results from 2009 Wet Season Survey



FRESHWATER LENS THICKNESS - WET SEASON 2009

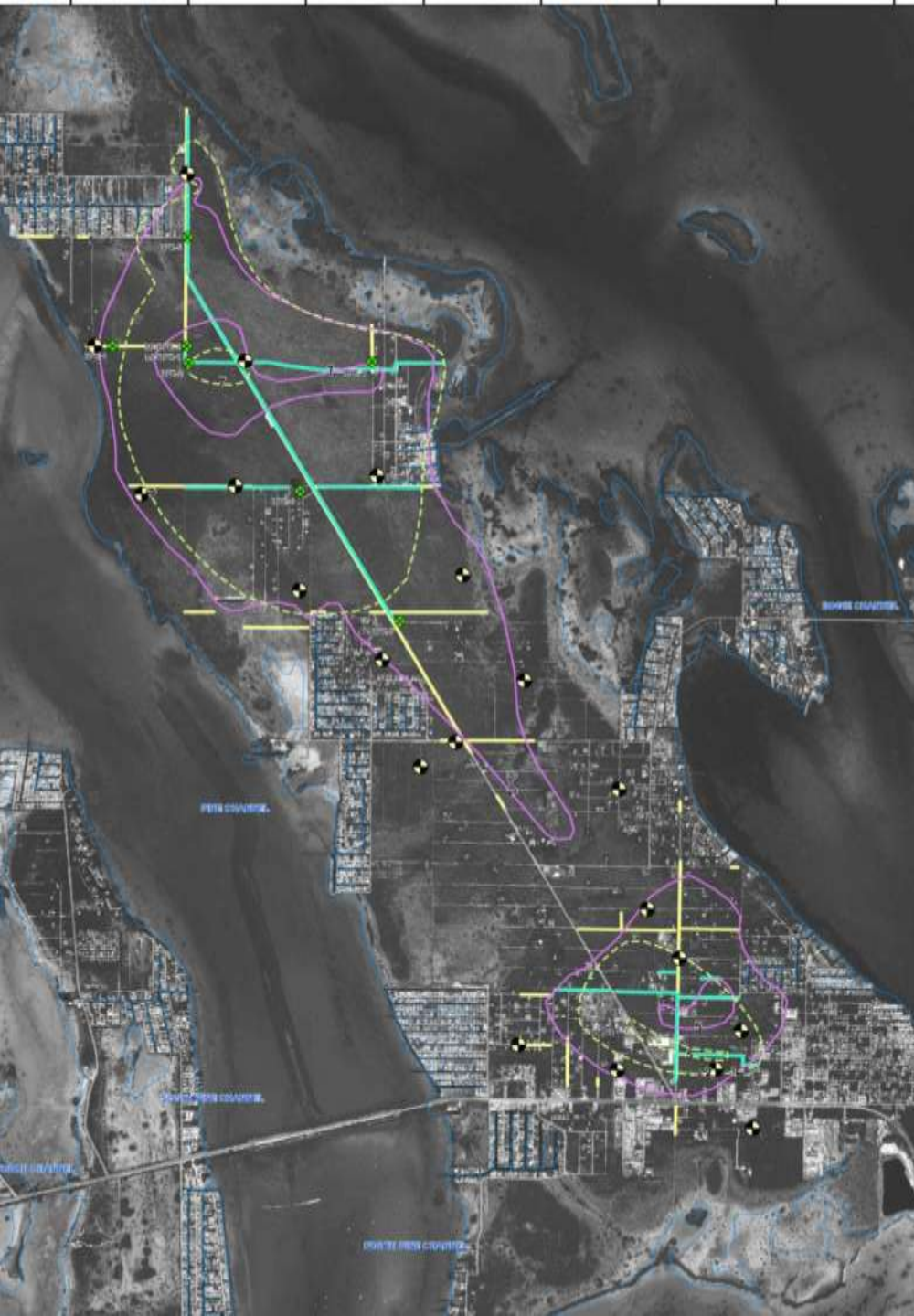


Changes in Freshwater Aquifers- Wet/Dry Season: 1987

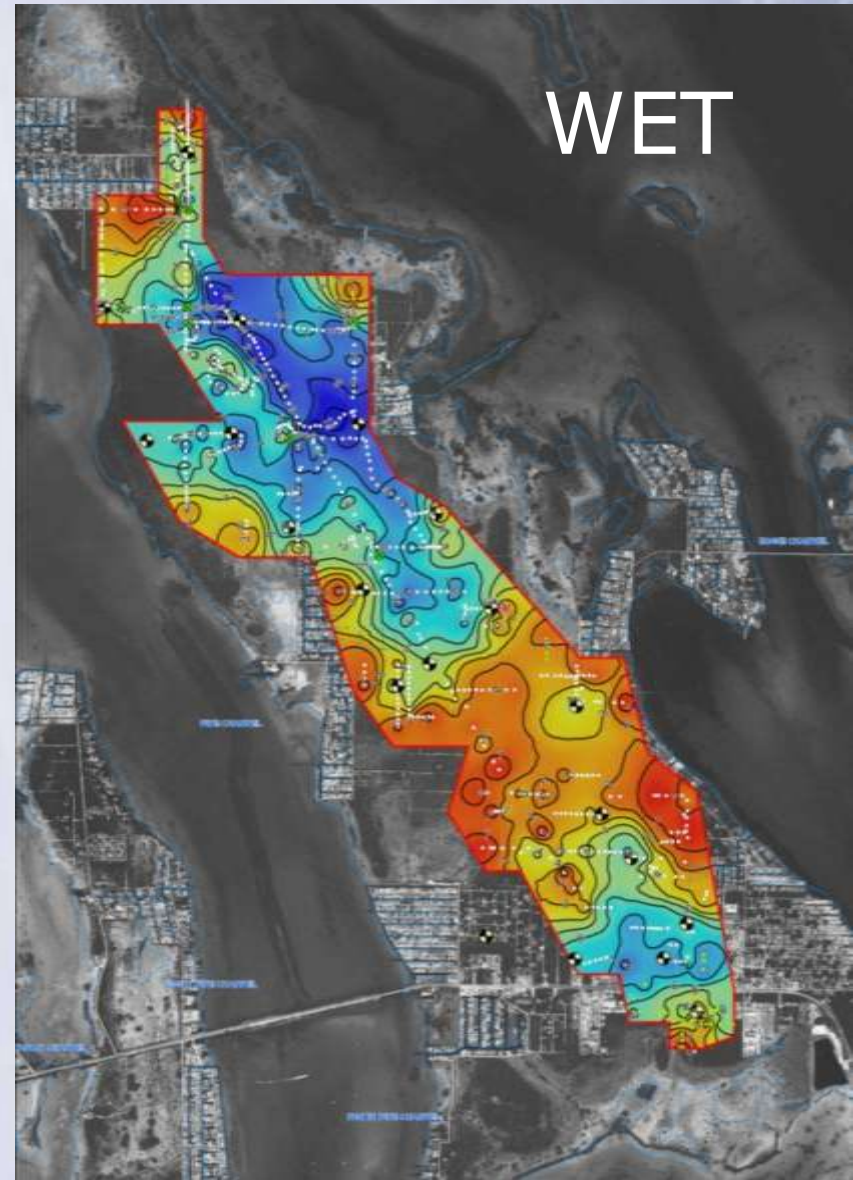
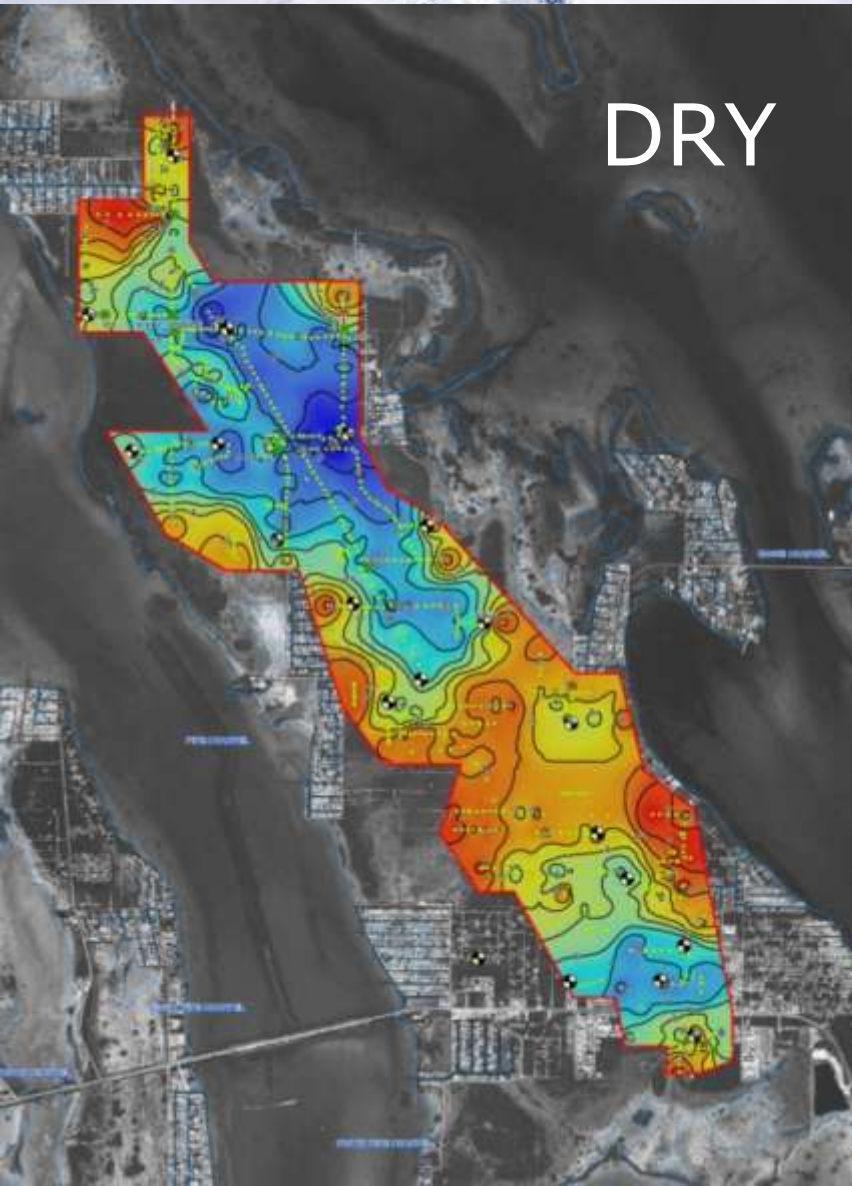
Very Dynamic

Change in Lateral
Boundaries 30 to
50 percent

No Change in
Maximum Depth



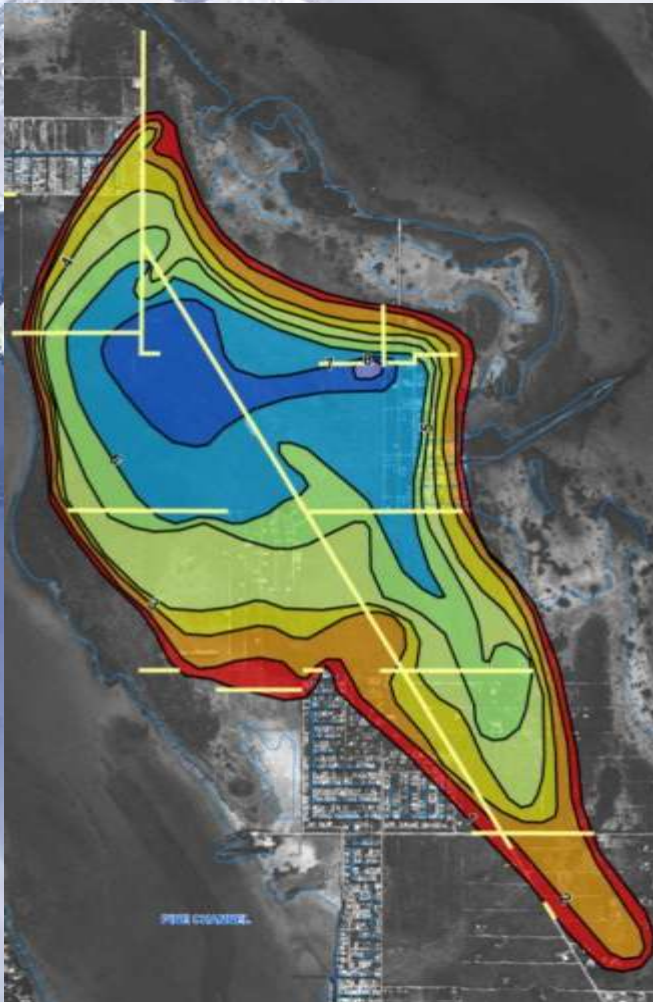
Changes in Freshwater Aquifers- Wet/Dry Season: 2009/2010



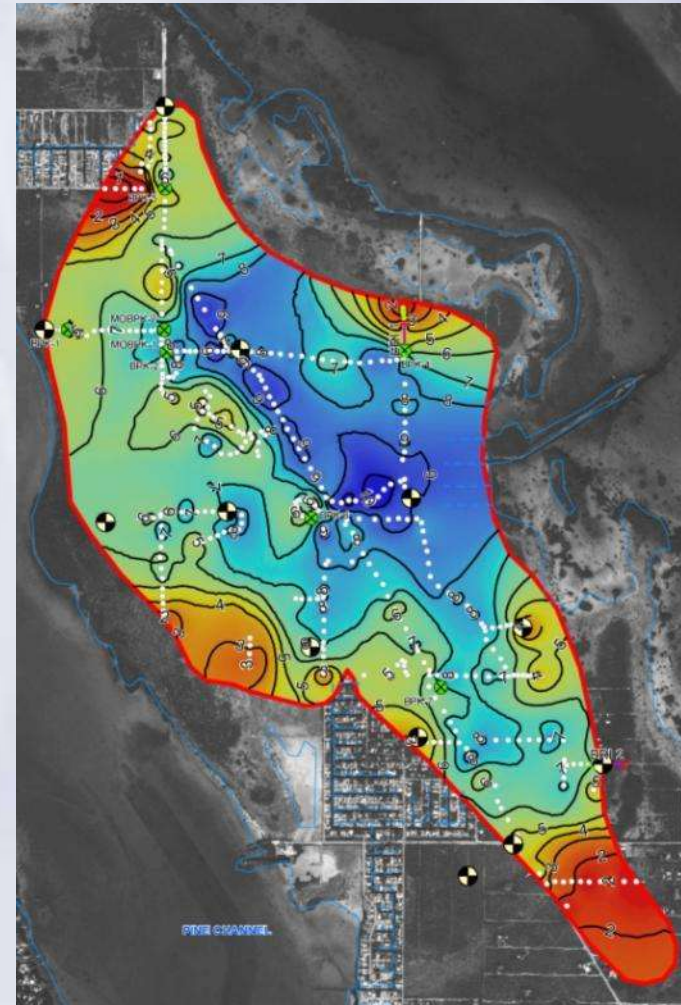
What Went Wrong—Do the Freshwater Lenses Really Change?

- 1987 was a somewhat abnormal year for Dry and Wet Season Rainfalls. The dry season was +11 inches (two major winter storms) and Wet Season was +2.5 inches
- However, the dry season study was conducted in March (not April) and Wet Season study was conducted in August not October.
- In Comparison the 2009-2010 studies were conducted at the end of the respective Wet and Dry Seasons.
- But the Wet Season (and preceding Dry Season) was very dry (-13 inches) with the Dry Season of the survey very wet (+5.5)

Partial Comparison of 1987 and 2009 Wet Season Surveys



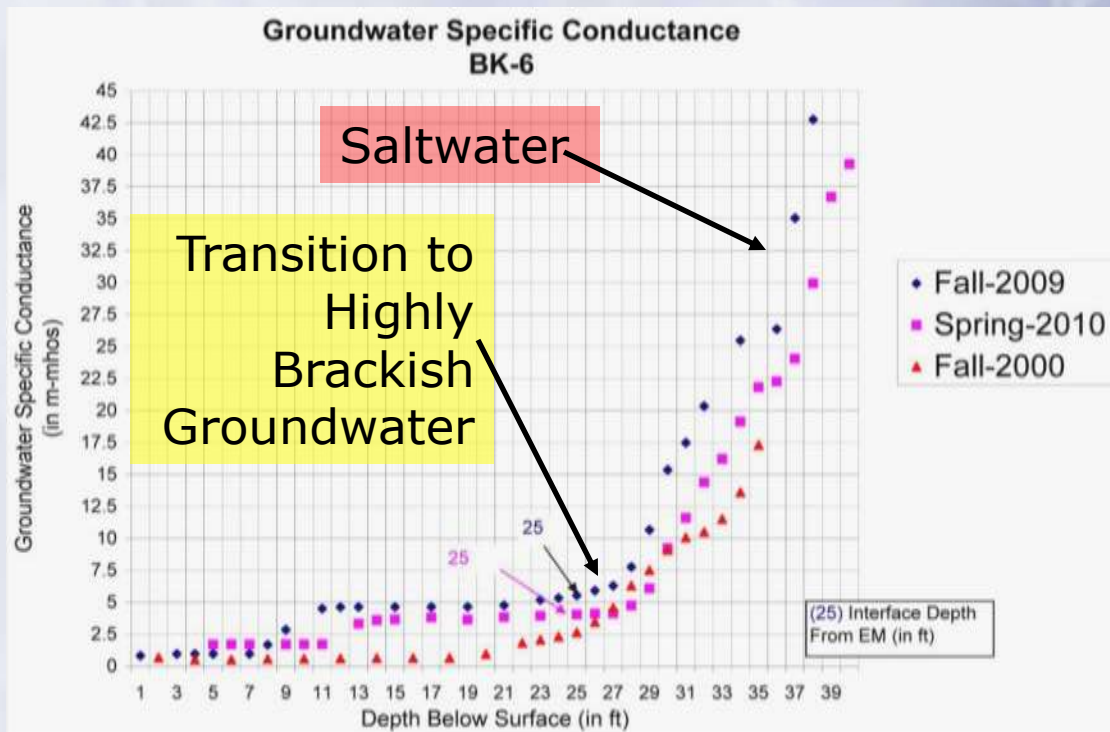
1987



2009

Vertical conductivity profiles were collected in available monitor wells

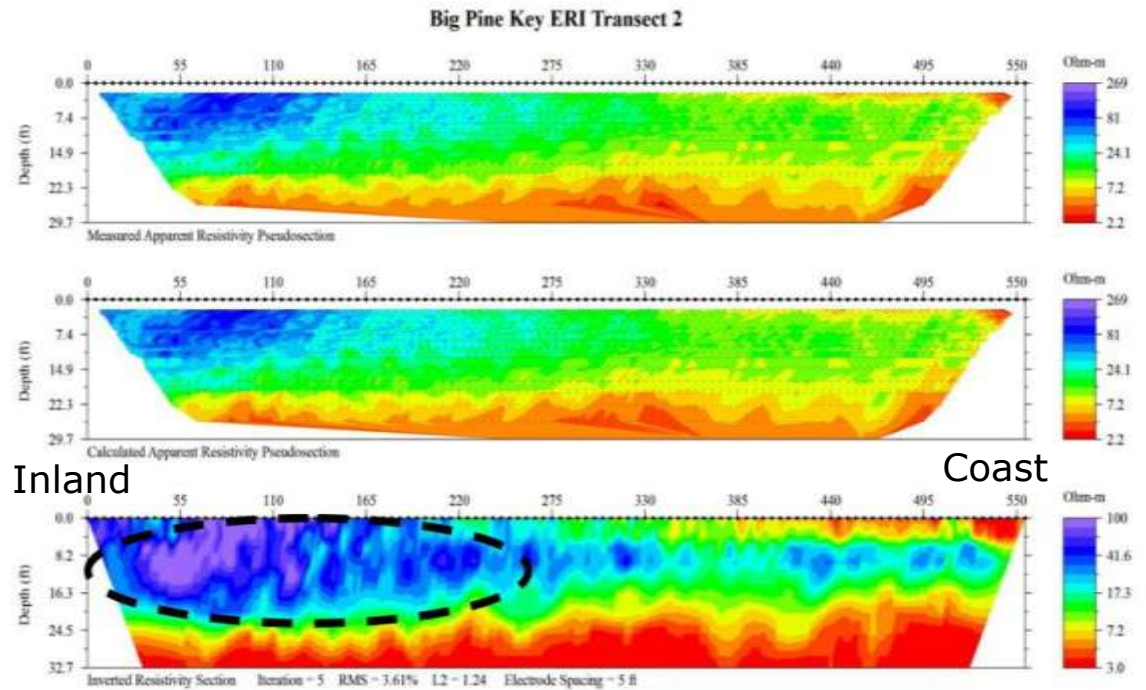
Monitor Well Profiling




EM-derived depths from the geophysical survey correlated very well to conductivity profiling results


ERI method was extremely effective in documenting horizontal change and vertical control of aquifer depth by Key Largo Limestone.

Electrical Resistivity Imaging




Explanation

 Fresh to Brackish

 Brackish to Saltwater

 Saltwater

 Boundaries of Fresh to Brackish Water Aquifer

Summary of Major Findings

- The size and maximum depth of the lenses did not change between the wet and dry seasons
- The lack of change was supported by both the EM and conductivity profiling results
- The reason for the lack of change was a very dry wet season and proceeding very wet dry season
- The EM derived lens thickness matches the conductivity profiling results very well in areas where a thick brackish transition zone is not present (towards center of island).
- The ERI method works well (but is very slow and should not be considered as a reconnaissance technique)

Looking Into The Future



Represents the Location for a Proposed Monitor Well. These wells will be 40 to 50 ft deep and extend throughout the entire freshwater aquifer and brackish water transition zone. The wells should be profiled on a semi-annual basis. Through this effort the effect of sea level rise on the freshwater aquifers will be documented

