Ground Water Monitoring Well Network
Field Trip

North Carolina
Department of Environment and Natural Resources
Division of Water Resources
Ground Water Management Section

December 21, 2004

12/21/2004 Field Trip with personnel from the Fiscal Research Division of the General Assembly and the Office of State Budget and Management

Time	Event	Discussion
8:00 AM	leave Raleigh meet John, Nat, Stephen W	
9:30 AM 9:45 AM	arrive Gold Point Station, Martin County leave Gold Point Station	new station construction, chloride interfaces, Time Domain ElectroMagnetic (TDEM) surveys, GW article
10:00 AM 10:30 AM	arrive North Pitt High School Station, Pitt County meet Mark, Stephen D, Keith leave North Pitt	chloride sampling with pump trailer and tripod, field testing of quality parameters, condition of network, telescoped well construction
11:15 AM 11:45 AM	arrive Savannah School Station, Lenoir County meet Kristen, Gabrielle, Blake, Jeff leave Savannah School	automatic ground water level recorder demonstration, 2004-05 drilling plans, drilling discussion
12:00 PM 1:00 PM	LUNCH in Kinston at Kings (Hwy 70 & 58) leave Kings	
1:15 PM 1:45 PM	arrive Beaver Creek Station, Jones County leave Beaver Creek	ground water data uses, CCPCUA permitting program, hydrographs, potentiometric surface maps, hydrogeologic mapping, web access
2:15 PM 2:45 PM	arrive Pink Hill Station, Duplin County leave Pink Hill	down-hole camera demonstration, example videos, condition of network, USGS Cooperative network
4:30 PM	arrive Raleigh	

NC DENR, Division of Water Resources, Ground Water Management Section

Gold Point Station
Martin County

Purpose of Visit:

- new station construction – wells constructed March to June 2002
- introduction to Time Domain ElectroMagnetic (TDEM) surveying

Reference Materials:

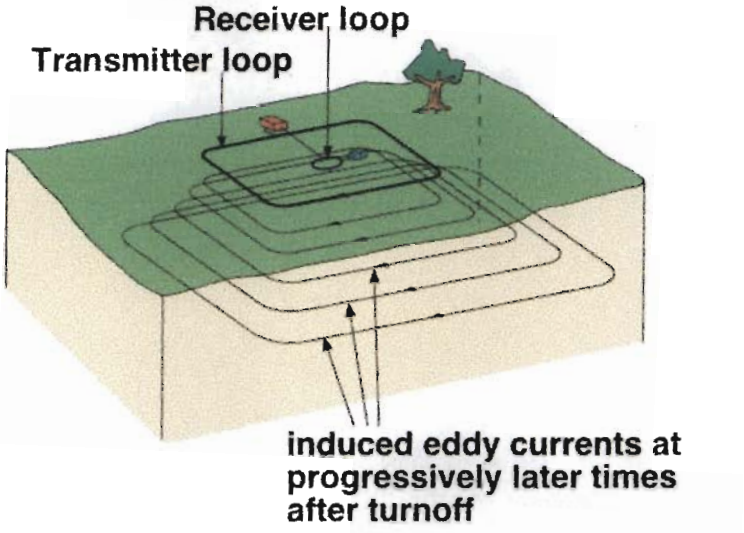
- introduction to TDEM
- revamped geophysical log diagram from *Geophysical Monitoring and Evaluation of Coastal Plain Aquifers*.
- copy of GROUND WATER article: *Geophysical Monitoring and Evaluation of Coastal Plain Aquifers*

Time Domain ElectroMagnetic Geophysics

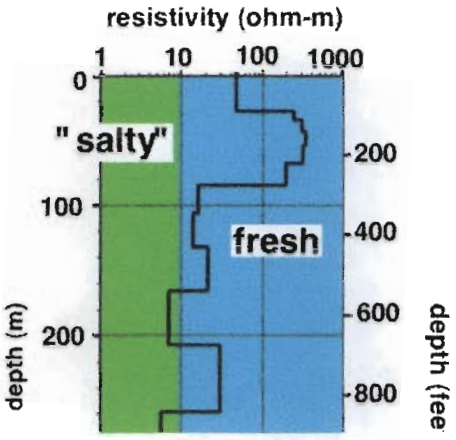
Time domain electromagnetic sounding (TDEM) is a geophysical technique used by the Division of Water Resources to supplement data from our network of monitoring wells. TDEM surveys are most commonly used in eastern North Carolina to investigate the extent of saltwater intrusion within freshwater aquifers beneath the Coastal Plain.

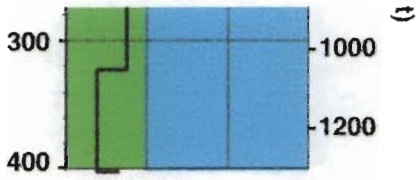
Basic Principles:

The time domain electromagnetic method employs a transmitter that drives an alternating current through a square loop of insulated electrical cable laid on the ground. The current consists of equal periods of time-on and time-off, with base frequencies that range from 3 to 75 Hz, producing an electromagnetic field. Termination of the current flow is not instantaneous, but occurs over a very brief period of time (a few microseconds) known as the ramp time, during which the magnetic field is time-varient. The time-varient nature of the primary electromagnetic field creates a secondary electromagnetic field in the ground beneath the loop, in accordance with Faraday's Law, that is a precise image of the transmitter loop itself (Halliday & Resnick, 1974). This secondary field immediately begins to decay, in the process generating additional eddy currents that propogate downward and outward into the subsurface like a series of smoke rings. Measurements of the secondary currents are made only during the time-off period by a receiver located in the center of the transmitter loop. Depth of investigation depends on the time interval after shutoff of the current, since at later times the receiver is sensing eddy currents at progressively greater depths. The intensity of the eddy currents at specific times and depths is determined by the bulk conductivity of subsurface rock units and their contained fluids (Stewart & Gay, 1986; Mills et al., 1988; Goldman et al., 1991; McNeill, 1994).

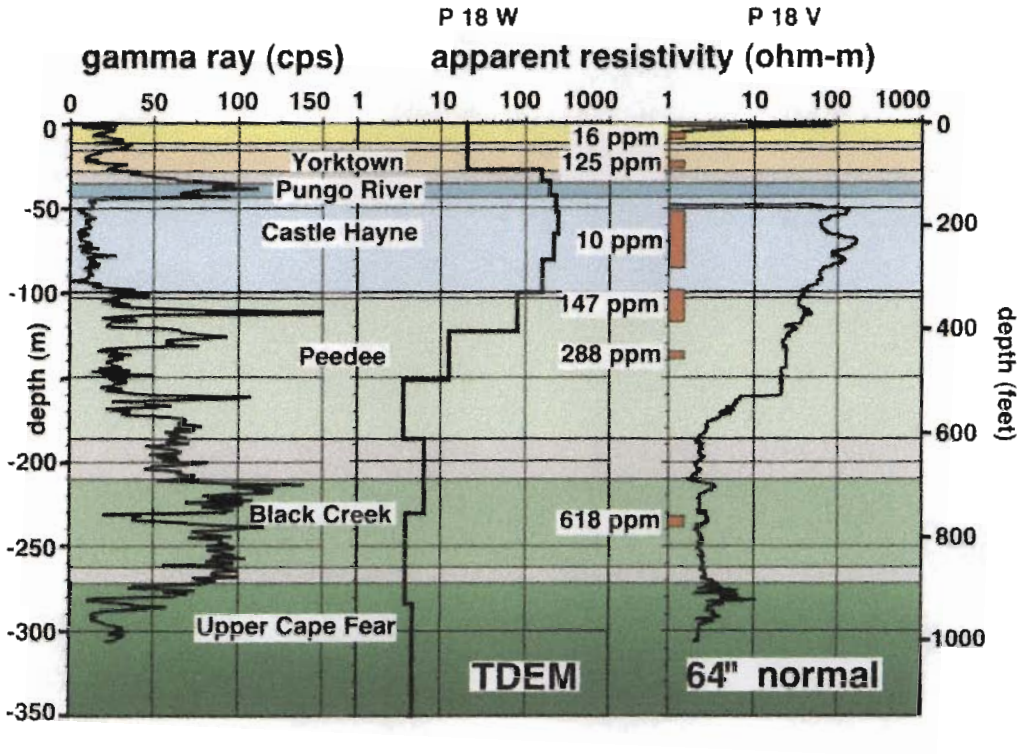


Because electrical conductivity is the inverse of resistivity, processing of the raw TDEM data yields a vertical profile of apparent formation resistivity vs. depth, similar to borehole resistivity profiles measured in monitoring wells with conventional logging tools. High resistivity values (greater than 10 ohm-m) usually result from the presence of fresh water in the subsurface. Resistivity values substantially less than 10 ohm-meters indicate that the groundwater at that depth is probably salty.





Compared to the cost of siting and drilling a new monitoring well, TDEM soundings can be made very quickly and cheaply. As the figure below indicates, resistivity data collected with TDEM compares favorably to borehole geophysical logs.



Saltwater encroachment into freshwater aquifers beneath the coastal plain is a serious problem in eastern North Carolina. When combined with information from boreholes, TDEM soundings can be used to help identify the interface between fresh and saltwater zones, and monitor the extent of saltwater intrusion.

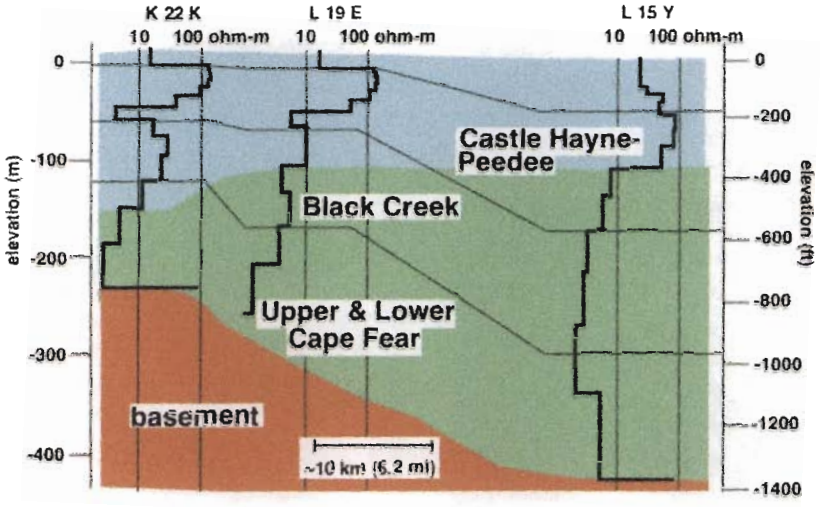
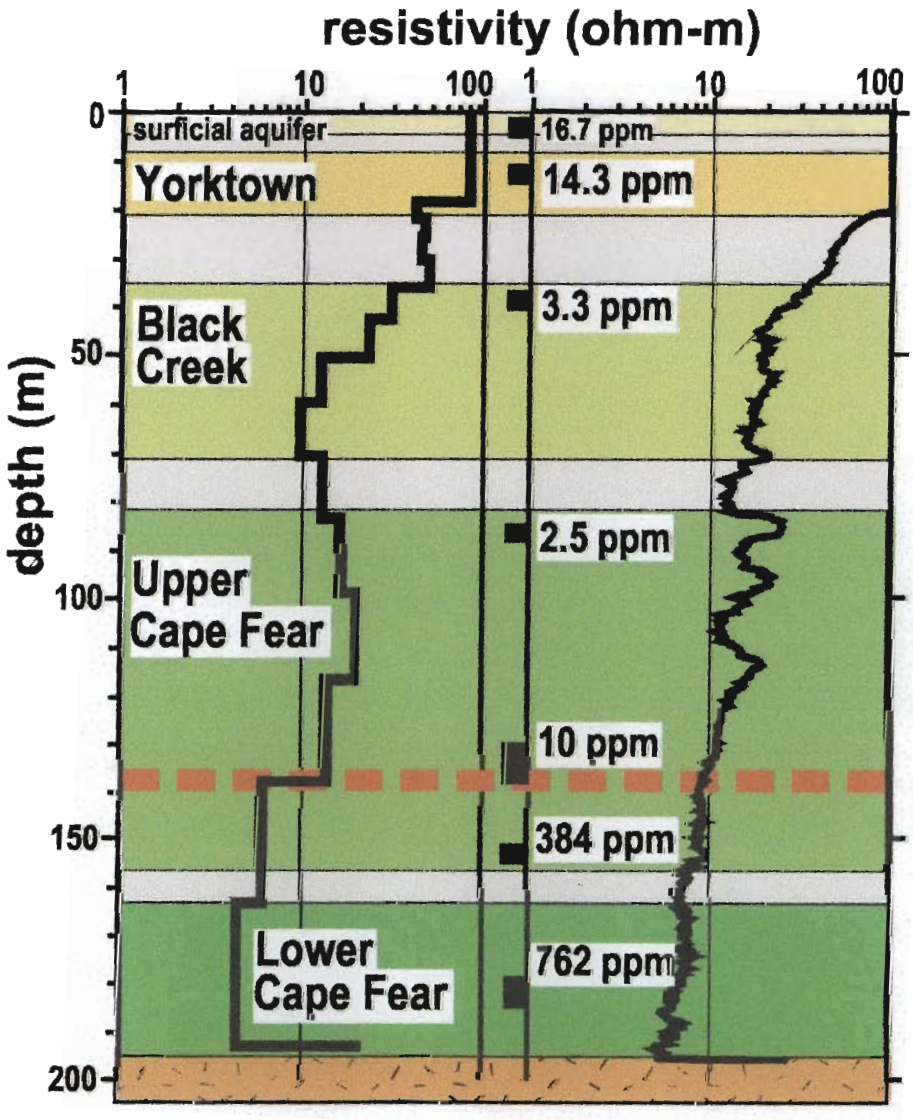


Figure 8 from Geophysical Monitoring and Evaluation of Coastal Plain Aquifers



North Pitt High School Station
Pitt County

Purpose of Visit:

- pump trailer and tripod demonstration
- chloride sampling and testing
- condition of monitoring well network – telescoped well construction

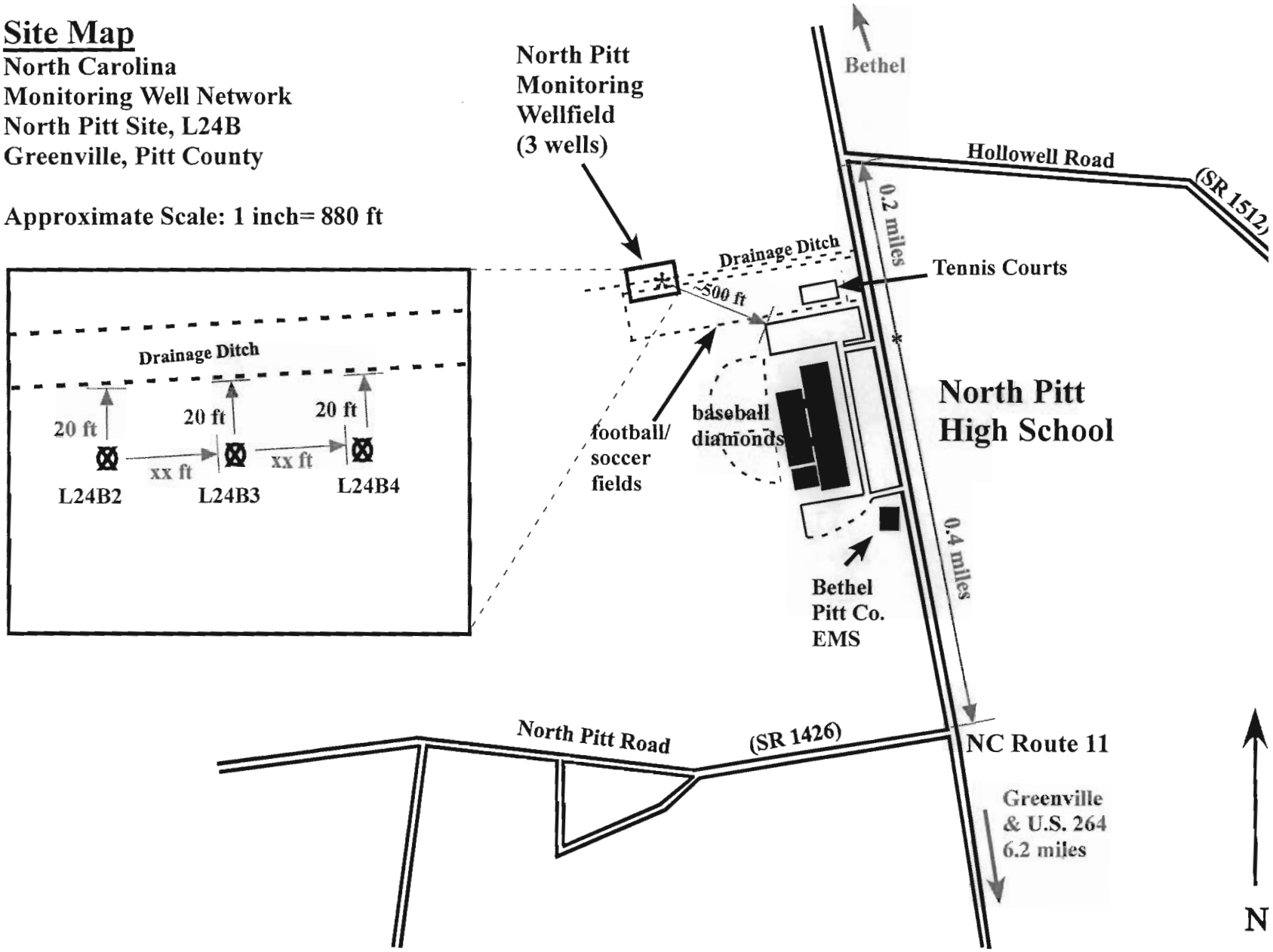
Reference Materials:

- example site map
- example fresh - salt water interface map
- well construction diagrams
- map of subset of network where telescoped construction exists or where other construction problems exist

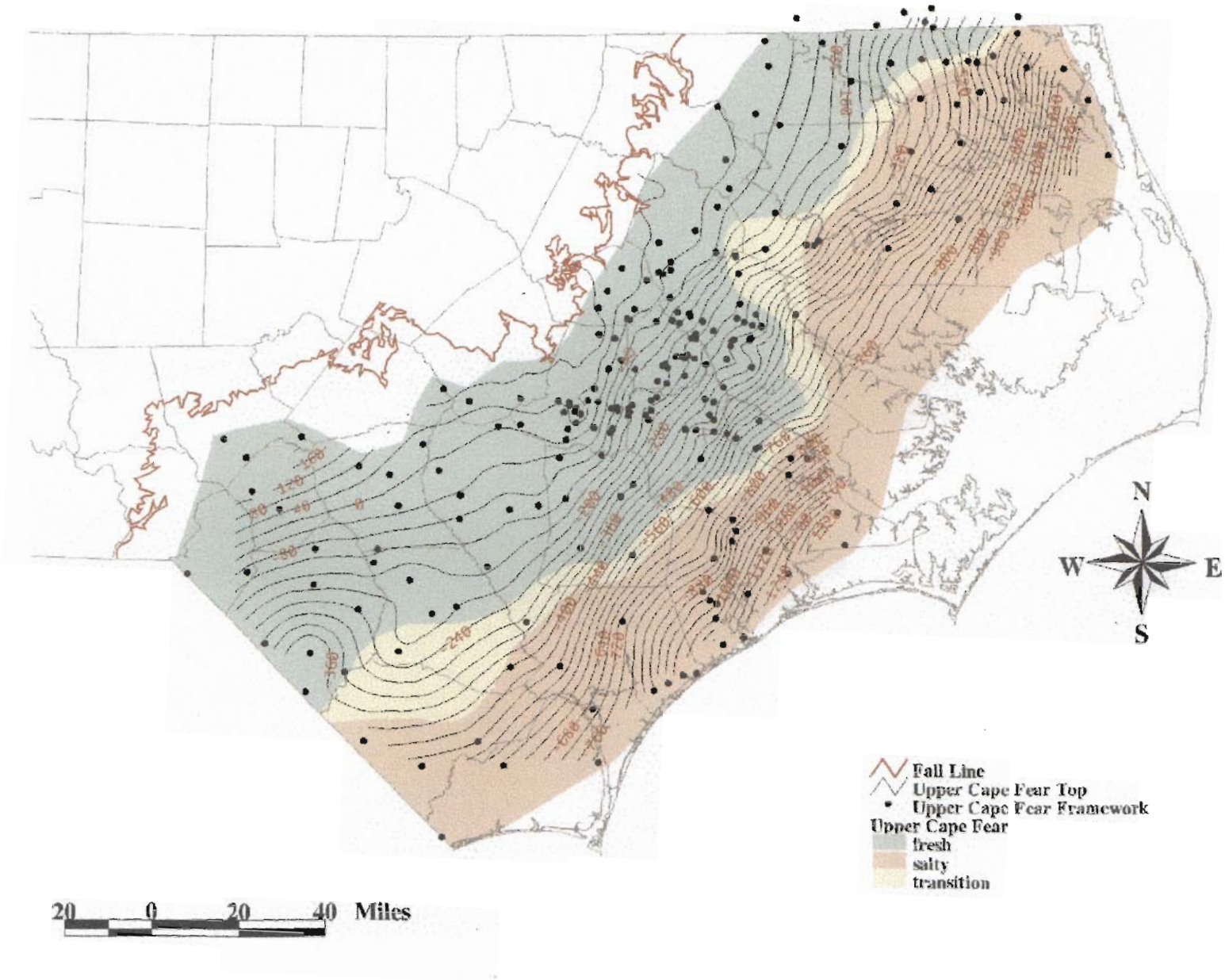
Site Map

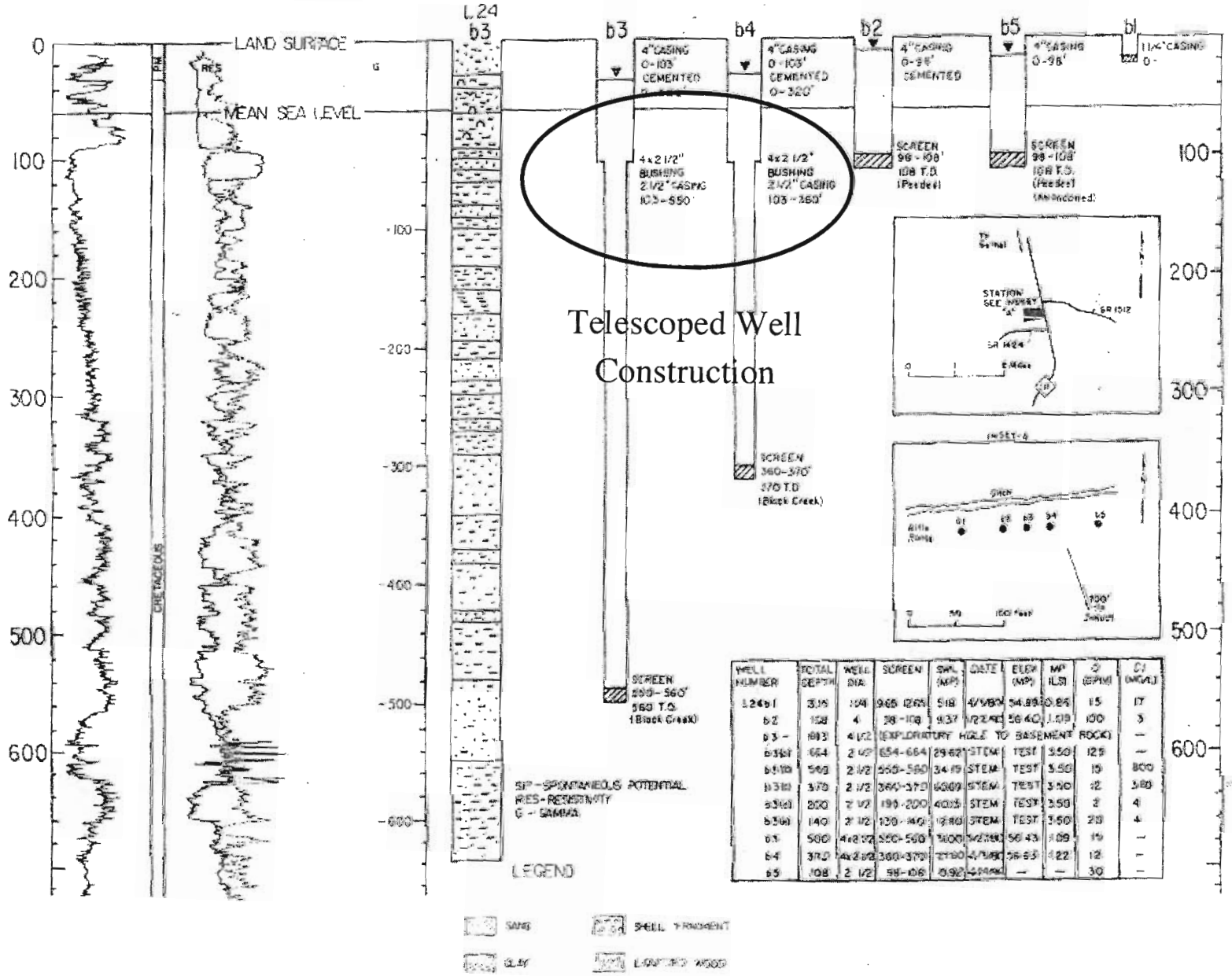
North Carolina
Monitoring Well Network
North Pitt Site, L24B
Greenville, Pitt County

Approximate Scale: 1 inch= 880 ft



Upper Cape Fear Aquifer Map

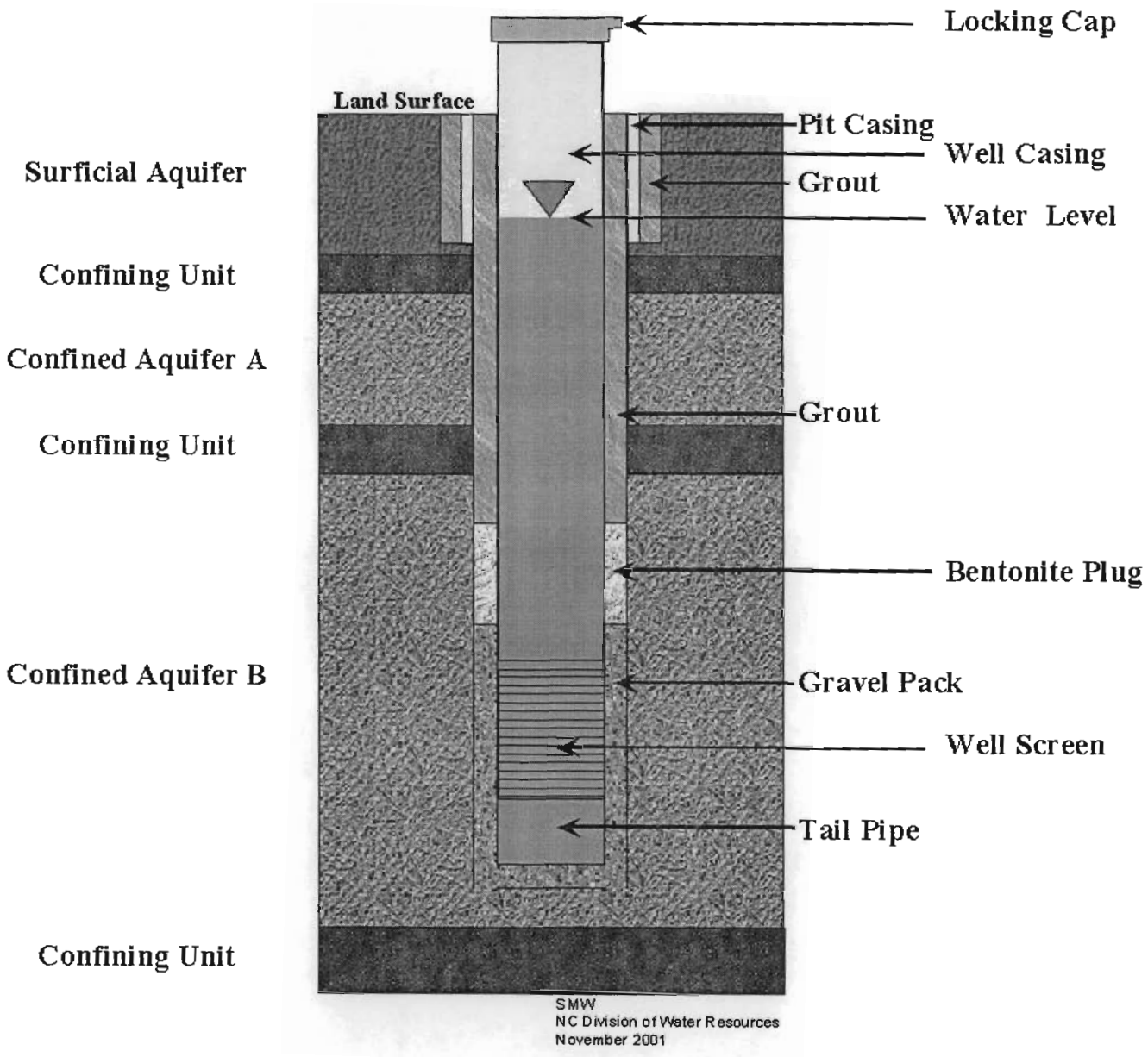




WELL NUMBER	TOTAL DEPTH	WELL DIA.	SCREEN	SWL (MP)	DATE	ELEV (MP)	MP (LS)	Q (GPM)	Cl (MG/L)
L24b1	315	10"	265-285	5.18	4/1980	54.89	0.86	15	17
b2	128	4	98-108	9.37	1/22/80	58.40	1.09	100	3
b3 -	1813	4 1/2	(EXPLORATORY HOLE TO BASEMENT ROCK)						—
b3(2)	664	2 1/2	654-664	29.62	STEM	TEST	3.50	125	—
b3(3)	568	2 1/2	550-560	34.19	STEM	TEST	3.50	15	800
b3(4)	378	2 1/2	360-370	6.09	STEM	TEST	3.50	12	580
b3(5)	208	2 1/2	198-208	4.05	STEM	TEST	3.50	2	4
b3(6)	140	2 1/2	130-140	12.80	STEM	TEST	3.50	20	4
b3	580	4x2 1/2	550-560	34.00	5/2/80	58.43	1.09	15	—
b4	378	4x2 1/2	360-370	27.90	4/1980	58.63	1.22	12	—
b5	108	2 1/2	98-108	0.92	4/1980	—	—	30	—

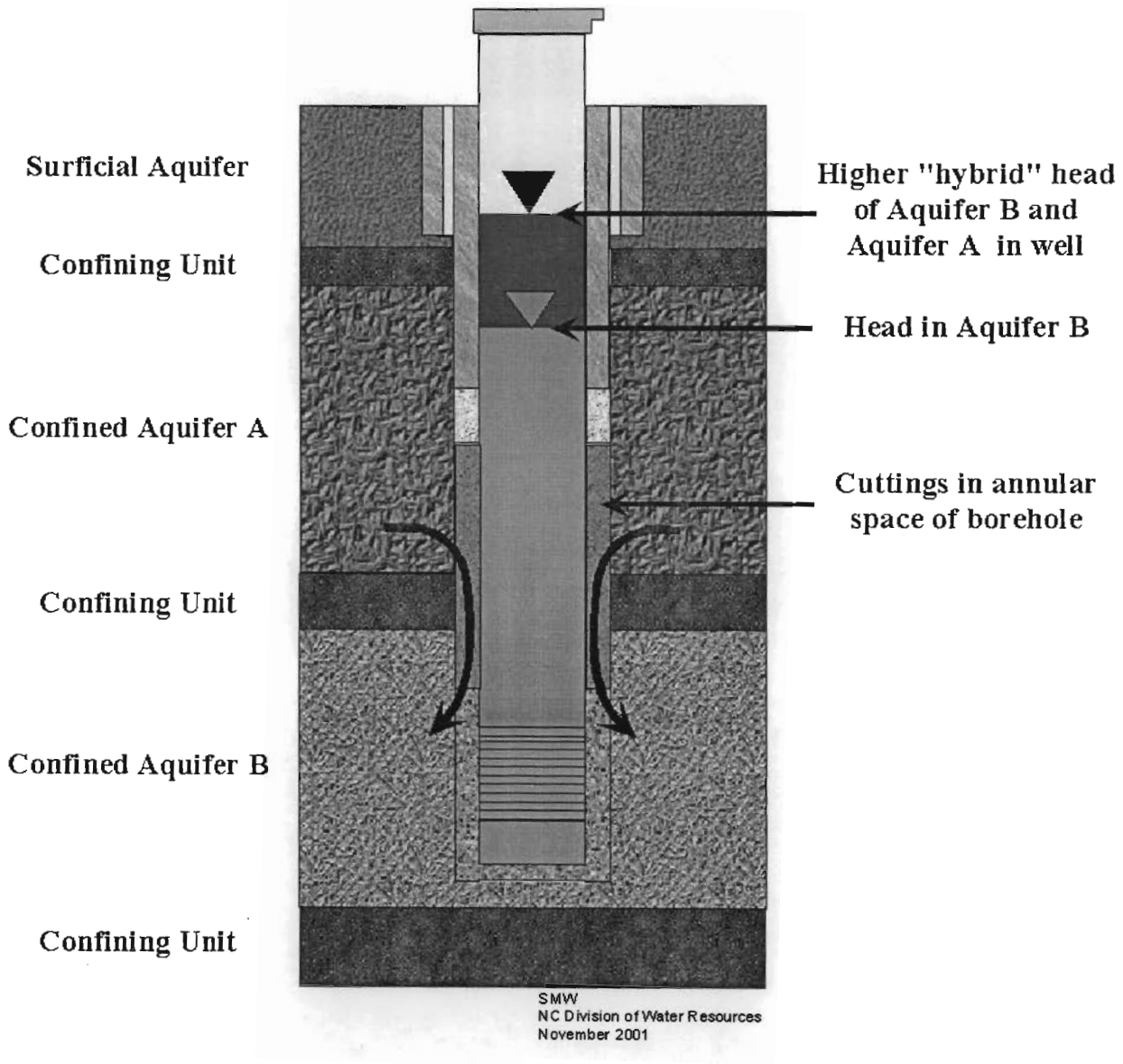
FIGURE 3 — DIAGRAM OF RESEARCH STATION AT BETHEL

Typical Coastal Plain Monitoring Well Construction Details

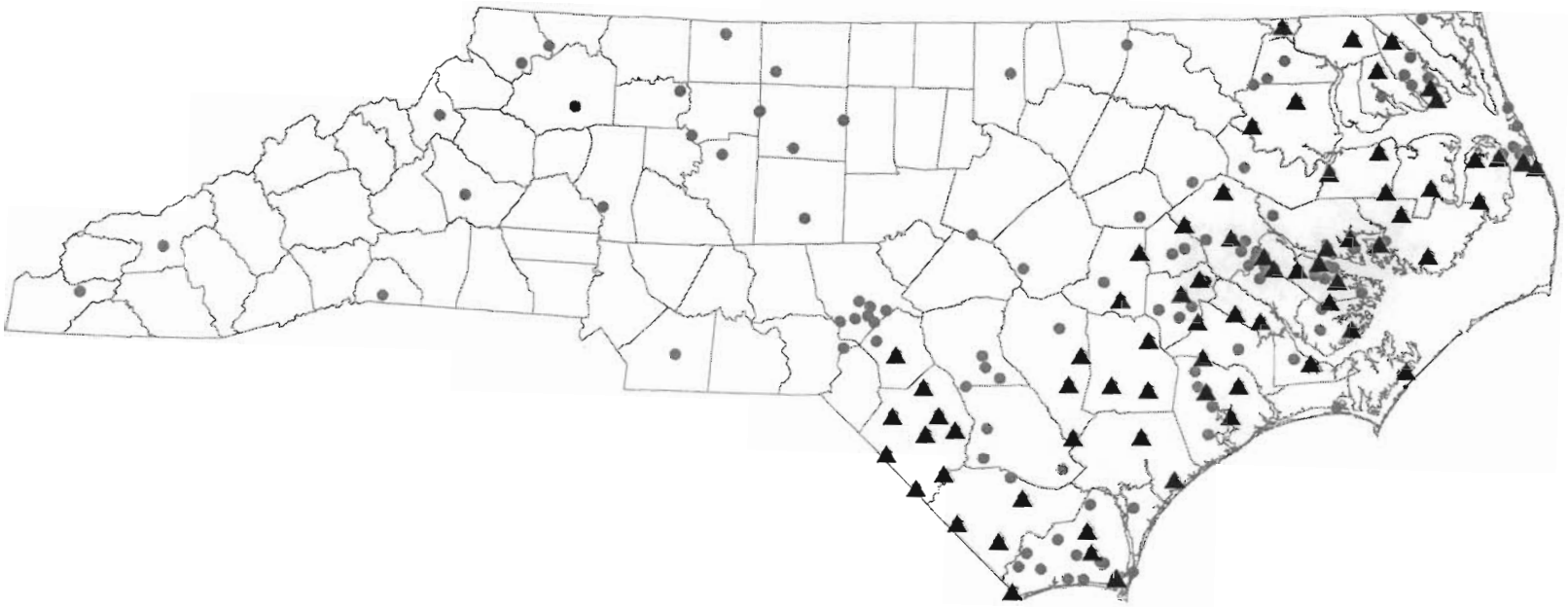


Annular Space Filled with Cuttings

Head in Aquifer B lower than head in Aquifer A



NCDWR Monitoring Wells with Telescoped or Blocked Casing
December 2004



▲ NCDWR Monitoring Well with telescoped or blocked casing (~140 wells total)
● NCDWR Monitoring Wellsite
County Boundary

100 0 100 200 Miles

N
W E
S

Savannah School Station
Lenoir County

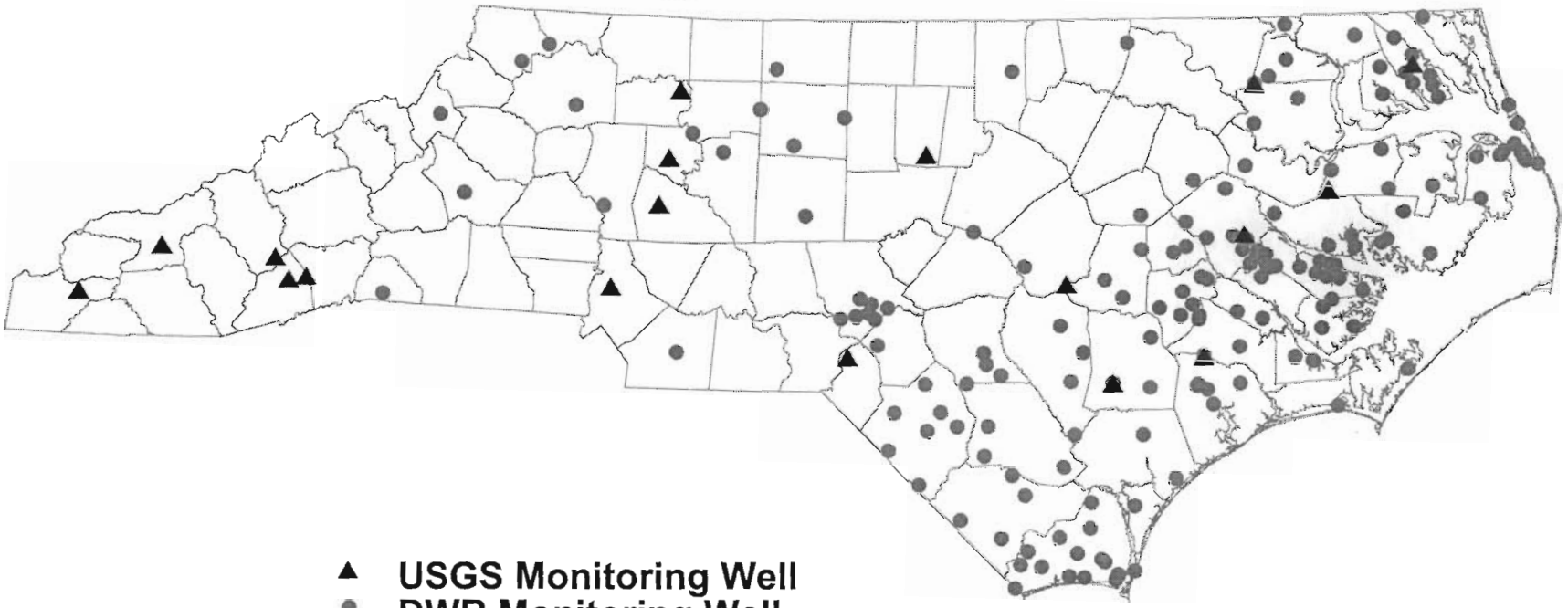
Purpose of Visit:

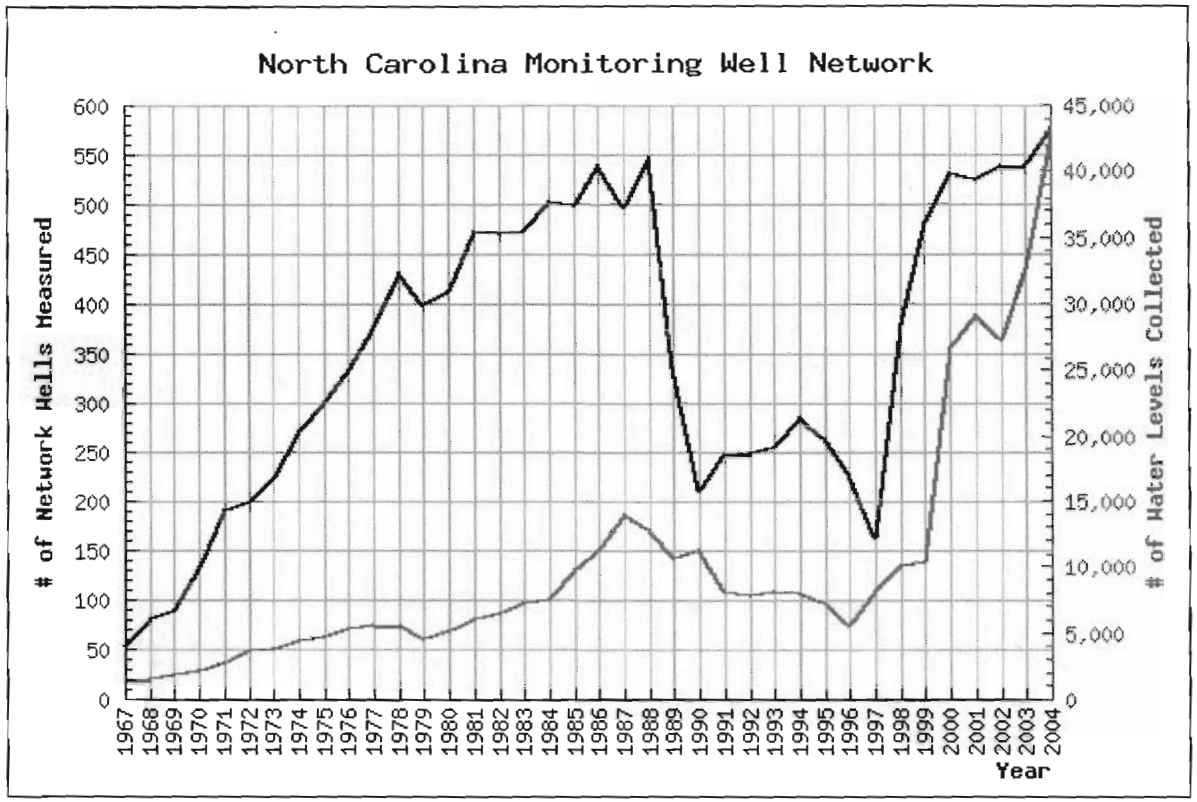
- 2004-05 drilling plans
- automatic water level recorder demonstration
- core samples of aquifer material

Reference Materials:

- map of DWR monitoring well network
- network statistics diagram
- Pitt County well sites
- automatic water level recorder information

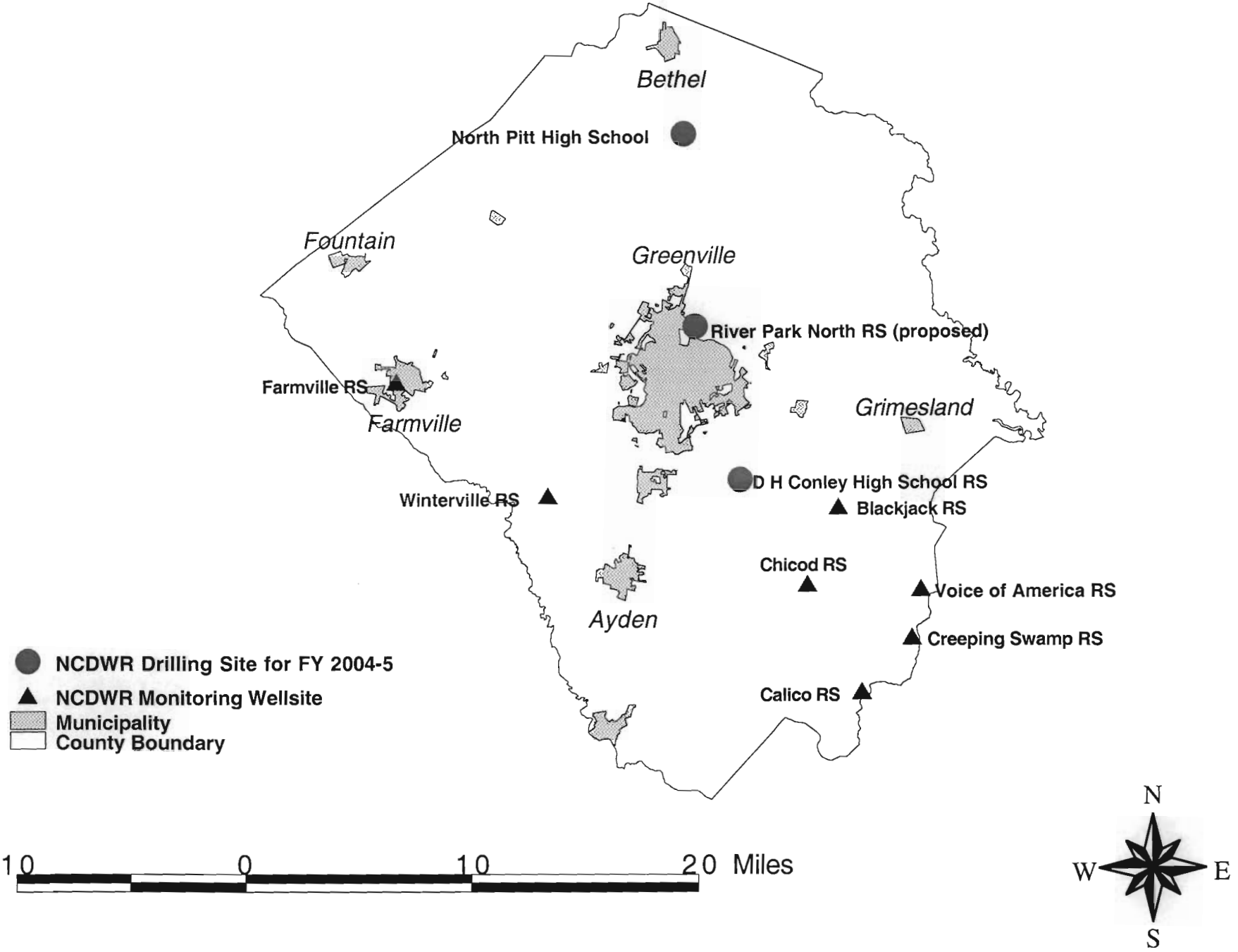
NC Division of Water Resources Monitoring Well Network



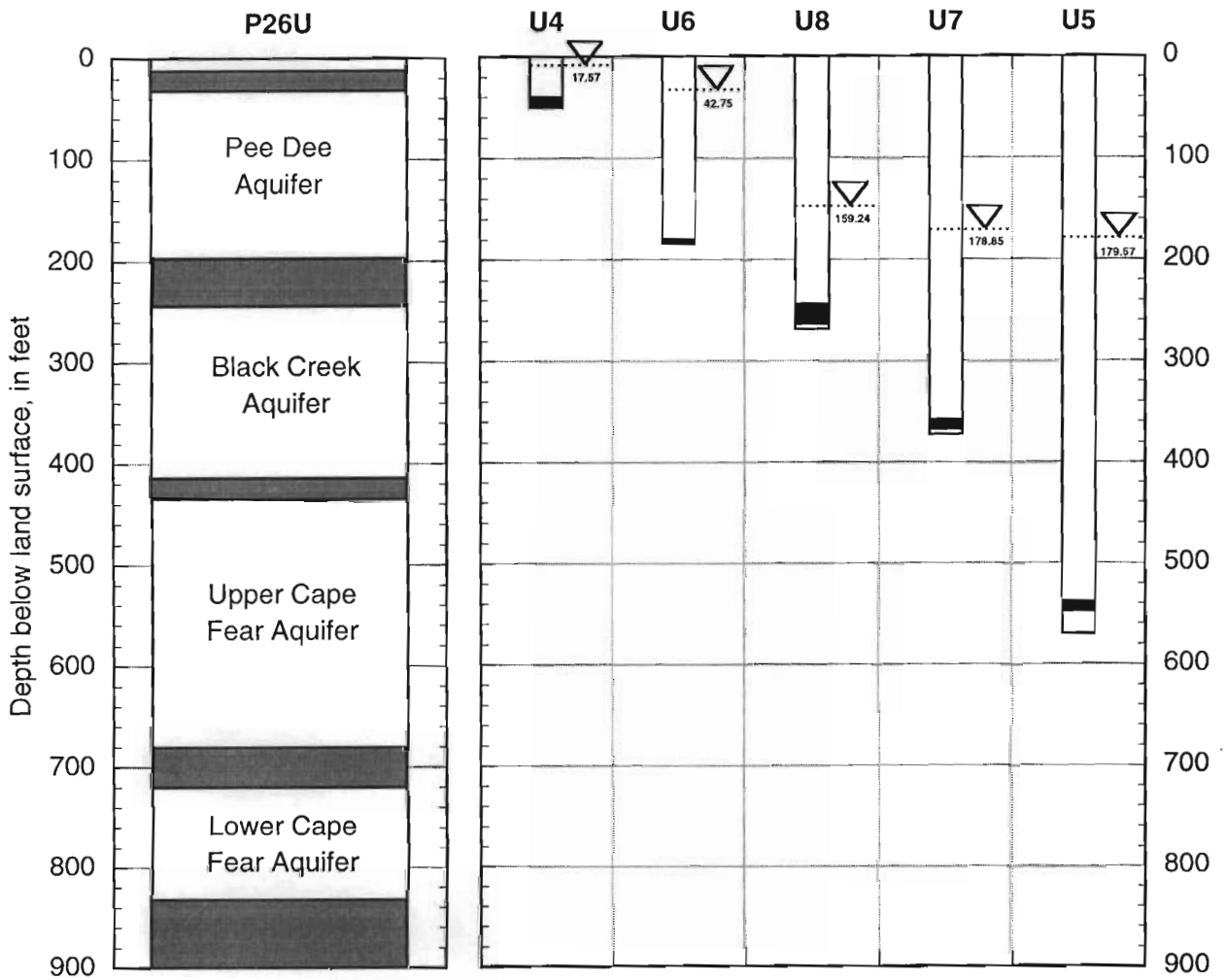


This plot includes DWR and USGS monitored wells

NCDWR Monitoring Well Network
Pitt County Monitoring Well Sites
December 2004



Hydrogeology of the Savannah School monitoring site, Lenoir County

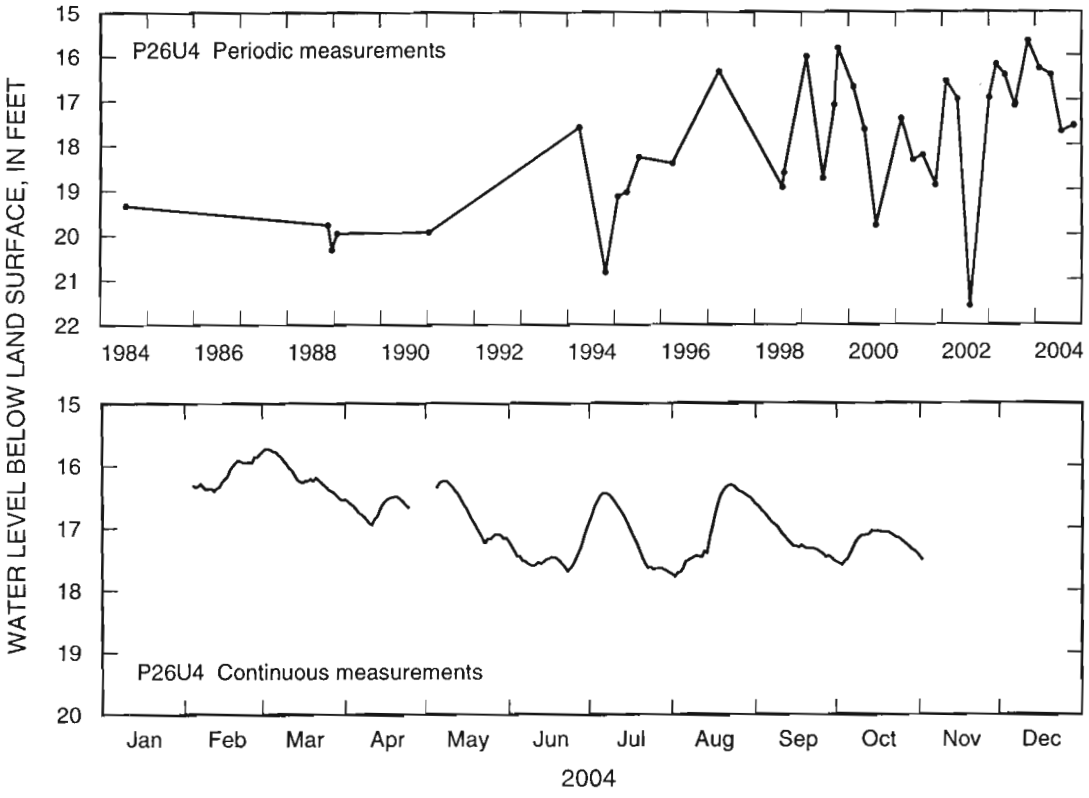


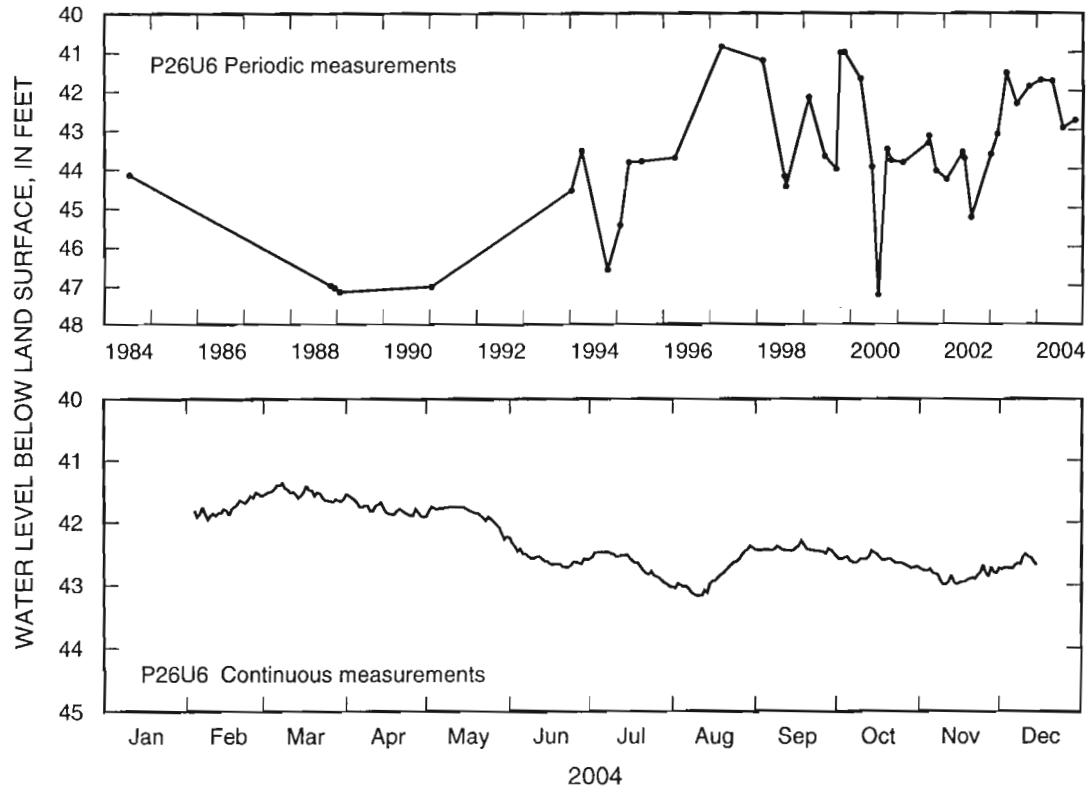
LEGEND

Well casing, black at screened interval

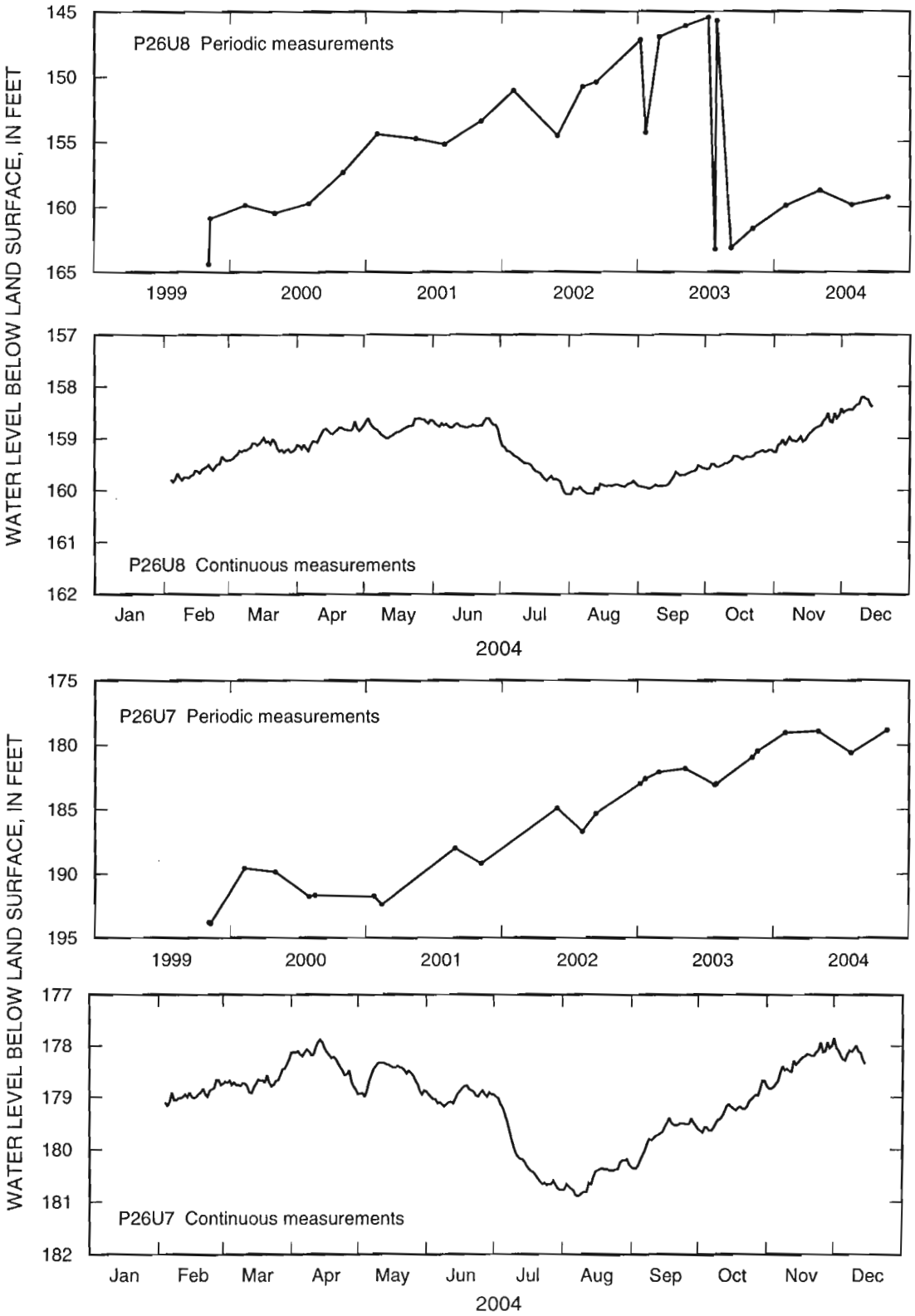
178.85 Water level on November 3, 2004 in depth below land surface, in feet

Water Level of Wells Completed in the Pee Dee Aquifer for the Period of Record and 2004

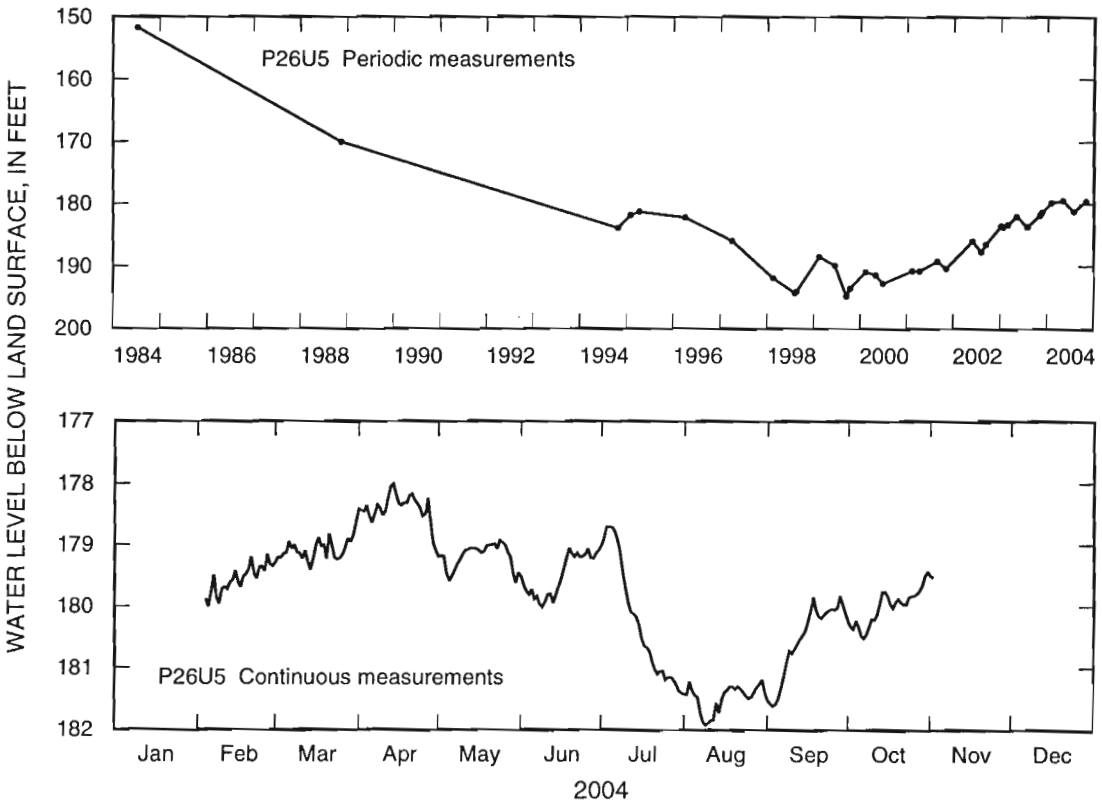




Water Level of Wells Completed in the Black Creek Aquifer for the Period of Record and 2004



Water Level of the Well Completed in the Upper Cape Fear Aquifer for the Period of Record and 2004



Beaver Creek Station
Jones County

Purpose of Visit:

- ground water data uses
  - management of ground water uses outside of regulated areas
  - ground water resource examination
  - drought monitoring
  - Central Coastal Plain Capacity Use Area permitting decisions
- web access to ground water data
- who uses the data?

Reference Materials:

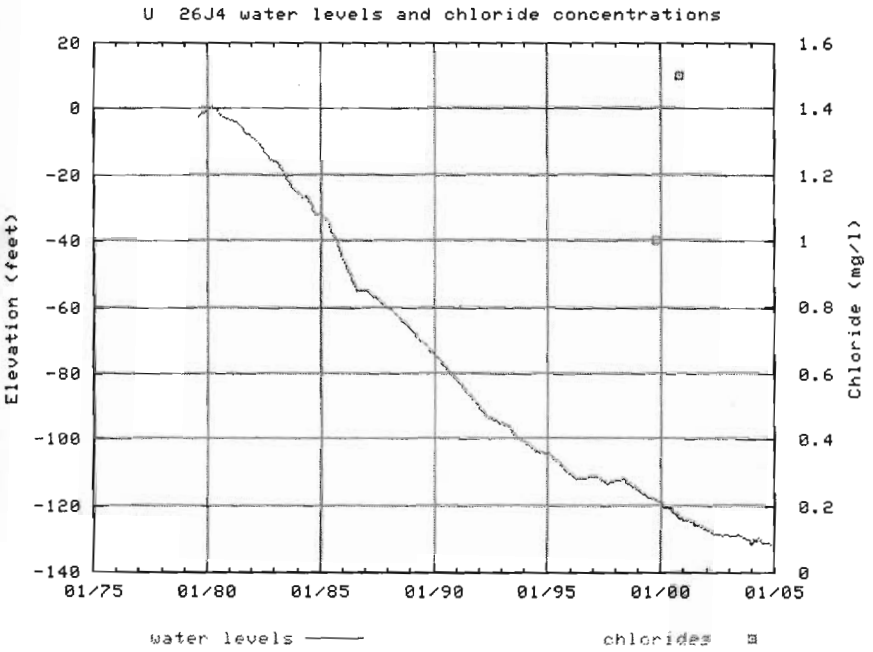
- example hydrographs
- example potentiometric surface map
- Drought Indicator Wells web page (NC Drought Management Advisory Council)
- hydrogeologic mapping
- CCPCUA background material
- CCPCUA water use summary tables
- Ask Greg from the News & Observer

DWR Monitoring Database Detail for U 26J4

Field	Data
County	Jones
USGS ID	345809077301404
Latitude	34.969429
Longitude	-77.503222
Location Accuracy	GPS
Quad (link to framework)	U 26J4
Netname (link to USGS data)	NC-172
Name (link to logs)	Comfort
Aquifer	Black Creek
Land Surface	68.00
Date Constructed	08/15/1979
Stickup, 11/02/2004	0.68
Depth	545.00
Diameter	6.00
Yield	75.00
Exists?	y
Recorder Box?	y
Top of Screen	506.00
Bottom of Screen	545.00
Number of Water Levels {date * feet below land surface * elevation} 08/15/1979 to 11/02/2004	697
Number of Chlorides {date * chlorppm * spcond_us * salin_ppt * comments} 06/25/1998 to 09/28/2004	4 ** -1 values equal no data ** -28 values equal below detection limit of 28

output files are tab-delimited text

Show Map
Monthly Statistics Plot
697 water level data points plotted

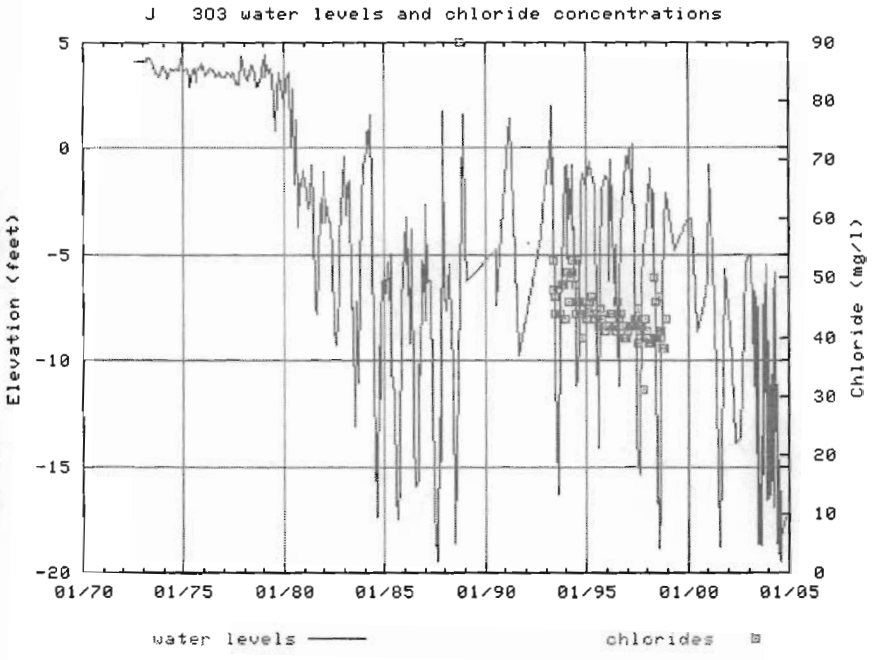


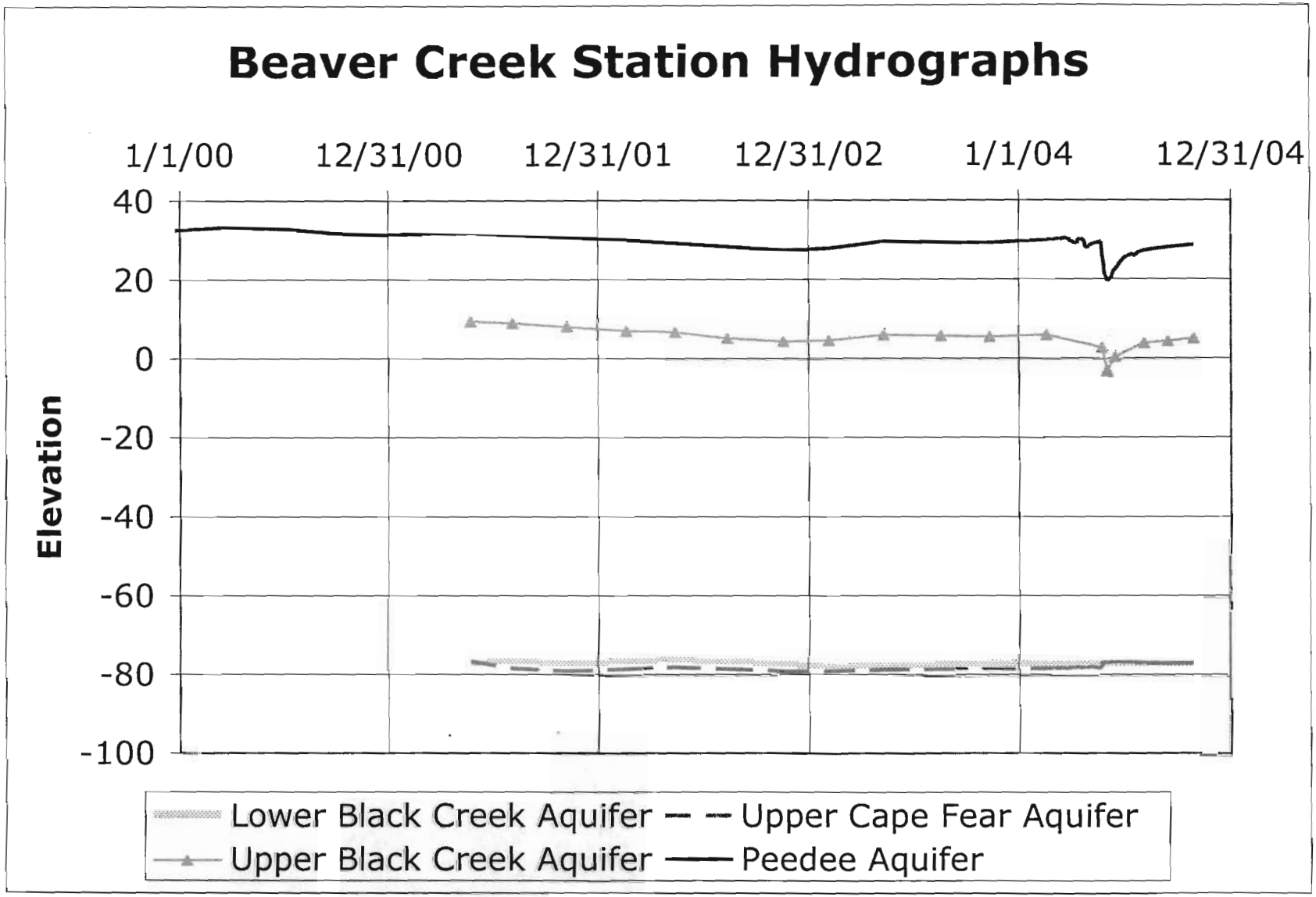
Field	Data
County	Dare
USGS ID	355300075390002
Latitude	35.880959
Longitude	-75.665774
Location Accuracy	GPS
Quad	J 3O3
Netname (link to USGS data)	
Name (link to logs)	Skyco Road
Aquifer	Yorktown
Land Surface	7.65
Date Constructed	07/26/1972
Stickup, 10/28/2004	1.15
Depth	220.00
Diameter	6.00
Yield	23.00
Exists?	y
Recorder Box?	y
Top of Screen	200.00
Bottom of Screen	220.00
Number of Water Levels {date * feet below land surface * elevation} 07/26/1972 to 10/28/2004	795
Number of Chlorides {date * chlorppm * spcond_us * salin_ppt * comments} 10/12/1988 to 12/11/1998	79 ** -1 values equal no data ** -28 values equal below detection limit of 28

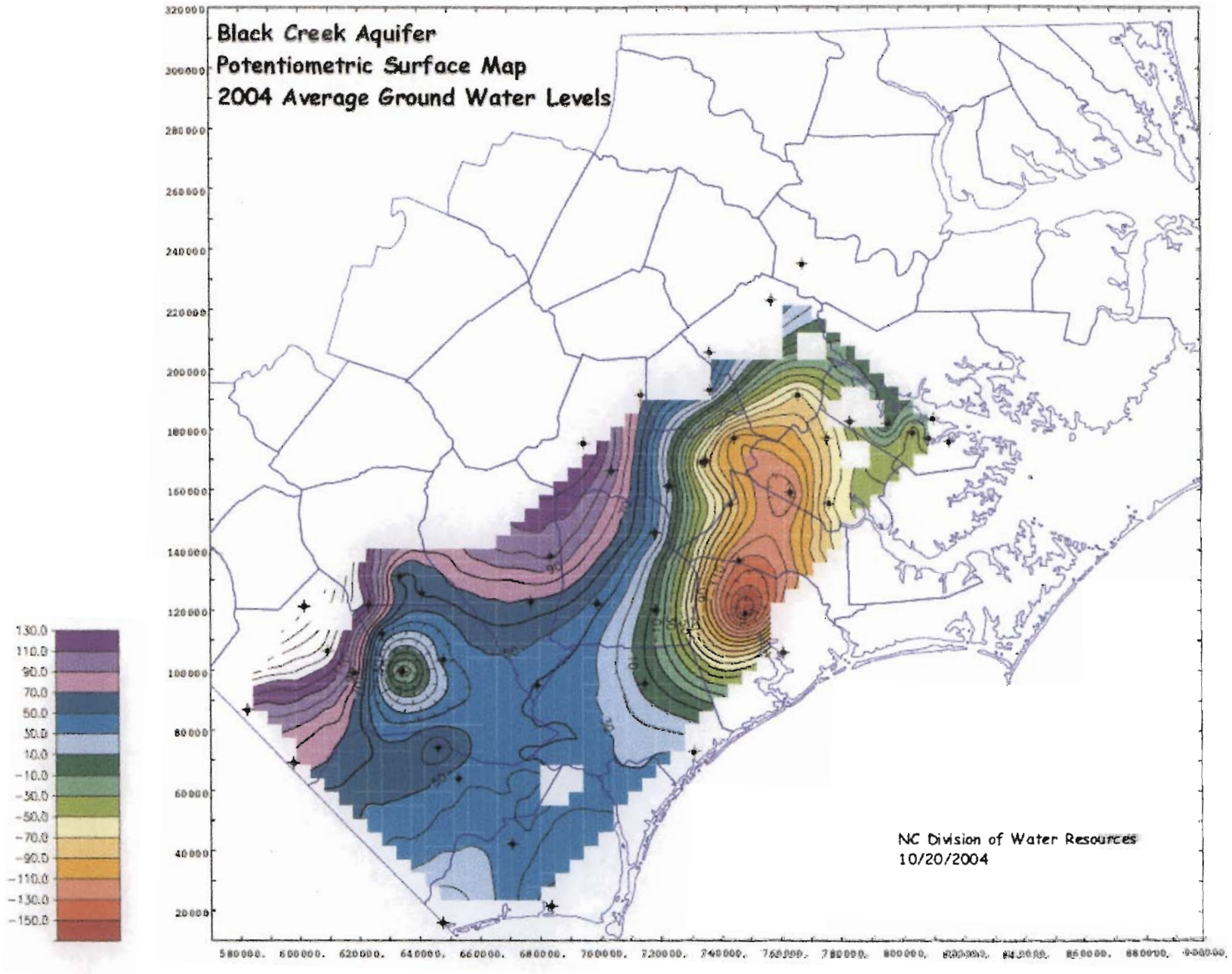
output files are tab-delimited text

DWR Monitoring Database Detail for J 3O3

Show Map
Monthly Statistics Plot
795 water level data points plotted




Beaver Creek Station Hydrographs
1/1/00
12/31/00
12/31/01
12/31/02
1/1/04
12/31/04
40
20
0
-20
-40
-60
-80
-100
Elevation
Lower Black Creek Aquifer
Upper Cape Fear Aquifer
Upper Black Creek Aquifer
Peedee Aquifer


Black Creek Aquifer
Potentiometric Surface Map
2004 Average Ground Water Levels
NC Division of Water Resources
10/20/2004
130.0
110.0
90.0
70.0
50.0
30.0
10.0
-10.0
-30.0
-50.0
-70.0
-90.0
-110.0
-130.0
-150.0

NORTH CAROLINA
DROUGHT MANAGEMENT ADVISORY COUNCIL

Next Meeting:
TBA

Drought Impact Survey
for Business & Government

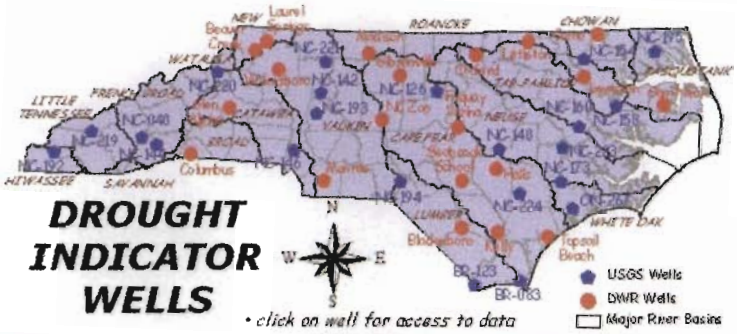
» Click To Fill Out «

Water Systems Under Water Use Restrictions
CLICK

Home
Current Conditions
Recommendations
About Us
Drought Contacts
Drought Links

Drought Education
Drought For Kids
Water Conservation
Types of Drought
The Hydro-Illogical Cycle

Get Adobe Reader



DROUGHT INDICATOR WELLS

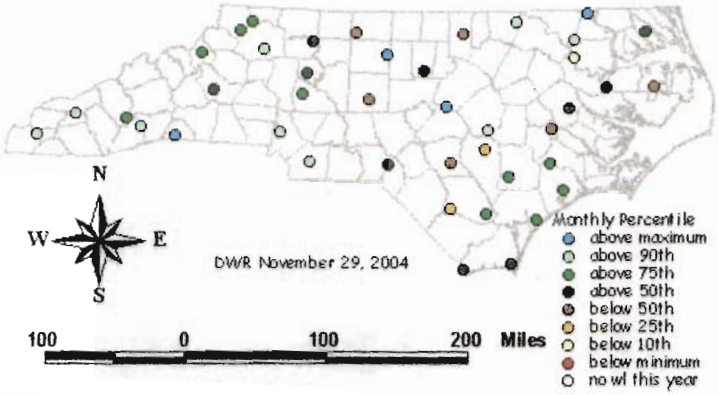
• click on well for access to data

Well Name (link to entire record)	Status (link to monthly stats)	County	River Basin
Columbus	11/02/2004	Polk	Broad
Kelly	11/02/2004	Bladen	Cape Fear
Southport (BR-083)	11/28/2004	Brunswick	Cape Fear
Seabrook School	11/05/2004	Cumberland	Cape Fear
Rose Hill (NC-224)	11/28/2004	Duplin	Cape Fear
Gibsonville Landfill	10/28/2004	Guilford	Cape Fear
UNC Campus (NC-126)	09/29/2004	Orange	Cape Fear
Topsail Beach	11/01/2004	Pender	Cape Fear
NC Zoo	10/26/2004	Randolph	Cape Fear
Halls	11/01/2004	Sampson	Cape Fear
Fuquay Varina	10/29/2004	Wake	Cape Fear
Linville (NC-220)	11/28/2004	Avery	Catawba
Glen Alpine	11/02/2004	Burke	Catawba
Hornets Nest Park (NC-146)	11/28/2004	Mecklenburg	Catawba
Roxobel (NC-154)	11/28/2004	Bertie	Chowan
Como	10/26/2004	Hertford	Chowan
Champion (NC-040)	11/28/2004	Haywood	French Broad
Blantyre (NC-144)	11/28/2004	Transylvania	French Broad
American Thread (NC-192)	11/28/2004	Cherokee	Hiwassee
Bryson City (NC-219)	11/28/2004	Swain	Little Tennessee
Bladenboro	11/09/2004	Bladen	Lumber
Calabash (BR-123)	11/28/2004	Brunswick	Lumber
Jordan Creek (NC-194)	11/28/2004	Scotland	Lumber
Comfort (NC-173)	11/28/2004	Jones	Neuse
Graingers (NC-223)	11/02/2004	Lenoir	Neuse
Grantham (NC-148)	09/20/2004	Wayne	Neuse
Laurel Springs	11/01/2004	Alleghany	New
Beaver Creek	11/01/2004	Ashe	New
Elizabeth City (NC-195)	11/28/2004	Pasquotank	Pasquotank
Gum Neck	10/29/2004	Tyrrell	Pasquotank
Lewiston	10/26/2004	Bertie	Roanoke
Madison	10/28/2004	Rockingham	Roanoke
Van Swamp (NC-158)	09/30/2004	Washington	Roanoke
Oxford	11/03/2004	Granville	Tar-Pamlico
Simpson (NC-160)	11/28/2004	Pitt	Tar-Pamlico
Littleton	11/03/2004	Warren	Tar-Pamlico
Camp LeJeune (ON-267)	11/05/2004	Onslow	White Oak
Mocksville (NC-142)	11/28/2004	Davie	Yadkin
Barber (NC-193)	11/28/2004	Rowan	Yadkin

Monroe	10/26/2004	Union	Yadkin
Wilkesboro	11/01/2004	Wilkes	Yadkin
East Bend (NC-221)	11/28/2004	Yadkin	Yadkin
Access the Division of Water Resources Ground Water Databases			

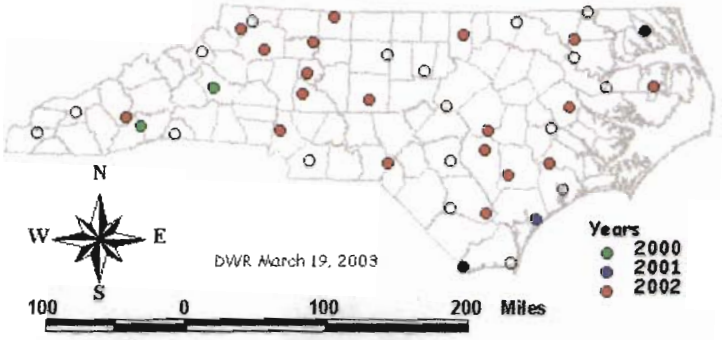
Most Recent Water Level Compared to Historical Monthly Water Levels	
	Above maximum
	Above mean and below maximum
	Below mean and above minimum
	Below minimum
	No water levels collected this year

Latest Ground Water Level Ranking



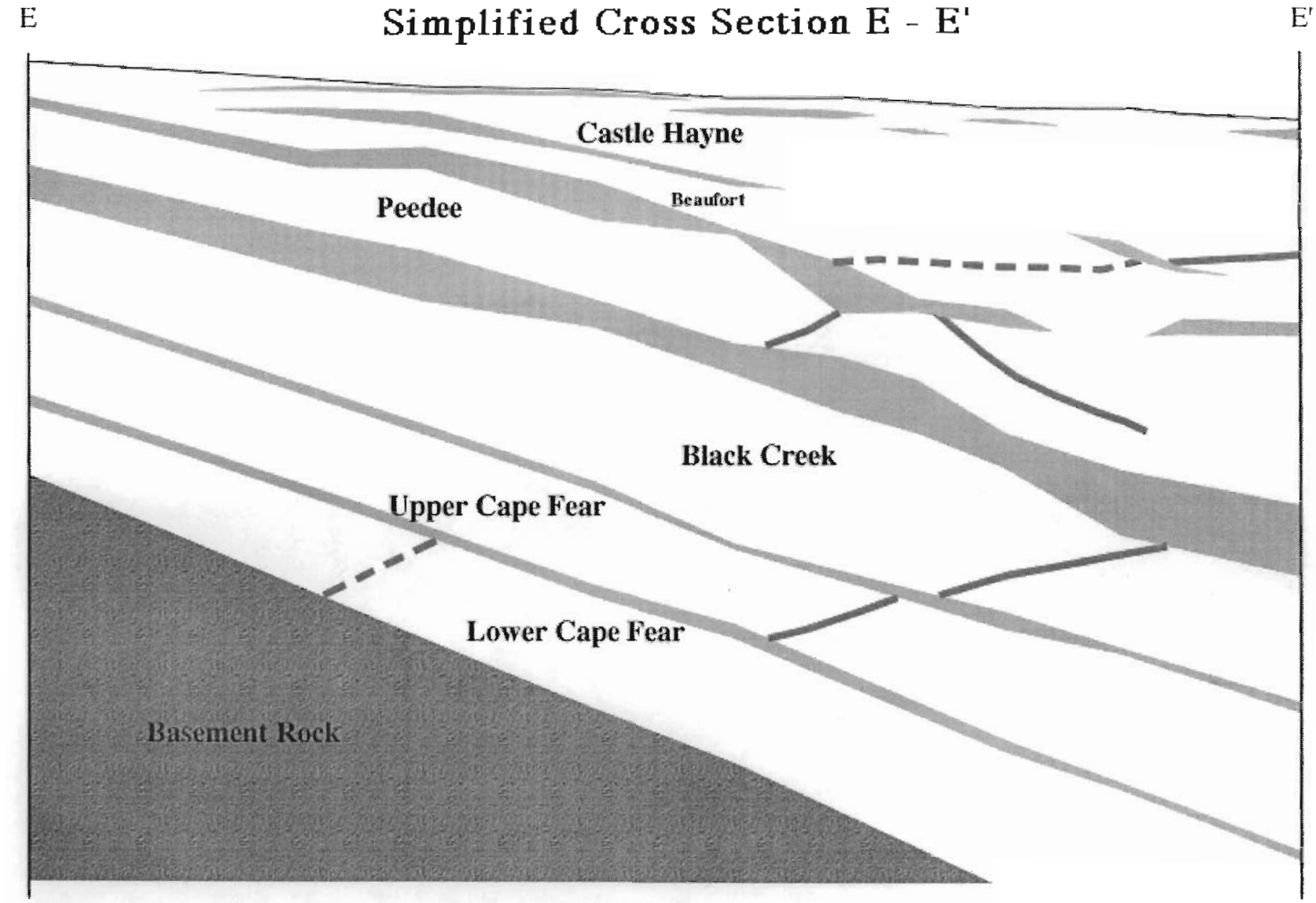
Minimum Ground Water Levels of Record in 2000, 2001 and 2002

24 of 42 Drought Indicator Wells Reached Record Minimum Water Levels in 2000, 2001 or 2002



CCP Cross-section Lines

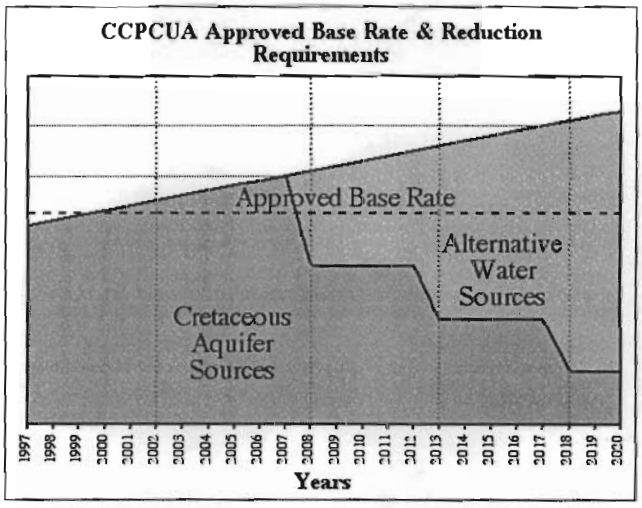
Simplified Cross Section E - E'



Central Coastal Plain Capacity Use Area Rules
15A NCAC 2E .0501 - .0507

Frequently Asked Questions

1. Why does the central coastal plain region need water use regulation? Some aquifers in this region are being overused such that they will fail to meet the area's water supply needs in the near future. Regulation is needed to decrease withdrawals from these aquifers to a sustainable rate of use.
2. How will the Central Coastal Plain Capacity Use Area (CCPCUA) rules work? They will require water users to cut back on use of these overused aquifers and increase use of other water sources (including alternative aquifers, surface water and other sources) over a sixteen year period.
3. When will these rules become effective? August 1, 2002.
4. When are applications for water use permit due? January 28, 2003 -- 180 days after the effective date of the rules
5. What counties are in the CCPCUA? Beaufort, Carteret, Craven, Duplin, Edgecombe, Greene, Jones, Lenoir, Martin, Onslow, Pamlico, Pitt, Washington, Wayne, and Wilson (see map).
6. What types of water users will be regulated in the CCPCUA? All ground water users using more than 100,000 gallons per day will be required to apply for and obtain a water use permit in order to continue withdrawing. Regulated withdrawals include those from a well, a group of wells operated as a system, or a sump.
7. What is a group of wells operated as a system? This refers to a water supply system (public or private) using multiple wells linked together with water lines and operated in a coordinated fashion that collectively withdraw more than 100,000 gallons per day.
8. When must ground water users apply for a permit? Users have 180 days after the effective date of the rule to apply for a permit.
9. Are there reporting requirements? Water users will need to report water withdrawals and ground water levels quarterly, in March, June, September and December, until they receive their permit. Permit conditions will also require reporting of water use and ground water levels.
10. Will water conservation plans be required? All water users will have some water conservation requirements [see Rule .0502(d)(5)]. Public water system conservation requirements include water conservation ordinances, leak detection programs, conservation rate structures, plumbing retrofit programs and public education.
11. Who is affected by the water use reduction requirements? Any regulated water user who withdraws ground water from the Cretaceous aquifer system within zones described in Rule .0503 and illustrated on the CCPCUA Cretaceous Aquifer Zones map (see map). Depending on the zone, the water user will be required to reduce water use from those Cretaceous wells over a sixteen year period by up to 75%. New sustainable water sources will need to be identified and constructed as needed.
12. How are reductions calculated? The Division of Water Resources will calculate a water user's approved base rate (see #1 in Rule .0507). That rate will be the annual withdrawals from Cretaceous wells during calendar year 1997 or the year extending from August 1, 1999 through July 31, 2000, whichever is larger. Adjustments to this rate may occur through negotiation with the Division. The three phases of 10% or 25% reduction will start from a user's approved base rate.



In this illustration, the applicant has established their approved base rate (ABR) as their August 1, 1999 through July 31, 2000 annual water use and is located in the Dewatering Zone. In 2008, the first 25% reduction is phased in and demand is met by a combination of 75% of the ABR from the Cretaceous aquifer wells and alternative supplies. Reductions and changes in the levels of use of alternative supplies occur in 2013 and in 2018. In 2018, the permittee has shifted most of their demand to alternative supplies and withdraws a sustainable 25% of the ABR from their Cretaceous wells.

13. Are surface water users or other ground water users affected? Rule .0505 requires any ground or surface water user of more than 10,000 gallons per day within the CCPCUA to register with the Division. Agricultural users may register with the Division of Water Resources or the Department of Agriculture and Consumer Services with the appropriate form, or take part in a water use survey to be conducted by the NC Department of Agriculture and Consumer Services in 2003.
14. Who is an intermittent user? Intermittent users are defined by #13 of Rule .0507 and are not affected by the reduction requirements. Intermittent users are those who withdraw water fewer than 60 days per year and will include many agricultural irrigators and fish farms.

NC Division of Water Resources, DENR - 1611 Mail Service Center - Raleigh, NC 27699-1611
Phone: (919)733-4064 - Fax: (919)733-3558
Last Modified: 12.09.2004

Central Coastal Plain Capacity Use Area Water Use Summary Tables

from November 1, 2003 through October 31, 2004
(Reported use averages based on withdrawal totals from 147 permit holders and applicants)

Water Use by County (in MGD)

County	Permitted Ground Water Use	Approved Base Rates (MGY)	Reported Ground Water Use
Beaufort	177.943		62.997
Carteret	8.496		5.252
Craven	47.533	2,502.632	18.078
Duplin	9.614	119.435	5.463
Edgecombe	5.860	150.018	0.955
Greene		1,043.241	1.436
Jones	14.206		7.439
Lenoir	0.290	5,479.464	6.157
Martin	5.156	905.049	1.843
Onslow	36.641	2,884.113	17.402
Pamlico	13.553		1.534
Pitt	9.340	2,948.995	5.778
Washington	30.098		3.779
Wayne	14.422	1,547.608	5.443
Wayne/Wilson	0.140		0.001
Wilson	7.874		1.184
Totals:	381.167	17,580.554	144.742

Water Use by Type of Use (in MGD)

Type of Use	Permitted Ground Water Use	Approved Base Rates (MGY)	Reported Ground Water Use
Aquaculture	35.832		1.583
Industrial	8.225	52.053	3.088
Industrial, Public Supply	5.700	205.836	1.744
Irrigation, Agricultural	18.136	496.926	0.609
Irrigation, Agricultural, Aquaculture, Livestock	3.673		0.031
Irrigation, Golf Course	4.972	101.145	0.635
Mine Dewatering	156.162		84.775
Other	1.200		0.329
Public Supply	87.106	16,724.594	51.947
Public Water Supplier	58.000		
Waterfowl Impoundments	2.160		
Totals:	381.167	17,580.554	144.742

RAL·WEATHER CENTER

Greg Fishel's five-day Triangle forecast

Hourly weather updates:
newsobserver.com/weather wral.com/weather

Partly to mostly cloudy

Today

Morning: Variable cloudiness
Midday: Mostly cloudy
Night: Clouds and maybe a shower

High 68°
Low 51°
Wind direction/speed Var and light
Dew point 53°
Wind chill 67°

Thursday

Mainly overcast and cool.

High 63°
Low 51°
Wind dir./speed NE at 5-10

Friday

Morning clouds should give way to a little afternoon sun.

High 68°
Low 56°
Wind dir./speed S-SW at 5-10

Saturday

Partly sunny and noticeably warmer.

High 80°
Low 58°
Wind dir./speed SW at 10-15

Sunday

Partly sunny and warm with a stray or thundershower possible.

High 80°
Low 58°
Wind dir./speed SW at 10-15

kGreg

questions to
reg@wral.com

Q: There was worry a while back that the aquifers might be affected by drought. How are they doing now? - George Houston, Chapel Hill

A: Groundwater levels fell significantly below normal in aquifers across much of North Carolina during the drought in 2002. These levels, which are tracked by way of a network of monitoring wells around the state, have recovered to well above normal levels in many places, with almost all sites reporting at least near normal capacity. See www.ncwater.org/drought/wells.php to access current readings.

A: Groundwater levels fell significantly below normal in aquifers across much of North Carolina during the drought in 2002. These levels, which are tracked by way of a network of monitoring wells around the state, have recovered to well above normal levels in many places, with almost all sites reporting at least near normal capacity. See www.ncwater.org/drought/wells.php to access current readings.

Pink Hill Station
Duplin County

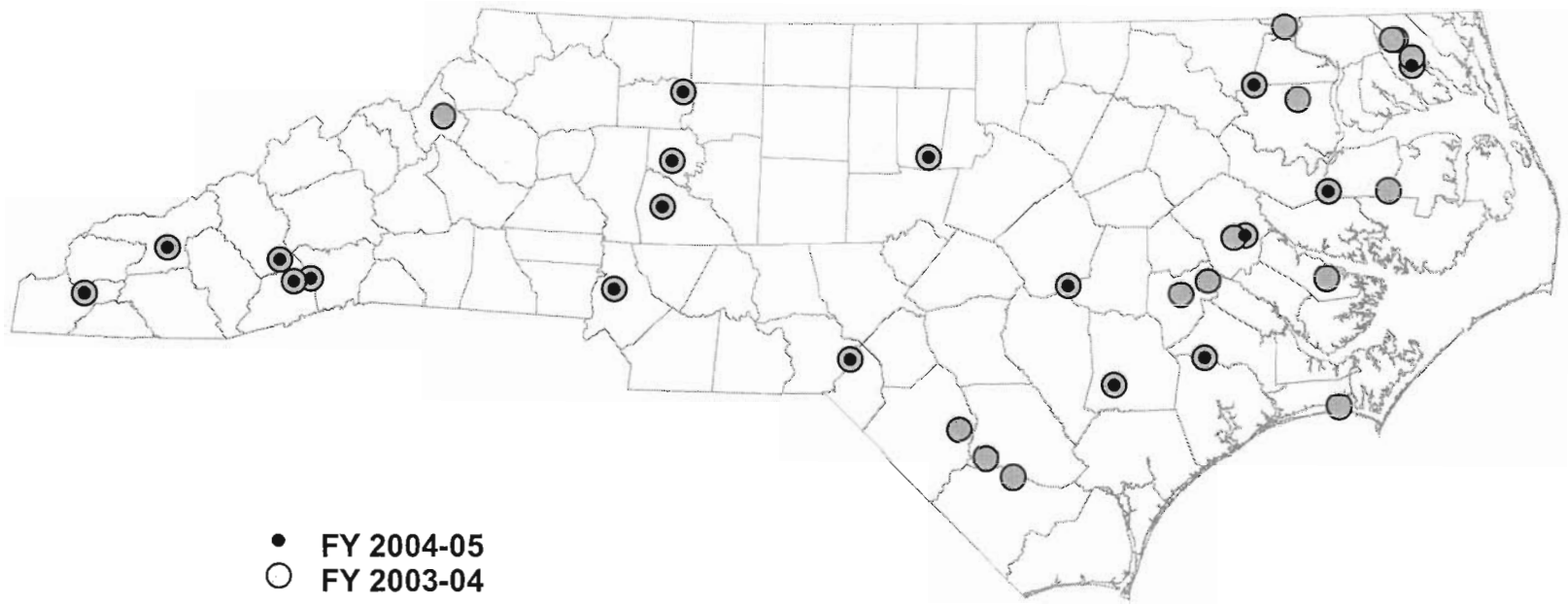
Purpose of Visit:

- down-hole video camera demonstration
- example videos
- condition of monitoring well network
- cooperative agreement with United States Geological Survey

Reference Materials:

- visual examples
- map of cooperative networks from FY 2003-04 and FY 2004-05

Comparison between FY 2003-04 and FY 2004-05 DWR-USGS Cooperative Monitoring Well Networks



● FY 2004-05
○ FY 2003-04

FY2004-05 = 20 wells at 18 locations
FY2003-04 = 38 wells at 33 locations

- 18 wells at 15 locations cut from FY 2004-05 budget

N
W E
S

100 0 100 200 Miles