

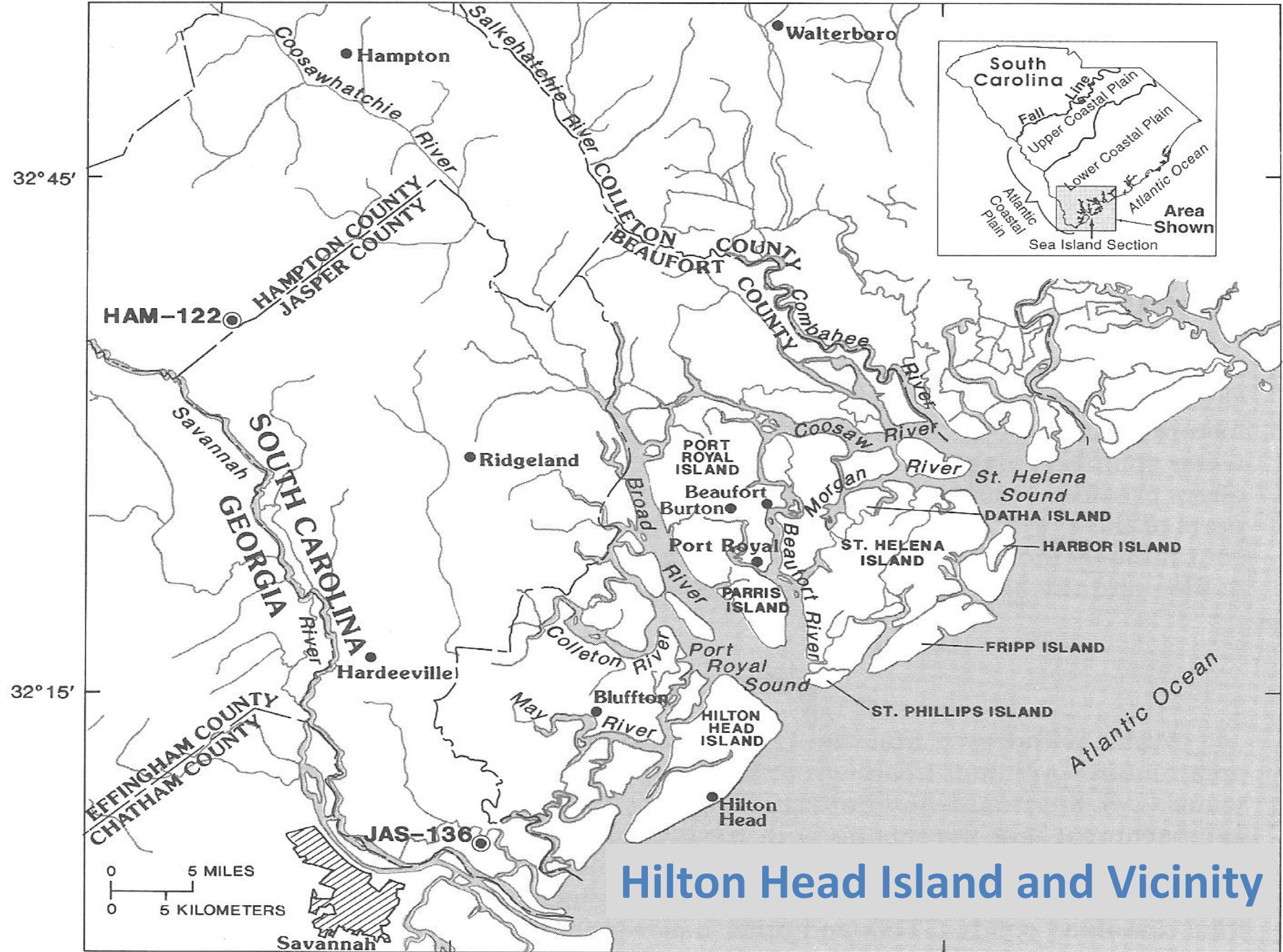


Hilton Head Public Service District



Groundwater Management Associates, Inc.

Strategies for Managing  
Water Resources in  
Saltwater Intrusion  
Environments



# Hilton Head Island and Vicinity

# Aquifers and Confining Layers in the Hilton Head Island Area

Feet Below  
Mean Sea  
Level

0

**Surficial Aquifer – Sand and Clay**

100

**Hawthorn Confining Layer - Clay**

200

**Upper Floridan Aquifer – Permeable Limestone**  
(under Capacity Use Area restrictions)

300

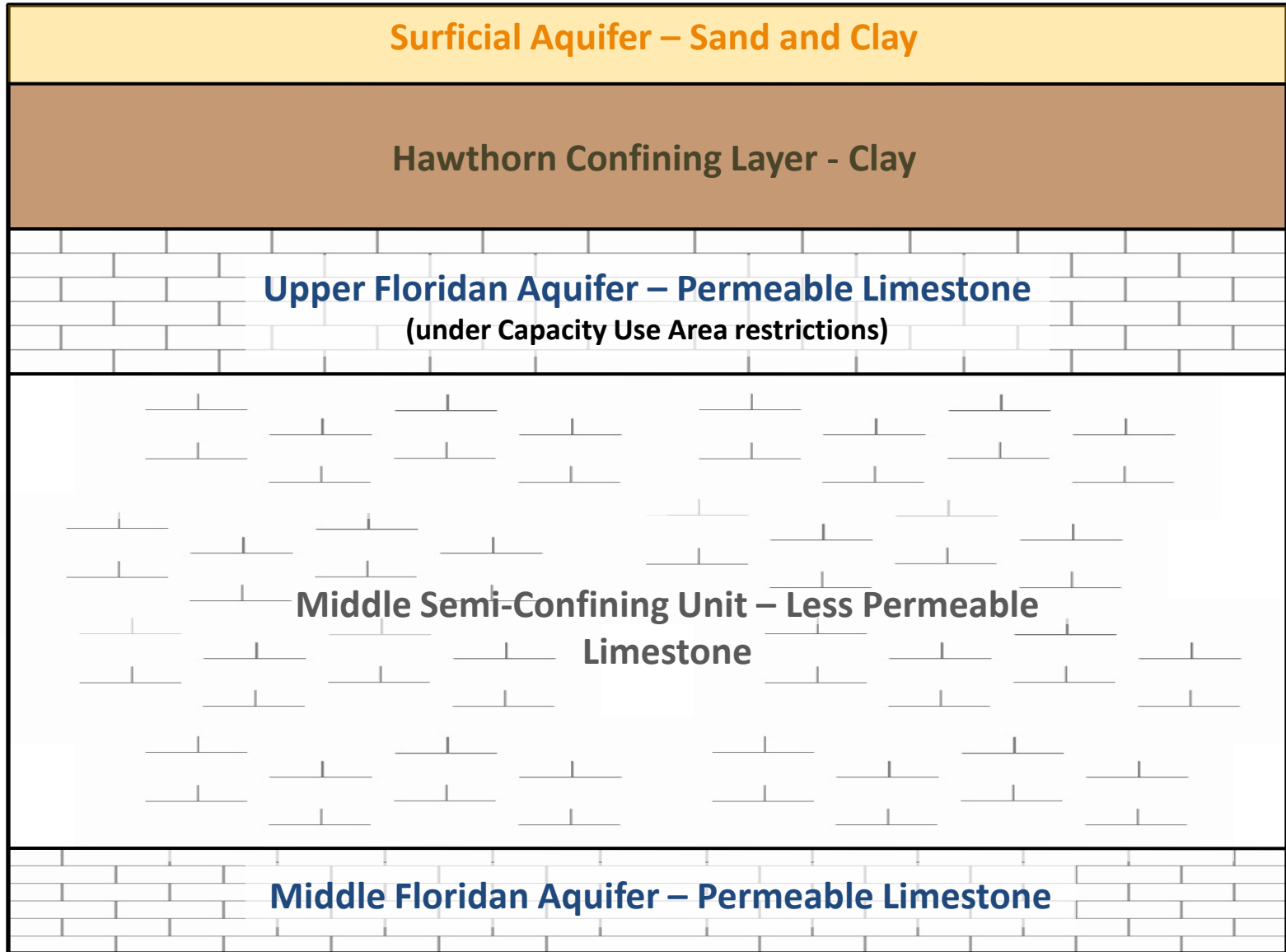
400

**Middle Semi-Confining Unit – Less Permeable  
Limestone**

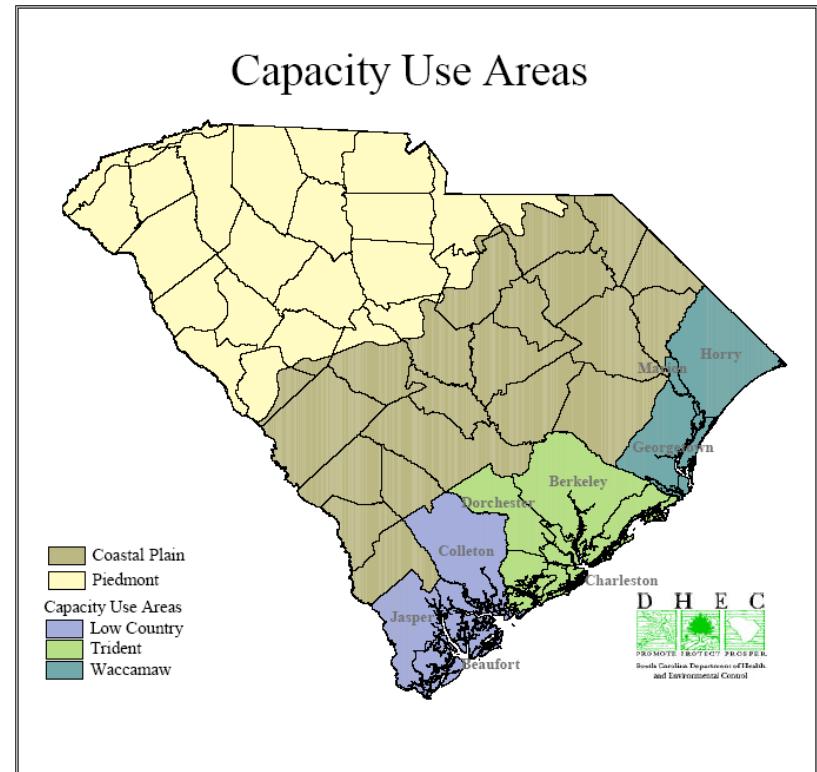
500

600

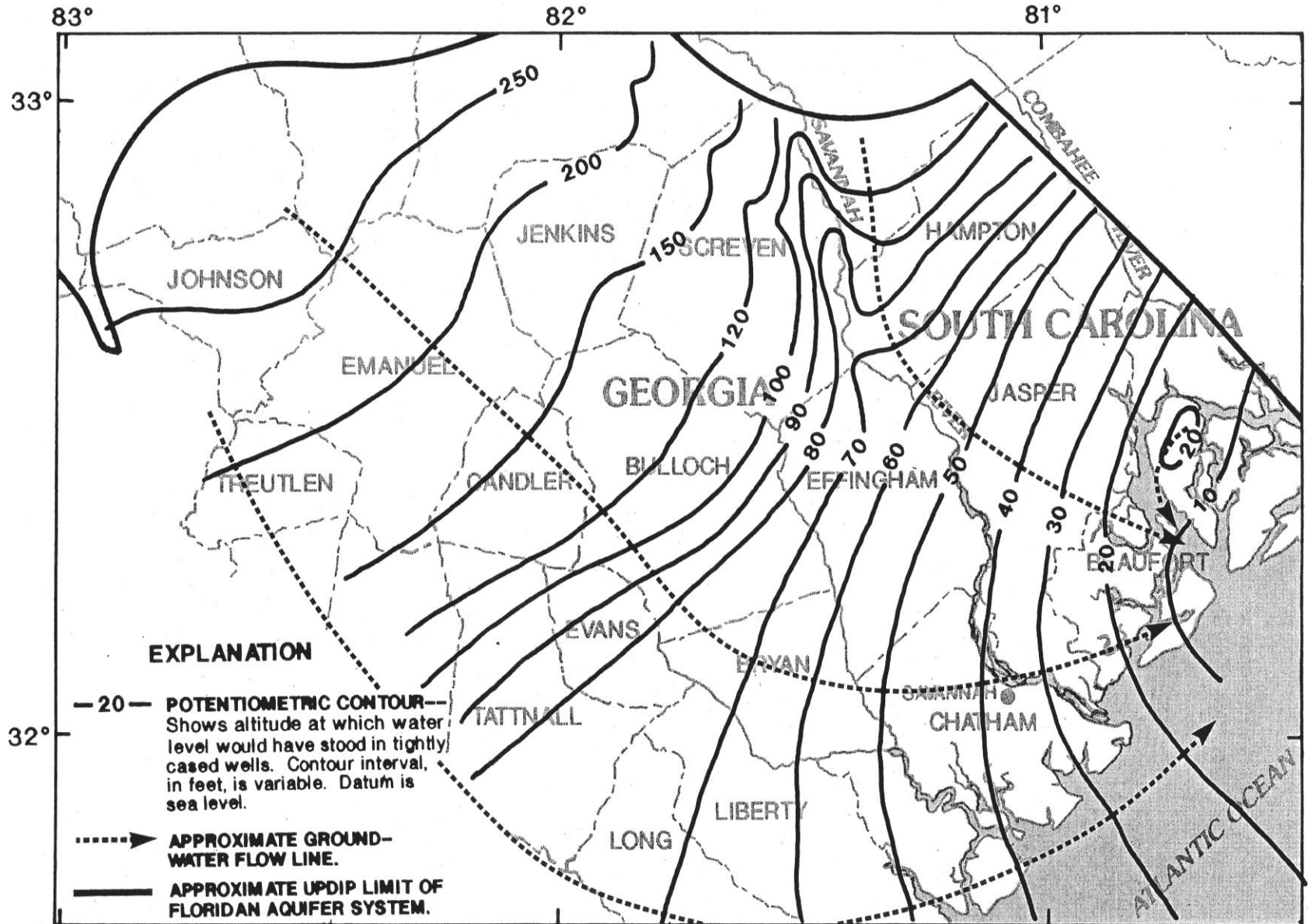
**Middle Floridan Aquifer – Permeable Limestone**



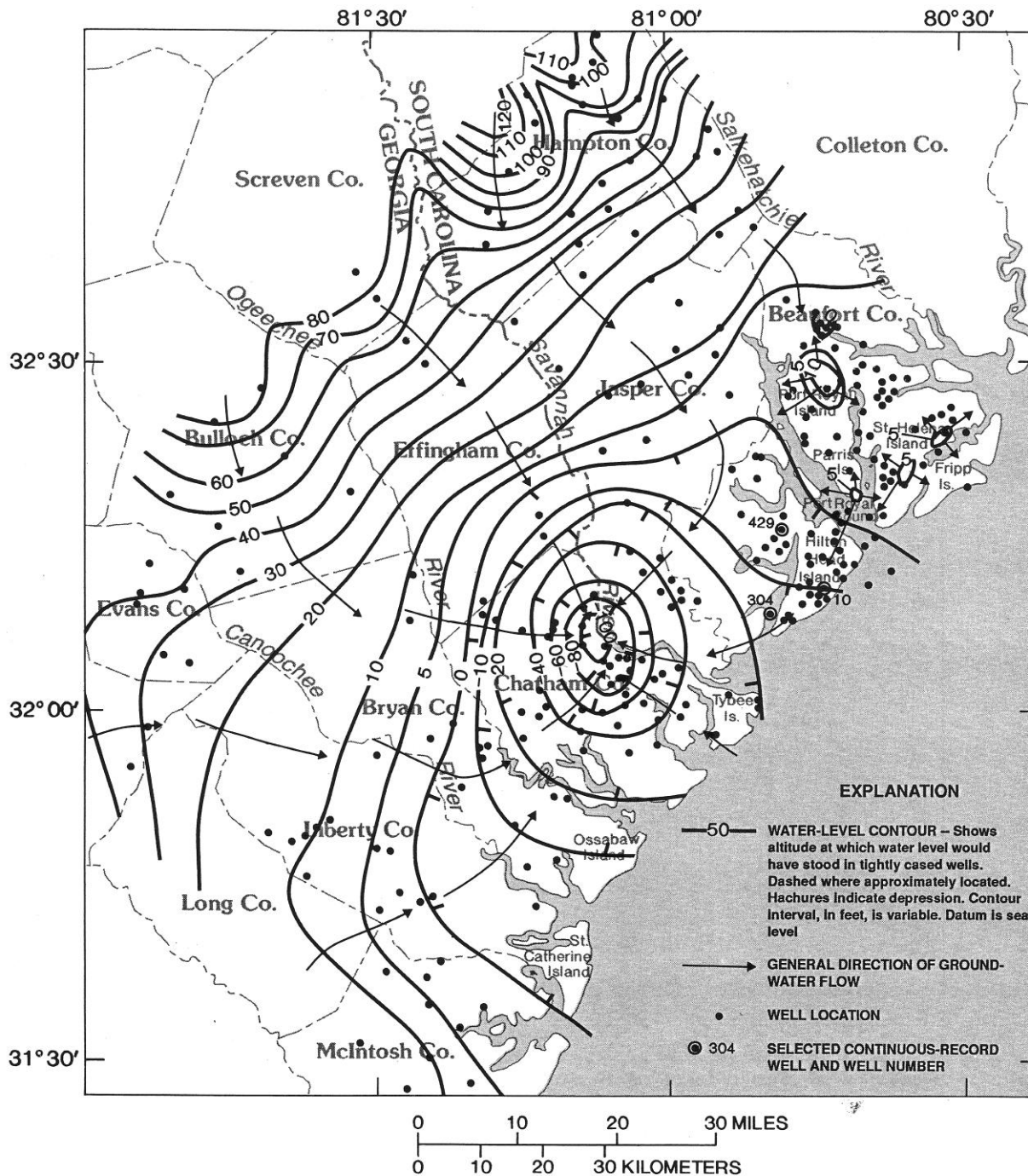
- **Upper Floridan Aquifer**
  - Primary source for drinking water for the Hilton Head Public Service District
- **Capacity Use**
  - District's groundwater capacity limited (2.88 MGD - 1995)
  - Additional capacity acquired (3.05 MGD – 2004)
- **BJWSA Surface Water Connection**
  - Connection to BJWSA (up to 7.5 MGD - 1997)
- **Groundwater Quality**
  - Salinity levels increasing from 1999 – 2008
  - Wells lost to saltwater intrusion (Palmetto Hall, Hospital, Spring Lake)
  - **Saltwater Intrusion is an Ongoing Problem for the Upper Floridan Aquifer at Hilton Head Island**



# Pre-Development Equipotential Map of the Upper Floridan Aquifer in South Carolina and Georgia (pre-1900's)



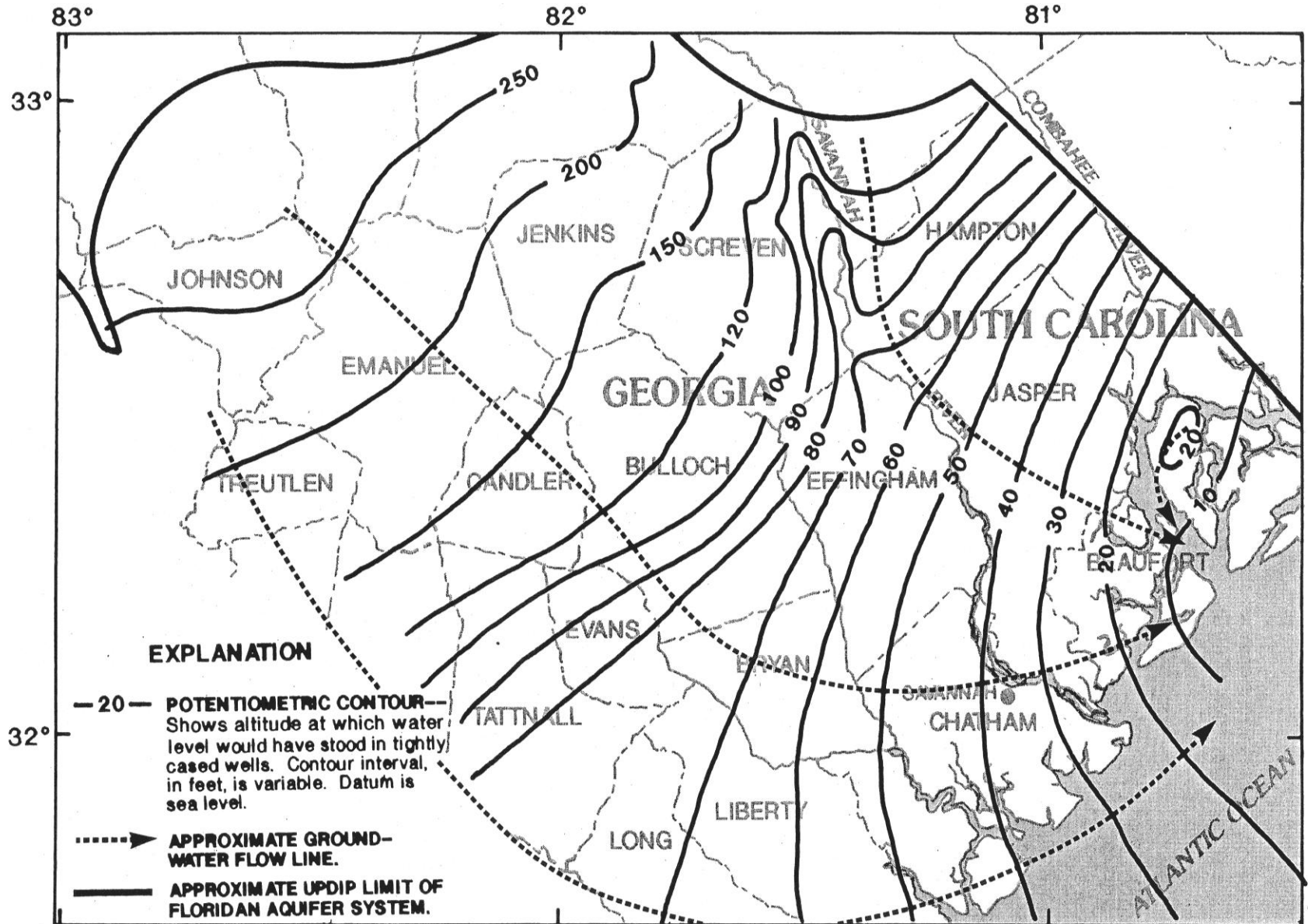
0 10 20 MILES



**Cone of Depression  
in the Upper  
Floridan Aquifer  
Associated with  
Withdrawals at  
Savannah, Georgia  
(1984)**

Adapted from Smith, 1998

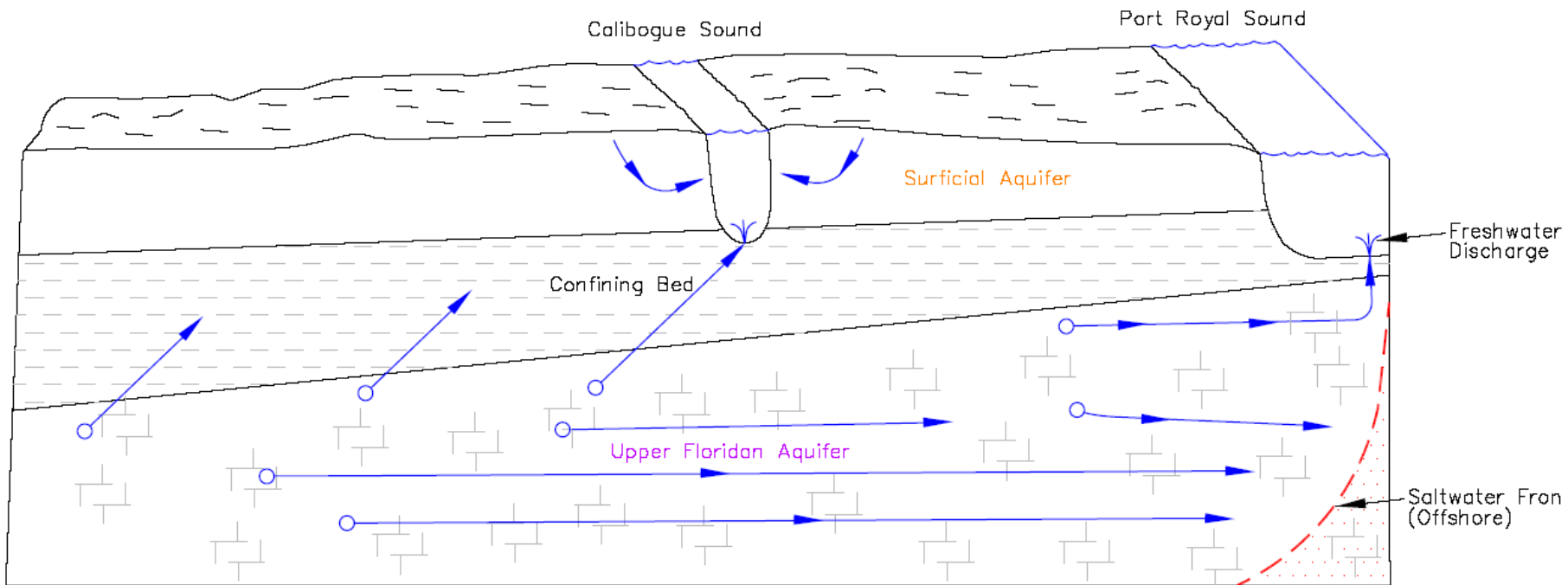
# Pre-Development Equipotential Map of the Upper Floridan Aquifer in South Carolina and Georgia (pre-1900's)



0 10 20 MILES

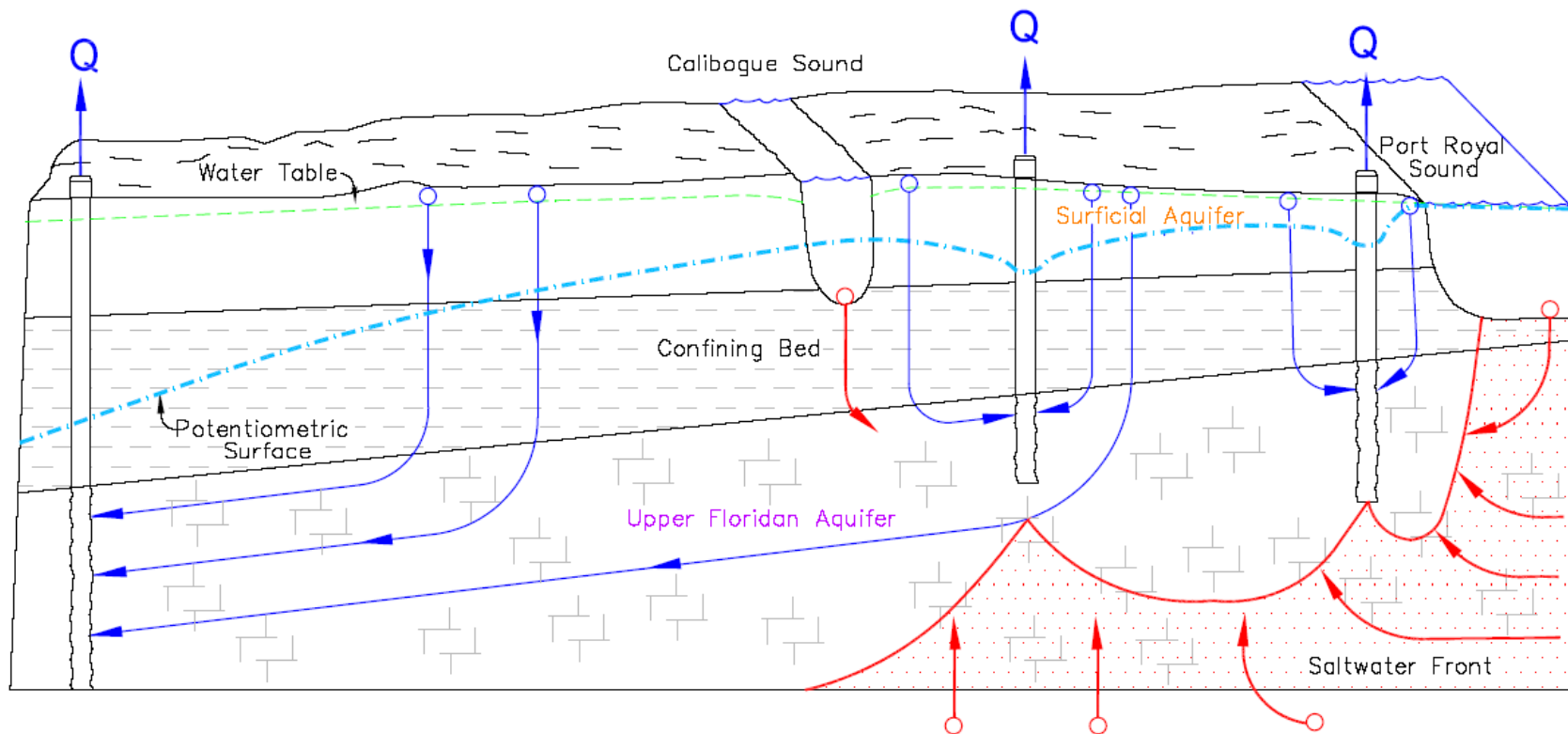
Adapted from Burt, 1992

# Conceptual Model of the Pre-Pumping Groundwater System in the Hilton Head Island Area

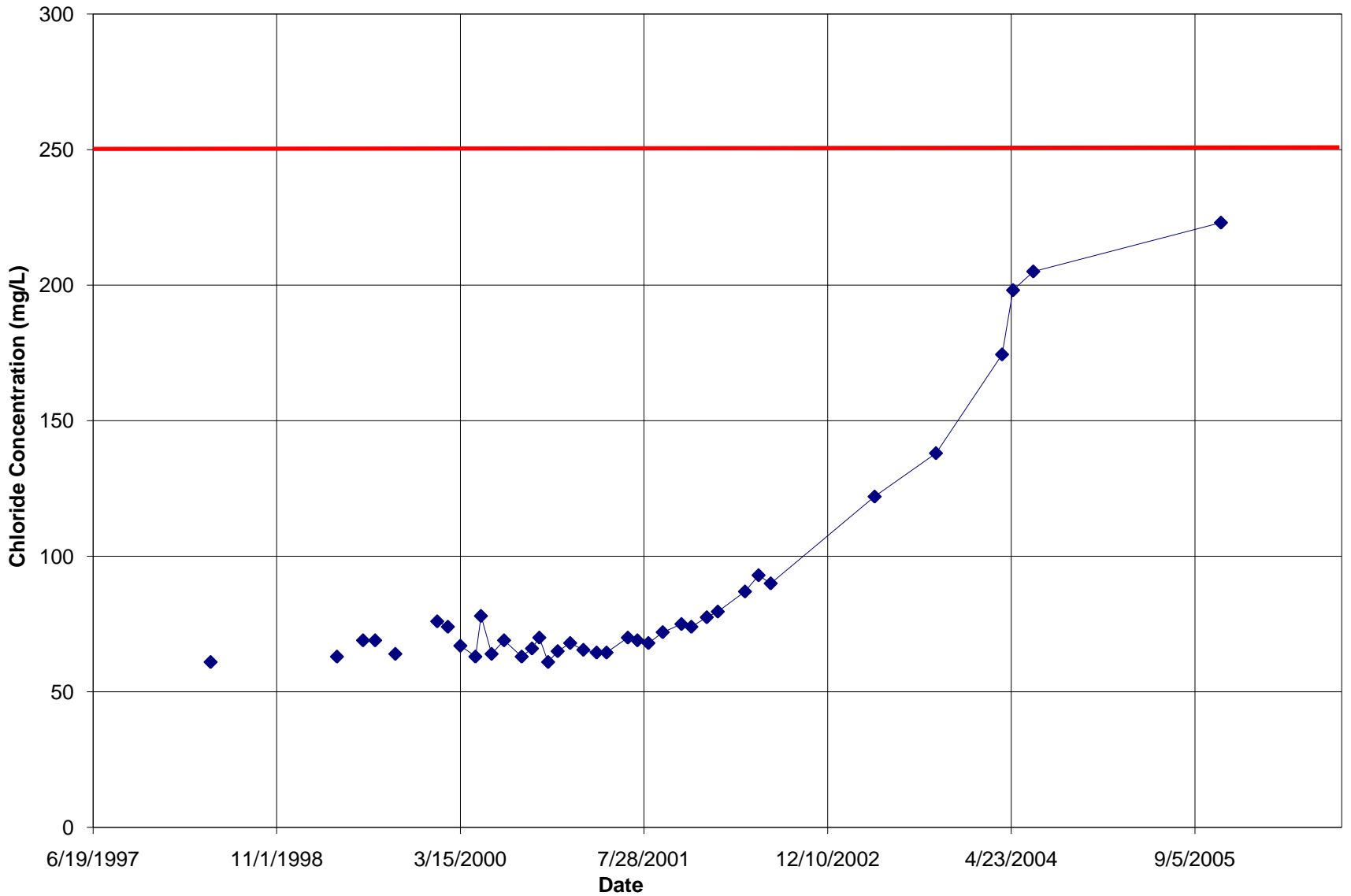




# Conceptual Model of the Groundwater System in the Hilton Head Island Area After Development



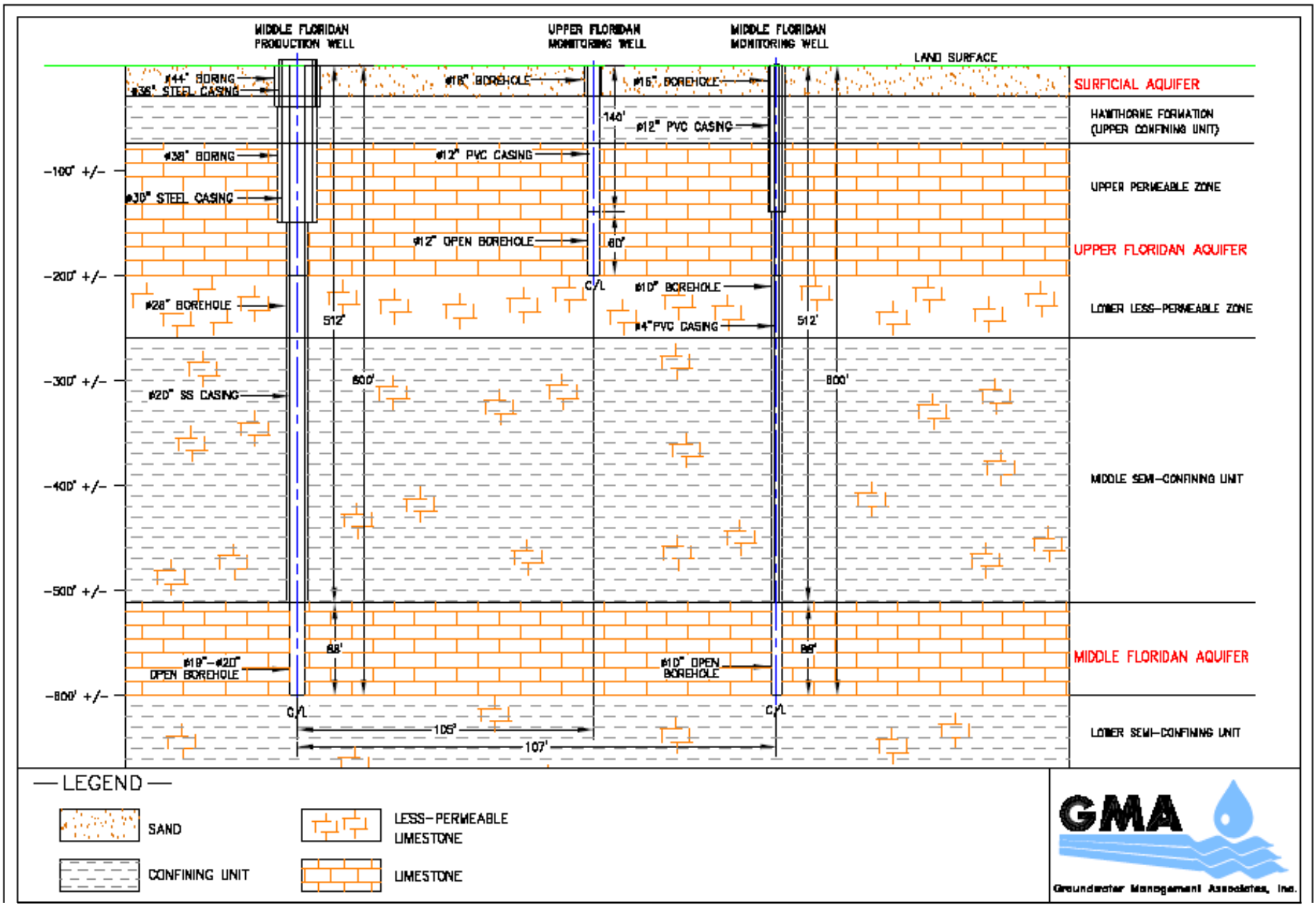
### Hilton Head PSD 1: Leg-O-Mutton Well Chloride Concentration Trend



## **Management Strategies:**

- **Matched optimized wellfield configurations with system demands**
- **Made efforts to enhance recharge on Island**
- **Developed a new well in Spanish Wells area away from saltwater front**
- **Evaluated use of ASR to mitigate saltwater intrusion**
- **Investigated use of Middle Floridan Aquifer**
- **Now developing the brackish Middle Floridan Aquifer as an alternative to the Upper Floridan Aquifer**

# Jenkins Island Site Well Details

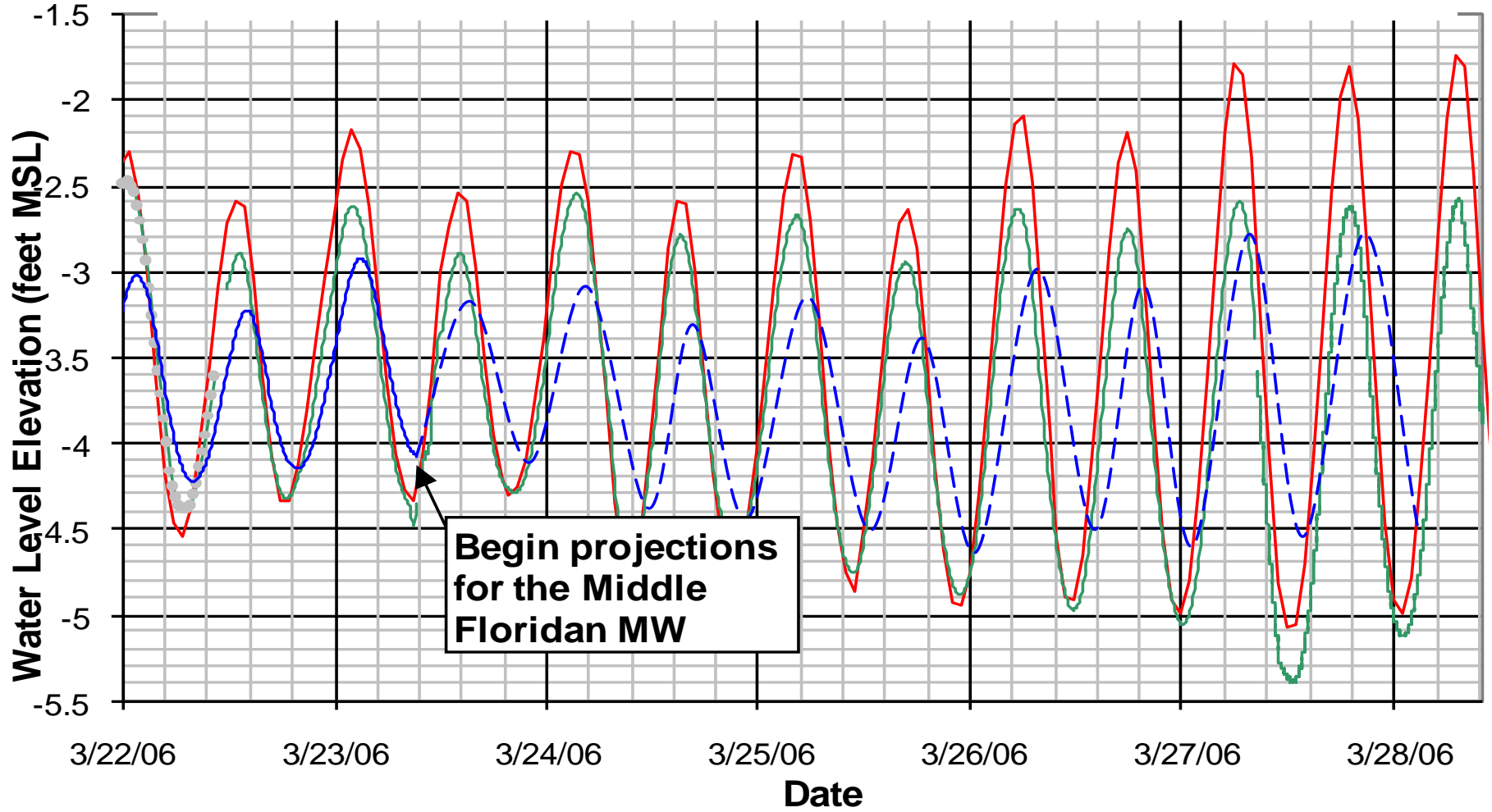




**Detailed Aquifer Testing,  
Monitoring, and  
Groundwater Modeling  
Required to Address  
Capacity Use Area  
Regulations**

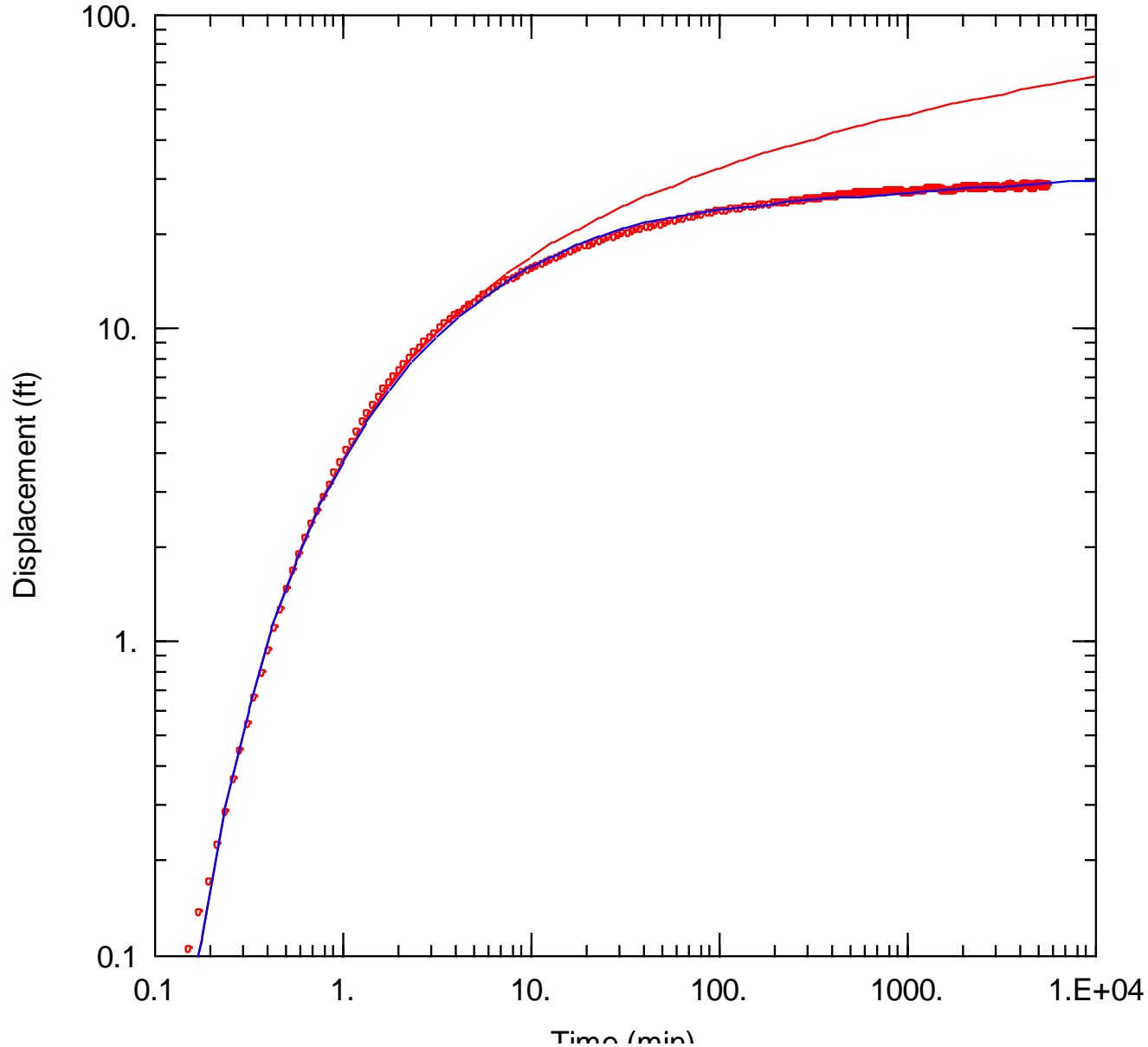
**Responsibility of the  
District to Prove the  
Impact to the Regulated  
Upper Floridan Aquifer**

## Tidal Influence and Data Correction



# Neuman-Witherspoon Plot of the Jenkins Island MFA MW Corrected Data from the 96-Hour Test

Middle Floridan Analysis



## Obs. Wells

• MFAq MW

## Aquifer Model

Leaky

## Solution

Neuman-Witherspoon

## Parameters

$T = 2256.1 \text{ ft}^2/\text{d}$

$S = 0.0002719$

$r/B = 0.2207$

$\beta = 0.003141$

$T' = 1.13\text{E}+04 \text{ ft}^2/\text{d}$

$S' = 0.0002771$

# Model Cross Section and Layers



Surficial Aquifer



Hawthorne Confining Unit



Upper Permeable Zone of the Upper Floridan Aquifer



Less Permeable Zone of the Upper Floridan Aquifer



Middle Floridan Confining Unit

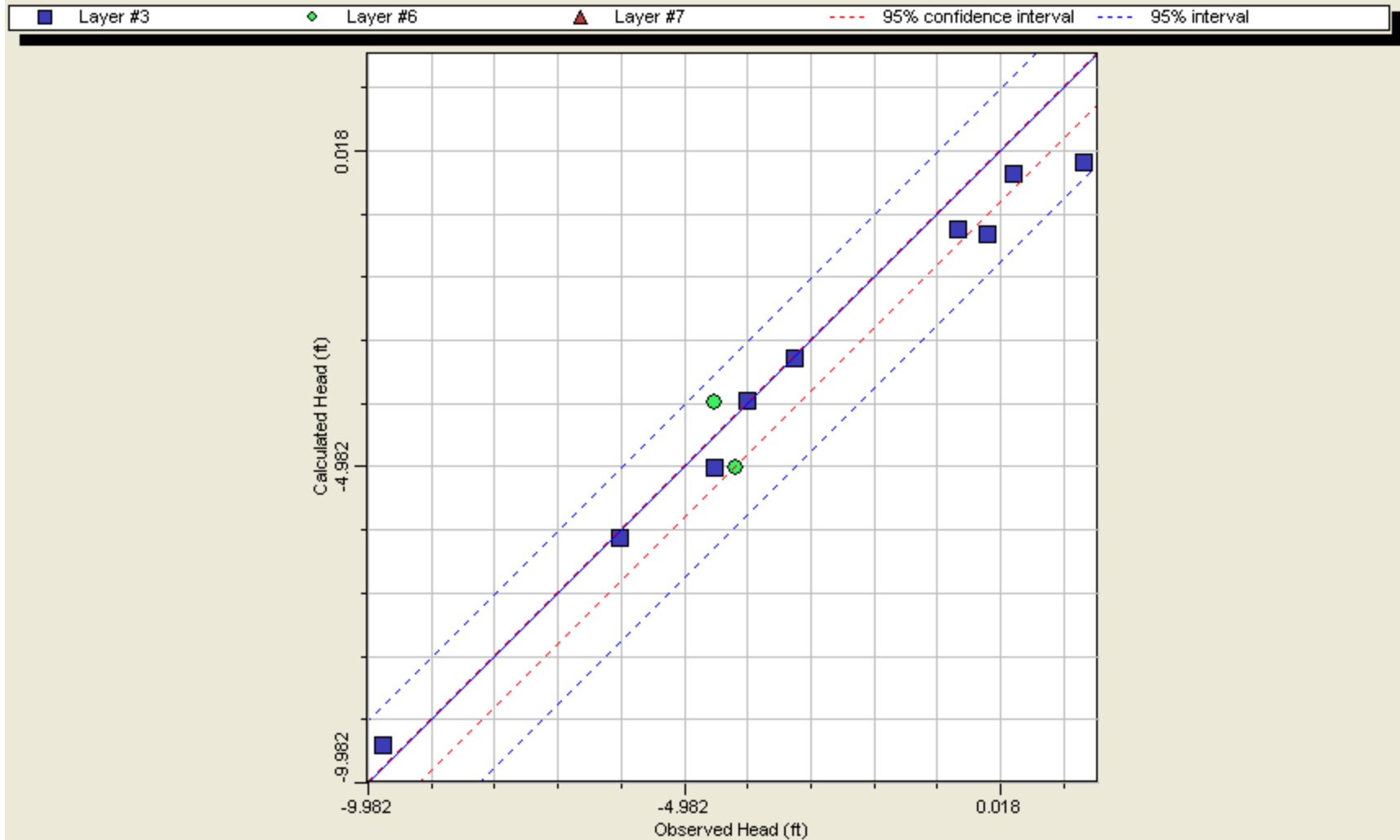


Middle Floridan Aquifer



# Steady State Calibration

## Calculated vs. Observed Head : Steady state

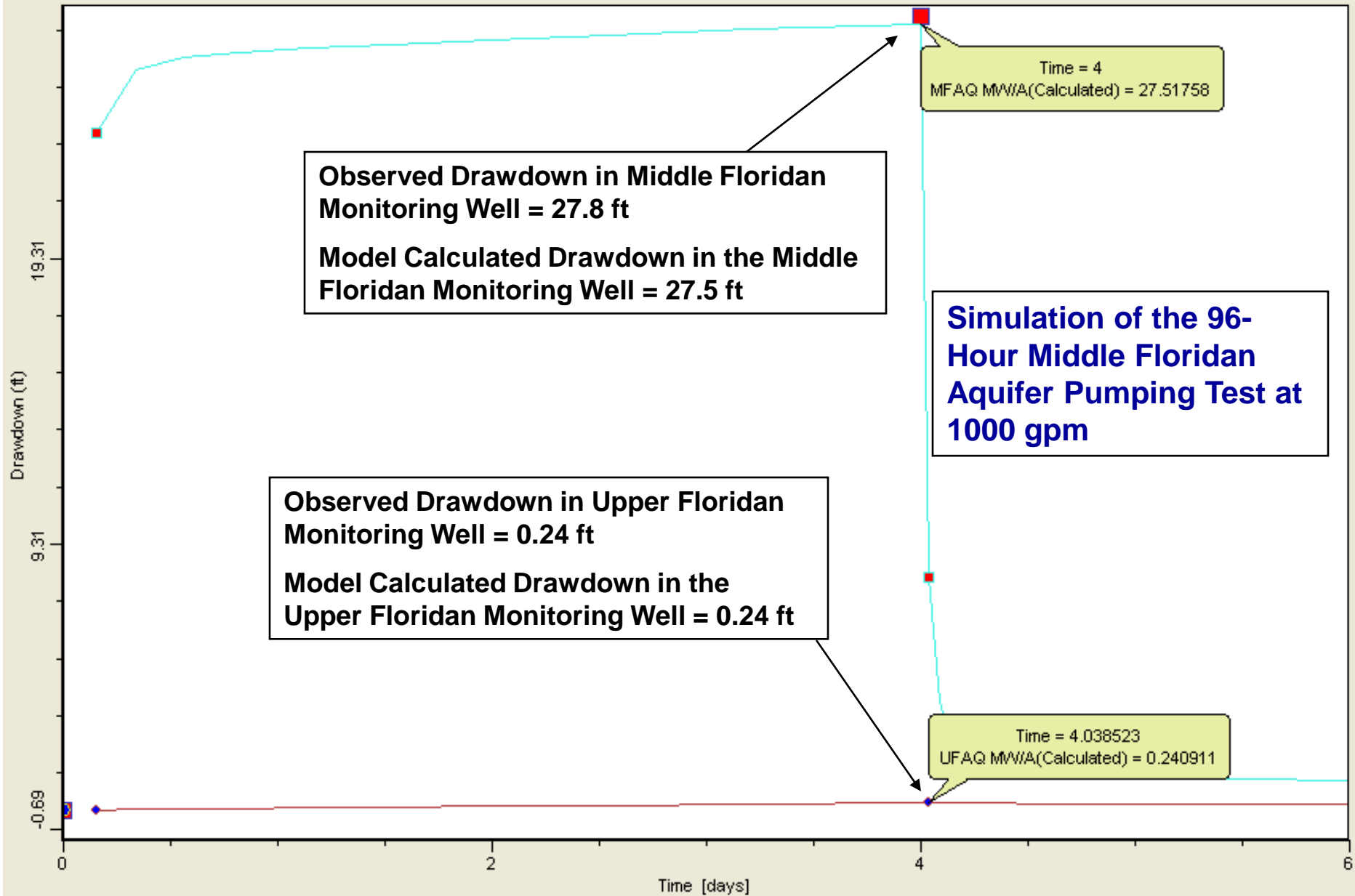


Num. of Data Points : 11  
Max. Residual: -1.496 (ft) at BFT-1810/A  
Min. Residual: -0.024 (ft) at BFT-2165/A  
Residual Mean : -0.387 (ft)  
Abs. Residual Mean : 0.56 (ft)

Standard Error of the Estimate : 0.187 (ft)  
Root Mean Squared : 0.706 (ft)  
Normalized RMS : 6.36 ( % )  
Correlation Coefficient : 0.989

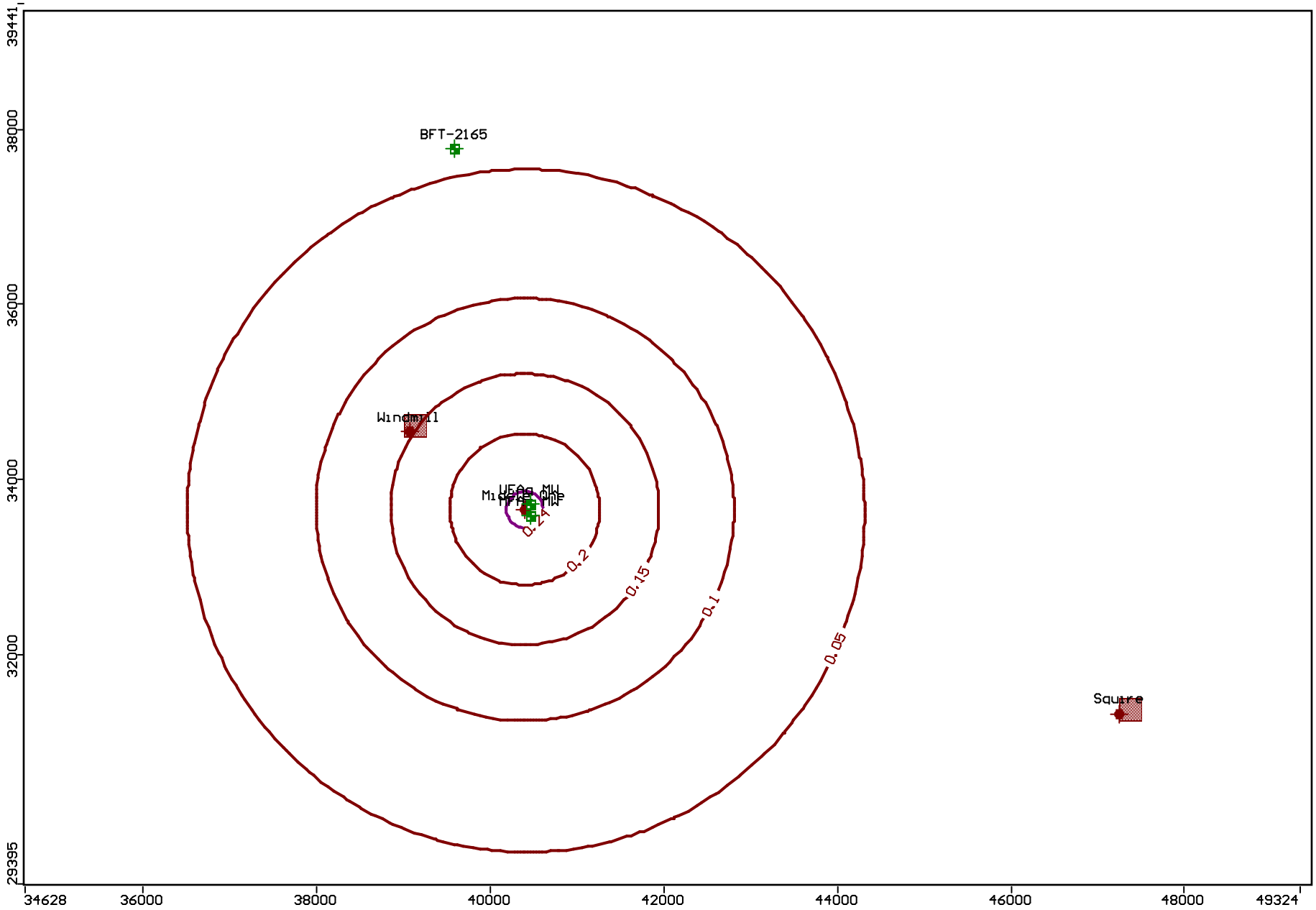
# Transient Verification

## Drawdown vs. Time

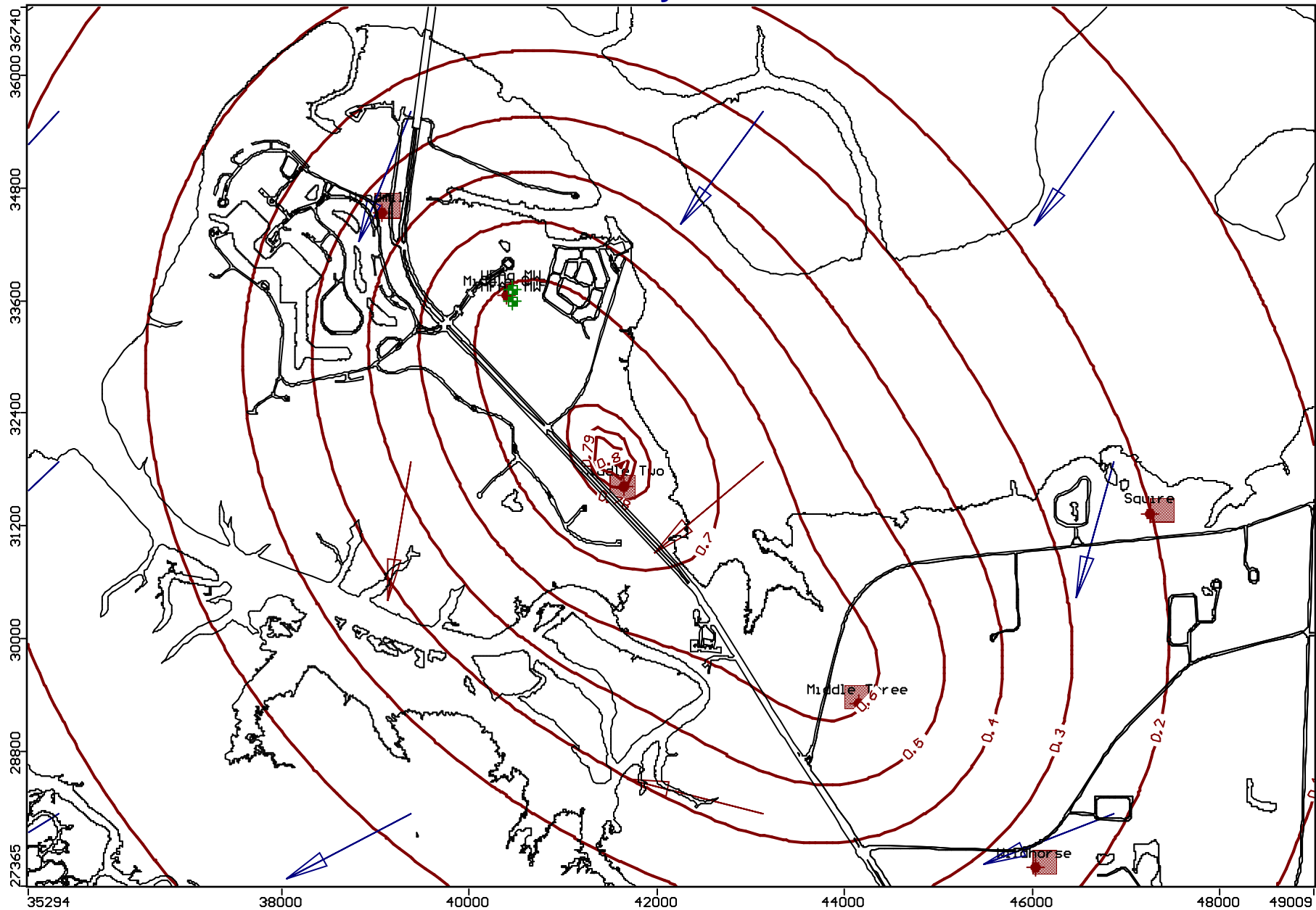


■ MFAQ MW/A(Observed)   ■ MFAQ MW/A(Calculated)   ● UFAQ MW/A(Observed)   ● UFAQ MW/A(Calculated)

# Simulated Drawdown in the UFA at the End of the 96-Hour 1000-gpm Test



# Simulated Drawdown in the UFA after 10-Days at 4.03 MGD Withdrawal from the MFA



 **Reds Wells Represent Active Pumping Wells**       **Green Wells Represent Observation Wells**

## Future Directions:

- **Upper Floridan Aquifer**

- Continuing to manage this source through optimized withdrawals and new well locations.

- **Middle Floridan Aquifer**

- Completing Wellfield and Reverse Osmosis Plant
- Middle Floridan Aquifer groundwater capacity will be 4 MGD
- Additional capacity may be added at new sites
- Middle Floridan Aquifer monitoring program is being implemented

- **Aquifer Storage Recovery**

- ASR can be used to slow saltwater intrusion while providing a method of seasonal storage

- **New Sources**

- The District will investigate the potential to utilize new sources such as the Cretaceous Aquifer System and the Lower Floridan Aquifer



**Questions?**

