

Water-level Trends in Aquifers of South Carolina

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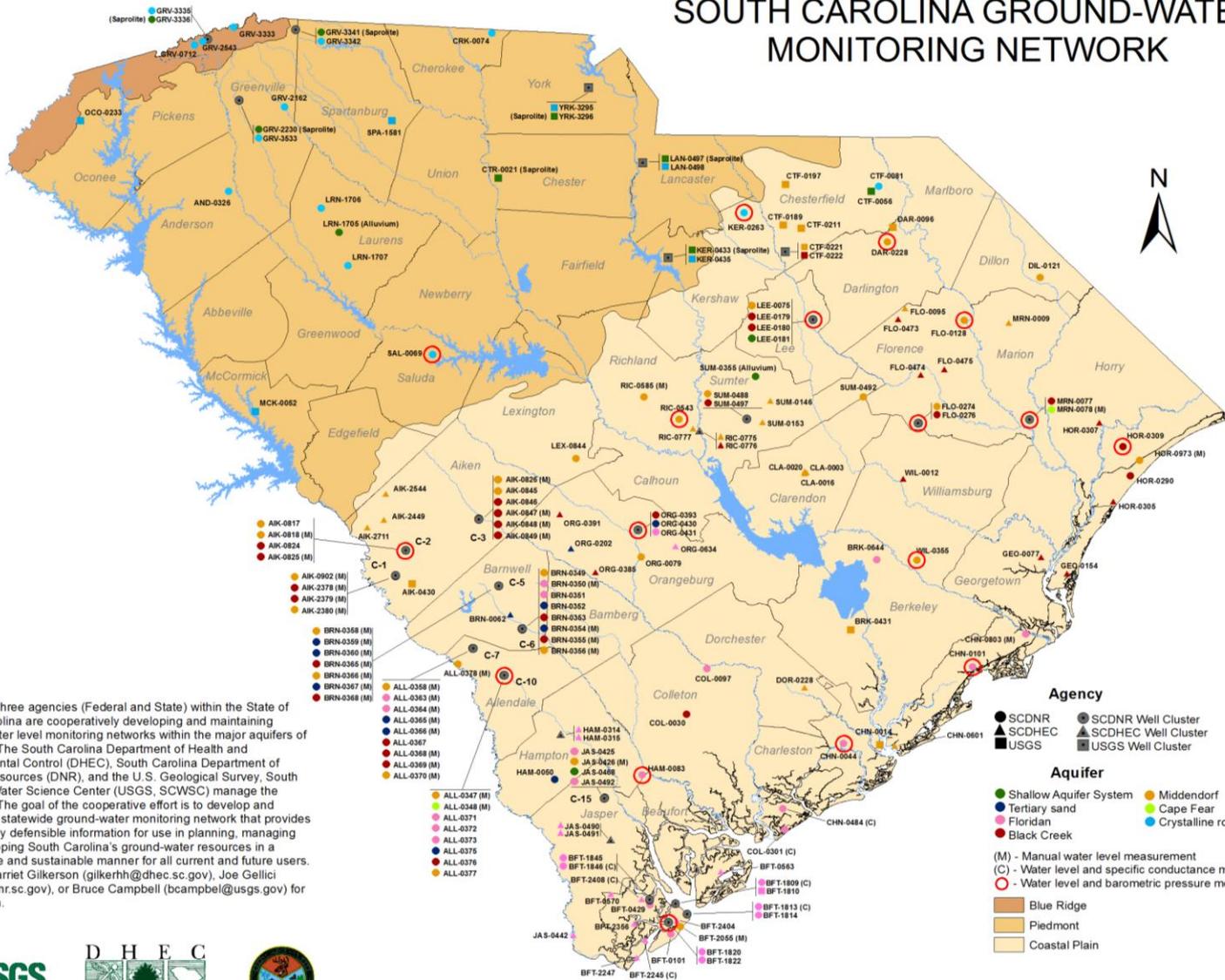
South Carolina Ground-Water Monitoring Network

- Collaborative effort between 3 agencies:
 - South Carolina Department of Natural Resources (SCDNR) - 115 wells
 - South Carolina Department of Health and Environmental Control (SCDHEC) - 40 wells
 - United States Geologic Survey (USGS) - 21 wells

“The goal of this cooperative effort is to develop and maintain a statewide ground-water monitoring network that provides scientifically defensible information for use in planning, managing, and developing South Carolina’s ground-water resources in a responsible and sustainable manner for all current and future users.”



SOUTH CAROLINA GROUND-WATER MONITORING NETWORK



Currently, three agencies (Federal and State) within the State of South Carolina are cooperatively developing and maintaining ground-water level monitoring networks within the major aquifers of the State. The South Carolina Department of Health and Environmental Control (DHEC), South Carolina Department of Natural Resources (DNR), and the U.S. Geological Survey, South Carolina Water Science Center (USGS, SCWSC) manage the networks. The goal of the cooperative effort is to develop and maintain a statewide ground-water monitoring network that provides scientifically defensible information for use in planning, managing and developing South Carolina's ground-water resources in a responsible and sustainable manner for all current and future users. Contact Harriet Gilkerson (gilkerh@dhec.sc.gov), Joe Gellici (gellicj@dnr.sc.gov), or Bruce Campbell (bcampbel@usgs.gov) for information.



Purpose of Ground-Water Monitoring Network

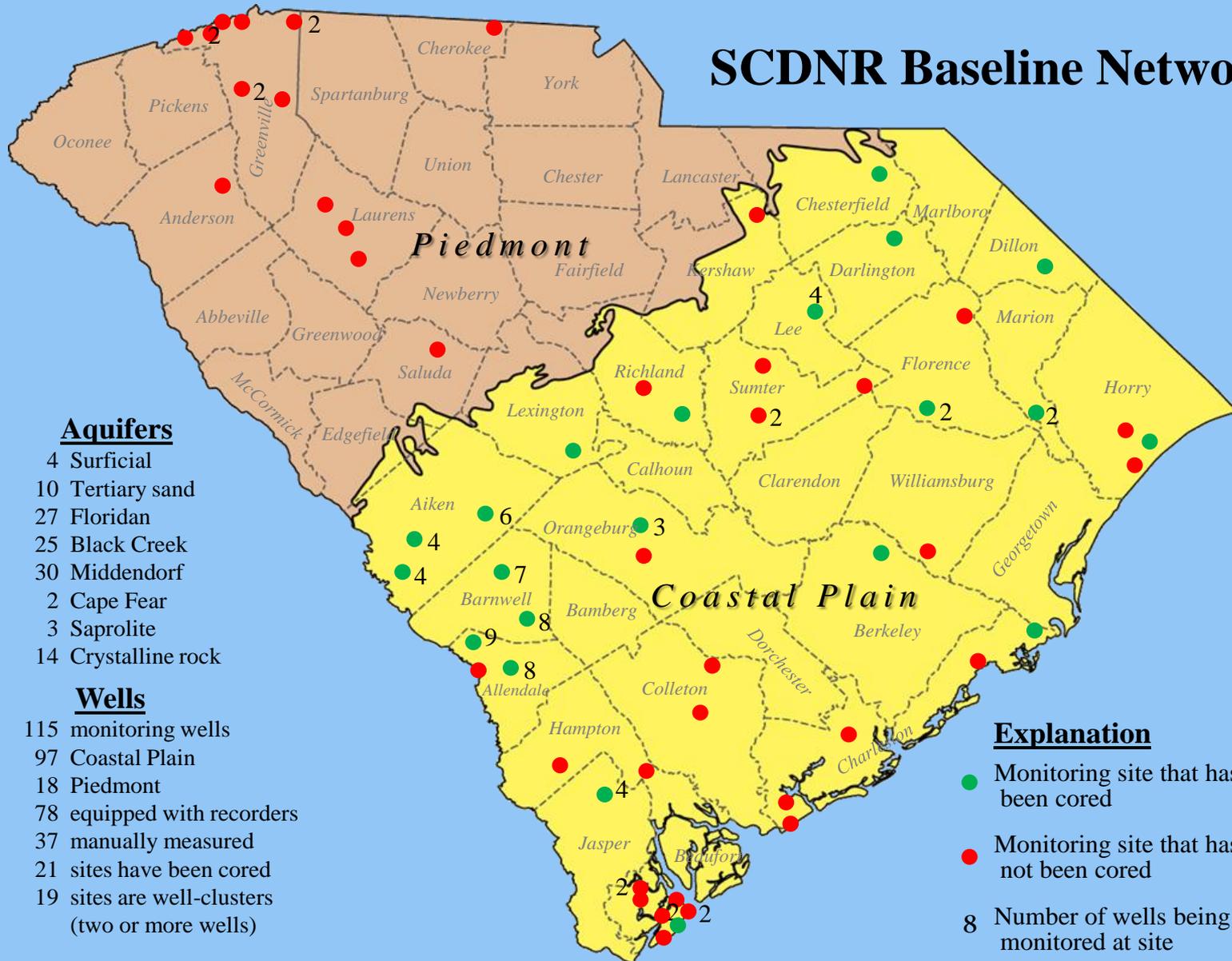
- Establish long-term ground water dataset to support
 - Ground-water management and permitting
 - Drought assessments
 - Identification of long-term trends
 - Ground-water flow modeling
 - Water-level (potentiometric) mapping
 - Evaluation of ground-water availability

SCDNR Baseline Ground-Water Monitoring Network

- 115 wells – most owned by SCDNR
- 78 wells – Equipped with automatic data recorders (ADRs) which record hourly water levels.
- 37 wells – Periodic measurements made every 2-3 months.
- Periods of Record
 - range from several months to over 50 years
 - 10-15 years is typical



SCDNR Baseline Network



Aquifers

- 4 Surficial
- 10 Tertiary sand
- 27 Floridan
- 25 Black Creek
- 30 Middendorf
- 2 Cape Fear
- 3 Saprolite
- 14 Crystalline rock

Wells

- 115 monitoring wells
- 97 Coastal Plain
- 18 Piedmont
- 78 equipped with recorders
- 37 manually measured
- 21 sites have been cored
- 19 sites are well-clusters (two or more wells)

Explanation

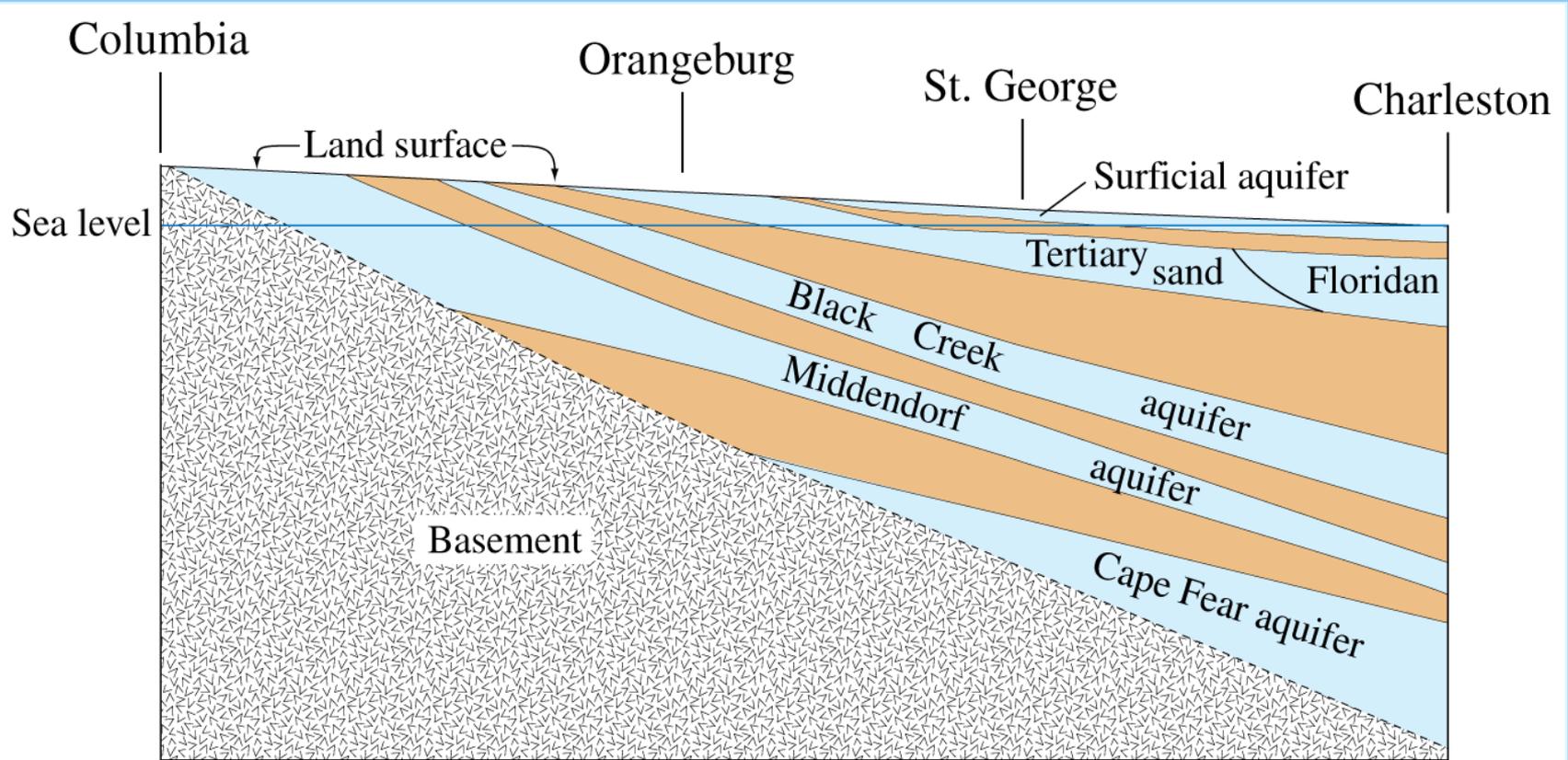
- Monitoring site that has been cored
- Monitoring site that has not been cored
- 8 Number of wells being monitored at site

Methods

- Field visits are taken every 2-3 months
 - Manual measurements are recorded
 - ADRs (predominantly of the pressure transducer variety) are downloaded
 - ADRs are calibrated, fixed or replaced as needed
- Manual and downloaded hourly data are checked for quality assurance and quality control and entered into SCDNR database
- Daily average water levels are computed from hourly data and converted to depths below land surface



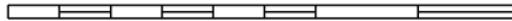
Principal Coastal Plain Aquifers



Vertical axis not to scale

 Aquifer  Confining unit  Crystalline rock

0 10 20 30 40 50 miles

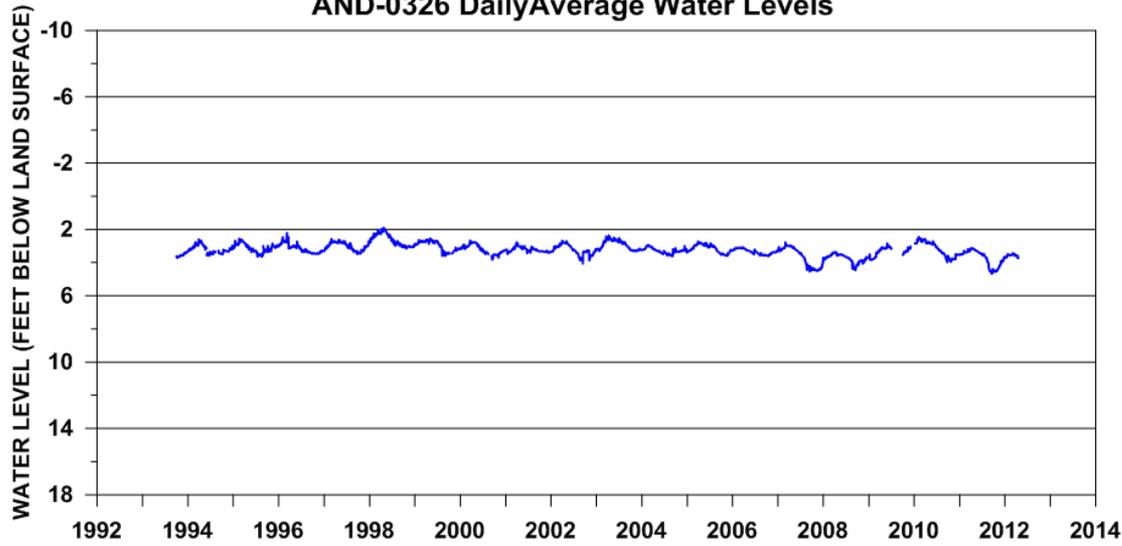


Interpreting Ground-Water Behavior Can Be Challenging:

- Some sites have inadequate periods of record from which to evaluate long-term trends.
- Can be difficult to distinguish between the impacts of drought and impacts of pumping.
- Limited spatial distribution of wells.
- Incomplete ground-water use data (historically and currently).

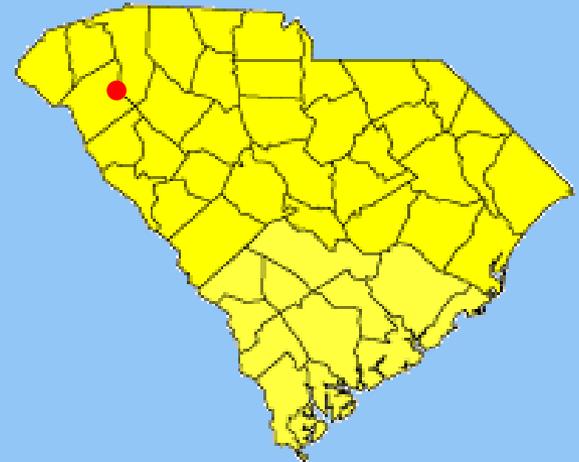
Water-Level Trends in the Crystalline Rock Aquifer

AND-0326 Daily Average Water Levels

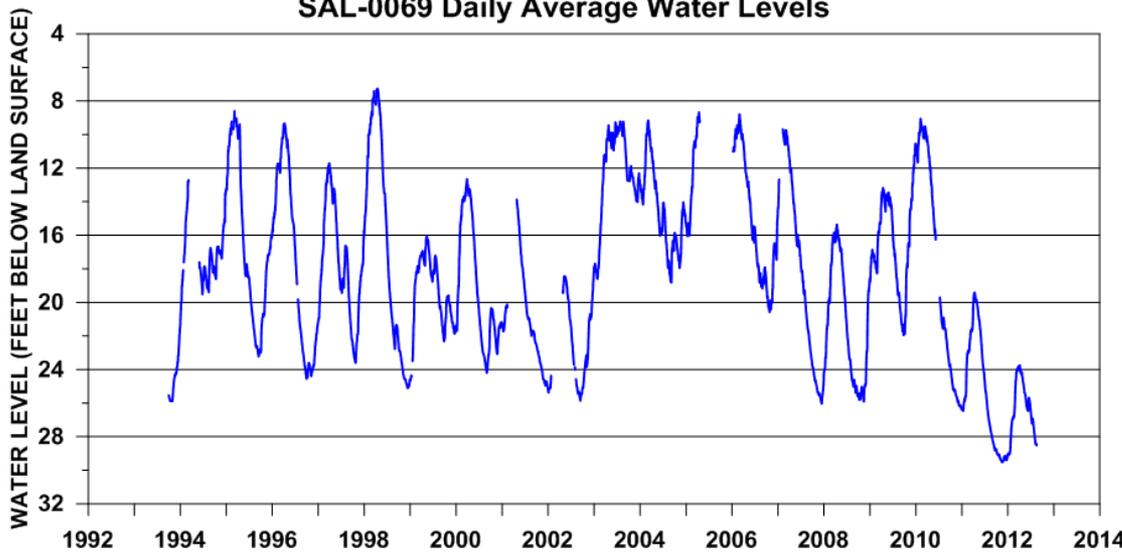


Aquifer: Crystalline Rock Depth: 398 ft.
Elevation: 785 ft. Screen: 75-398 ft.

Small seasonal variations

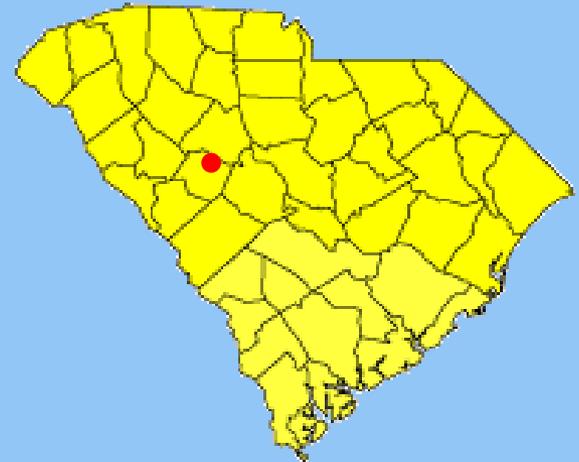


SAL-0069 Daily Average Water Levels

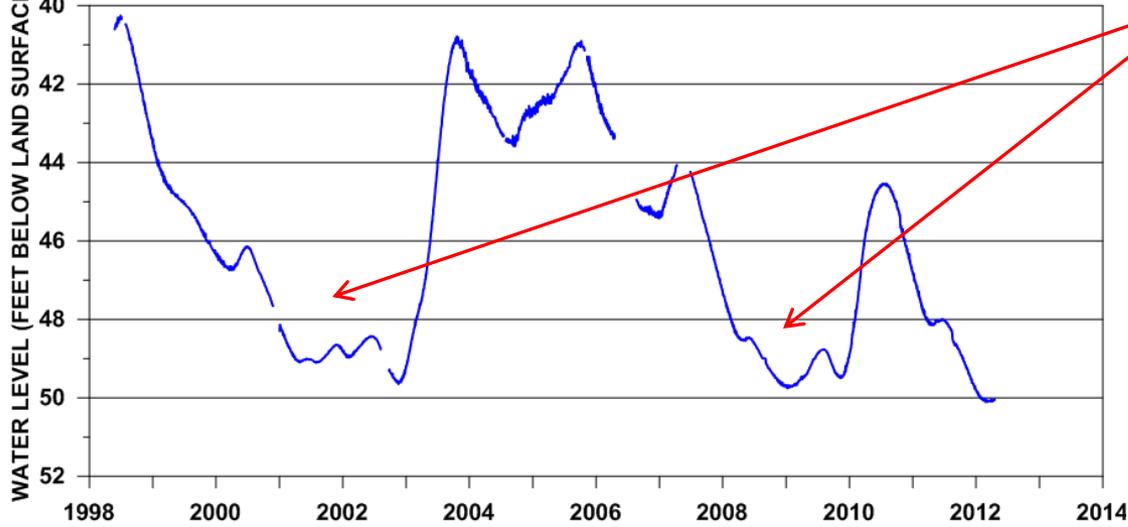


Aquifer: Crystalline Rock Depth: 480 ft.
Elevation: 445 ft. Screen: 92-480 ft.

Large seasonal variations



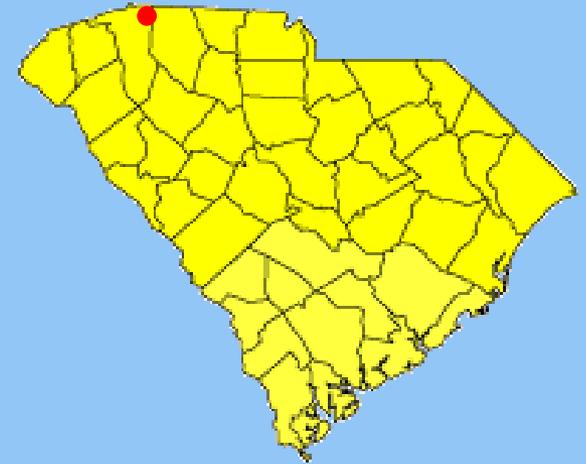
GRV-3342 Daily Average Water Levels



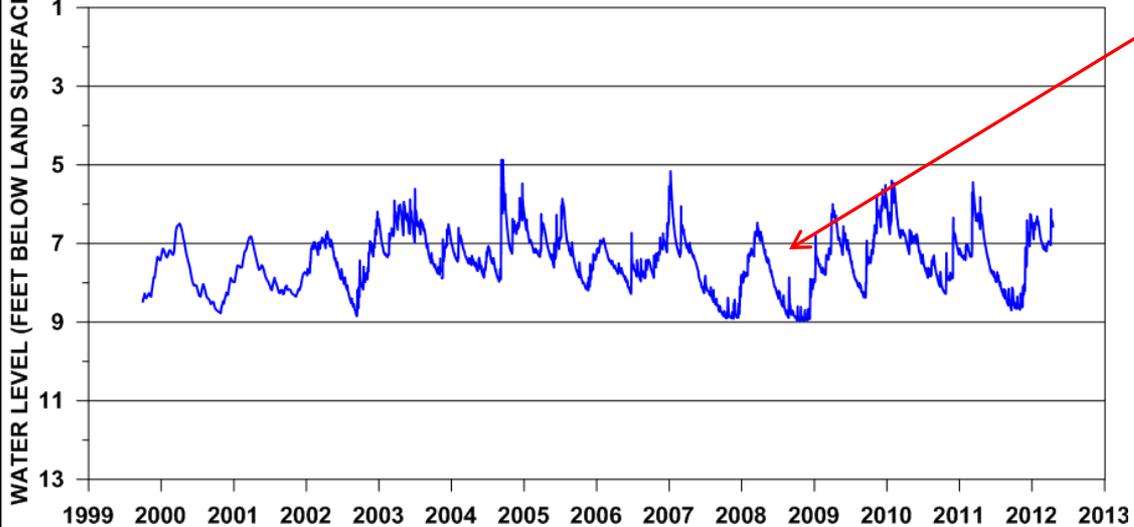
Aquifer: Crystalline Rock
Elevation: 1030 ft.

Depth: 334 ft.
Screen: Open Hole

Strong drought signature



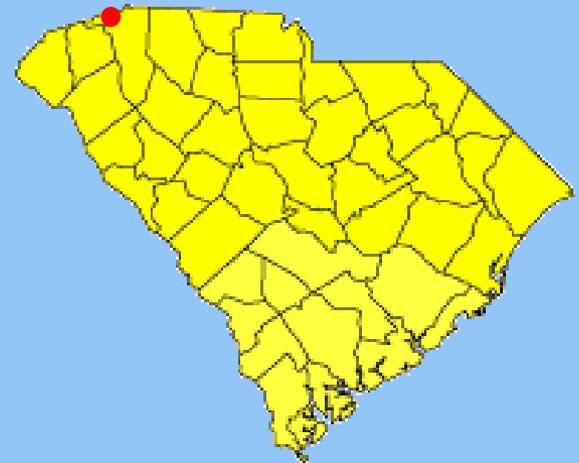
GRV-3335 Daily Average Water Levels



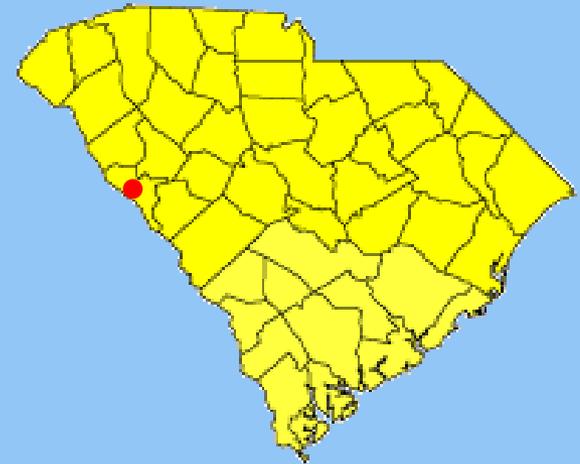
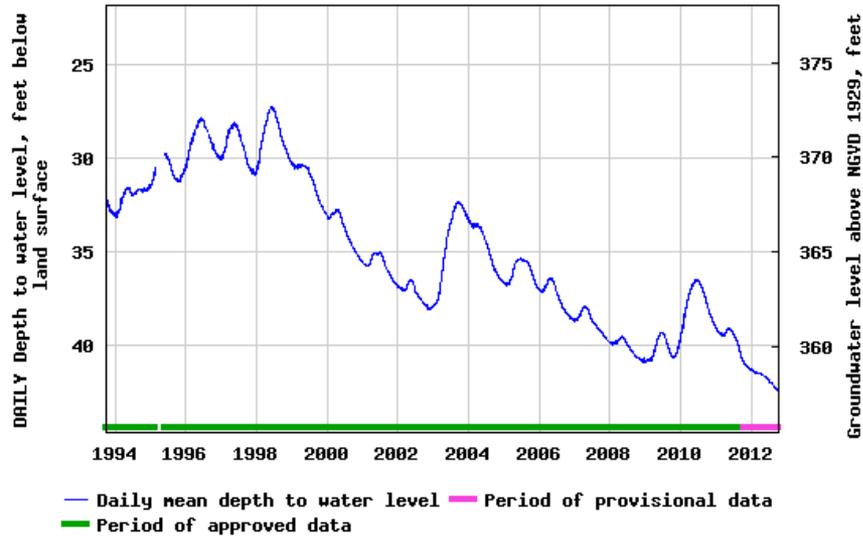
Aquifer: Crystalline Rock
Elevation: 1352 ft.

Depth: 110 ft.
Screen: Open Hole

Weak drought signature

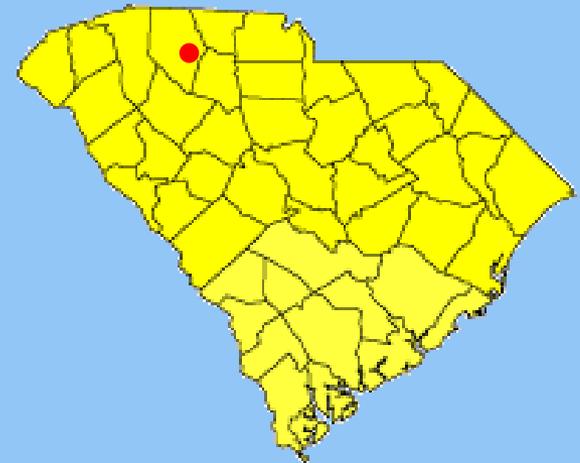
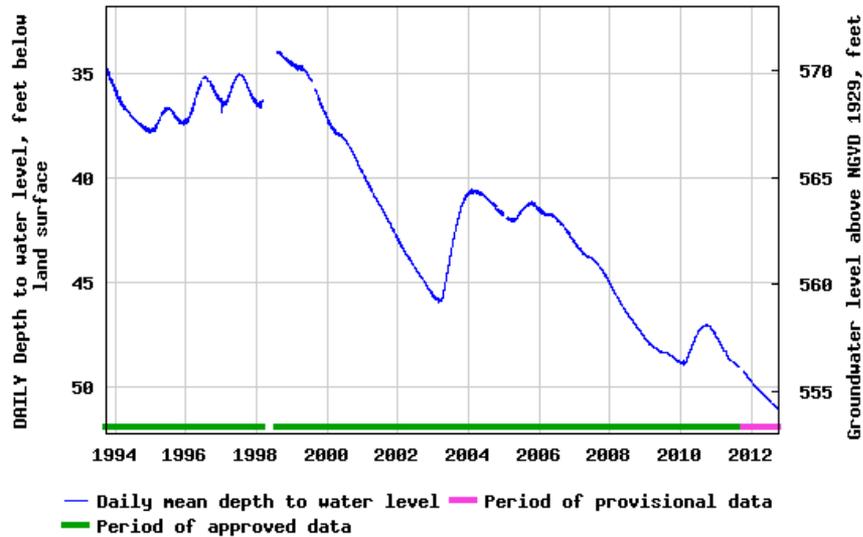


USGS 335336082214600 MCK- 52

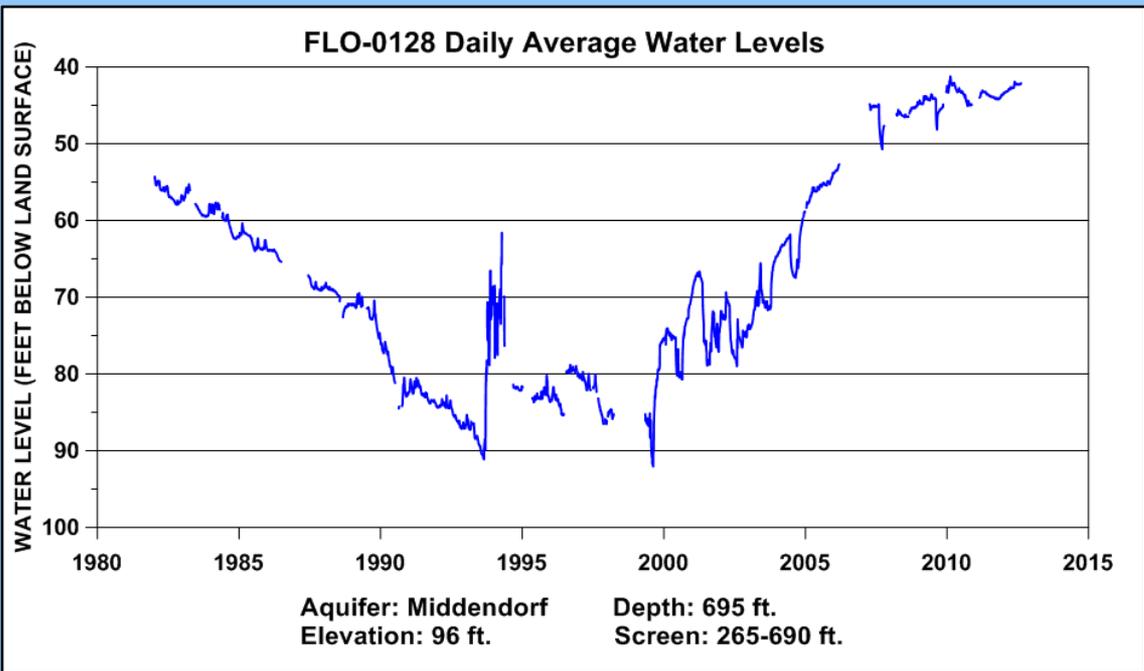


Weak recovery after 1998-2002 and 2007-2008 droughts and overall downward trends

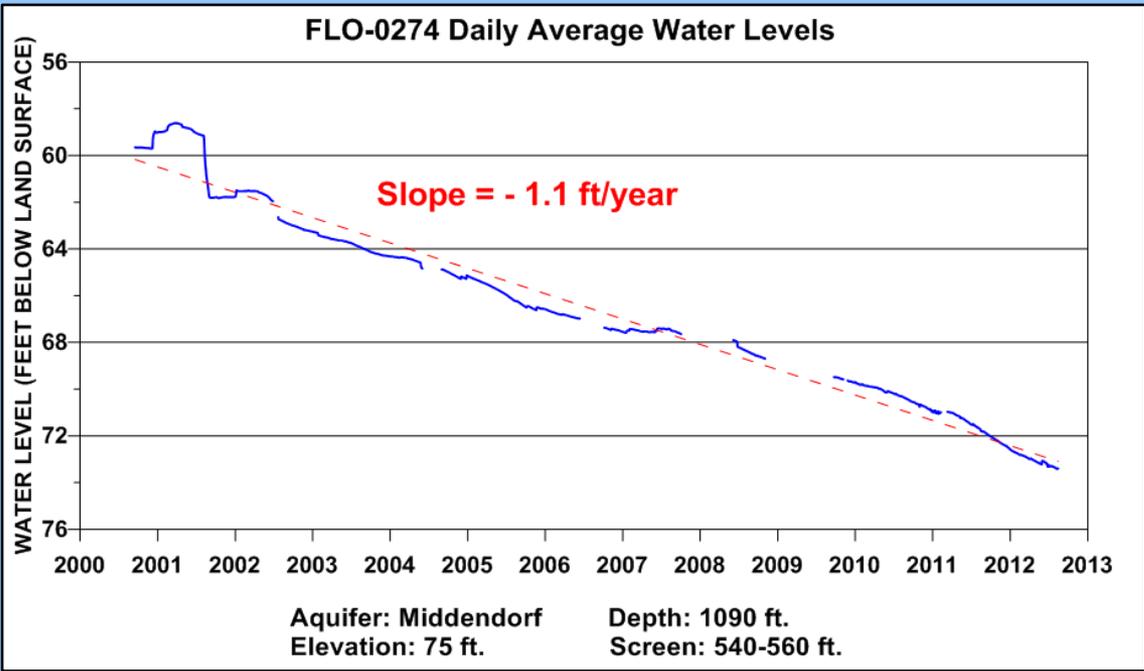
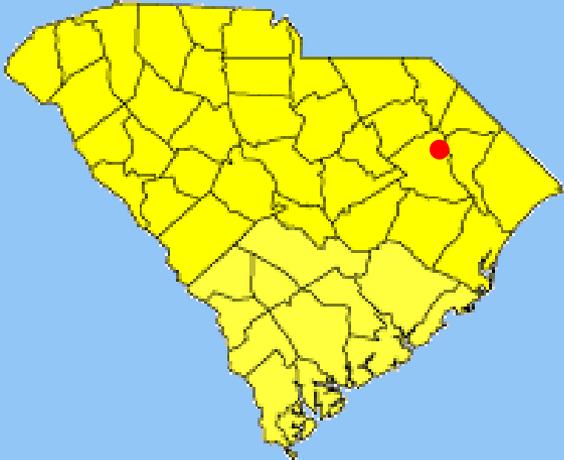
USGS 345145081502900 SP-1581



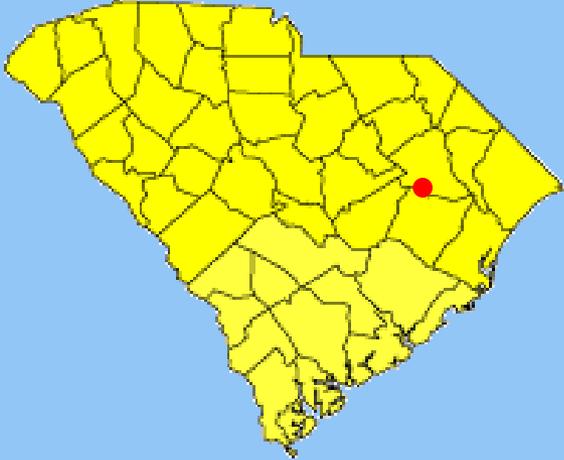
Water-Level Trends in the Middendorf Aquifer

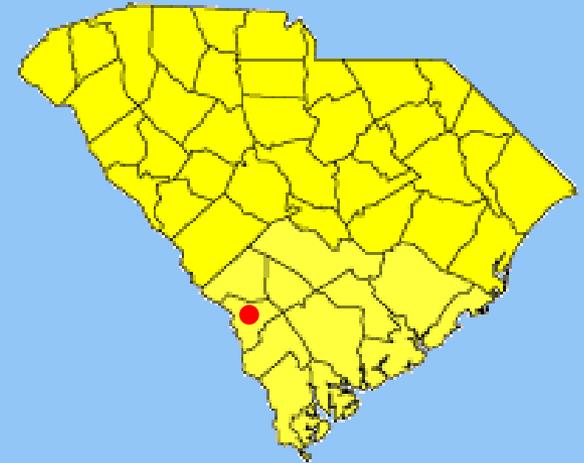
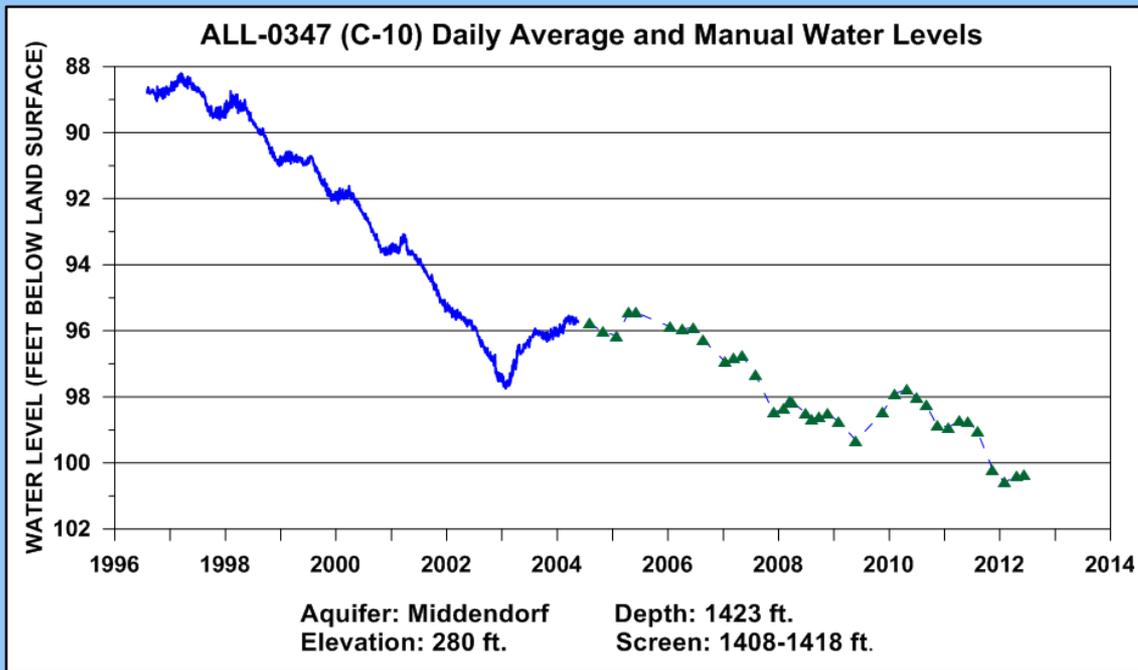


Significant recovery after City of Florence supplemented groundwater supply with Pee Dee River

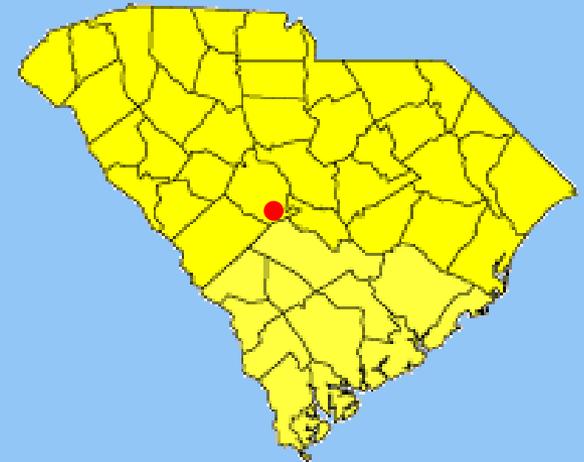
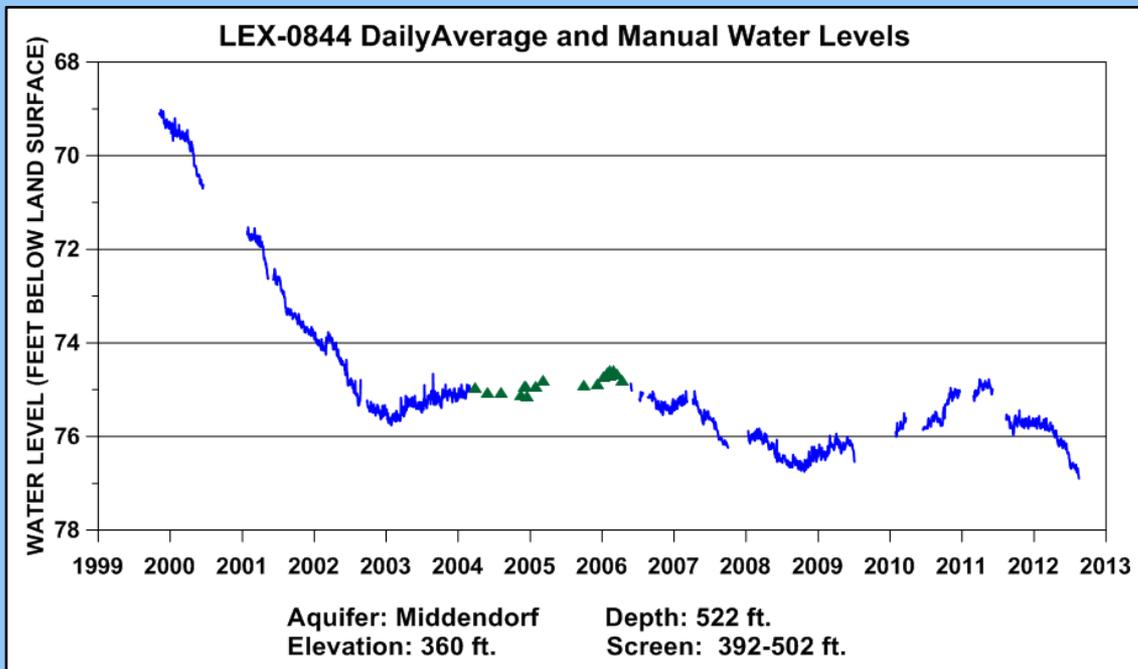


Steady decline over past 10 years likely due to municipal pumping

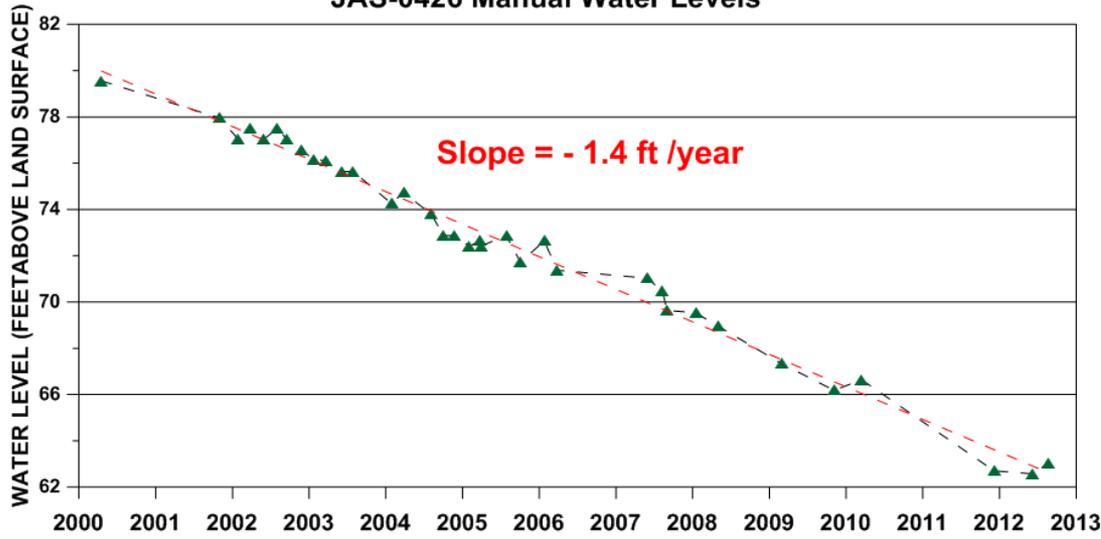




**Little to no recovery after
1998-2002 drought**

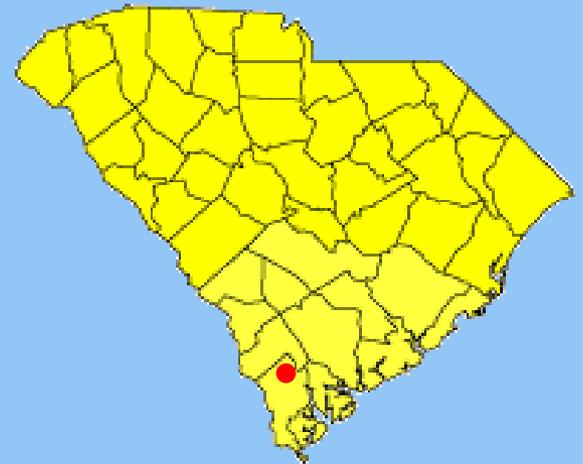


JAS-0426 Manual Water Levels

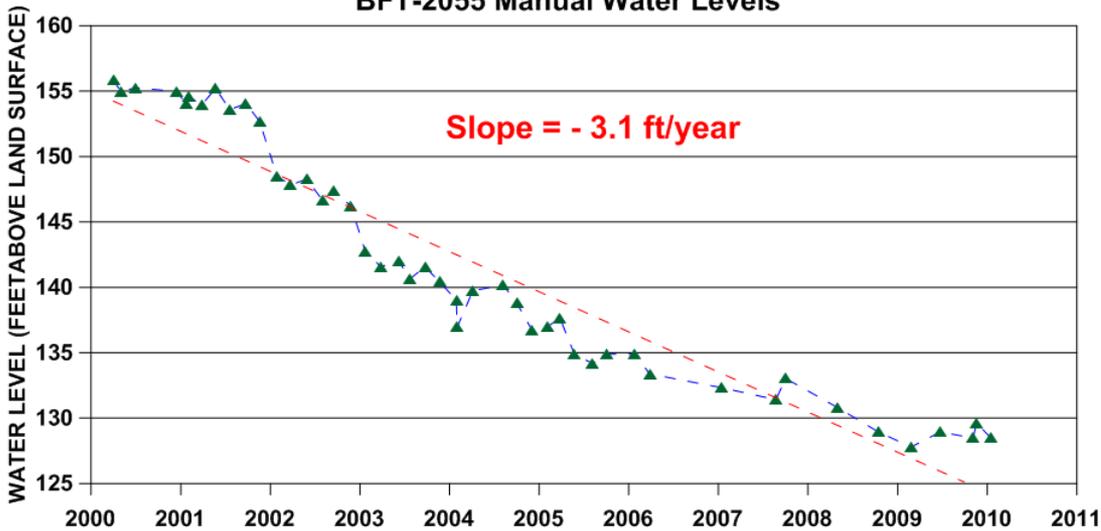


Aquifer: Middendorf Depth: 1994 ft.
Elevation: 63.2 ft. Screen: 1949-1994 ft.

Cause of decline uncertain

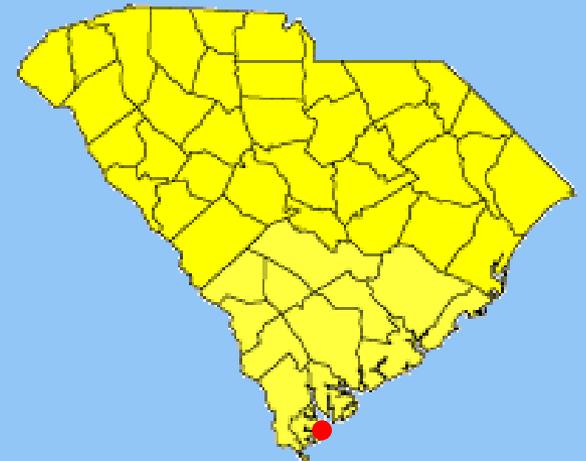


BFT-2055 Manual Water Levels

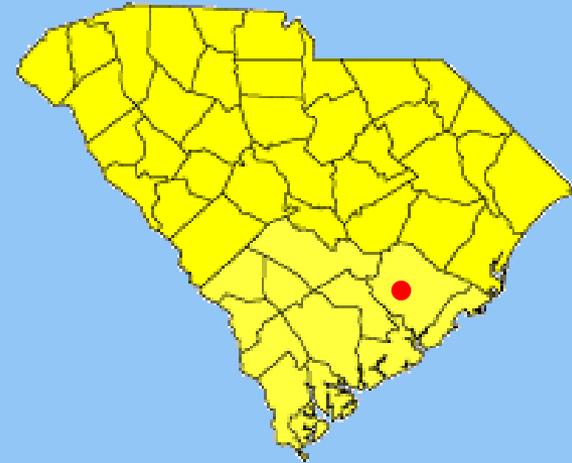
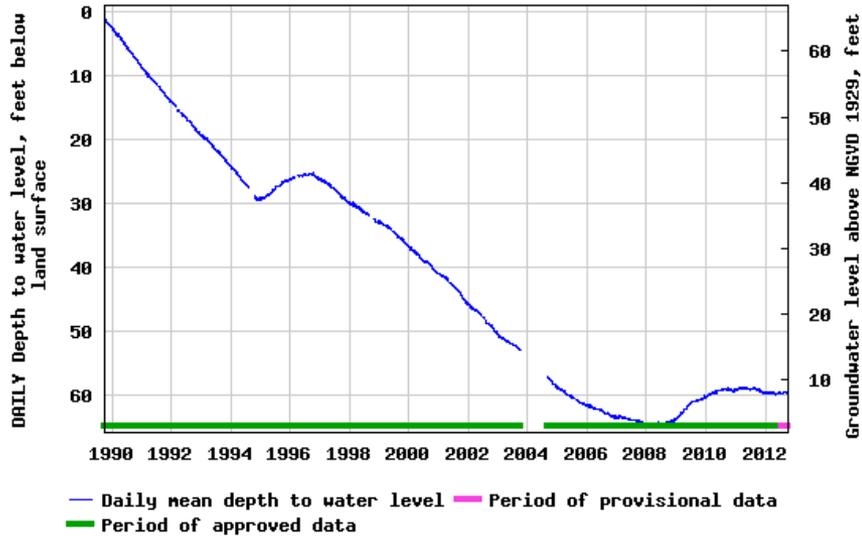


Aquifer: Middendorf Depth: 3708 ft.
Elevation: 11.21 ft. Screen: 2782-3688 ft.

Decline likely due to pumping on Hilton Head

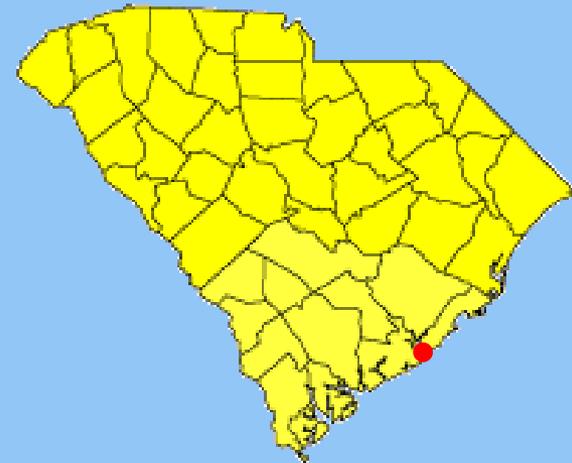
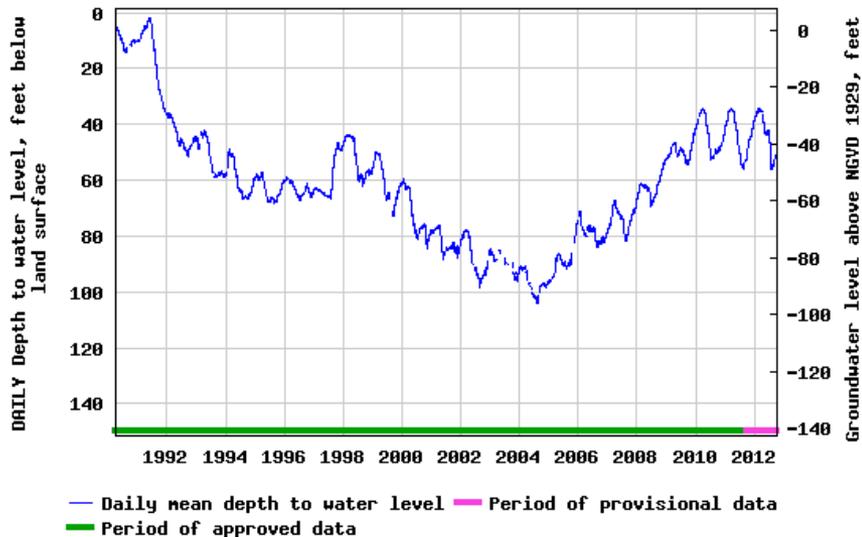


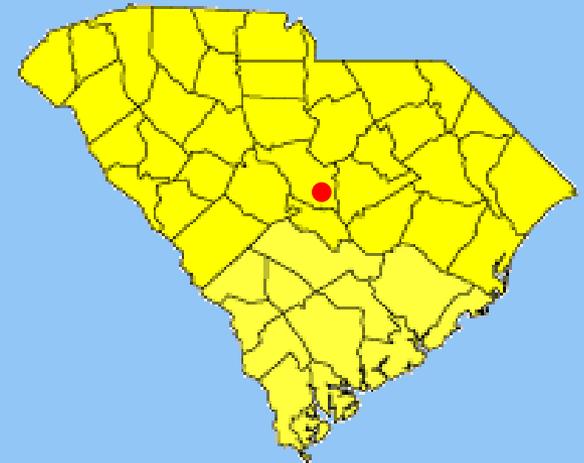
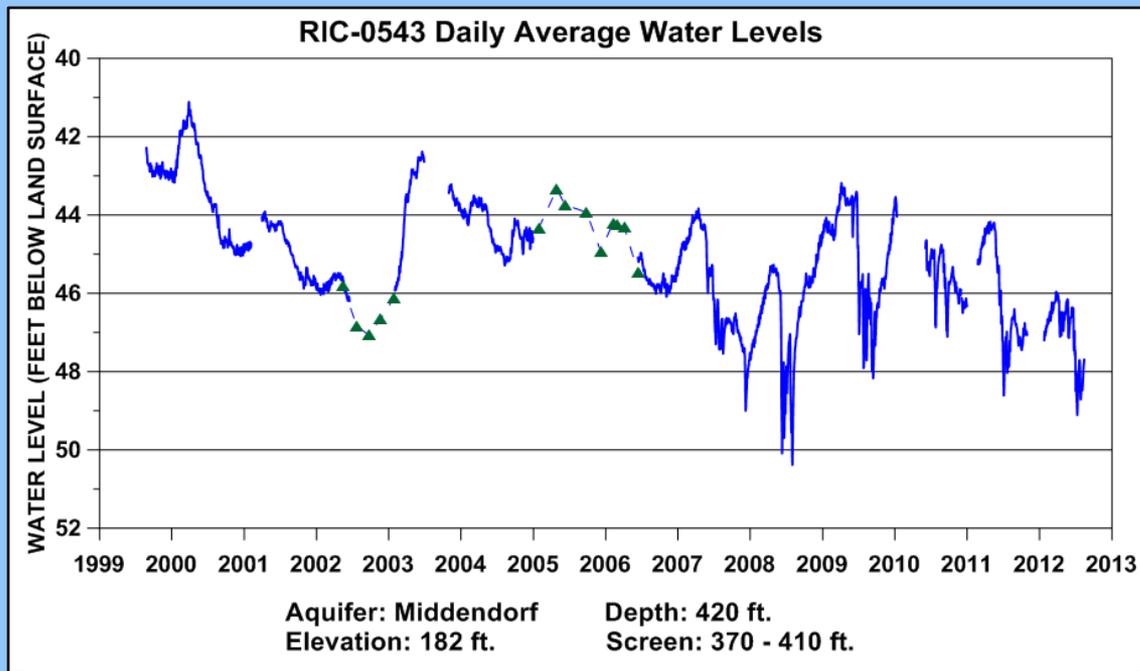
USGS 331022080021801 BRK- 431



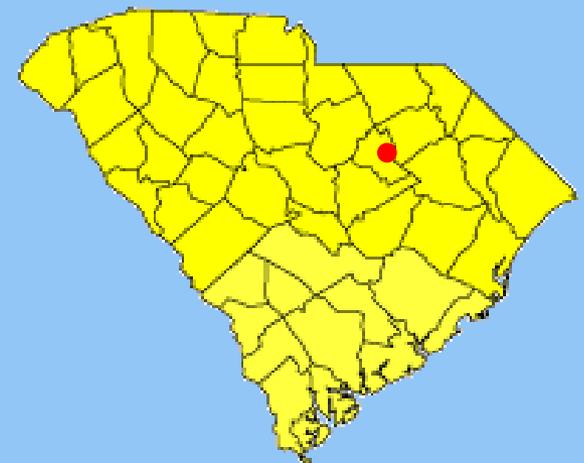
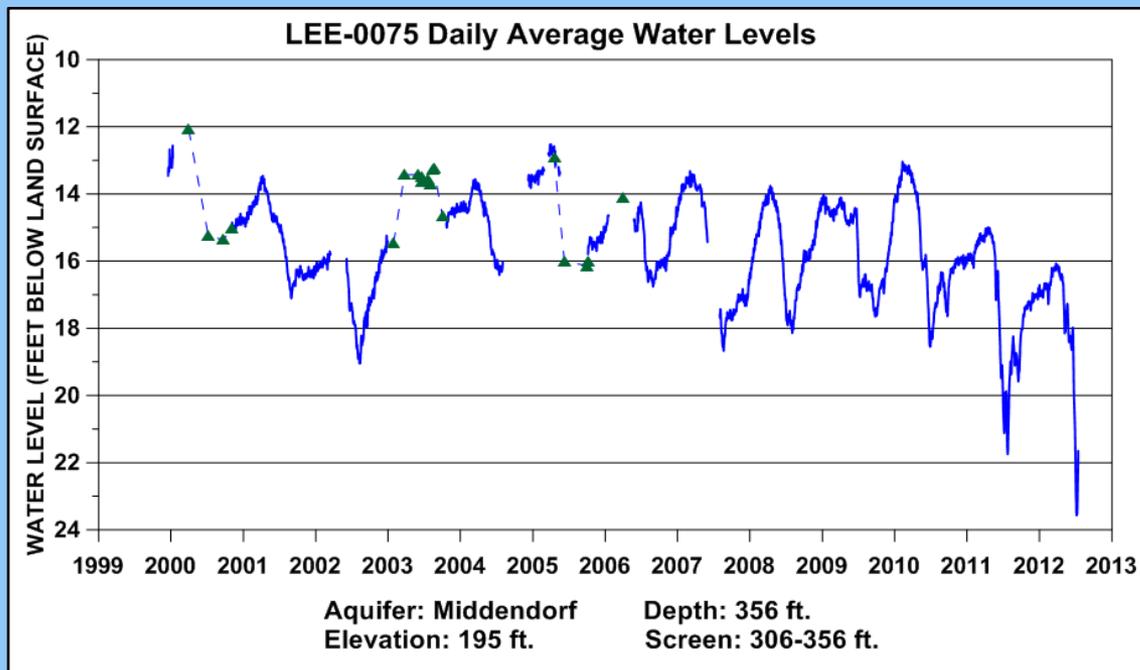
Some recovery after water users began supplementing ground water with surface water

USGS 324729079472001 CHN- 14

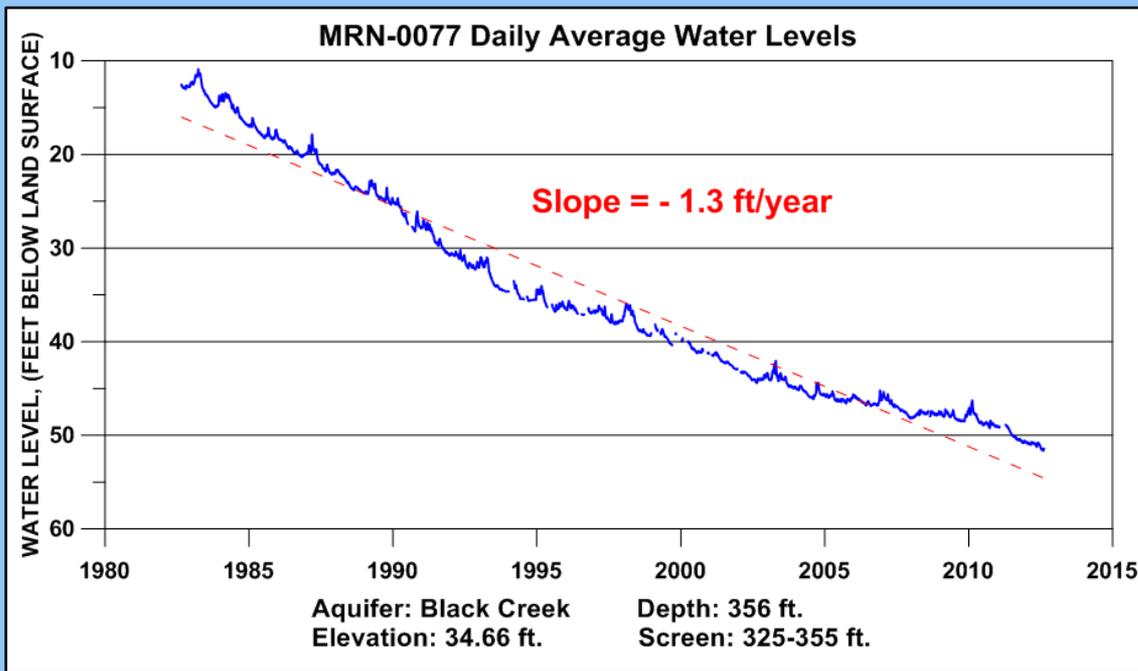




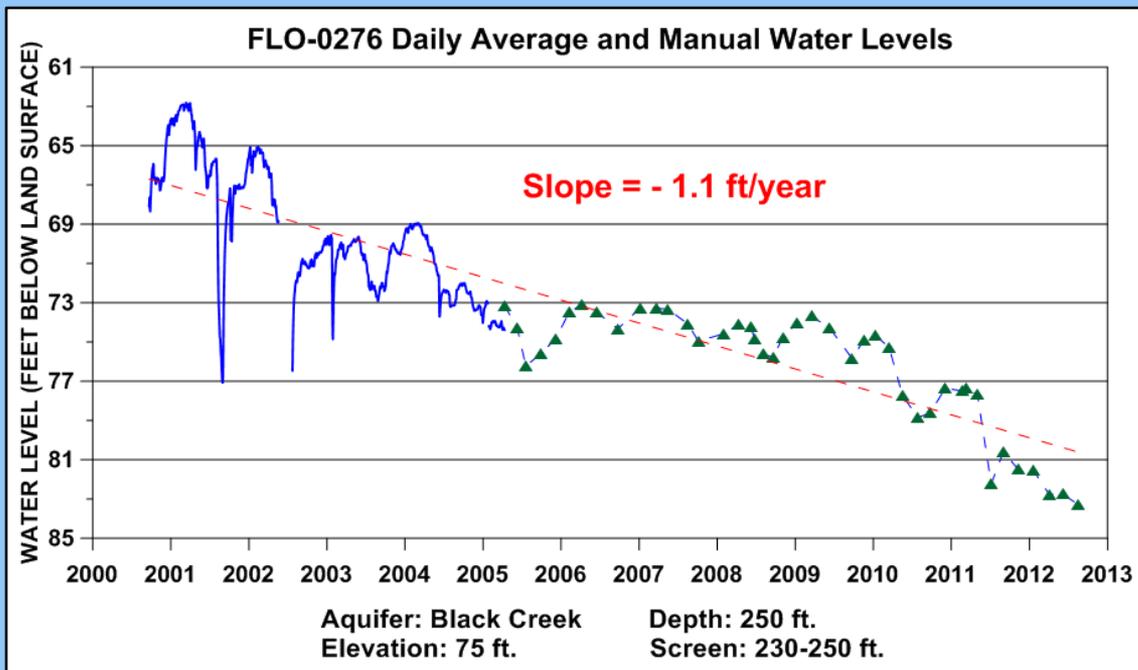
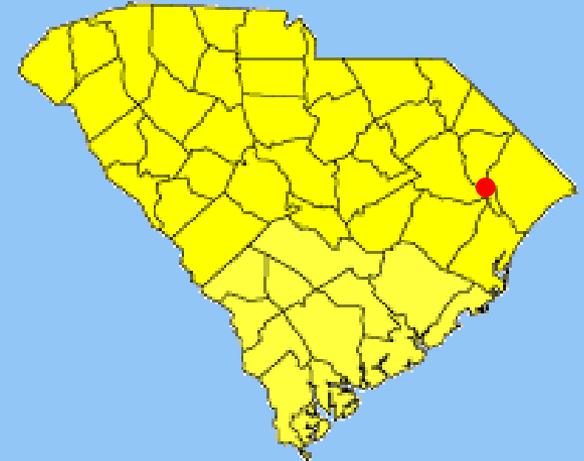
**Smaller downward trends,
stronger recovery from
drought and evidence for
recent increased pumping**



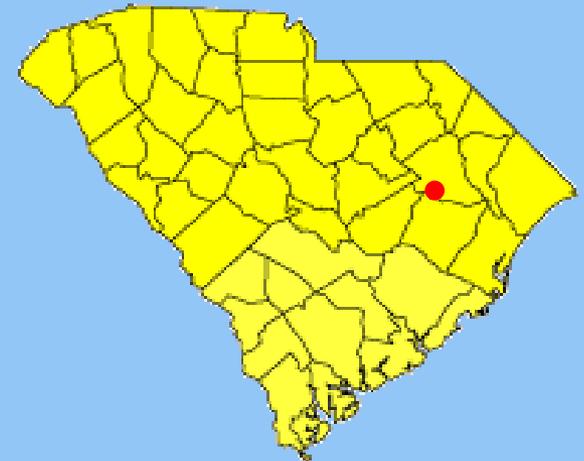
Water-Level Trends in the Black Creek Aquifer

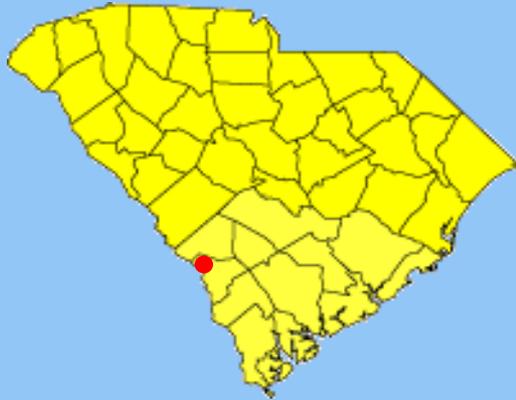


Industrial and Municipal Pumping in southeastern Florence County

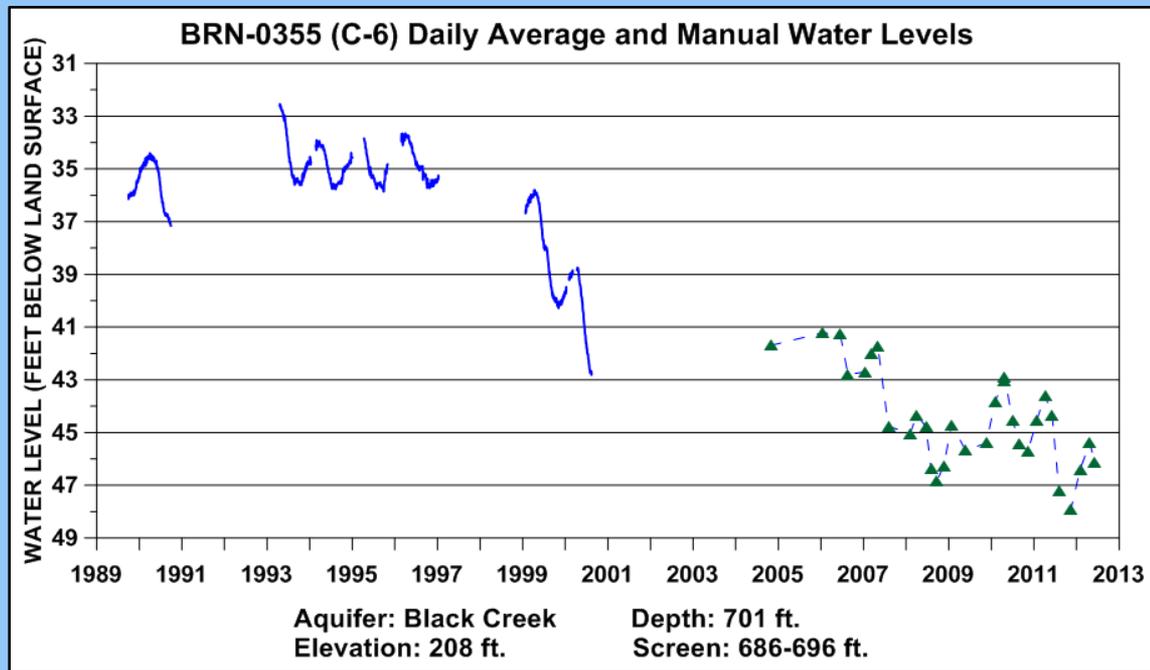
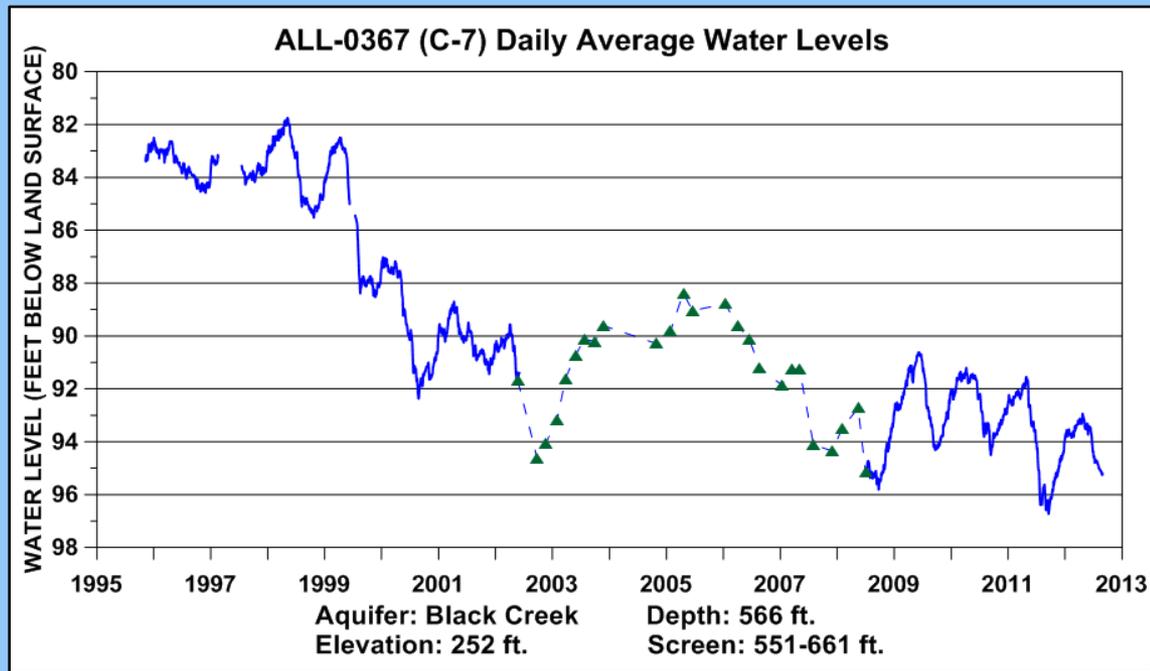
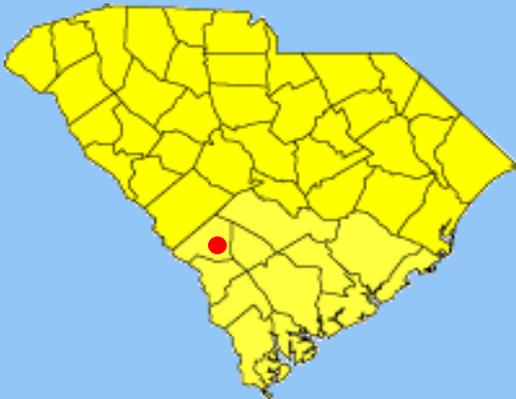


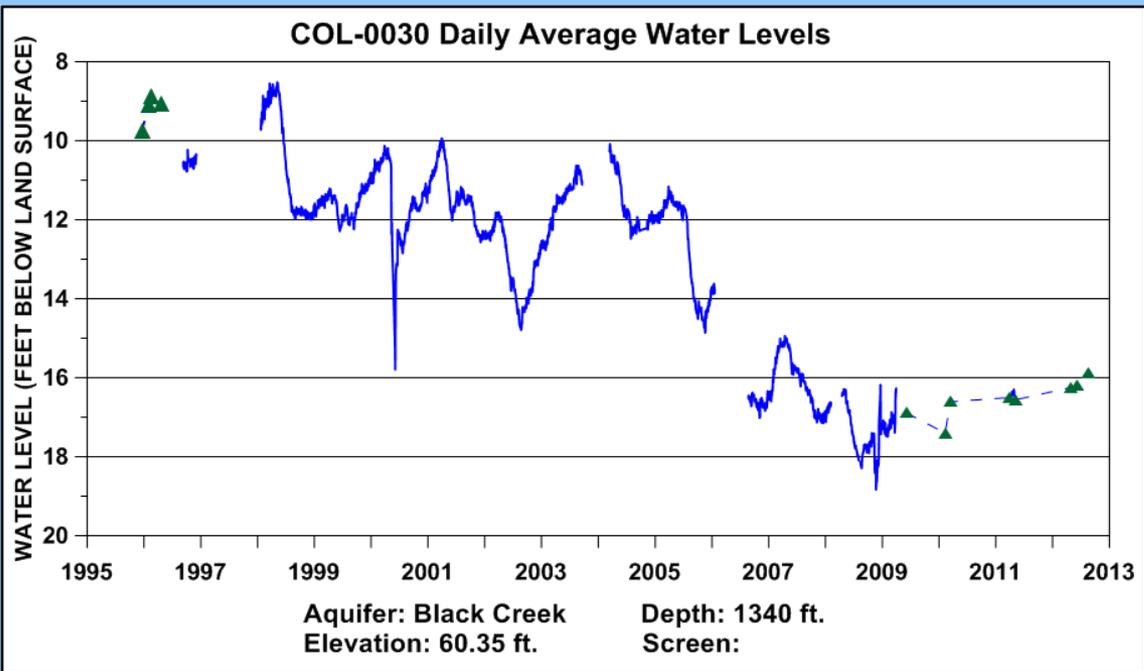
Declines due to regional pumping?



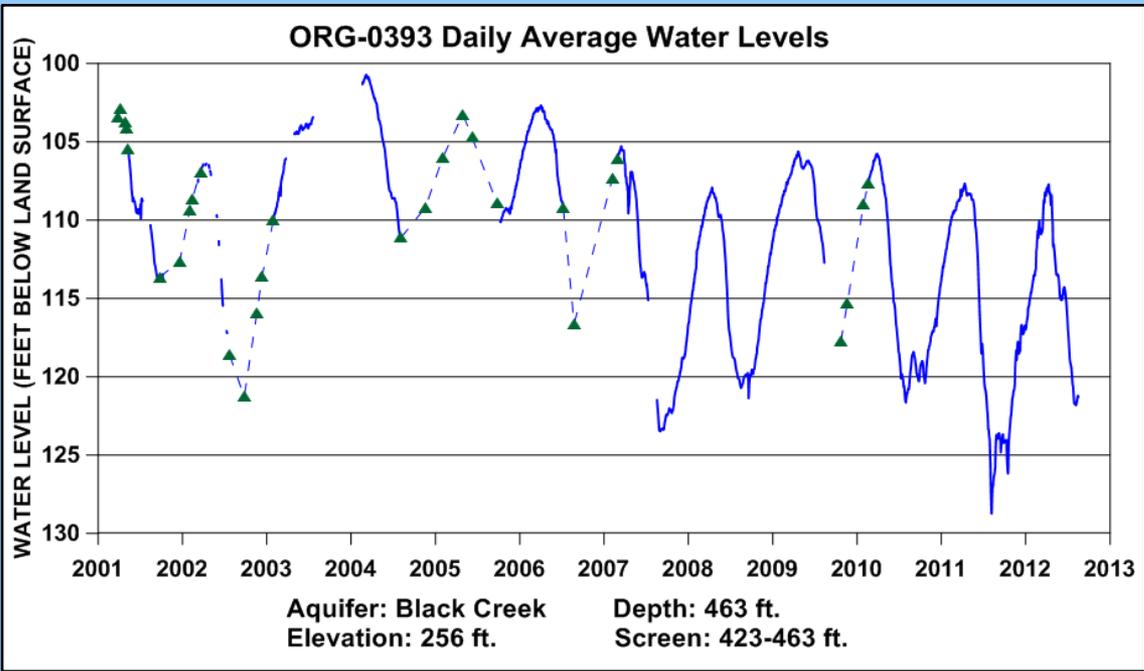
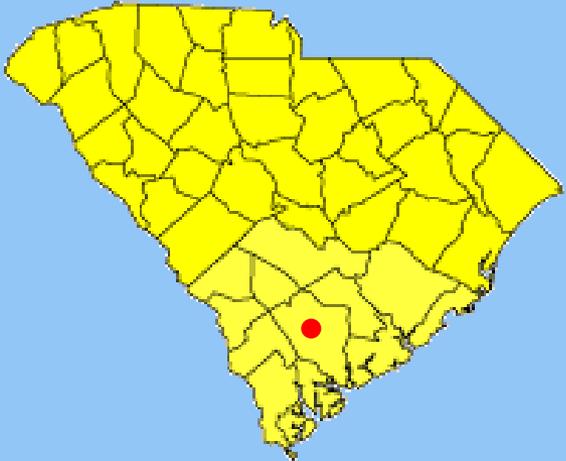


Similar to observations in the Middendorf aquifer for these counties, little to no recovery after 1998-2002 drought

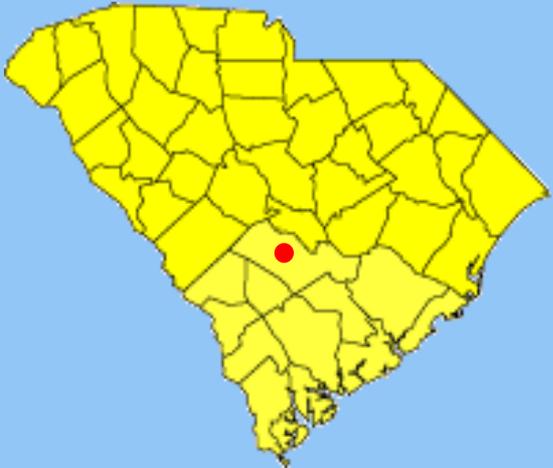




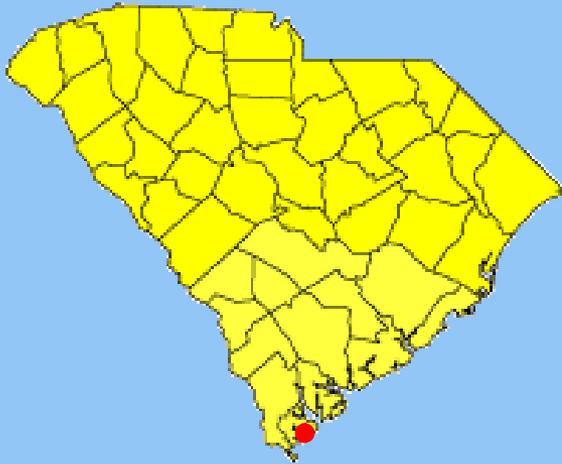
Cause of decline uncertain



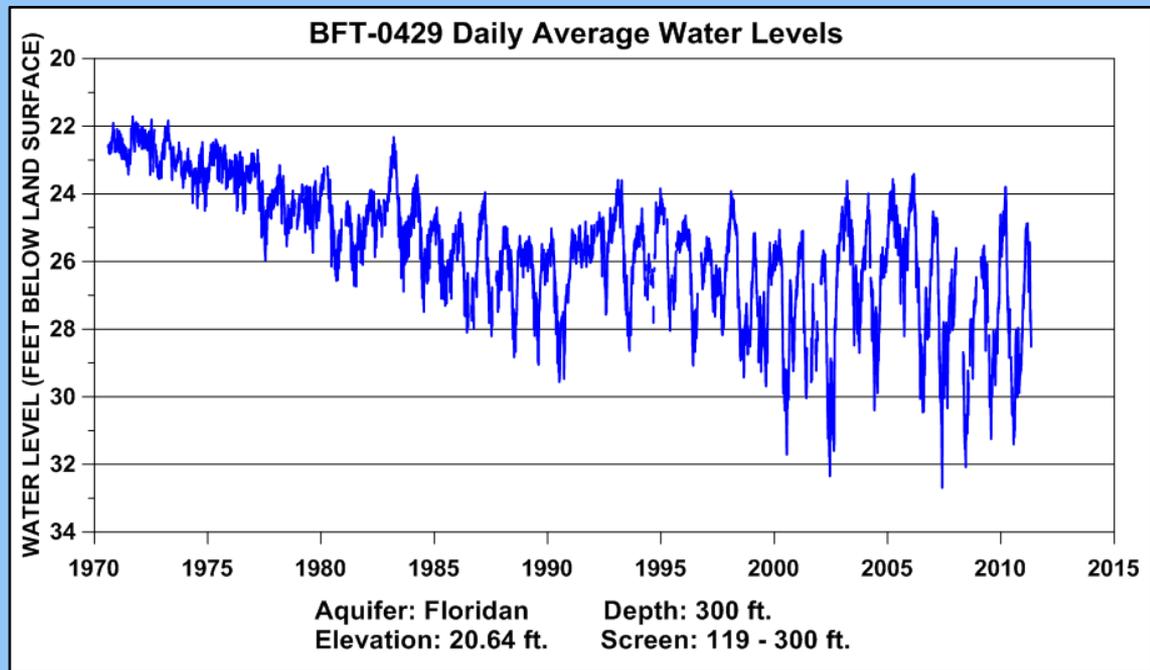
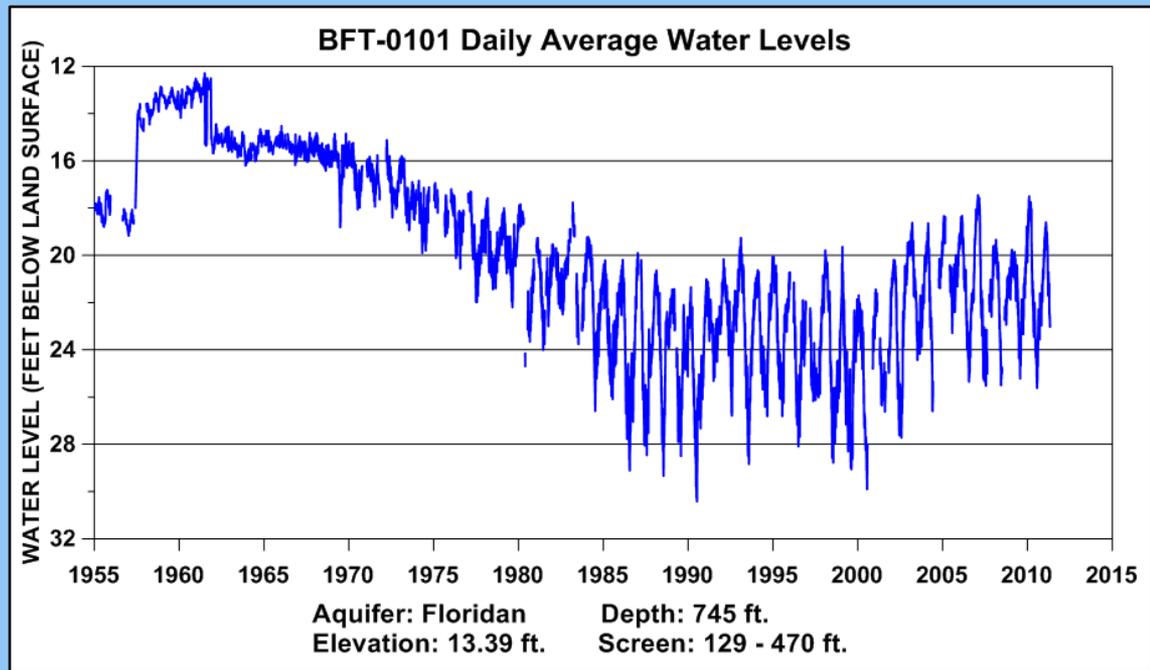
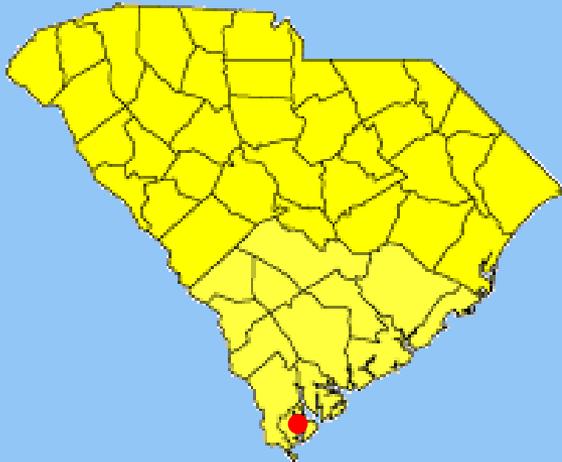
Strong seasonal signature – likely due to irrigation

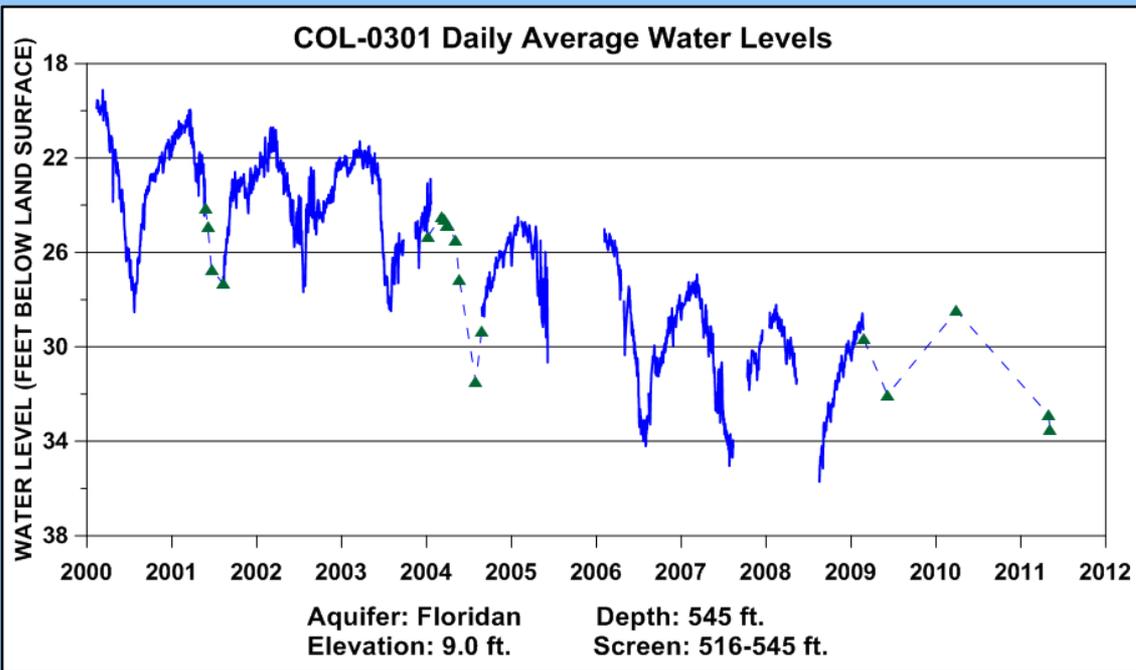


Water-Level Trends in the Floridan Aquifer

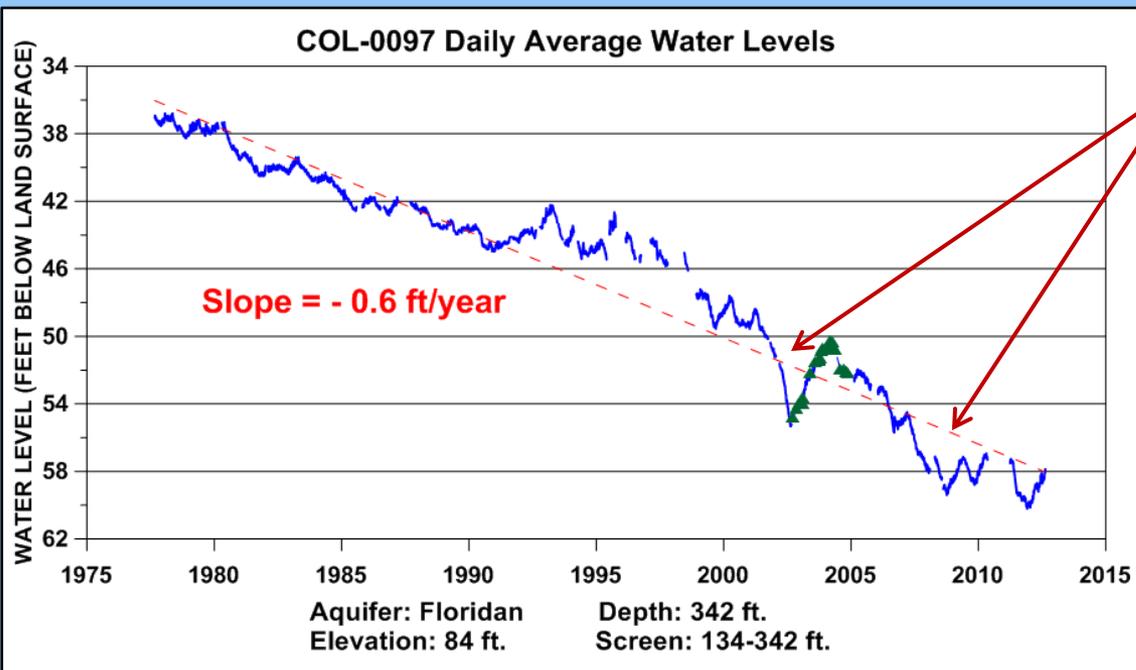
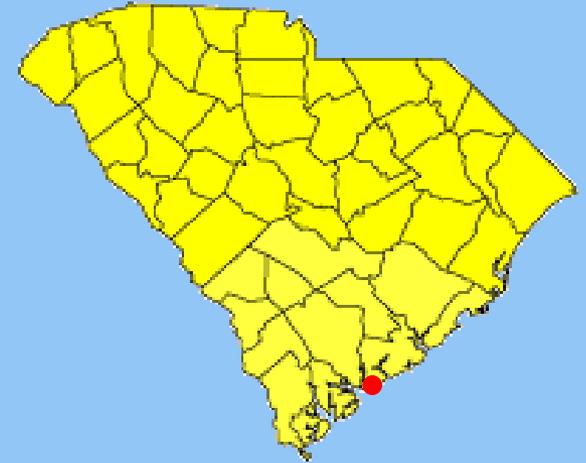


Water levels have leveled off after declines during the 1960s, 1970s and 1980s, but have greater seasonal variations

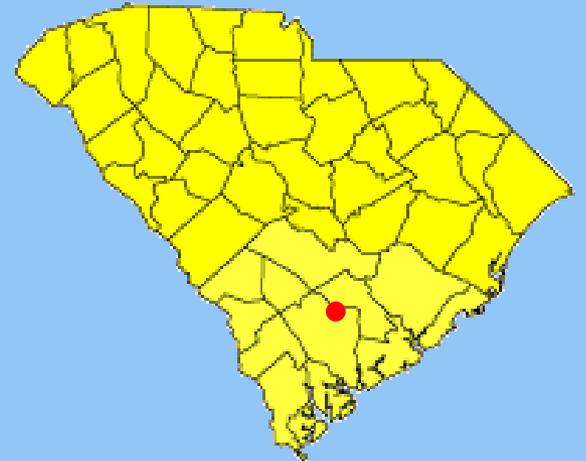




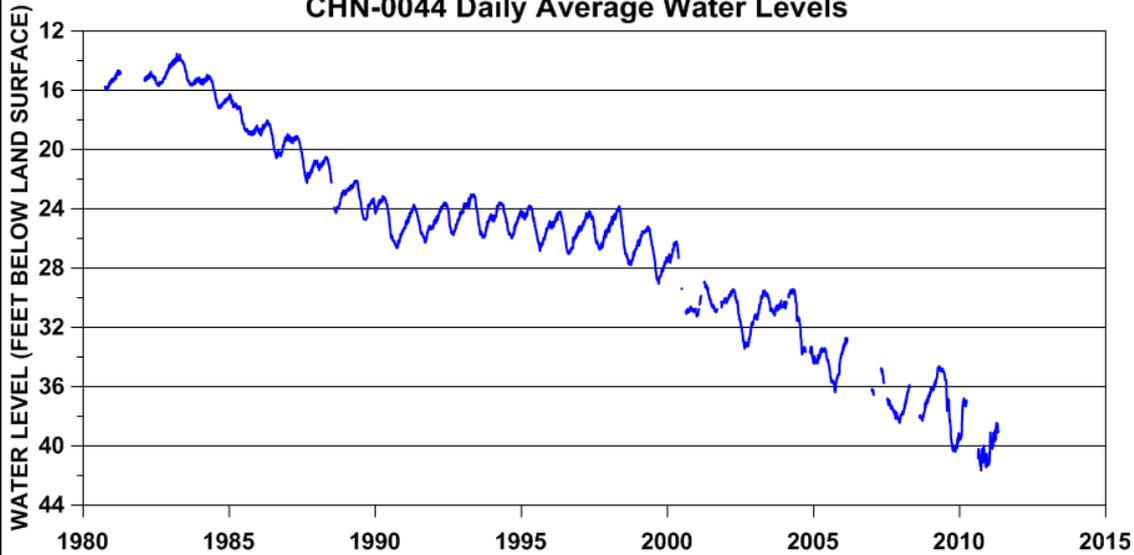
Strong seasonal signal and overall downward trend



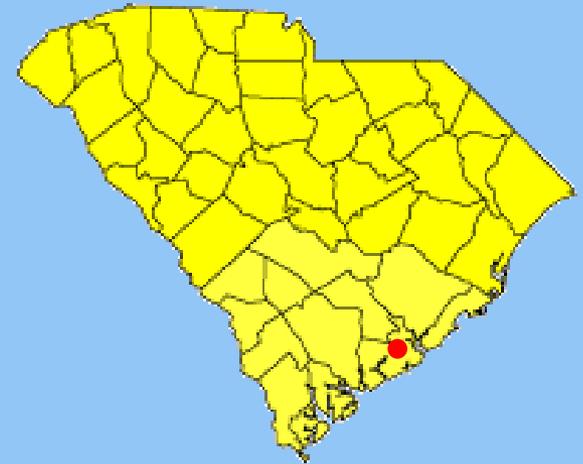
Evidence of drought impacts superimposed over long-term downward trend



CHN-0044 Daily Average Water Levels

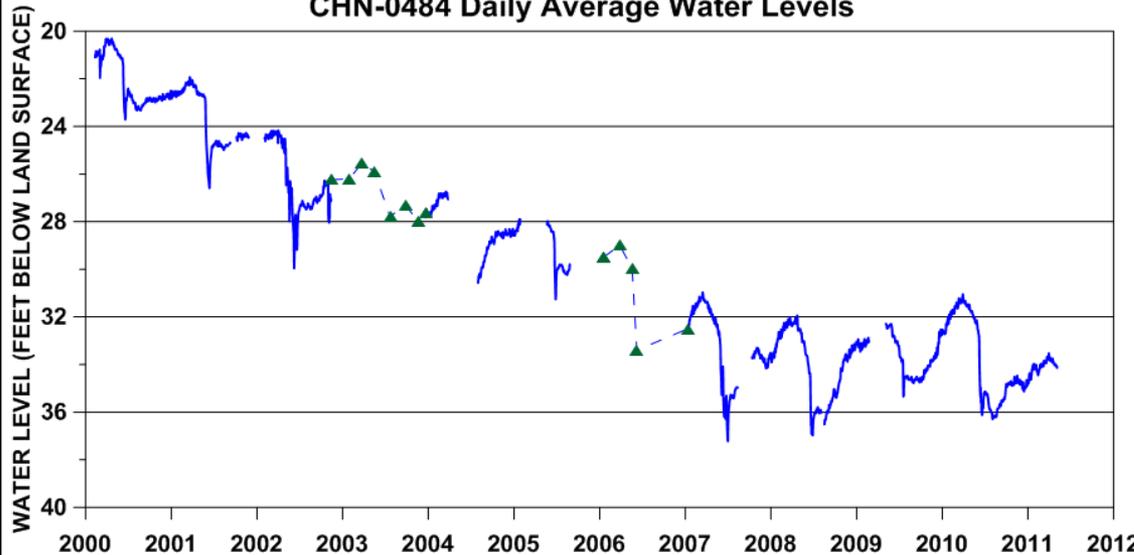


Aquifer: Floridan Depth: 434 ft.
Elevation: 10 ft. Screen: 180-425 ft.

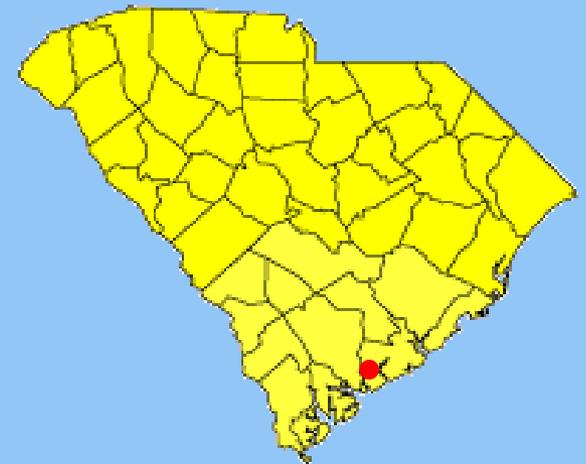


**Seasonal fluctuations
coupled with overall
downward trends**

CHN-0484 Daily Average Water Levels



Aquifer: Floridan Depth: 560 ft.
Elevation: 13.46 ft. Screen: 280-548 ft.



Summary

- Many of our well sites are experiencing downward trends.
 - Declines are generally more severe along the Coastal counties.
 - Substantial number of sites had little to no recovery after 1998-2002 drought.
 - Water level behavior likely a function of increased drought frequency and local/regional pumping.
- Upward trends associated with areas where water users have supplemented water supply with surface water or transitioned from ground water to surface water.

Future Work

- Detailed study of water withdrawals from each aquifer is needed to better understand ground water trends
 - How much of the declines are due to the severe droughts over the last 15 years and how much is due to pumping?

- Hydrographs and other information about the network can be found in:
 - *Ground-Water Levels in South Carolina, 2006-2010*
South Carolina Department of Natural Resources
Water Resources Report 50
- Report is available at:
<http://dnr.sc.gov/water/hydro/PubsDNRrep.htm>
- Data are available at:
<http://dnr.sc.gov/water/hydro/groundwater/groundwater.html>
- Contact Information
 - Scott Harder
 - 803-734-4764
 - harders@dnr.sc.gov