Hydrogeologic Assessment of the Proposed Deepening of the Wilmington Harbor Shipping Channel, New Hanover and Brunswick Counties, North Carolina

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EXECUTIVE SUMMARY

A proposal by the State of North Carolina to deepen the twenty six mile long Wilmington Harbor shipping channel has brought about the need for a joint feasibility study with the U.S. Army Corps of Engineers to investigate the potential for adverse environmental impacts. The Wilmington Harbor ground water study is a particular aspect of the Wilmington Harbor Navigation Comprehensive Feasibility Study, having originated by agreement between the State of North Carolina and the U.S. Army Corps of Engineers. The central purpose of the comprehensive feasibility study is to determine the economic and environmental practicality of deepening the Wilmington Harbor shipping channel to accommodate larger container ships. This would greatly benefit the economy of the Wilmington area and the State of North Carolina in general. The main objective of the ground water study was to determine through a comprehensive hydrogeologic assessment, the potential for adverse impacts to New Hanover and Brunswick county fresh water aquifers that could be induced by deepening the existing shipping channel. Possible impacts considered in this investigation included saltwater intrusion into fresh ground water supplies, lowering of water levels, and changes in the direction of ground water flow in the Peedee, Castle Hayne, and surficial aquifers.

The study was conducted in two phases, as presented in this report. The first phase involved the development of a hydrogeologic framework or conceptual model of the area of potential impact, which most importantly included a study of the physical contact and hydraulic relationship between the shipping channel and the New Hanover/Brunswick County aquifer system. The hydrogeologic framework served as a basis for the second phase of the study, which involved the application of the three dimensional finite element model FEMWATER to the area of concern.

The study area includes New Hanover, and eastern Brunswick Counties, North Carolina as shown in figure i. The region is underlain by an eastward thickening wedge of sediments and sedimentary rock of Cretaceous to Quaternary age, consisting of sands, silts, conglomerates, clays, shell hash, and fossiliferous limestones that were deposited in near-shore to deeper marine environments. The hydrogeologic section studied includes all units recognized between the top of the Black Creek aquifer and the top of the surficial aquifer. Within this interval, three major aquifers, and three major confining units are recognized. They include the surficial, Castle Hayne, and Peedee aquifers, and the Castle Hayne, Peedee, and Black Creek confining units (figure ii). The principle freshwater bearing aquifers are the surficial, Castle Hayne, and the upper Peedee as indicated by chloride concentration analyses.

Hydrogeologic units within the study area were mapped and described using borehole geophysical logs, lithologic logs, aquifer test data, chloride and water level data. Each pertinent hydrogeologic unit was described in terms of altitude, thickness, lateral extent, hydraulic characteristics, and relation to geologic units. Aquifers were further described in terms of interrelationships, chloride distribution, and natural or pump induced ground water movement. Inasmuch as the focus of this study was to examine the potential for detrimental impacts due to deepening the Wilmington Harbor shipping channel, special emphasis was placed on the relationship between the river and the aquifers and confining units that connect with or directly underlie the river.

Altitude and thickness maps, water level data, and regional cross-sections incorporating shipping channel core data indicate the following relationships between the hydrogeologic section and the Wilmington Harbor shipping channel:

- Water level data from the surficial, Castle Hayne and Peedee aquifers indicate that the shallow ground water system maintains a discharge relationship to the Cape Fear River along

WILMINGTON HARBOR GROUNDWATER STUDY

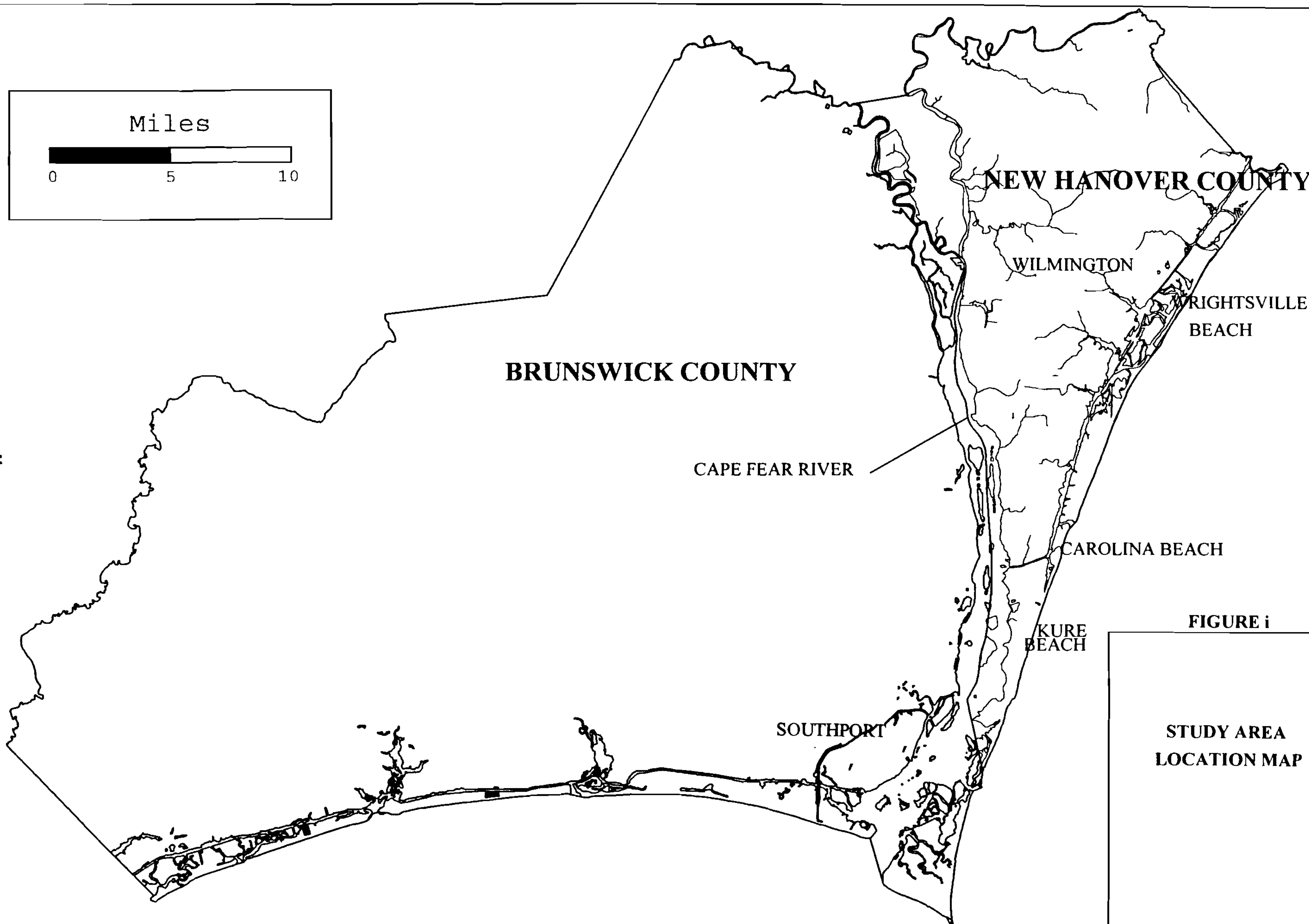

FIGURE i

STUDY AREA
LOCATION MAP

GEOLOGIC UNITS			HYDROGEOLOGIC UNITS
SYSTEM	SERIES	FORMATION	AQUIFERS AND CONFINING UNITS
Quaternary	Holocene	Undifferentiated	Surficial aquifer
	Pleistocene		
Tertiary	Pliocene	Undifferentiated	Tertiary aquifer and confining unit [4]
	Oligocene	River Bend Fm. [1]	
	Eocene	Castle Hayne Fm.	Castle Hayne aquifer and confining unit
	Paleocene	Beaufort Fm. [2]	
Cretaceous	Upper Cretaceous	Rocky Point Member [3]	Pee Dee aquifer and confining unit
		Pee Dee Formation	
			Black Creek Confining Unit
		Black Creek Formation	Black Creek aquifer

1. Present only in southern New Hanover County.
2. Present only in southern New Hanover and southeastern Brunswick County.
3. Present only in north central New Hanover County and southeastern Brunswick County.
4. Confining unit is discontinuous through study area.

Figure ii. General relationship between geologic and hydrogeologic units in Wilmington Harbor study area. (geologic units from Zarra, 1991) the twenty-six mile length of the shipping channel. Ground water flow patterns across the area are illustrated in cross-sectional view in figure iii.

- From north to south along the length of the channel, hydrogeologic data indicate that from Castle Street through the northern part of Brunswick channel, the base of the shipping channel is within the Peedee aquifer (figure iv). Five feet of deepening along this stretch would increase the surface area of the Peedee aquifer exposed to the channel.

- From the northern part of the Brunswick through the Lilliput channel the base is within the Castle Hayne aquifer. Thus, deepening along this stretch would increase the surface area of the Castle Hayne aquifer exposed to the channel.

- From south of Lilliput channel to the mouth of the Cape Fear River, maps and cross-sections indicate that deepening the existing channel may cause penetration, or increase penetration of the channel into the Castle Hayne confining unit.

The question of whether deepening the shipping channel would cause adverse impacts to the ground water system could only be answered satisfactorily by use of a regional ground water model. This was the basis of the second phase of the study, which involved the application of the three-dimensional finite element model FEMWATER. FEMWATER was designed for both transient and steady state, coupled flow and transport, as well as unsaturated or saturated flow simulations. The FEMWATER model was used in conjunction with a preprocessor/postprocessor called GMS (Groundwater Modeling System) developed by the U.S. Army Waterways Experiment Station-Hydraulics Lab.

The process of development and application of FEMWATER to the Wilmington Harbor study site involved the following key steps as discussed in this report:

1. Design and construction of the 3-d finite element mesh using data and interpretations from the hydrogeologic framework study.

2. Assignment of model boundary conditions using data and interpretations from the hydrogeologic framework study.

3. Model calibration and sensitivity analysis.

4. Applied flow simulations.

5. Analysis of simulation results.

The first step in setting up the FEMWATER model was to create a 3-d finite element mesh. To apply the finite element method, the problem region was subdivided into a set of smaller regions called finite elements. Nodes were located at the vertices of each triangular element, and correspond to wells or well fields where appropriate. Figure v shows the entire model area, element boundaries, and positions of each node. The regional model boundaries extend to natural physical features such as the Atlantic shoreline as well as to other hydraulic boundaries, to be discussed later in this report. In accordance with findings in the framework study, the 3-d mesh represents a three layer aquifer system separated by confining units. Each aquifer and confining unit was represented as closely as possible to actual geometries defined by regional altitude and thickness maps in the framework study.

Representing the pre-deepening and post-deepening geometry of the Cape Fear River shipping channel presented a rather unique problem which was handled by constructing two different 3-d

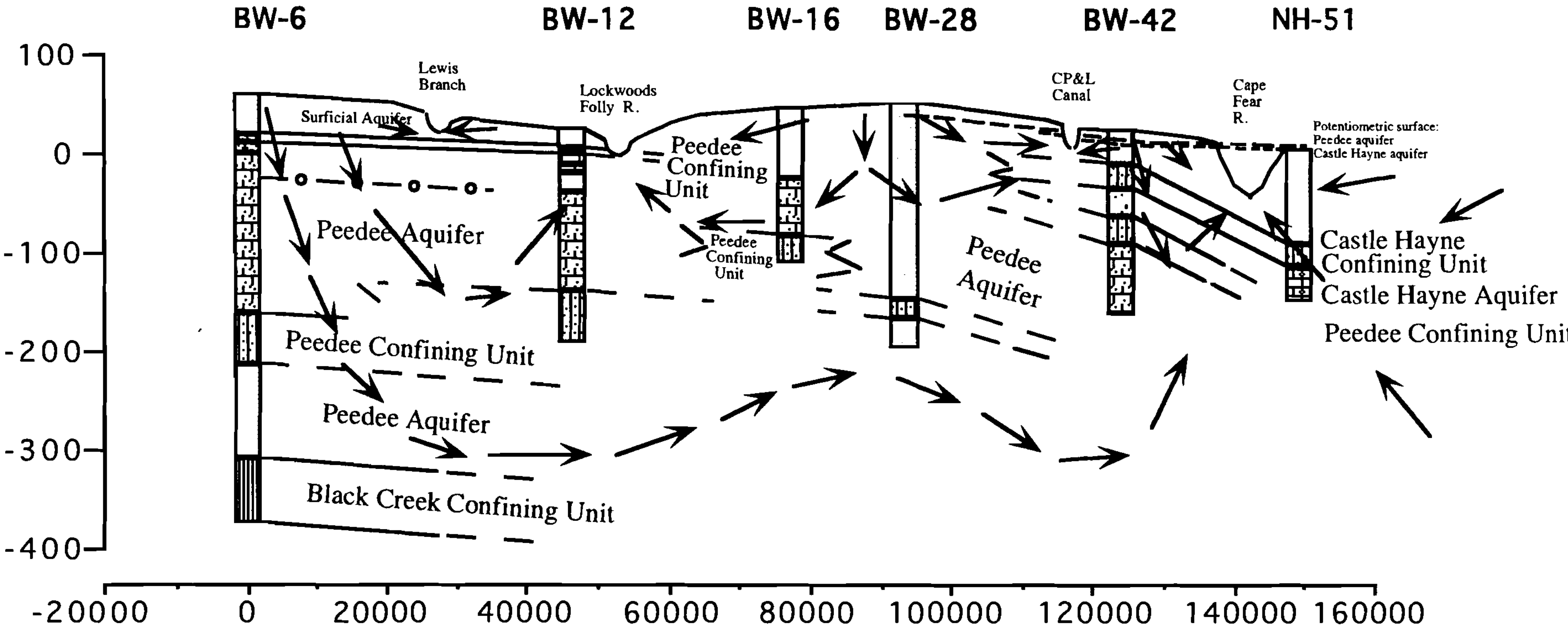

FIGURE iii

Hydrogeologic Units and Ground Water Flow Along W-E Cross-Section E-E'. Trace of Section Shown in Appendix Figure A-2. New Hanover and Brunswick Counties, NC. Datum: Sea Level

o—o—o – Line of equal chloride concentration 250 ppm

——> General direction of ground water flow

WILMINGTON HARBOR GROUNDWATER STUDY

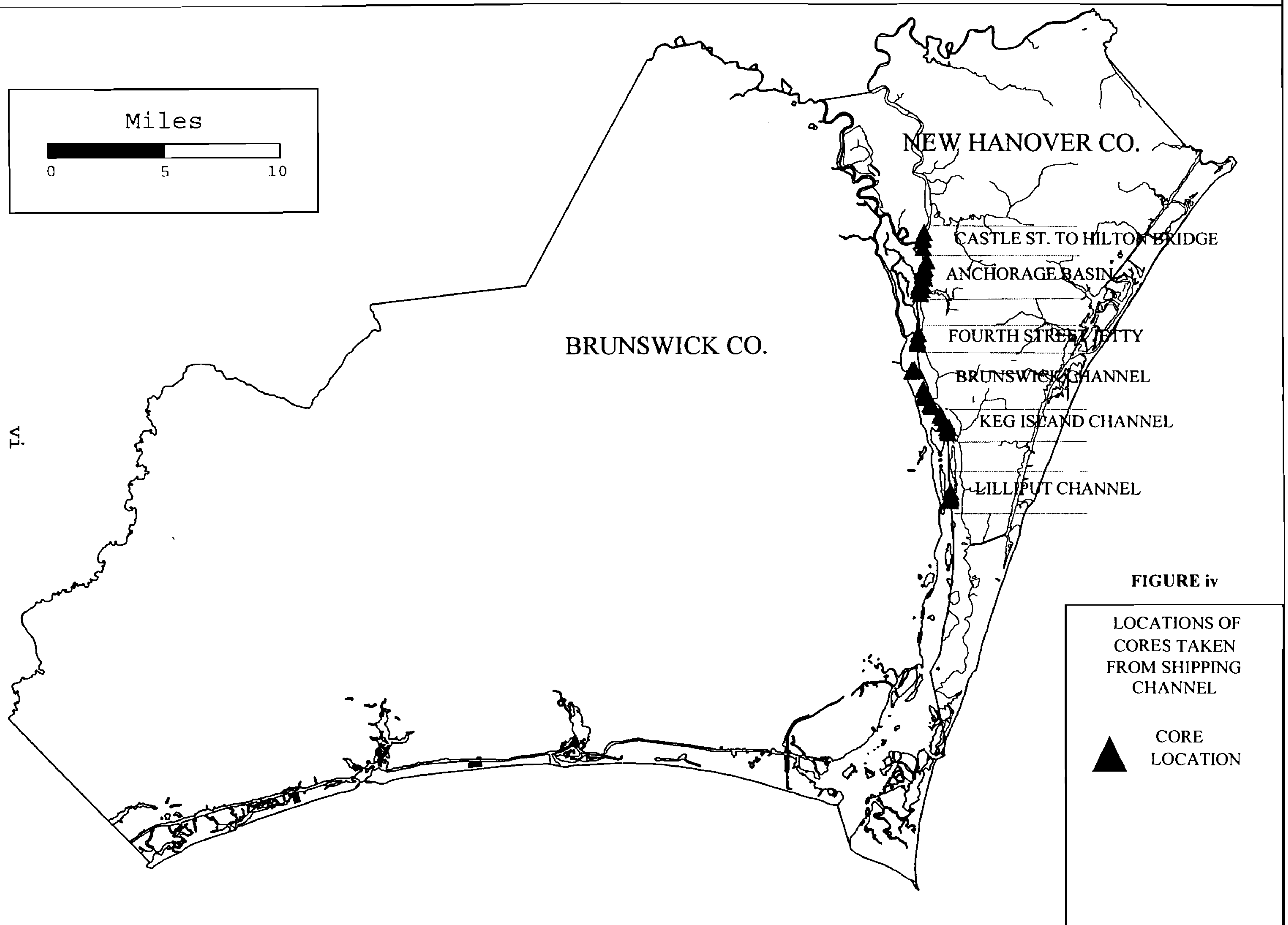

FIGURE iv

LOCATIONS OF CORES TAKEN FROM SHIPPING CHANNEL

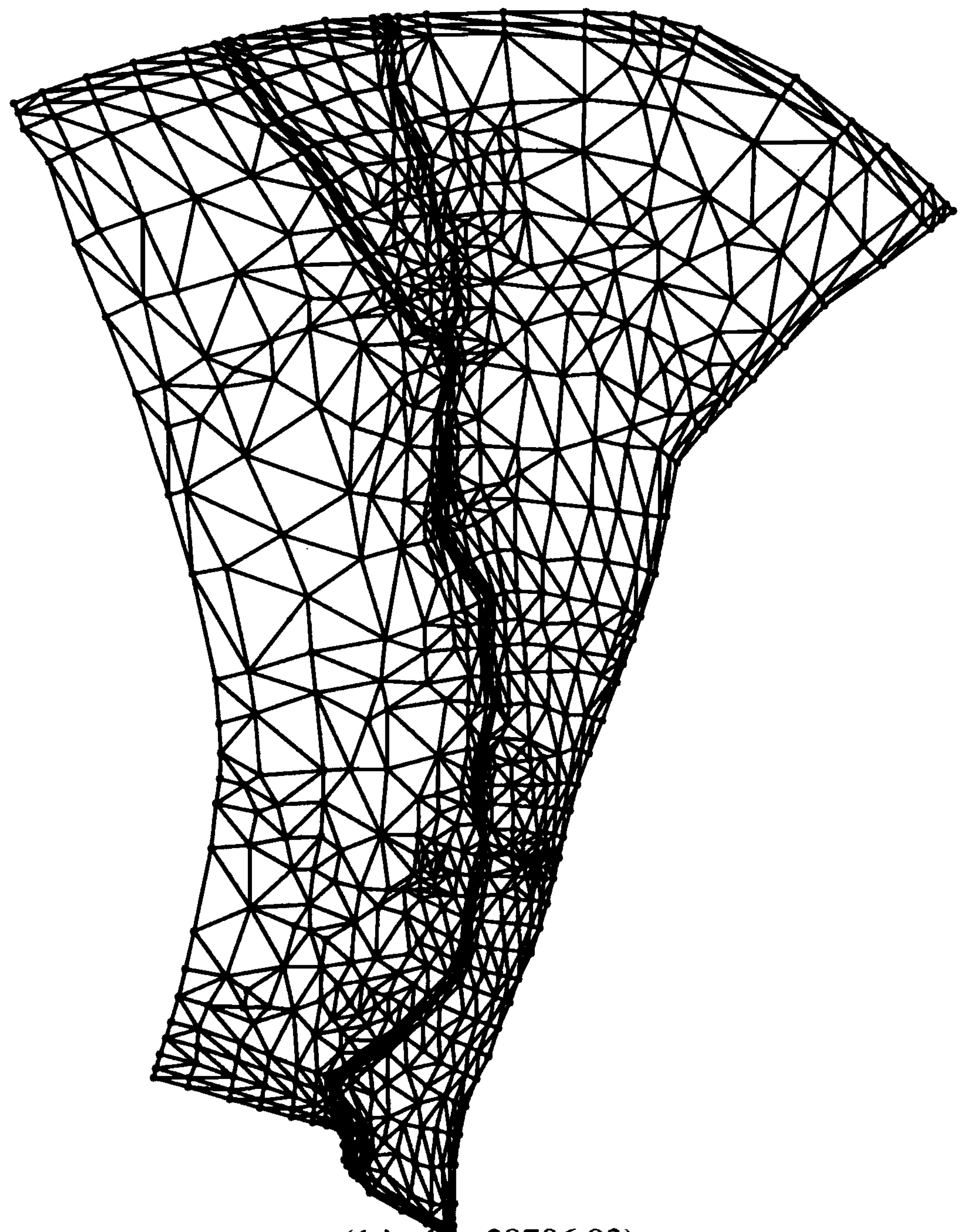

Figure V: Top view of 3-D Mesh

meshes, one to show the current configuration of the channel, and one to represent a deepened channel (5 foot maximum) in accordance with Army Corps of Engineers design specifications. Elements were deleted in the river channel in both meshs to represent the incision of the Cape Fear River. Channel nodes at the bottom of the shipping channel were shifted to the specified depth in the plan mesh to represent the deepened channel. In keeping with findings in the framework study, the base mesh was constructed to show the channel in contact with the Peedee Aquifer from Castle Street channel (fig.iv) through the northern part of the Brunswick channel. From the northern part of the Brunswick through the Lilliput channel, the base is shown to be within the Castle Hayne Aquifer. From south of the Lilliput channel to the mouth of the Cape Fear River, the base is indicated to range from a position above the Castle Hayne confining unit to within the confining unit. The plan mesh indicates that deepening of the channel would primarily increase its penetration into aquifer material, and not into confining beds. However, an exception to this is seen in the area south of the Lilliput channel, where deepening would increase the penetration of the channel further into the Castle Hayne confining unit.

A major aspect of designing the 3-d mesh was to determine what boundary conditions were appropriate to represent the physical and mathematical limits of the problem area. A primary concern in this study was to accurately model the hydraulic relationship between the shipping channel and adjoining aquifer system. The Cape Fear River and shipping channel were handled as a constant head boundary, assuming that the small tidal elevation range observed in the river would have a minimal effect on model output results. Each node along the surface of the river channel was assigned a fixed head value of 2.25 feet above mean sea level. This corresponds to mean tidal elevation along the extent of the river.

The southern and eastern perimeters of the mesh correspond to the position of the Atlantic coastline. Nodes along this boundary face were assigned a constant head of 0.0, corresponding to the elevation of mean sea level.

The western and northern perimeters of the mesh were treated as specified (variable) head boundaries. Values of head were assigned to nodes along this boundary face using pieziometric maps constructed from measured field values from the regional observation network. The modeling period covers a 16 month span (June, 1993 through September, 1994), the time during which monthly measurements of water levels and chloride concentrations were made. This boundary accounts for lateral inflow of ground water from the west and northwest.

The base of the mesh is a no flow boundary which corresponds to the top of the Black Creek confining unit (fig.ii) The Black Creek confining unit was chosen as the basal no flow boundary because it is a thick, regionally continuous clay unit (68 feet average thickness).

In order to simulate recharge to the model the top boundary face of the 3-d mesh was assigned a specified flux boundary condition. Rainfall data from the study region was obtained from the National Climatic Data Center to cover the 16 month modeling period. Total recharge to the system was calculated using an EPA method (EPA, 1985) which compares monthly values of average rainfall with monthly average evapotranspiration for a monthly recharge approximation (fig.5, part 2 of report). Recharge rates used in the model were calculated using values of average daily rainfall measured at the New Hanover County Airport. Over the 16 month model period a total of 81 inches of total rainfall was measured. Recharge calculations indicate 34 inches of total recharge to the ground water system over the same time period.

Ground water withdrawals from the system due to pumping from municipal and industrial wells and well systems were accounted for in the model as point sink boundary conditions. Well fields that actually contain numerous wells spread out over a large area are signified as one or two wells in the model. This produced a more concentrated pumping effect, thus causing a more substantial drawdown in some areas. For the purposes of this study pumping data was collected only for wells which withdrew over 10,000 gallons per day on any day of the modeling period.

The object of the model calibration process was to ensure that the model was a good representation of the physical ground water system in the study area and that it could be used with confidence to predict aquifer behavior. The calibration process involved making numerous model runs in order to compare computer derived water levels to actual observation well hydrographs. Observation well hydrographs represent the ground water systems response to varying conditions such as changes in rainfall and recharge, pumping and land use. The models ability to reproduce similar water levels over time is a good measure of its ability to accurately simulate the actual system. The model was calibrated by making adjustments to input parameters such as hydraulic conductivity, boundary conditions, and material coefficients. Model runs were continued with changes made each time to sensitive parameters until a satisfactory match between observed and computed heads was obtained for several key observation wells.

The model was found to be the most sensitive to changes in hydraulic conductivity, the specified head boundary along the northern and western boundaries of the mesh, initial water level conditions, and to changes in the unsaturated zone head series. The unsaturated zone head series consists of xy plots of pressure head versus moisture content, pressure head versus relative conductivity, and pressure head versus water capacity. Changes to unsaturated zone head series curves affected the infiltration rate of rainfall through the vadose or unsaturated zone, and thus had significant effects on water level fluctuations at model gage stations.

Upon completion of the calibration and sensitivity analysis process, two separate, flow only, transient model simulations were run over a 450 day time period using variable time steps. The first simulation was run to evaluate changes in the potentiometric surfaces of the Peedee and Castle Hayne Aquifers, and changes in the elevation of the water table using the base mesh (present channel depths). The second run was intended to determine what changes occur over the same period of time to the potentiometric surfaces and water table using the plan mesh (deepened channel). Then a comparison was made of the elevations of the potentiometric surfaces and water table between base and plan over the same model period. Comparison of results from both base and plan simulations indicate that there are no changes in water levels in the Peedee, Castle Hayne, or surficial aquifers over the 450 day simulation. Figures 13 through 18 (part 2 of report) are model output results at time step 450, consisting of contour maps (colors filled between contours) of water level distribution for each of the three aquifers. Both base and plan simulations are included. Analysis of the water level output results indicate the following:

- Comparison of results between base and plan simulations indicate that virtually no changes in water level distribution occur in the three aquifers over the model period. The model results indicate that dredging would not cause any short term changes in water levels in the area of concern.

- The aquifer system maintains a discharge relationship with the Cape Fear River and shipping channel over the modeling period. In other words, distribution of hydraulic head near the river in each of the three aquifers is high enough in comparison to the head of the Cape Fear River to maintain a discharge relationship over the 450 day time period. This is consistent with the findings of the hydrogeologic framework study. Model results indicate that this discharge relationship would be maintained after dredging.

- Head differentials between aquifers are small over most of the model area, with the exception of a few locations as mentioned in the framework study. This is apparently due to the lithologies of the confining units, which consist in much of the area of sandy to silty clays or siltstones. Sand and silt content in clay units will produce higher vertical hydraulic conductivities than would be observed in a pure clay.

- A cone of depression is apparent in the Peedee Aquifer, as shown in both the base and plan water level maps at an east-central location in the mesh (figure 15 and 18, part 2 of report). This is due to the assignment of several high volume pumping wells to one node position. In fact, the wells are much more widely distributed. Therefore, the observed drawdown at this position is greatly exaggerated. Due to the lack of fine resolution in the mesh around the pumping nodes, localized drawdown effects for the most part could not be indicated in model output. The focus of the modeling effort was primarily to study the regional effects of deepening the channel on the aquifer system, and not to concentrate on effects on localized areas.

In order to test the sensitivity of the system to the combined effects of dredging and future increases in pumping, another simulation was performed using projected pumping rates from the year 2020, as well as average recharge rates for the Wilmington area. In the same manner as before, both base and plan simulations were run, and a comparison was made of water levels from each of the three aquifers. No changes were observed to occur between base and plan model output results (figures 19-24, part 2 of report). A comparison was then made between the 1993-1994 base simulation and the 2020 base simulation, and between the corresponding plan simulations to determine if the combined effects of dredging and increased pumping rates would produce changes in water levels. A comparison of base simulations indicates changes in water levels in all three aquifers (figures 13-15 and 19-21, part 2 of report). A comparison of plan simulations from both runs indicates that the changes in water level distribution are identical to those observed in the base runs (figures 16-18 and 22-24, part 2 of report). This is indicative that the changes in water level distribution are caused entirely by pumping rate increases, and not by channel deepening.

In view of the fact that base and plan modeling results do not indicate changes in water level distribution in the aquifer system induced by channel deepening, it was considered superfluous for the purposes of this study to conduct coupled flow and transport simulations. Advection is the primary mechanism by which dredging would affect the position of the fresh water/salt water interface. Changes in the advection process would not occur as a result of dredging if comparative changes do not occur in water levels from base to plan flow simulations. Therefore it is apparent by analysis of model output results that dredging of the Wilmington Harbor shipping channel to the proposed depths will not produce detrimental changes to the aquifer system in New Hanover and Brunswick Counties.

PART 1: HYDROGEOLOGIC FRAMEWORK STUDY

PURPOSE AND SCOPE

The Wilmington Harbor ground water study is a particular aspect of the Wilmington Harbor Navigation Comprehensive Feasibility Study, having originated by agreement between the State of North Carolina and the U.S. Army Corps of Engineers. The central purpose of the comprehensive feasibility study is to determine the economic and environmental practicality of deepening the Wilmington Harbor shipping channel to accommodate larger container ships. This would greatly benefit the economy of the Wilmington area and the State of North Carolina in general. The main objective of the ground water study is to determine through a comprehensive hydrogeologic assessment, the potential for adverse impacts to New Hanover and Brunswick county freshwater aquifers that could be induced by deepening the existing shipping channel. Possible impacts due to deepening the 26 mile long channel include saltwater intrusion into fresh ground water supplies, lowering of water levels, and changes in the direction of ground water flow in the Peedee aquifer, Castle Hayne aquifer, and possibly the surficial aquifer.

The first phase of the study involved the construction of a hydrogeologic framework of the area of potential impact. The study area includes Eastern Brunswick County and all of New Hanover County (figure 1). The portion of the hydrogeologic section examined includes all recognizable units between the top of the Black Creek aquifer and the top of the surficial aquifer (figure 2). Construction of the hydrogeologic framework was accomplished by correlation and interpretation of approximately 125 borehole geophysical logs, core and cutting sample data, use of chloride and water level data from a network of ground water monitoring wells, and aquifer test data.

The second phase of the study involved the application of the 3-D finite element computer model FEMWATER. The FEMWATER model was used as a risk assessment tool to determine if adverse impacts to the ground water system would occur as a result of deepening the shipping channel.

PREVIOUS INVESTIGATIONS

Previous investigations of the area of interest have provided an excellent source of information for this latest study.

LeGrand (1960) published a ground water reconnaissance study of the Wilmington-New Bern area in which he described the geology and physiography, and identified the Castle Hayne aquifer as a major source of ground water in the area. Bain (1970) conducted a detailed study of the hydrogeology of New Hanover County in which he described the Quaternary through Upper Cretaceous age aquifers in terms of altitude, lithology, thickness, lateral distribution, hydraulic properties, water quality including chloride distribution, water levels, and identified what he considered to be the major confining units.

A detailed hydrogeologic study was performed by Harshburger and Associates (unpublished report, 1977) of the Sunny Point Military Ocean Terminal as a result of ground water contamination problems caused by saltwater leachate from several dredge spoil lagoons. A large number of nested well stations were installed to provide a characterization, including hydraulic differentiation, of the Quaternary through Tertiary age aquifer system.

The GroundWater Section of the North Carolina Division of Water Quality installed several ground water monitoring research stations under the supervision of Rick Shiver during the 1970s

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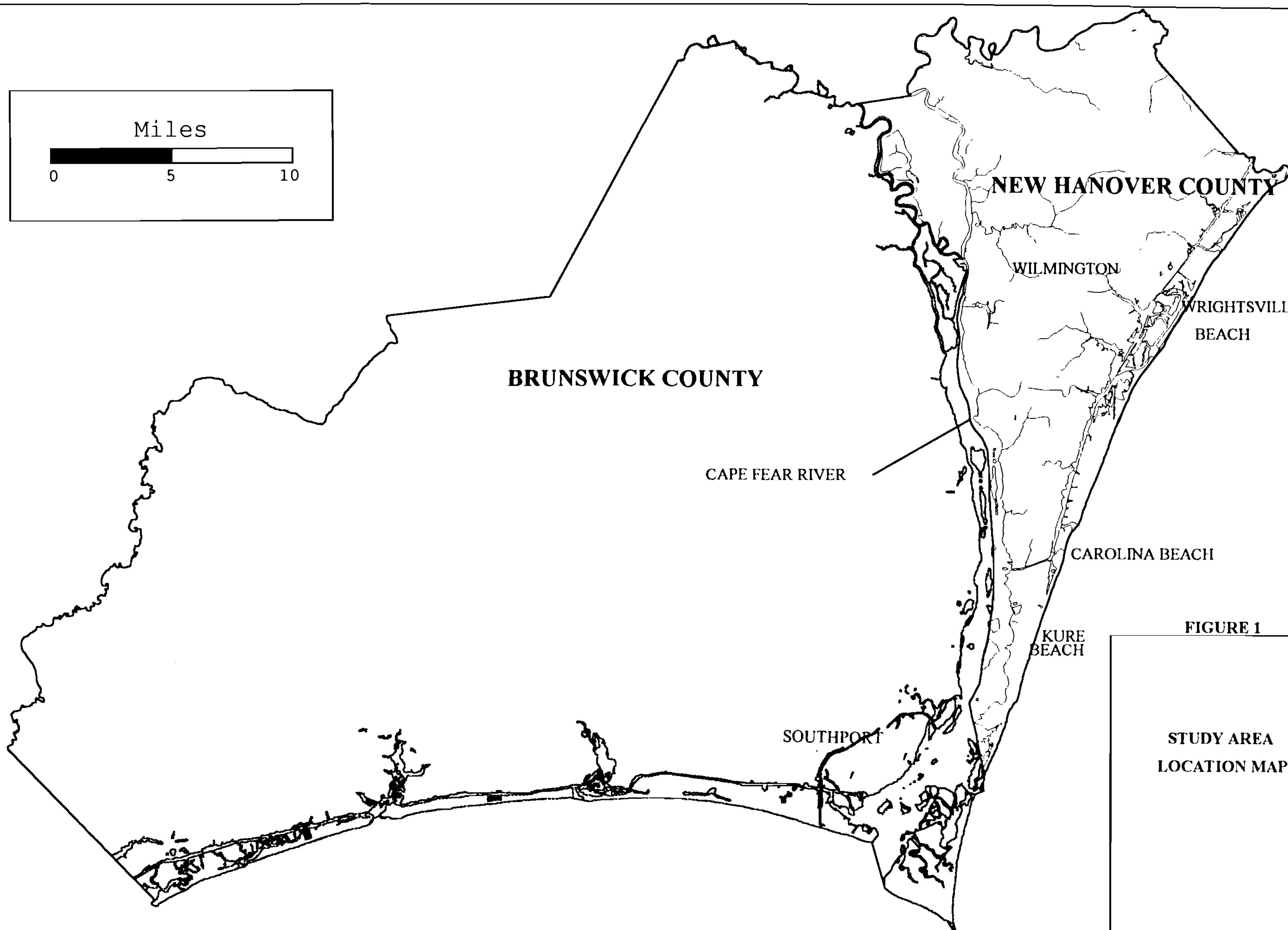


FIGURE 1

STUDY AREA LOCATION MAP

GEOLOGIC UNITS			HYDROGEOLOGIC UNITS
SYSTEM	SERIES	FORMATION	AQUIFERS AND CONFINING UNITS
Quaternary	Holocene	Undifferentiated	Surficial aquifer
	Pleistocene		
Tertiary	Pliocene	Undifferentiated	Tertiary aquifer and confining unit [4]
	Oligocene	River Bend Fm. [1]	
	Eocene	Castle Hayne Fm.	Castle Hayne aquifer and confining unit
	Paleocene	Beaufort Fm. [2]	
Cretaceous	Upper Cretaceous	Rocky Point Member [3]	Pee Dee aquifer and confining unit
		Pee Dee Formation	
		Black Creek Formation	Black Creek Confining Unit
			Black Creek aquifer

1. Present only in southern New Hanover County.
2. Present only in southern New Hanover and southeastern Brunswick County.
3. Present only in north central New Hanover County and southeastern Brunswick County.
4. Confining unit is discontinuous through study area.

Figure 2. General relationship between geologic and hydrogeologic units in Wilmington Harbor study area. (geologic units from Zarra, 1991)

and 1980s in Eastern Brunswick County. As a result of his data collection and interpretation efforts, much valuable information was provided on the aquifer system, covering the range between basement and the water table aquifer.

As a part of the U.S. Geological Survey Regional Aquifer System Analysis Program (RASA), Winner and Coble (1989), conducted a regional hydrogeologic framework study of the North Carolina Coastal Plain, including Brunswick and Northern New Hanover Counties. They identified and described six major aquifers and five confining units from basement to surface in the Wilmington Harbor Study area.

Zarra (1991) conducted a reconnaissance study to identify and delineate Cenozoic Formations and informal stratigraphic units in Brunswick and New Hanover Counties.

Descriptions of the various geologic formations that compose the North Carolina Coastal Plain sedimentary column are included in various regional geologic reports. Examples include Brown (1972), Dennison and Wheeler (1975), Mixon and Pilkey (1976), and Harris, Thayer and Curran (1986).

ACKNOWLEDGEMENTS

Thanks are extended to the U.S. Geological Survey Water Resources Branch, North Carolina Geological Survey, North Carolina DWQ-Groundwater Section, and U.S Army Corps of Engineers for providing valuable data used in this study. Appreciation is expressed to Bob Evans of the U.S.Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi for his work in the design and construction of the model, and running of model simulations. Thanks are extended to the following individuals and organizations who allowed DWR employees access to private wells for monthly data collection, and in some cases assigned their own personnel to assist: The Town of Carolina Beach, The Town of Wrightsville Beach, Walter J. Hodder, Corning Inc., U.S. Army Sunny Point Terminal, Cape Industries, Carolina Power and Light-Sutton Lake Plant, Arcadian Corporation and the North Carolina State Aquarium.

HYDROGEOLOGIC SETTING

The Wilmington Harbor Project study area is situated in the Tidewater region of the North Carolina Coastal Plain physiographic province (figure 3). In this area, large rivers such as the Cape Fear River and its tributaries are affected by oceanic tides. The region is generally of low relief, and is swampy in many places. Land surface elevations range from sea level to 80 feet above sea level.

The study area is underlain by an eastward thickening wedge of sediments and sedimentary rock of Cretaceous to Quaternary age, consisting of sands, conglomerates, silts, clays, shell hash and fossiliferous limestones that were deposited in near-shore to deeper marine environments. The Upper Cretaceous through Tertiary section is commonly glauconitic, and contains some slightly to highly phosphatic units (Zarra, 1991). Sediments of the study area lie on an eroded surface of Precambrian or Early Paleozoic age igneous and metamorphic basement rocks which range in altitude between 1120 feet below sea level (NGVD 1929) at Supply in Brunswick County, to 1550 feet below mean sea level in southern New Hanover County.

The sediments have been differentiated into geologic formations and formation members based

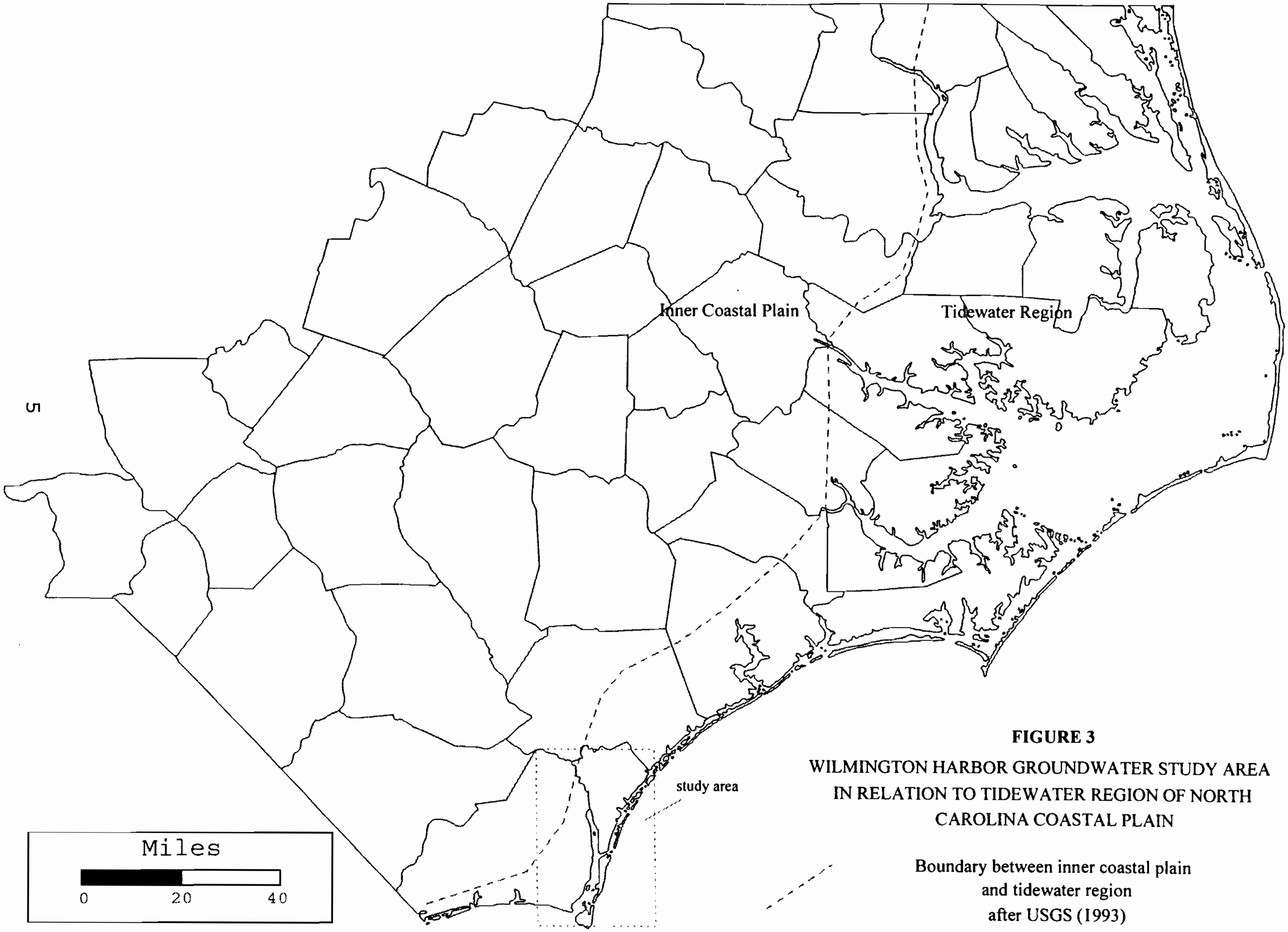


FIGURE 3
WILMINGTON HARBOR GROUNDWATER STUDY AREA
IN RELATION TO TIDEWATER REGION OF NORTH
CAROLINA COASTAL PLAIN

on paleontological characteristics and lithologic similarities. Formations included in the stratigraphic interval studied are shown in figure 2. Differentiation of the sedimentary column into distinctive aquifers is dependent upon the mapping of hydraulically connected permeable units, the boundaries of which may not follow those of stratigraphic units. Differences in boundaries result from facies changes and regional and localized unconformities present in the geologic section. Aquifers and confining units recognized within the geologic section are shown in comparison with formation and member boundaries in figure 2.

Recharge to New Hanover and Brunswick County aquifers occurs by rainfall in the interstream areas, and by lateral inflow from areas located up gradient to the study region. Heath (1980) estimated recharge to North Carolina Coastal Plain aquifers to be in the range of 5 to 21 inches of rainfall per year. In the Castle Hayne and Peedee aquifer recharge areas, water leaks downward from the surficial aquifer through the confining beds. In these recharge areas, the water table in the surficial aquifer is above the potentiometric surface of the underlying Castle Hayne or Peedee aquifer. The rate of recharge depends on the difference in head values between the surficial aquifer system and the Castle Hayne or Peedee aquifer, and on the thickness and permeability of the confining beds. Recharge rates are proportional to head difference and confining bed permeability and are inversely proportional to confining bed thickness. Water levels are highest in interstream areas and lower where discharge takes place along the Atlantic coast, the Cape Fear River, and other rivers, streams, swamps, and lakes in the region. Ground water flow directions follow a complex three-dimensional pattern through the aquifer system in the Cape Fear River Basin. Ground water flows laterally through aquifers from recharge to discharge areas along flowlines which parallel directions of steepest hydraulic gradient, and well as vertically downward or upward in response to differences in total hydraulic head between aquifers.

For modeling purposes, rainfall data was obtained from the National Climatic Data Center covering the simulation period of June, 1993 through September, 1994. Total rainfall was reported to be 81 inches over the 16 month time span, with an estimated 34 inches of recharge. Recharge was calculated using a method (EPA,1985) which involved subtracting evapotranspiration and runoff from total rainfall, taking into account local soil types and the variation in soil moisture content from wet to dry periods.

METHODS USED FOR DELINEATION OF HYDROGEOLOGIC UNITS

In order to provide a conceptual model for ground water flow simulations, the Upper Cretaceous through Quaternary sediments of New Hanover and Eastern Brunswick Counties were separated into component aquifers and confining units by integration of the following tools and techniques:

1. Observation of significant differences in hydraulic head across confining units, indicating hydraulic separation between aquifers. This method was used only in areas that were not being influenced by pumping.

2. Interpretation and correlation of borehole geophysical logs, including spontaneous potential, gamma ray, and resistivity logs. Density and neutron logs were found to be available on a few exploratory wells drilled by oil and gas companies.

3. Interpretation of lithologic logs from both core and cutting samples.

4. Observation of differences in chloride concentrations across confining units, and chloride

concentration similarities within the same aquifer.

5. Drawdown effects observed from pump test data.

Confining units separating aquifers are composed of beds, or groups of beds composed of clay, silt, and varying amounts of sand or calcium carbonate material. Some confining units are correlative over large areas of the study region, and some, specifically within the Peedee Formation, have very limited lateral extent. It is recognized that confining units may not be stratigraphically equivalent everywhere, however, the most important factor is whether or not they cause hydraulic separation between aquifers. Aquifers recognized within the hydrogeologic section of concern in this study include the surficial, Castle Hayne, and the Peedee . The lowermost freshwater bearing zone occurs within the upper half of the Peedee aquifer, as indicated on regional cross-sections (Appendix: figures A-3 through A-12). Confining units recognized were assigned numbers as indicated in the cross-sections. Three of the 14 confining units recognized have regional continuity and cause widespread separation between the surficial, Castle Hayne, Peedee and Black Creek aquifers. The Peedee aquifer is subdivided over regions of varying extent by a series of regionally discontinuous clay, silt, and sandy clay deposits designated in this study as confining units 3A through 7. Due to their discontinuous nature, these confining units cause intermittent hydraulic separation of the overall Peedee aquifer into a series of sub-aquifers, none of which exhibit widespread lateral continuity.

The Pliocene-Pleistocene age section above the Castle Hayne confining unit (CU-2) contains discontinuous clay and sandy clay beds that cause confinement over limited areas. These units are named CU-1 and CU-1A (Appendix: figures A-4, A-5, A-6, A-9, and A-10). These confining beds do not provide a regional basis for further aquifer separation above the Castle Hayne confining unit. Over localized areas, they do provide a basis for further separation.

Borehole Geophysical Logs and Lithologic Logs

One hundred twenty five borehole geophysical logs and 56 lithologic logs were available on a total of 127 boreholes used in this study for investigation of the subsurface (figure 4). The combination of both types of data provided for lithologic differentiation both laterally and vertically through the stratigraphic section. Where geophysical logs were of poor or questionable quality more emphasis was placed on the lithologic log, and vice versa. The most common geophysical log types used were the spontaneous potential (SP), gamma ray, single point resistance, and resistivity.

The spontaneous potential log is a recording versus depth of the difference between the potential of a movable electrode in the borehole and the fixed potential of a surface electrode. The SP is the resulting effect of several electromotive forces, including clay potential, liquid junction potential, and electrokinetic potential. The right-hand boundary of the curve generally indicates impermeable formations such as clay. The left-hand boundary generally indicates formations of higher permeability such as those made up of sand or porous limestone. The SP log was used in this study to determine permeable bed boundaries, estimate permeability, and to estimate clay content of beds. In addition, it permitted correlation of beds from well to well, especially when it was used in conjunction with gamma ray, resistivity and lithologic logs.

The gamma ray curve is a measurement of natural gamma radiation emitted by a geologic formation. Higher curve values were reflective of higher amounts of clay and phosphate minerals in the area of study, whereas lower curve values were indicative of the presence of limestone and sand in the geologic section. Gamma ray curves in many cases were valuable for correlation, by

WILMINGTON HARBOR GROUNDWATER STUDY

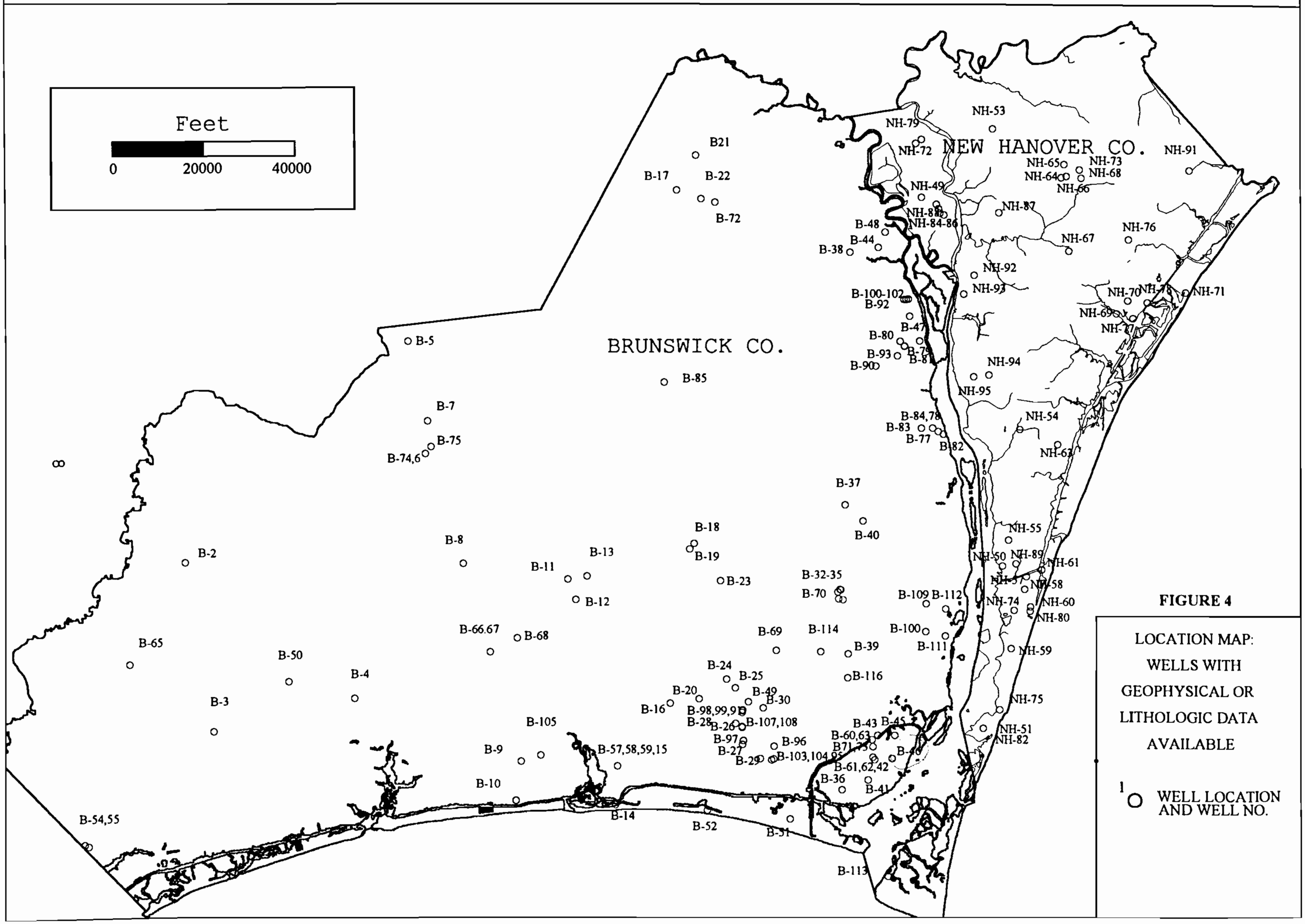


FIGURE 4

LOCATION MAP: WELLS WITH GEOPHYSICAL OR LITHOLOGIC DATA AVAILABLE virtue of having produced distinctive signatures across zones of phosphorite mineralization.

The single point resistance log is a measurement of electrical resistance, measured in ohms, between an electrode in a well and an electrode at the land surface, or between two electrodes in a well. The measurement does not take into account the length or cross-sectional area of the current travel path, and thus can not be used for quantitative interpretation (Keyes, 1987). However, the single point resistance curve was useful for interpreting lithology and for thin bed detection.

Normal resistivity logs measure formation resistivity in ohm-meters, which takes into account the length and cross-sectional area of the current travel path. Thus, short and long normal measurements take into account the intrinsic properties of the material and can be used for quantitative interpretation of formation fluids. The long normal curve provides a reading beyond the flushed zone of the borehole where formation fluids are generally undisturbed by drilling fluid. Resistivity curves in combination with SP and gamma ray curves helped to distinguish between freshwater and saltwater bearing strata, and between permeable and nonpermeable strata.

A data base of 55 cores from the bottom of the Wilmington Harbor shipping channel was used to determine the position of the channel in relation to hydrogeologic and geologic units (figure 5). The cores span the range of the river from Castle Street (north of Wilmington) to the Lilliput channel (across from Orton Plantation in Brunswick County), and average 3.6 feet of recovery. The maximum recovery was nine feet. According to plans, the channel would be deepened to a maximum of five additional feet.

Ground Water Levels and Chloride Distribution

For the purposes of this study, monthly ground water level data collection began in June, 1993 and continued through September, 1994. Water levels and chloride concentration data were collected from a network of 67 wells distributed throughout the study region (Appendix: tables A-1 and A-2, figure A-13). Included in the network are several ground water monitoring research stations installed by the North Carolina DWQ-Ground Water Section and by the U.S. Army at the Sunny Point Military Ocean Terminal. Research station data was used for determining hydraulic head and chloride distribution throughout the hydrogeologic interval studied. Used in combination with well log correlations, plotting of head and chloride distribution data provided an accurate way of differentiating between aquifers and confining units, and for tracing their lateral continuity. Drawdown data from multi-well pump tests was also used for this purpose. In areas where research station data was not available, more emphasis was placed on well log interpretation and correlation.

Pump Test Data

Pump test data from 130 wells was used for calculation of hydraulic conductivity, transmissivity, and storativity values. The database included several NCDWQ-Ground Water Section Research Station pump tests, numerous multi-well tests from the U.S. Army Military Ocean Terminal, Carolina Beach area tests performed by the U.S. Army Corps of Engineers, and numerous data from other sources in the study region (Appendix: tables A-3,4,5). Some of the data from New Hanover County was taken from Bain (1970). Analysis of pump test data from the region indicates that most of the confining units have sufficient vertical hydraulic conductivity to be termed "leaky". In other words, water is transmitted into the aquifer from or through the overlying leaky confining bed in response to pumping, causing drawdowns to differ from those that would be predicted by the Theis equation (Heath, 1987). Therefore, methods used to analyze pump tests for this region were primarily those developed for semi-confined aquifers. Methods used included

WILMINGTON HARBOR GROUNDWATER STUDY

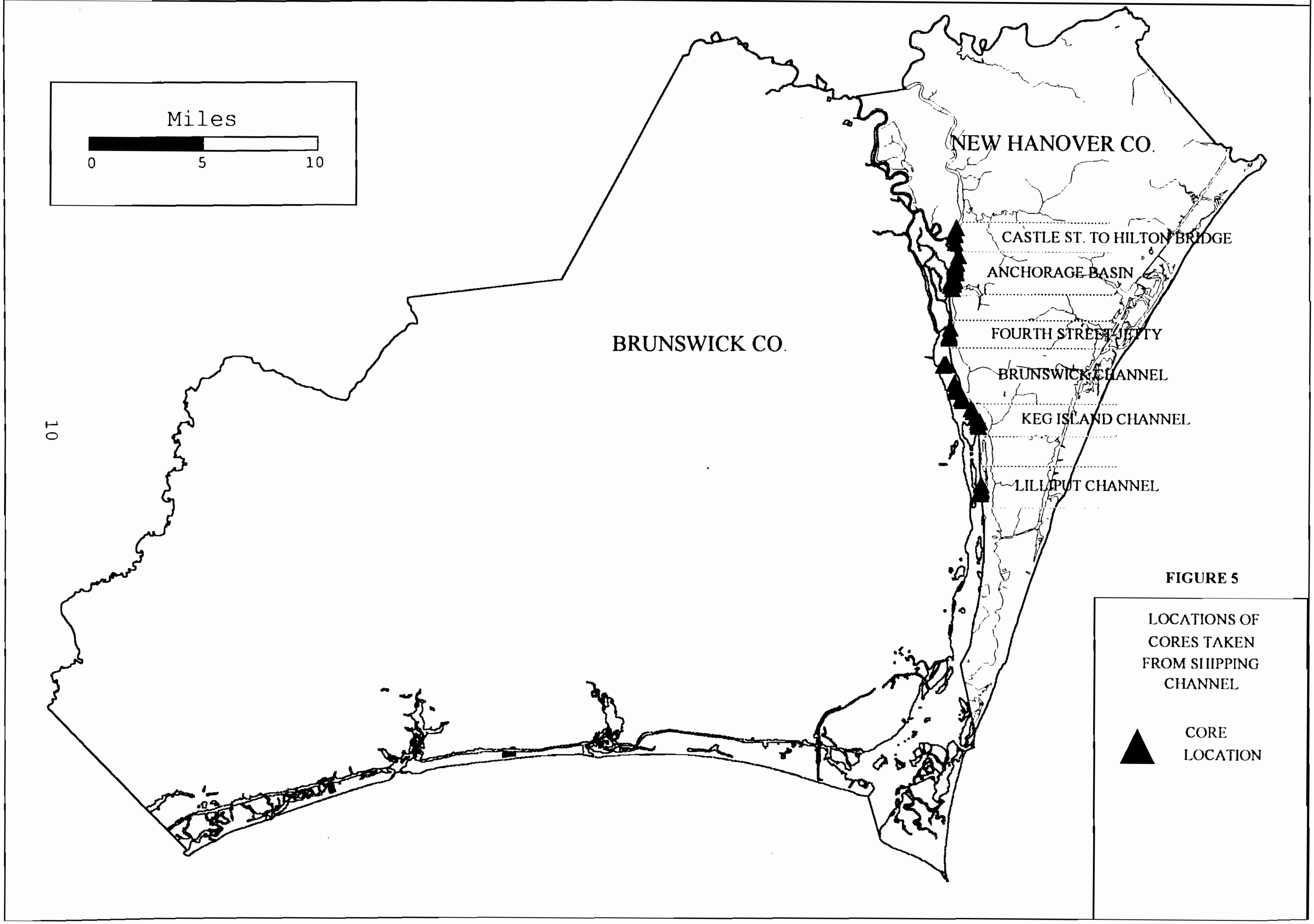


FIGURE 5

those developed by Hantush-Jacob, and Walton (described in Fetter, 1988). For the surficial, unconfined aquifer the Neuman method was used (Neuman, 1975).

MAPPING TECHNIQUES

The initial step in the process of mapping the various aquifers and confining units recognized within the study area was to construct a network of intersecting cross sections in approximate parallel orientation to the dip and strike of bedding (Appendix: figures A-2 through A-12). Thirty-one wells with borehole geophysical and lithologic logs, as well as four lithologic logs from core samples taken from the base of the Cape Fear River shipping channel were used to construct the cross-section network. This provided a basic framework from which to tie in well log data from the remaining 96 well data base. Using altitude values calculated from logs, contour maps were prepared of the altitude of the top of each of the major aquifers and confining units recognized. In addition, isopach (thickness) maps were prepared for each aquifer and confining unit (Appendix: figures A-19 through A-30).

Where a confining unit was inferred to pinch out (due to changes in depositional environment, erosion, or nondeposition) on an isopach map, the isopach map was overlain with an altitude map of the top of the underlying aquifer, and the altitude contours were terminated against the zero thickness line of the confining unit. As a matter of course, if another confining unit exists higher in the stratigraphic section, the top of the mapped aquifer becomes the base of the next higher confining unit. In order to avoid complications that would result from large mapping horizon jumps, altitude lines were left to terminate against zero thickness lines. Moreover, isopach contours of an aquifer were overlain with isopach contours of the overlying confining unit. Aquifer isopach lines were terminated against zero confining unit thickness lines. The aquifer material does not necessarily disappear where its confining unit is absent. It is either unconfined, or confined from another clay or silt unit higher in the section.

HYDROGEOLOGIC FRAMEWORK OF THE STUDY AREA

This section describes each pertinent hydrogeologic unit recognized within the interval and area of investigation in terms of thickness, altitude, lateral extent, hydraulic characteristics, and relation to geologic units. Aquifers are further described in terms of interrelationships, chloride distribution, and natural or pump induced ground water movement. Inasmuch as the focus of this study is to examine the potential for detrimental impacts due to deepening the Cape Fear River shipping channel, special emphasis is placed on the relationship between the river and the aquifers and confining units that connect with or directly underlie the river.

Surficial Aquifer

Over most of the study area, the surficial aquifer is composed primarily of sediments ranging in age from Holocene through Plio-Pleistocene. In areas where detailed, shallow, multi-well research station data was available, thin clay beds of limited extent are found in Plio-Pleistocene strata, and are demonstrated to cause differences in hydraulic head values between under and overlying, water bearing sediments. This was observed in particular at the U.S. Army Sunny Point Military Ocean Terminal (Harshburger and Associates, 1977). Where thin clay units are absent in Plio-Pleistocene sediments, and the Castle Hayne confining unit is absent, Eocene Castle Hayne sediments are probably part of the surficial aquifer. Moreover, in areas where the Castle Hayne Formation is missing and Peedee age sediments are unconfined and close to the surface, the upper Peedee Formation is probably a component of the surficial aquifer. Cross-sections A-A' through Z-Z' (Appendix: figures A-3 through A-12) illustrate these relationships.

For the above-mentioned reasons, the thickness and lithology of the surficial aquifer varies considerably from place to place in the study region.

Holoocene age sediments are made up primarily of medium to fine-grained sands with trace quantities of clay, coarse grained sand, pebbles, and feldspar. Peat is present locally. Underlying Holocene age sediments are the shelly quartz sands and shelly carbonates of Plio-Pleistocene age. Included in the Plio-Pleistocene is the Fort Fisher coquina of southern New Hanover County. Miocene age sediments are present only in the southern tip of New Hanover County (Zarra, 1991). Older sediments which sometimes compose the surficial aquifer are described later in this report.

Hydraulic data calculated for the surficial aquifer are reported in table A-3 (Appendix). Transmissivity values range between 401 and 13369 ft^2/day, with an average of 2790 ft^2/day. Values of hydraulic conductivity range between 18.2 and 607 ft/day, with an average of 130 ft/day.

Chloride concentrations measured from June, 1993 and through September, 1994 are in the range of 5 to 60 parts per million.

The surficial aquifer is recharged by rainfall, and thus serves as a source bed that supplies water moving downward to deeper aquifers. Most of the water received from recharge is discharged laterally via the surficial aquifer to the Cape Fear River, its tributaries, and other local surface water bodies. A small percentage of recharge water reaches the underlying Castle Hayne aquifer through the Castle Hayne confining unit, and the Peedee aquifer through the upper Peedee confining unit.

Castle Hayne Aquifer

The Castle Hayne aquifer within the study region is made up mainly of the Eocene Castle Hayne Formation. It also includes part of the upper Peedee Formation of Cretaceous age in central New Hanover County, part of the lower River Bend Formation of Oligocene age in Southern New Hanover County, and part of the upper Beaufort Formation of Paleocene age in southeastern Brunswick County. The aquifer consists primarily of light gray or white moldic limestones, and bryozoan-rich limestones of the Castle Hayne Formation, grading to calcareous fine grained sandstone in the deeper subsurface. The upper part of the aquifer commonly contains finely disseminated phosphate, allowing for good correlation of gamma ray logs from well to well. Where the upper Peedee, upper Beaufort, and lower River Bend Formations are included, the aquifer may also include gray to light brown silty, fine grained quartz sand, sandy moldic limestone or fine grained shelly sandstone (Appendix: figures A-3 through A-12).

Over localized areas, especially in southeastern Brunswick County, sinkholes have formed in the Castle Hayne formation due to dissolution of the limestone by ground water. This has caused direct hydraulic connection laterally between the Castle Hayne limestone and the permeable beds of younger geologic units in the sinkhole zones.

The top of the aquifer is the base of the Castle Hayne confining unit, a clay to sandy clay bed, or group of beds which is regionally continuous through the southeastern tip of Brunswick County and southern New Hanover County (Appendix: figure A-19).

West of the zero thickness line exhibited on the isopach map of the Castle Hayne confining unit, water bearing geologic units which make up the Castle Hayne aquifer are either confined by higher clay, sandy clay or silt units, or are unconfined. The Castle Hayne Formation thins to zero feet in thickness further to the west of the zero thickness line of the confining unit. The base of the aquifer is defined as the top of the uppermost Peedee confining unit (CU-3), which extends over approximately two-thirds of the study region and includes part of the Beaufort Formation to the south (Appendix: figures A-23 and A-24).

The altitude of the top of the Castle Hayne aquifer ranges between 14 feet above sea level in southeastern Brunswick County to 132 feet below sea level in the Carolina beach area of New Hanover County. The altitude map (Appendix: figure A-22) indicates that the top of the aquifer gently slopes toward the southeast at an average of 20 feet per mile. At the extreme southern edge of the study area the slope lessens to approximately 10 feet per mile.

The Castle Hayne aquifer ranges in thickness from zero feet in eastern Brunswick County and northern New Hanover County to over 78 feet at Carolina Beach in New Hanover County (Appendix: figure A-21). It is inferred that thicknesses exceed 78 feet at Carolina Beach in well numbers NH-60 and NH-80.

A database of hydraulic conductivity, transmissivity and storativity values (Appendix: table A-4) were calculated from pump test data on the Castle Hayne aquifer, indicating the following ranges and averages:

	Range	Average
Hydraulic Conductivity:	3.66 to 108.8 ft/day	38.08 ft./day
Transmissivity:	250 to 10,888 ft^2/day	2,763 ft^2/day
Storativity:	.00006 to .0097	.002

Castle Hayne Confining Unit

The Castle Hayne confining unit is made up of clay, sandy clay, and silt beds that are present in the lower River Bend Formation in southern New Hanover County, lower Plio-Pleistocene deposits, and sometimes in the upper Castle Hayne Formation. As mentioned earlier, this confining unit is regionally continuous through the southeastern tip of Brunswick County and southern New Hanover County (Appendix: figure A-19). The thickness ranges from 0 to 38 feet. In areas where data was available to observe head differentials across the Castle Hayne confining unit, they achieved a maximum of 33 feet. This was observed at the NC-DWQ Southport Research Station No. 3. At this location clay and sandy clay beds of the confining unit are 25 feet thick. At the U.S. Army Sunny Point Military Terminal, little to no head differential was observed across the interval where the Castle Hayne confining unit normally occurs, no clay units are present, and the unit was considered to be absent.

Relationship of Castle Hayne Aquifer and Confining Unit to the Cape Fear River Shipping Channel

Regional cross-sections incorporating shipping channel core data, altitude and isopach maps, and water level maps were analyzed in combination to evaluate the relationship of the Castle Hayne aquifer and confining unit to the shipping channel (refer to Appendix: figures A-1 through A-30). The following determinations were made:

1. The Castle Hayne confining unit is missing along the stretch of the proposed dredge area extending north of the Brunswick channel due to regional erosion or non-deposition of confining beds (Appendix: figures A-3, A-12, A-19 and A-20). The Cape Fear River and shipping channel have completely penetrated the confining unit in the Brunswick, Big Island and Keg Island channels, where the base elevation averages 38.8 feet below sea level (Appendix: figures A-3 and A-20). Further south along the river, cores from Lilliput channel were taken within the same stratigraphic interval where the confining unit normally occurs. One core (CB-51) out of six total, contained lithology indicative of the presence of confining beds. This was a silty clay bed which was present only in the top 1.5 feet of the 6.8 foot core. South of the Lilliput channel to the mouth of the river, core data is not available at this time. However, maps and cross-sections indicate that dredging the lower reaches of the channel south of Lilliput channel could easily incise the confining unit where its elevation is very close to the elevation of the base of the channel. This would pose a risk of increasing the degree of hydraulic connection between the river and Castle Hayne aquifer.

2. Along the length of the river north of, and including the Lilliput channel, clay beds which are sometimes present in the upper Plio-Pleistocene section have been incised by the existing river channel. This is illustrated in cross-sections C-C' and D-D' (Appendix: figures A-5 and A-6).

3. The Castle Hayne aquifer as delineated in this study is not present within the proposed dredge area north of the Brunswick channel (Appendix: figures A-3, A-21 and A-22). Cores taken from southern Brunswick, Big Island, and Keg Island channels are all within the Castle Hayne aquifer. South of Keg Island channel, the channel base is either just above, or within the Castle Hayne confining unit over areas of varying extent (Appendix: figures A-7, A-8, A-19 and A-20).

4. A water level contour map of the Castle Hayne aquifer (Appendix: figure A-15) indicates that its potentiometric surface is above the elevation of the surface of the Cape Fear River within the study area. This indicates that the Castle Hayne aquifer primarily has a discharge relationship to the Cape Fear River.

5. Research station head data near the river in the Southport area indicates an upward component of ground water flow from the Peedee aquifer to the Castle Hayne aquifer, and a downward component of flow from the surficial aquifer to the Castle Hayne aquifer. Discharge into the river in this region apparently takes place from all three aquifers.

Chloride Distribution in the Castle Hayne Aquifer

Chloride concentration data gathered from the Castle Hayne aquifer on a monthly basis from June, 1993 through Sept., 1994 indicate a range of 15 to 1150 parts per million (Appendix: table A-2). Levels exceeding the drinking water threshold of 250 ppm were found only in two wells at the North Carolina State Aquarium and in several wells at the U.S. Army Sunny Point Military Ocean Terminal. High levels at the Sunny Point Terminal are due to contamination from dredge disposal lagoons on the site. High levels in the NC State Aquarium are due to close proximity to the Atlantic Ocean and the lower Cape Fear River. Levels as high as 210 ppm were found in one well at Carolina Beach. With the exception of these few locations, chloride levels in the Castle Hayne aquifer were low in the region of study.

Peedee Aquifer

As mentioned previously, the Peedee Aquifer is subdivided over regions of varying extent by a series of regionally discontinuous clay, silt, and sandy clay deposits which are designated in this study as confining units 3A through 7. Due to their discontinuous nature, these confining units cause intermittent hydraulic separation of the overall Peedee aquifer into a series of sub-aquifers, none of which exhibit widespread lateral continuity. The Peedee aquifer within the area of investigation is made up primarily of the Upper Cretaceous Peedee Formation. It also includes permeable beds within the lower Beaufort Formation (Paleocene) in the southeastern corner of the area. In southeastern Brunswick and north central New Hanover Counties, the Rocky Point Member makes up the uppermost part of the Peedee Formation. The Peedee aquifer consists primarily of gray or light brown, silty, fine to very fine grained quartz sand with trace quantities of glauconite, phosphorite, oyster shells, and pyrite (Zarra, 1991). Where the lower Beaufort Formation is included, the upper part of the aquifer consists of fine-grained sandstone with traces of glauconite, mica or pyrite. Where the Rocky Point Member is present, the aquifer also consists of gray, sandy, moldic limestone, grading downward to a very calcareous sandstone (Zarra, 1991). The upper part of the Rocky Point Member is rich in phosphorite, producing distinctive gamma ray responses that can be correlated from well to well.

The top of the Peedee aquifer is defined as the base of the uppermost Peedee confining unit (CU-3), which extends over approximately two-thirds of the study region (Appendix: figures A-23 and A-24). The base of the aquifer is defined as the top of the Black Creek confining unit (CU-8), which is continuous throughout the study region (Appendix: figures A-28 through 30). Where CU-3 is missing over parts of the study area, the Peedee aquifer is in direct hydraulic communication with the Castle Hayne aquifer. The Black Creek confining unit, (CU-8) in all likelihood, produces good hydraulic separation of the Peedee and underlying Black Creek aquifer over most of the study region.

The altitude of the top of the Peedee aquifer ranges between 38 feet above sea level in north-eastern Brunswick County to 219 feet below sea level in southern New Hanover County (Appendix: figure A-25). The top of the aquifer gently slopes toward the southeast at an average of 17 feet per mile. A database of hydraulic conductivity, transmissivity, and storativity values (Appendix: table A-5) were calculated from pump test data on the Peedee aquifer, indicating the following ranges and averages:

	Range	Average
Hydraulic Conductivity:	1.02 to 243 ft/day	38.26 ft/day
Transmissivity:	128 to 18620 ft^2/day	3062.9 ft^2/day
Storativity:	.00002 to .1	.014

Peedee Confining Units

Peedee confining units recognized within the study area are all within the Upper Cretaceous Peedee Formation, with the exception of the uppermost confining unit, CU-3. This unit is part of the Paleocene Beaufort Formation in the southeastern part of the study region. Elsewhere it is present within the Peedee Formation. In most cases, Peedee confining units were identified on the basis of borehole geophysical and lithologic log interpretation and correlation. Where data was available to determine hydraulic head differentials across CU-3, they ranged between 3 and 12 feet, with an average of 9 feet. A maximum differential of 12 feet occurred across CU-3 at NC-DWQ Southport Research Station 2. A 22 foot head difference was observed across CU-4 at the

NC-DWQ Maco Tower Research Station, and a 5.7 foot difference was observed across CU-5 at the Sunset Harbor Research Station.

CU-3 ranges in thickness from zero to 50 feet across the study region as shown by an isopach map (Appendix: figure A-23). It has a widespread lateral extent, covering approximately two-thirds of the study region. Its altitude ranges from 31 feet above sea level in western Brunswick County to 175 feet below sea level at Carolina Beach in New Hanover County (Appendix: figure A-24). CU-3A is found in only two wells as shown on figure A-26 and cross-section B-B' (Appendix: figure A-4). CU-4 ranges in thickness from zero to greater than 92 feet (Appendix: figure A-27). It is of limited lateral extent, being present exclusively in northern New Hanover and Brunswick Counties, and south central Brunswick County. It was considered to be superfluous for the purposes of this study to map confining units 4A through 7, since they are discontinuous and of limited regional significance (Appendix: figures A-3 through A-12). Furthermore, they are located well below the incision of the Cape Fear River and shipping channel.

Relationship of Peedee Aquifer and Peedee Confining Units to the Cape Fear Shipping Channel

Regional cross-sections incorporating shipping channel data, altitude and isopach maps, and water level maps were analyzed in combination to evaluate the relationship of the Peedee aquifer and confining units to the Cape Fear shipping channel (refer to Appendix: figures A-3 through A-30). The following determinations were made:

1. Peedee confining unit CU-3 was completely incised, where formerly present, by the Cape Fear River and shipping channel from Castle Street to Hilton Bridge in Wilmington, through the northern part of Brunswick channel (Appendix: figures A-11, A-12, A-23, and A-24).

2. Maps, cross-sections and core data indicate that the shipping channel contacts the Peedee aquifer from Castle Street to Hilton Bridge through the northern part of Brunswick channel (Appendix: figures A-11, A-12, and A-25). Core lithologies are primarily sandy moldic limestone (indicative of the Rocky Point Member/upper Peedee Formation), and carbonate cemented, fine-grained sandstone. The Peedee aquifer is below the proposed dredge zone from the southern part of Brunswick channel to the mouth of the Cape Fear River.

3. The potentiometric surface of the Peedee aquifer, as shown on figure A-17, exhibits a higher elevation than the surface of the Cape Fear River throughout the length of the shipping channel. This indicates that the Peedee aquifer has primarily a discharge relationship to the channel. As discussed earlier, an upward component of ground water flow from the Peedee to the Castle Hayne aquifer was observed to occur along the edge of the river in the Southport region of Brunswick County.

Chloride Distribution in the Peedee Aquifer

Chloride concentration data gathered from the Peedee aquifer on a monthly basis since June, 1993 indicates a range of 10 to 169 parts per million (Appendix: table A-2). With the exception of the North Carolina State Aquarium wells, which show chloride concentrations as high as 1150 parts per million in the overlying Castle Hayne aquifer, wells sampled were not of sufficient depth to determine the position of the freshwater-saltwater interface. NC-DWQ Ground Water Section research station data from central Brunswick County and data from the USGS RASA study

(Winner and Coble, 1989) does, however, indicate the position of the interface, and was plotted on cross-sections constructed for this study (Appendix: figures A-6, A-7, and A-10).

Black Creek Confining Unit

The Black Creek confining unit (CU-8) was the deepest hydrogeologic unit mapped in this study. It maintains an average thickness of 68 feet (Appendix: figure A-28) and is continuous throughout the mapped area. Where data was available to observe hydraulic head differentials across this unit, they ranged between 5 and 18.6 feet, with an average value of 10 feet. The altitude of the top of the Black Creek confining unit ranges between 307 feet below sea level in western Brunswick County to 534 feet below sea level as observed in the Coastal States, No.1 Suggs in southern New Hanover County (Appendix: figure A-29). The lithology of this unit consists of clay, with variable amounts of sand and silt.

GROUND WATER WITHDRAWALS

In order to account for the influence of major pumping centers in the study area on the ground water system, and in particular, the Cape Fear River, ground water withdrawal data was collected for the modeling period of June, 1993 through September, 1994 (Appendix: table A-6). In addition, projections of future pumping rates up to the year 2020 were obtained through State of North Carolina Water Supply Plans and questionnaires (Appendix: table A-6). For the purposes of this study, pumping data was collected only for wells which withdraw 10,000 gallons per day or more, during any given period of time.

Water level contour maps of the Castle Hayne and Peedee aquifers for the summer months of 1993 indicate that cones of depression are present, occurring primarily as a result of pumping from municipal water supply wells in the cities of Wrightsville Beach and Carolina Beach (Appendix: figures A-15 and A-17).

GROUND WATER FLOW

Recharge to New Hanover and Brunswick County aquifers occurs by rainfall in the inter-stream areas, and by lateral inflow from areas located upgradient to the study area. Heath (1980) estimated recharge to North Carolina Coastal Plain aquifers to be in the range of 5 to 21 inches of rainfall per year. In the Castle Hayne and Peedee aquifer recharge areas, water leaks downward from the surficial aquifer, through the confining beds. In these recharge areas, the water table in the surficial aquifer is above the potentiometric surface of the underlying Castle Hayne or Peedee aquifer. The rate of recharge depends on the difference in head values between the surficial aquifer and the Castle Hayne or Peedee aquifer, and on the thickness and permeability of the confining beds. Recharge rates are proportional to head difference and confining bed permeability and are inversely proportional to confining bed thickness. Water levels are highest in interstream areas and lower where discharge takes place along the Atlantic coast, the Cape Fear River, and other rivers, streams, swamps and lakes in the region. Ground water flow directions follow a complex pattern through the aquifer system in the Cape Fear River Basin are illustrated in figure 6. Ground water flows laterally through aquifers from recharge to discharge areas along flowlines which parallel directions of steepest hydraulic gradient, and well as vertically downward or upward in response to differences in total hydraulic head between aquifers.

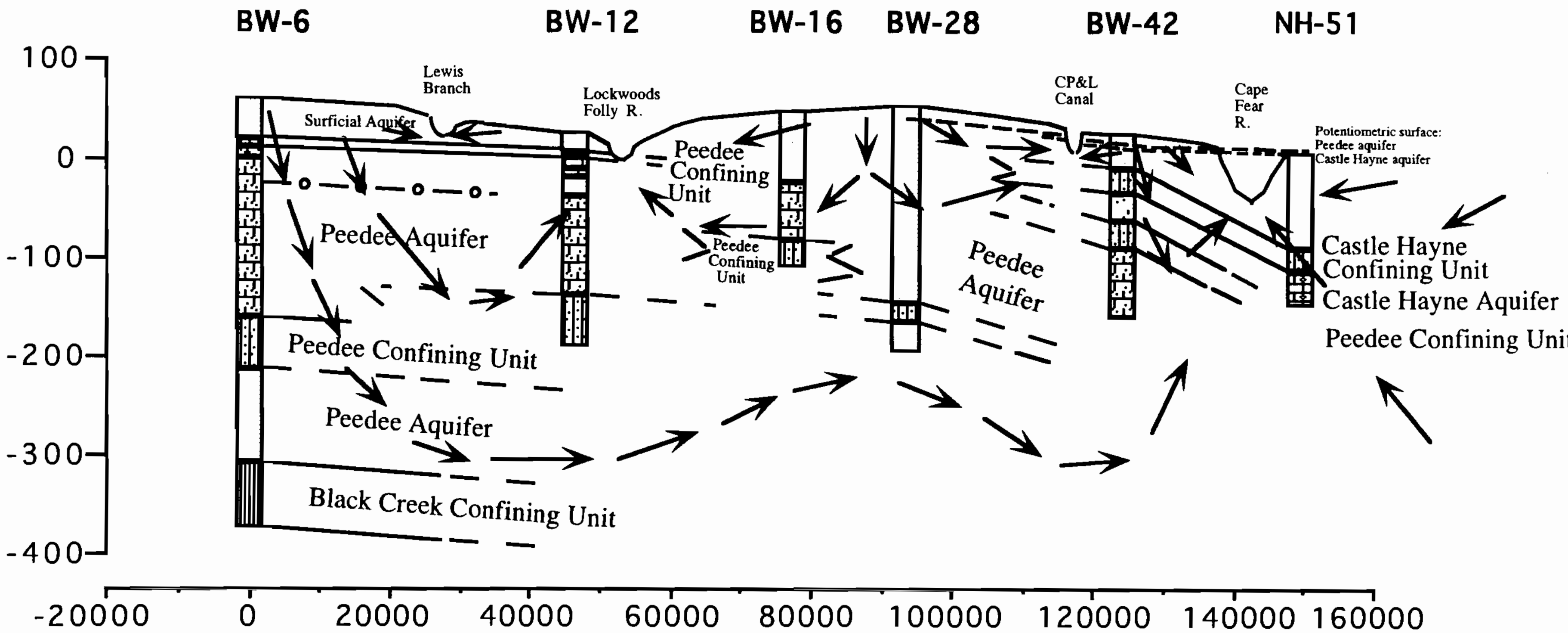


FIGURE 6

Hydrogeologic Units and Ground Water Flow Along W-E Cross-Section E-E'. Trace of Section Shown in Appendix Figure A-2. New Hanover and Brunswick Counties, NC. Datum: Sea Level

o—o—o — Line of equal chloride concentration 250 ppm

→ General direction of ground water flow

Cones of depression in response to ground water withdrawals from municipal well fields are evident on the Castle Hayne potentiometric surface at Carolina Beach, and on the Peedee potentiometric surface at Wrightsville Beach in New Hanover County (Appendix: figure A-15 and A-17).

As mentioned earlier, rainfall data was obtained from the National Climatic Data Center covering the model simulation period of June, 1993 through September, 1994. Total rainfall was reported to be 81 inches over the 16 month time span, with an estimated 34 inches of recharge. Recharge was calculated using a method (EPA,1985) which involved subtracting evapo-transpiration and runoff from total rainfall, taking into account local soil types and the variation in soil moisture content from wet to dry periods.

The Cape Fear River is identified as an area of natural discharge from the surficial, Castle Hayne and Peedee aquifers. This is evidenced by the higher elevations of water level contours relative to the elevation of the river surface. Research station data along the Cape Fear River in Brunswick County indicates an upward component of ground water flow from the Peedee aquifer to the Castle Hayne aquifer. This is indicated by lower values of hydraulic head in the Castle Hayne than in the Peedee aquifer.

PART 1: SUMMARY AND CONCLUSIONS

A proposal by the State of North Carolina to deepen the 26 mile long Wilmington Harbor shipping channel has provided an impetus for a joint feasibility study with the U.S. Army Corps of Engineers to investigate the potential for detrimental environmental impacts. Of particular concern is the possibility of causing irreversible alteration of the natural ground water regime in the form of changes in ground water flow patterns, lowering of hydraulic heads in the local aquifer system, and saltwater intrusion into fresh ground water supplies.

The study area encompasses New Hanover County, and Eastern Brunswick County, North Carolina. The region is underlain by an eastward thickening wedge of sediments and partially consolidated rock of Cretaceous to Quaternary age, consisting of interbedded sands, calcareous sands, conglomerates, silts, clays, shell hash, and fossiliferous limestones that were deposited in near-shore to deeper marine environments. The hydrogeologic section studied includes all units recognized between the top of the Black Creek aquifer and the top of the surficial aquifer. Within this interval, three major aquifers, and three major confining units are recognized. They include the surficial, Castle Hayne, and Peedee aquifers, and the Castle Hayne, Peedee, and Black Creek confining units. The principle freshwater bearing aquifers are the surficial, Castle Hayne, and the upper Peedee as indicated by chloride concentration analyses.

Hydrogeologic units within the study area were mapped and described using borehole geophysical logs, lithologic logs, aquifer test data, chloride and water level data. Each pertinent hydrogeologic unit was described in terms of altitude, thickness, lateral extent, hydraulic characteristics, and relation to geologic units. Aquifers were further described in terms of interrelationships, chloride distribution, and natural or pump induced ground water movement.

The surficial aquifer is composed mainly of sediments ranging in age from Holocene through Plio-Pleistocene. Over regions of varying extent it also includes older sedimentary units, depending on the presence or absence of confining units and the thickness of strata. The surficial aquifer is directly recharged by rainfall in the interstream areas of the study region, discharging laterally into the Cape Fear River and its tributaries, and downward to deeper confined aquifers.

Recharge rates to the surficial aquifer were calculated to be 34 inches over the 16 month modeling period (June, 1993 through Sept. 1994).

Hydraulic data calculated for the surficial aquifer indicate a hydraulic conductivity range of 18.2 to 607 ft/day, with an average of 130 ft/day. Transmissivity values range from 401 to 13,369 ft^2/day, with an average of 2,790 ft^2/day. Chloride concentrations range between 10 and 60 parts per million.

The Castle Hayne aquifer within the region of study is made up primarily of the Eocene Castle Hayne Formation, and over areas of varying extent the upper Peedee Formation of Cretaceous age, lower River Bend Formation of Oligocene age, and upper Beaufort Formation of Paleocene age. The aquifer is composed primarily of bryozoan rich limestone and moldic limestone, grading to calcareous fine grained sandstone in the deeper subsurface in southern New Hanover County. The top of the aquifer ranges from 14 feet above sea level to 132 feet below sea level over the mapped area, and slopes southeastward at 20 feet per mile. Its thickness ranges from 0 to greater than 78 feet. Hydraulic conductivity values range from 3.66 to 108.8 ft/day, with an average of 38.08 ft/day. Transmissivity values range from 250 to 10,888 ft^2/day, with an average of 2,763 ft^2/day. Storativities range from .00006 to .0097, with an average of .002. Chloride concentrations range from 15 to 862 parts per million.

The Castle Hayne confining unit overlies the Castle Hayne aquifer and is made up of clay, sandy clay and silt beds. The unit is regionally continuous over southern New Hanover County and the southeastern tip of Brunswick County. Its thickness ranges from 0 to 38 feet. Hydraulic head differentials across the unit average 21 feet, and range between 14.4 and 33 feet.

The Peedee aquifer within the region of study is made up primarily of the Cretaceous Peedee Formation. It also includes over regions of variable extent, the lower Beaufort Formation of Paleocene age. It is composed primarily of gray or light brown silty, fine to very fine grained quartz sand. The top of the Peedee aquifer ranges between 38 feet above sea level to 219 feet below sea level, and slopes to the southeast at 17 feet per mile.

Hydraulic conductivity values range from 1.02 to 243 ft/day, with an average of 38.26 ft/day. Transmissivity values range from 128 to 18,620 ft^2/day, with an average of 3063 ft^2/day. Storativities range from .00002 to .1, with an average of .014.

Chloride concentrations from the freshwater zone of the aquifer are in the range of 10 to 169 parts per million. A freshwater-saltwater interface occurs within the upper half of the aquifer, as exhibited in a network of regional cross sections prepared for the study.

The Peedee aquifer is overlain by the Peedee confining unit, which is continuous over approximately two-thirds of the area. The unit ranges in thickness between 0 and 50 feet. The average hydraulic differential across it is 9 feet, ranging between 3 and 12 feet.

The top of Black Creek confining unit is the base of the Peedee aquifer. This confining unit maintains an average thickness of 68 feet, and is continuous throughout the area of study. Hydraulic head differentials range between 5 and 18.6 feet, with an average value of 10 feet. The top of the Black Creek confining unit ranges between 307 feet below sea level to 534 feet below sea level.

Altitude and isopach maps, water level data, and regional cross-sections incorporating shipping channel core data, indicate the following relationships between the hydrogeologic section and the

Cape Fear shipping channel:

- Findings of the framework study indicate that the surficial, Castle Hayne and Peedee aquifers exhibit a discharge relationship to the Cape Fear River along the twenty-six mile length of the shipping channel.

- From north to south along the length of the channel, hydrogeologic data indicate that from Castle Street through the northern part of Brunswick channel the base of the shipping channel is within the Peedee aquifer. Five feet of deepening along this stretch would increase the surface area of the Peedee aquifer exposed to the channel.

- From the northern part of the Brunswick through the Lilliput channel the base is within the Castle Hayne aquifer. Thus, deepening along this stretch would increase the surface area of the Castle Hayne aquifer exposed to the channel.

- From south of Lilliput channel to the mouth of the Cape Fear River, maps and cross-sections indicate that deepening the existing channel may cause penetration, or increase penetration of the channel into the Castle Hayne confining unit.

PART 2: GROUND WATER MODELING

INTRODUCTION

The primary objective of the ground water modeling phase of the Wilmington Harbor Study is to determine if deepening the shipping channel will cause detrimental alterations to the adjoining aquifer system in New Hanover and Brunswick Counties. Possible impacts considered in this investigation include the following:

1. Changes in water levels or directions of ground water movement in the surficial, Castle Hayne or Peedee Aquifers.

2. Saltwater intrusion as a result of changes in the hydraulics of the aquifer system. Possibilities considered include the following:

   - Upward movement of the underlying freshwater/saltwater interface (within the Peedee Aquifer) caused by lowering of hydraulic head in shallower aquifers.

   - Initiation of recharge from the Cape Fear River to the aquifer system due to lowering of hydraulic head in the adjoining aquifers.

In order to investigate these possibilities, the modeling study was designed to test the significance of removal of confining beds by dredging, as well as the removal and resultant increase in surface area of aquifer material exposed in the shipping channel. In addition, the model was designed to estimate the effect on the ground water regime of deepening the channel in conjunction with both present and projected future pumping rates from nearby municipal and industrial well systems.

The ground water model chosen for the study is a three dimensional finite element model called FEMWATER. FEMWATER was designed for both transient and steady state, coupled flow and transport, as well as unsaturated or saturated flow simulations. The FEMWATER model was used in conjunction with a preprocessor/postprocessor called GMS (Groundwater Modeling System) developed by the U.S. Army Waterways Experiment Station-Hydraulics Lab. The graphical interface of GMS greatly facilitated the construction and set up of the model and allowed for convenient viewing of model input, as well as convenient viewing and interpretation of model output results.

The process of development and application of the FEMWATER model to the Wilmington Harbor study site involved the following key steps which will be discussed in detail in this report.

1. Design and construction of the 3-d finite element mesh using data and interpretations from the hydrogeologic framework study.

2. Assignment of model boundary conditions using data and interpretations from the hydrogeologic framework study.

3. Model calibration and sensitivity analysis.

4. Applied flow simulations.

5. Analysis of simulation results.

GROUND WATER MODEL DEVELOPMENT

The 3-d finite element model FEMWATER was chosen for use in this investigation because of its suitability for handling the complex ground water system found in the Wilmington Harbor study area. The finite element method is particularly useful in designing a mesh to represent regions with complex geometry, such as the curvature of the Cape Fear River and the configuration of the shipping channel. FEMWATER was originally written by G.T. Yeh of Penn State University. The version that is supported in GMS is a special version that was modified by Yeh and the U.S. Army Corps of Engineers Waterways Experiment Station in order to handle coupled flow and transport problems. In order to accomplish this, the original FEMWATER was combined with the transport model LEWASTE.

3-D Mesh Design and Construction

The first step in setting up the FEMWATER model was to create a 3-d finite element mesh. To apply the finite element method, the problem region was subdivided into a set of smaller regions called finite elements. Nodes were located at the vertices of each triangular element, and correspond to wells or well fields where appropriate. Figure 1 shows the entire model area, element boundaries, and positions of each node. The regional model boundaries extend to natural physical features such as the Atlantic shoreline as well as to hydraulic boundaries, to be discussed later in this report. In accordance with findings in the framework study, the 3-d mesh represents a three layer aquifer system separated by confining units. Each aquifer and confining unit was represented as closely as possible to actual geometries defined by regional altitude and thickness maps in the framework study. In GMS, a layer that pinches out laterally can be represented by first constructing continuous layers in the 3d mesh module, and then changing the material properties of elements in the region where the layer is missing to that of the layer above or below.

The Black Creek confining unit was chosen as the basal no flow boundary because it is a thick, regionally continuous clay unit (68 feet average thickness). High head differentials were consistently exhibited above and below this unit where research station data was available, indicating a high degree of confinement effectiveness. Representing the pre-deepening and post-deepening geometry of the Cape Fear River shipping channel presented a rather unique problem which was handled by constructing two different 3-d meshes, one to show the current configuration of the channel, and one to represent a deepened channel (5 foot maximum) in accordance with Army Corps of Engineers design specifications. Elements were deleted in the river channel in both meshs to represent the incision of the Cape Fear River. Channel nodes at the bottom of the shipping channel were shifted to the specified depth in the plan mesh to represent the deepened channel. In keeping with findings in the framework study, the base mesh was constructed to show the channel in contact with the Peedee Aquifer from Castle Street channel (fig.2) through the northern part of the Brunswick channel. From the northern part of the Brunswick through the Lilliput channel, the base is shown to be within the Castle Hayne Aquifer. From south of the Lilliput channel to the mouth of the Cape Fear River, the base is indicated to range from a position above the Castle Hayne confining unit to within the confining unit. Figure 3 shows the mouth of the Cape Fear River and channel where it transects the southern boundary face of the base mesh. The plan mesh indicates that deepening of the channel would primarily increase its penetration into aquifer material, and not into confining beds. However, an exception to this is seen in the area south of the Lilliput channel, where deepening would increase the penetration of the channel further into the Castle Hayne confining unit.

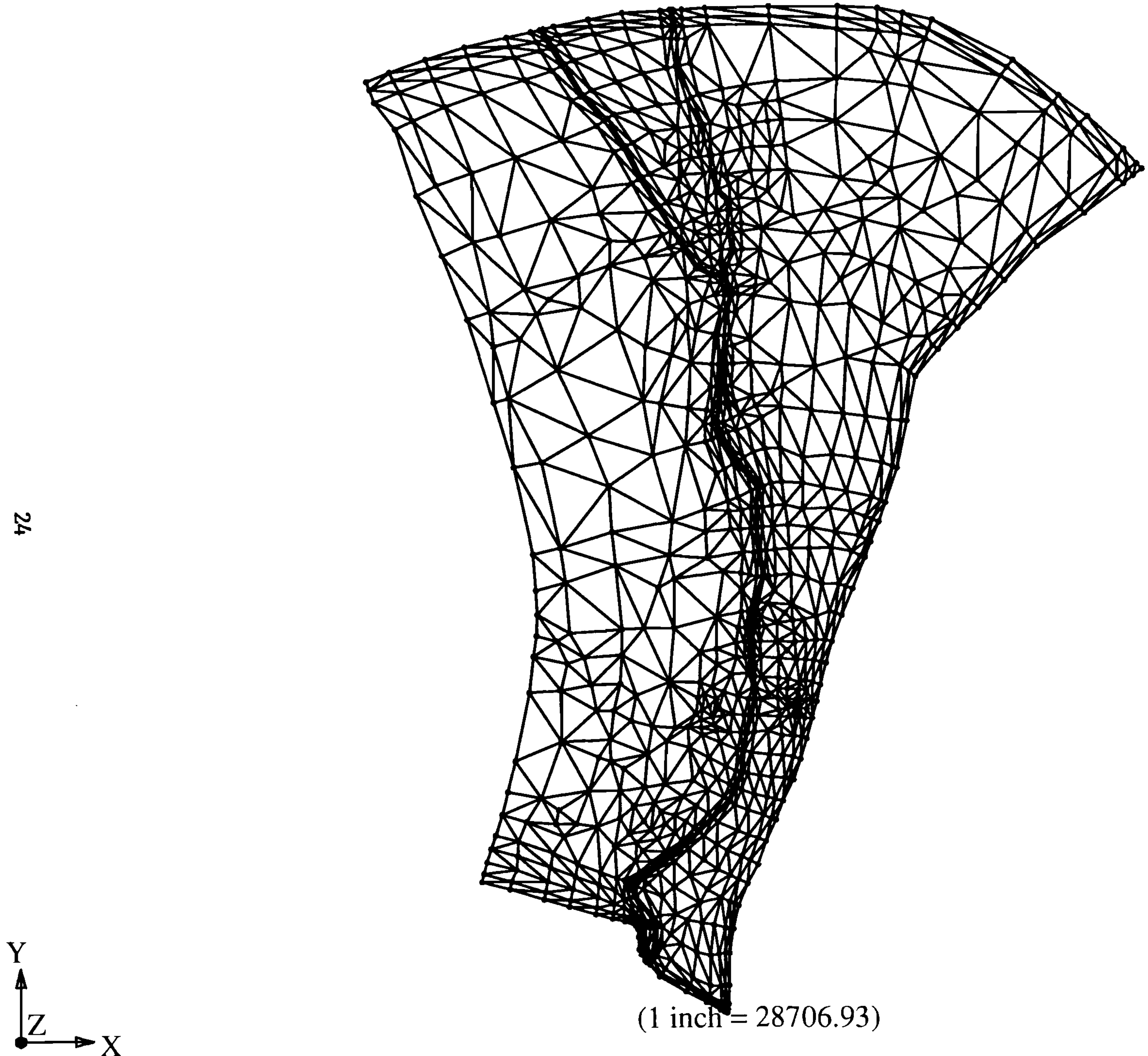


Figure 1: Top View of 3-D Mesh

WILMINGTON HARBOR GROUNDWATER STUDY

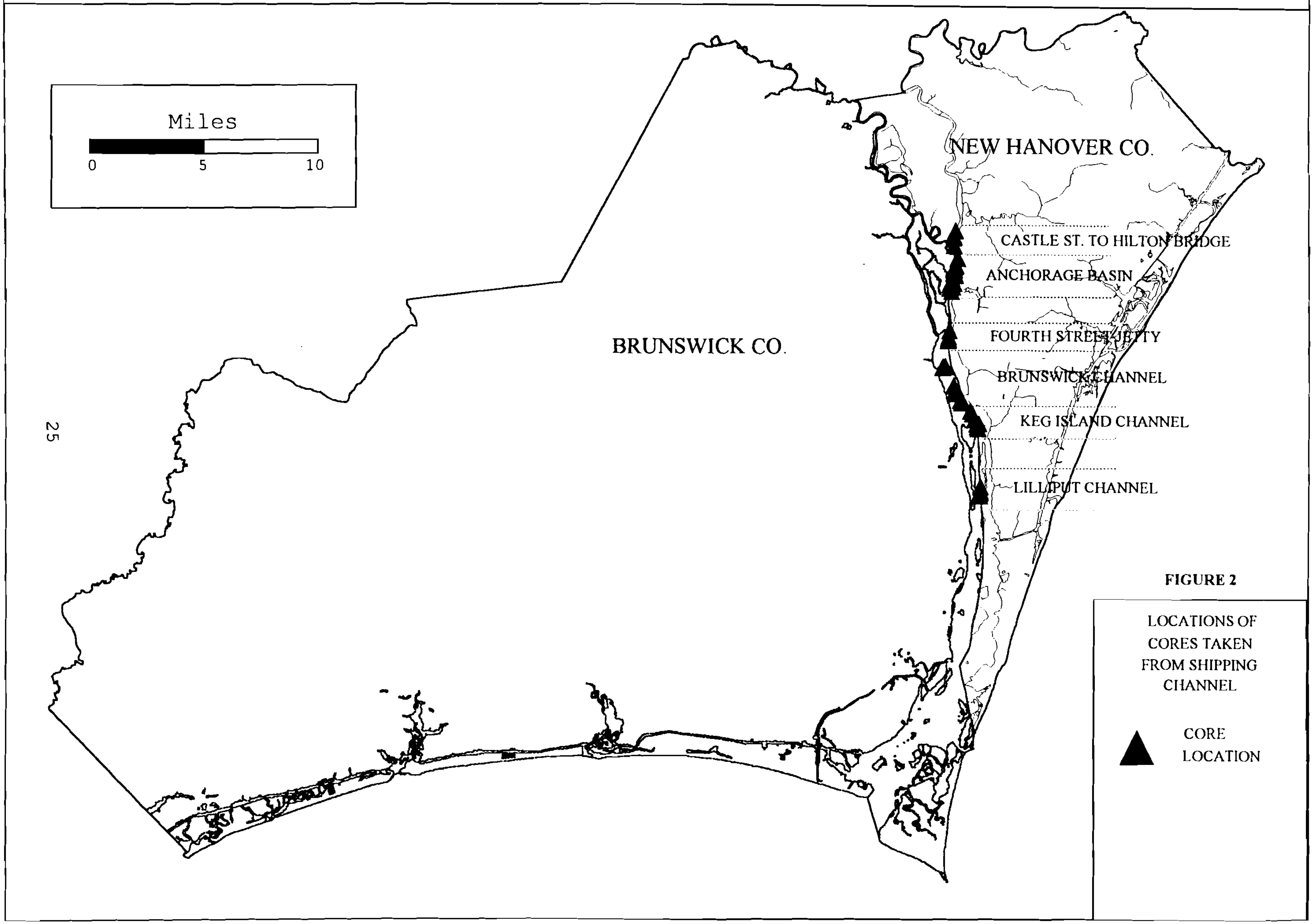


FIGURE 2

LOCATIONS OF CORES TAKEN FROM SHIPPING CHANNEL

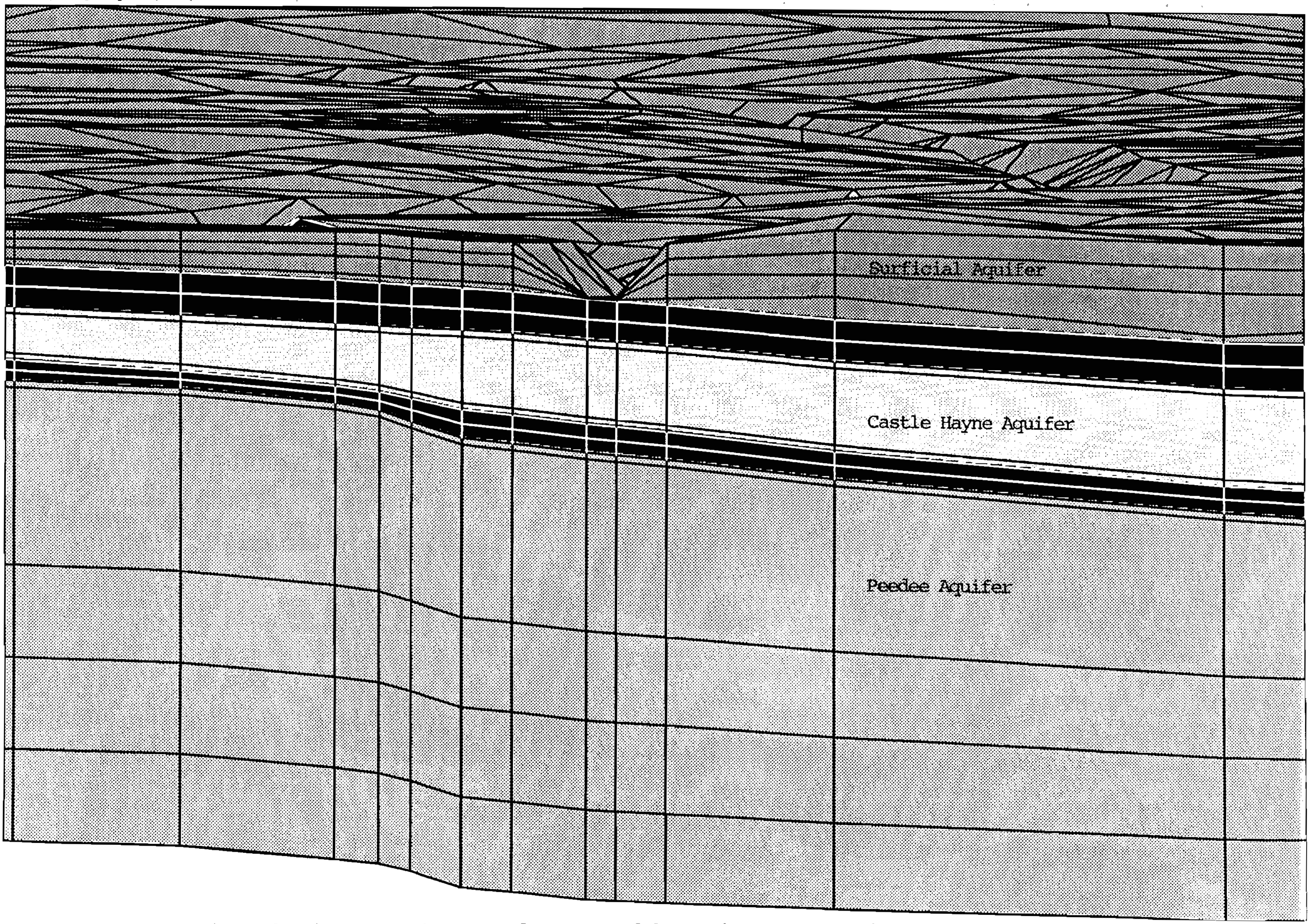


Figure 3: View of Southern Boundary Face of 3-D Mesh at Intersection with the Mouth of the Cape Fear River

Boundary Conditions

A major aspect of designing the 3-d mesh was to determine what boundary conditions were appropriate to represent the physical and mathematical limits of the problem area. A primary concern in this study was to accurately model the hydraulic relationship between the shipping channel and adjoining aquifer system. The Cape Fear River and shipping channel were handled as a constant head boundary, assuming that the small tidal elevation range observed in the river would have a minimal effect on model output results. Each node along the surface of the river channel was assigned a fixed head value of 2.25 feet above mean sea level. This corresponds to mean tidal elevation along the extent of the river.

The southern and eastern perimeters of the mesh correspond to the position of the Atlantic coastline. Nodes along this boundary face were assigned a constant head of 0.0, corresponding to the elevation of mean sea level.

The western and northern perimeters of the mesh were treated as specified (variable) head boundaries. Values of head were assigned to nodes along this boundary face using pieziometric maps constructed from measured field values from the regional observation network. The modeling period covers a 16 month span (June, 1993 through September, 1994), the time during which monthly measurements of water levels and chloride concentrations were made. This boundary accounts for lateral inflow of ground water from the west and northwest.

The base of the mesh is a no flow boundary which corresponds to the top of the Black Creek confining unit (fig.4) The Black Creek confining unit was chosen as the basal no flow boundary because it is a thick, regionally continuous clay unit (68 feet average thickness). As mentioned earlier, high head differentials are consistently exhibited across this unit where research station data is available, indicating a high degree of confinement effectiveness.

In order to simulate recharge to the model the top boundary face of the 3-d mesh was assigned a specified flux boundary condition. Rainfall data from the study region was obtained from the National Climatic Data Center to cover the 16 month modeling period. Total recharge to the system was calculated using an EPA method (EPA, 1985) which compares monthly values of average rainfall with monthly average evapotranspiration for a monthly recharge approximation (fig.5). Recharge rates used in the model were calculated using values of average daily rainfall measured at the New Hanover County Airport. Over the 16 month model period a total of 81 inches of total rainfall was measured. Recharge calculations indicate 34 inches of total recharge to the ground water system over the same time period.

Ground water withdrawals from the system due to pumping from municipal and industrial wells and well systems were accounted for in the model as point sink boundary conditions. Well fields that actually contain numerous wells spread out over a large area are signified as one or two wells in the model. This produced a more concentrated pumping effect, thus causing a more substantial drawdown in some areas. For the purposes of this study pumping data was collected only for wells which withdrew over 10,000 gallons per day on any day of the modeling period. Figure 6 is a map of the study region showing the locations of significant pumping wells used in the model. Correspondingly, a listing of significant pumping locations and withdrawal rates over the 16 month model period is provided in table A-6 (Appendix). Figure 7 indicates where point source boundary conditions were assigned to nodes in the mesh.

GEOLOGIC UNITS			HYDROGEOLOGIC UNITS
SYSTEM	SERIES	FORMATION	AQUIFERS AND CONFINING UNITS
Quaternary	Holocene	Undifferentiated	Surficial aquifer
	Pleistocene		
Tertiary	Pliocene	Undifferentiated	Tertiary aquifer and confining unit [4]
	Oligocene	River Bend Fm.[1]	
	Eocene	Castle Hayne Fm.	Castle Hayne aquifer and confining unit
	Paleocene	Beaufort Fm.[2]	
Cretaceous	Upper Cretaceous	Rocky Point Member [3]	Pee Dee aquifer and confining unit
		Pee Dee Formation	
		Black Creek Formation	Black Creek Confining Unit
			Black Creek aquifer

1. Present only in southern New Hanover County.
2. Present only in southern New Hanover and southeastern Brunswick County.
3. Present only in north central New Hanover County and southeastern Brunswick County.
4. Confining unit is discontinuous through study area.

Figure 4. General relationship between geologic and hydrogeologic units in Wilmington Harbor study area. (geologic units from Zarra, 1991)

			I	No Runoff	Etp	I-Etp	SumNeg	S	DelS	Eta	I-Eta-DelS		
		modrech Wilmington			Evapotranspiration						Recharge		
1993	1993	JAN			0.002500								
		FEB			0.005000								
		MAR			0.007500								
		APR			0.010000								
		MAY			0.012500								
		JUN	0.010278	0.0102778	0.014167	-0.003889	-0.003889	0.000000	0.000000	0.010278	0.000000		
		JUL	0.018925	0.0189247	0.013333	0.005591	0.000000	0.002200	0.002200	0.013333	0.003391		
		AUG	0.015215	0.0152151	0.011667	0.003548	0.000000	0.002200	0.000000	0.011667	0.003548		
		SEP	0.022472	0.0224722	0.010000	0.012472	0.000000	0.002200	0.000000	0.010000	0.012472		
		OCT	0.022285	0.0222849	0.005833	0.016452	0.000000	0.002200	0.000000	0.005833	0.016452		
		NOV	0.007167	0.0071667	0.004167	0.003000	0.000000	0.002200	0.000000	0.004167	0.003000		
		DEC	0.007177	0.0071774	0.002500	0.004677	0.000000	0.002200	0.000000	0.002500	0.004677		
1994	1994	JAN	0.018898	0.0188978	0.002500	0.016398	0.000000	0.002200	0.000000	0.002500	0.016398		
		FEB	0.009702	0.0097024	0.005000	0.004702	0.000000	0.002200	0.000000	0.005000	0.004702		
		MAR	0.022231	0.0222312	0.007500	0.014731	0.000000	0.002200	0.000000	0.007500	0.014731		
		APR	0.002222	0.0022222	0.010000	-0.007778	-0.007778	0.000000	-0.002200	0.004422	0.000000	Total	
		MAY	0.007177	0.0071774	0.012500	-0.005323	-0.013100	0.000000	0.000000	0.007177	0.000000	Rainfall (in)	Rainfall (in/year)
		JUN	0.007639	0.0076389	0.014167	-0.006528	-0.019628	0.000000	0.000000	0.007639	0.000000	81.199021	60.899266
		JUL	0.012796	0.0127957	0.013333	-0.000538	-0.020166	0.000000	0.000000	0.012796	0.000000	Total	
		AUG	0.016210	0.0162097	0.011667	0.004543	0.000000	0.002200	0.002200	0.011667	0.002343	Recharge (in)	Recharge (in/year)
		SEP	0.021917	0.0219167	0.010000	0.011917	0.000000	0.002200	0.000000	0.010000	0.011917	34.199136	25.649352
					0.005833							%	%
					0.004167							42.12	42.12
					0.002500								

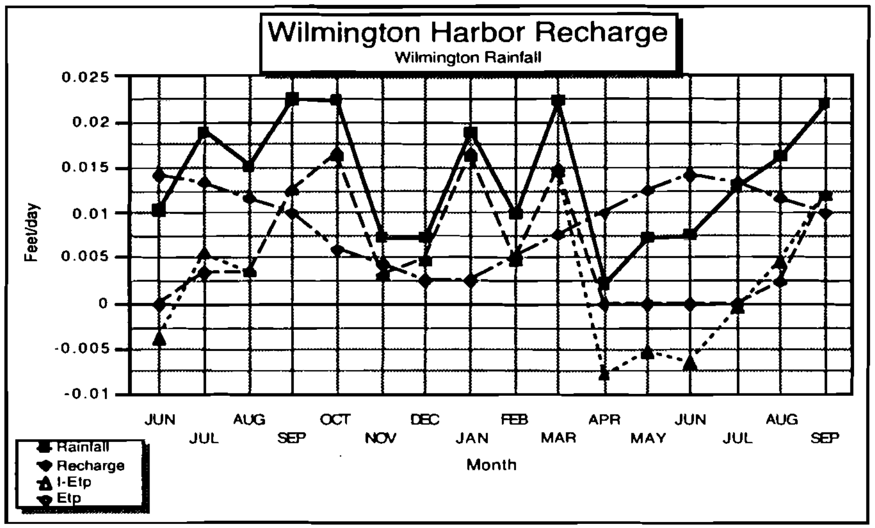


Figure 5: Rainfall vs. Recharge, Wilmington Area in feet per day

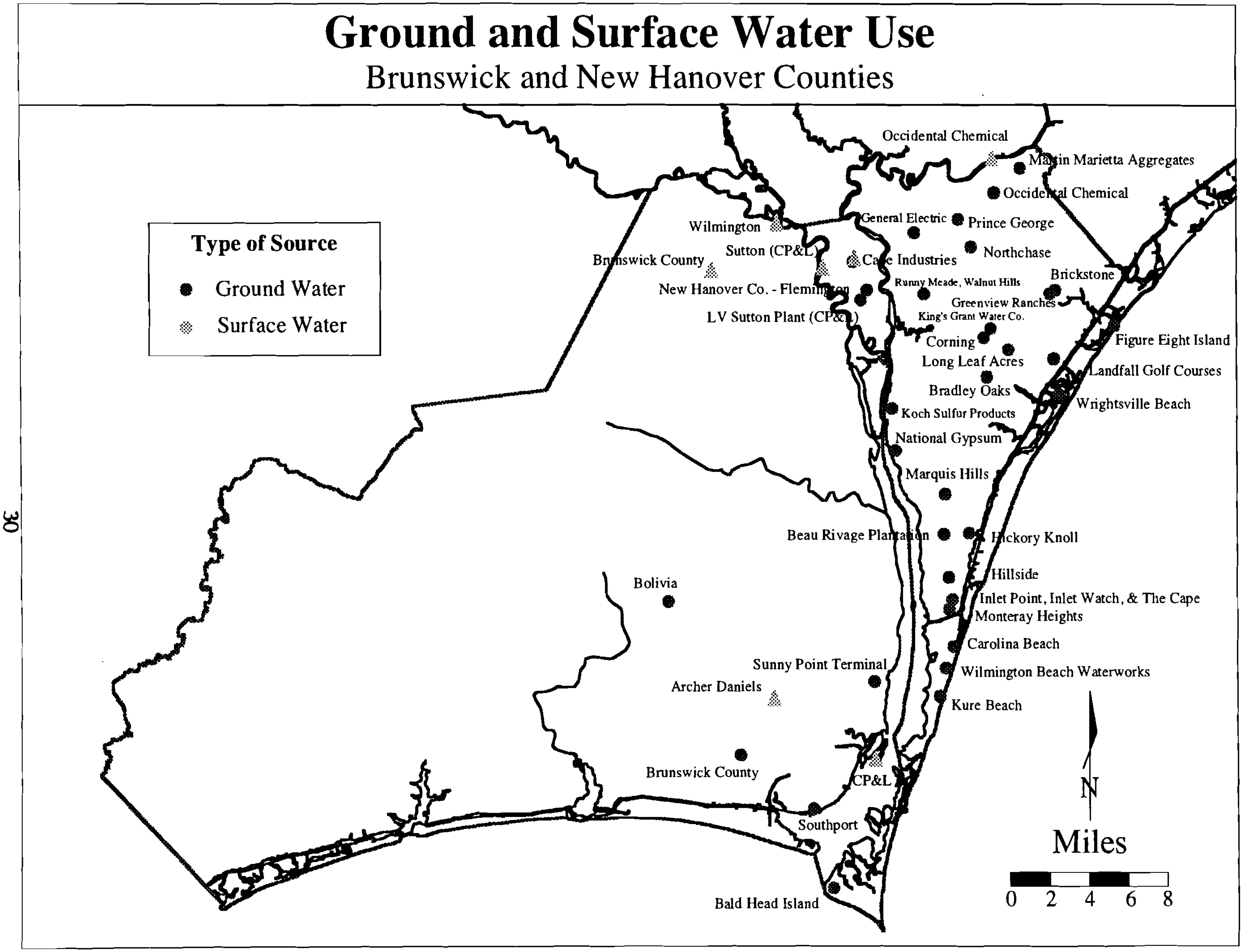
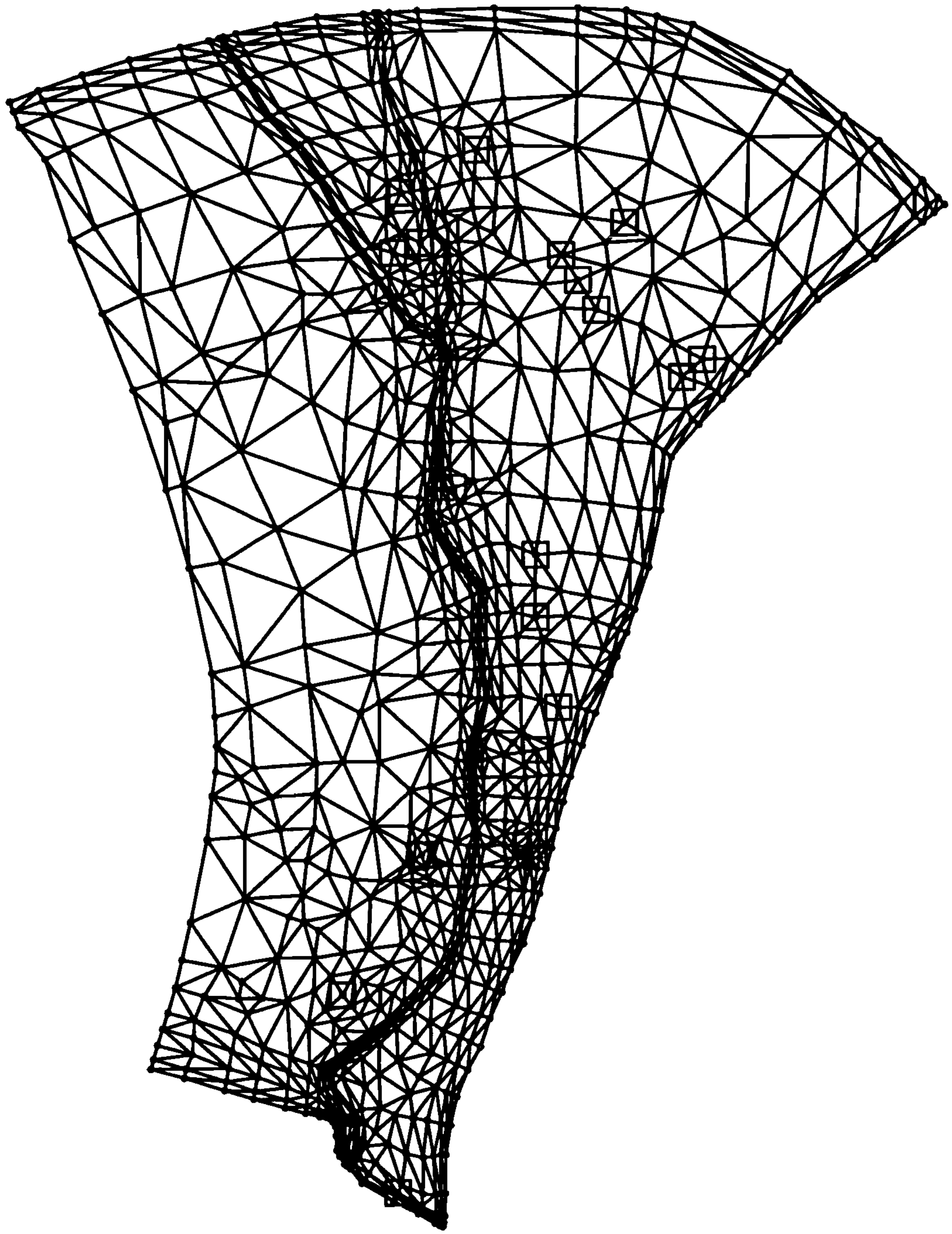


Figure 6: Map Showing Locations of Ground Water Pumping (>10,000 GPD) and Surface Water Usage



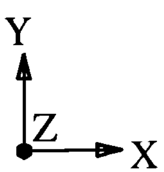


Figure 7: Locations of Point Sink Nodes

Model Calibration and Sensitivity Analysis

The object of the model calibration process was to ensure that the model was a good representation of the physical ground water system in the study area and that it could be used with confidence to predict aquifer behavior. The calibration process involved making numerous model runs in order to compare computer derived water levels to actual observation well hydrographs. Observation well hydrographs represent the ground water systems response to varying conditions such as changes in rainfall and recharge, pumping and land use. The models ability to reproduce similar water levels over time is a good measure of its ability to accurately simulate the actual system. The model was calibrated by making adjustments to input parameters such as hydraulic conductivity, boundary conditions, and material coefficients. Model runs were continued with changes made each time to sensitive parameters until a satisfactory match between observed and computed heads was obtained for several key observation wells.

Comparisons of computed versus measured hydrographs are depicted in figures 9 through 12. The model was found to be the most sensitive to changes in hydraulic conductivity, the specified head boundary along the northern and western boundaries of the mesh, initial water level conditions, and to changes in the unsaturated zone head series. The unsaturated zone head series consists of xy plots of pressure head versus moisture content, pressure head versus relative conductivity, and pressure head versus water capacity. Changes to unsaturated zone head series curves affected the infiltration rate of rainfall through the vadose or unsaturated zone, and thus had significant effects on water level fluctuations at model gage stations.

MODEL SIMULATIONS

Upon completion of the calibration and sensitivity analysis process, two separate, flow only, transient model simulations were run over a 450 day time period using variable time steps. The first simulation was run to evaluate changes in the potentiometric surfaces of the Peedee and Castle Hayne Aquifers, and changes in the elevation of the water table using the base mesh (present channel depths). The second run was intended to determine what changes occur over the same period of time to the potentiometric surfaces and water table using the plan mesh (deepened channel). Then a comparison was made of the elevations of the potentiometric surfaces and water table between base and plan over the same model period. Comparison of results from both base and plan simulations indicate that there are no changes in water levels in the Peedee, Castle Hayne, or surficial aquifers over the 450 day simulation. Figures 13 through 18 are model output results at time step 450, consisting of contour maps (colors filled between contours) of water level distribution for each of the three aquifers. Both base and plan simulations are included. Analysis of the water level output results indicate the following:

- Comparison of results between base and plan simulations indicate that virtually no changes in water level distribution occur in the three aquifers over the model period. The model results indicate that dredging would not cause any short term changes in water levels in the area of concern.

- The aquifer system maintains a discharge relationship with the Cape Fear River and shipping channel over the modeling period. In other words, distribution of hydraulic head near the river in each of the three aquifers is high enough in comparison to the head of the Cape Fear River to maintain a discharge relationship over the 450 day time period. This is consistent with the findings of the hydrogeologic framework study. Model results indicate that this discharge relationship would be maintained after dredging.

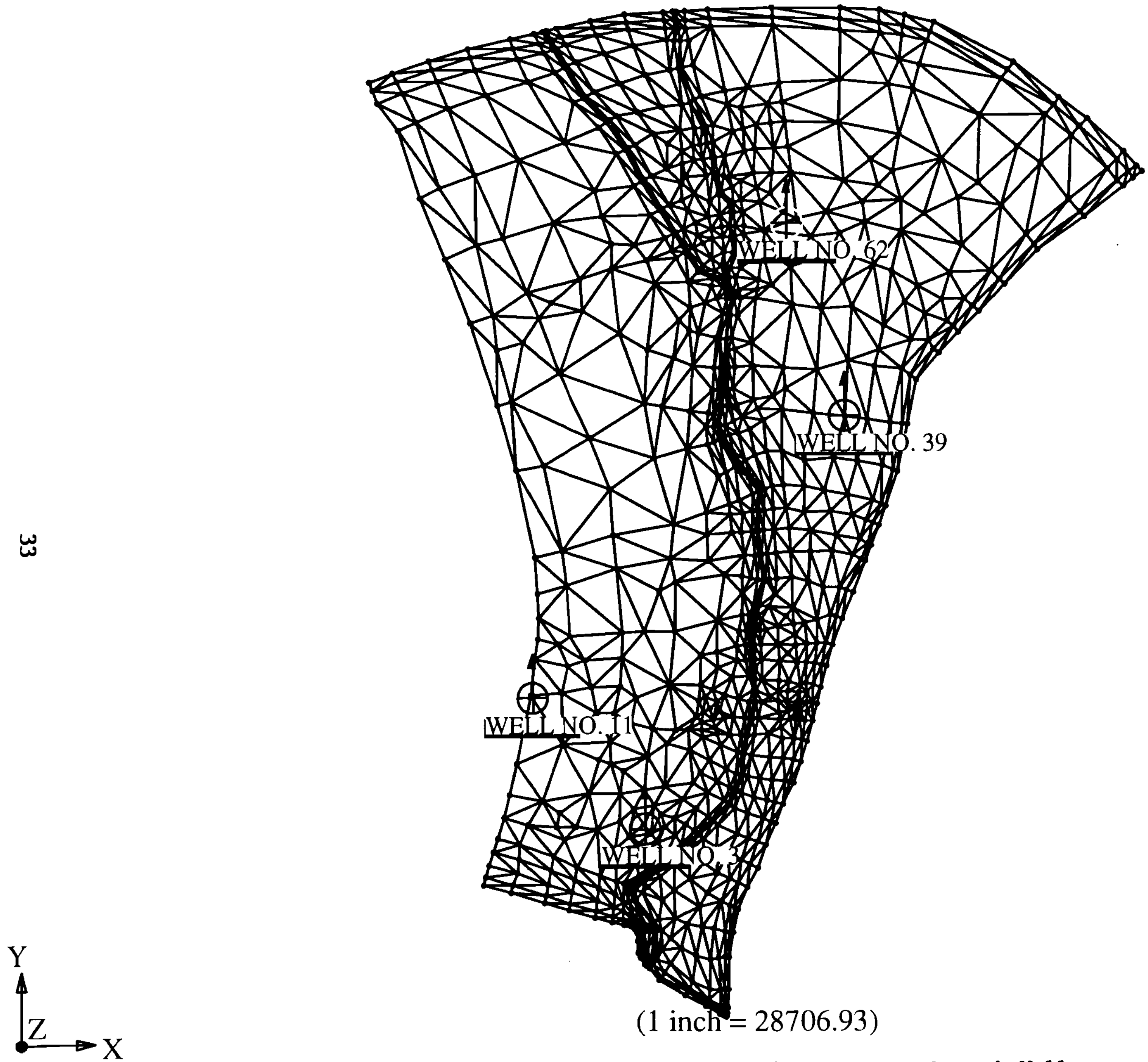


Figure 8: Locations of Gage/Observation Network Wells

Figure 9: Obs. Well No. 39: Computed vs. Obs. Head

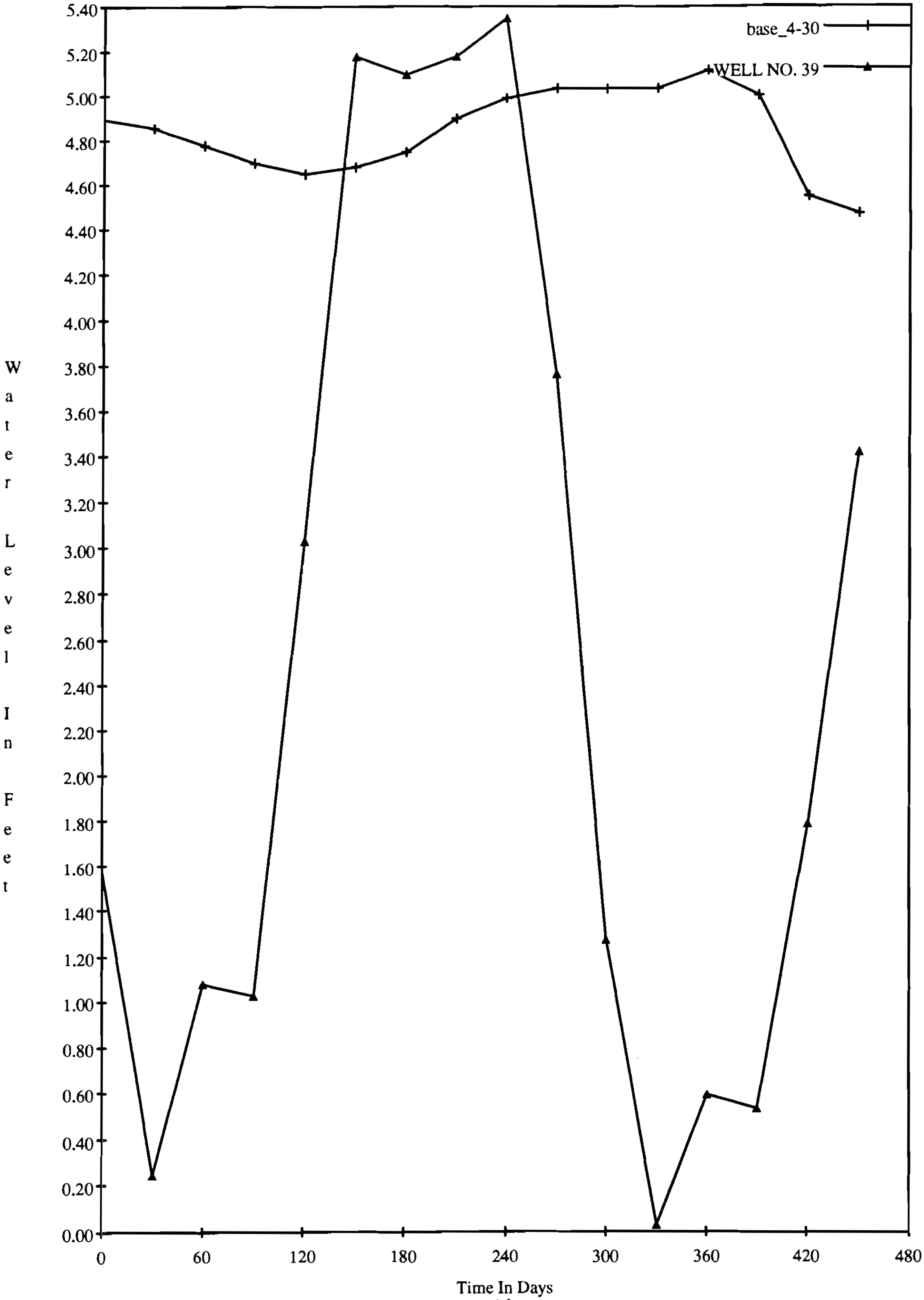


Figure 10: Obs. Well No. 11: Computed vs. Obs. Head

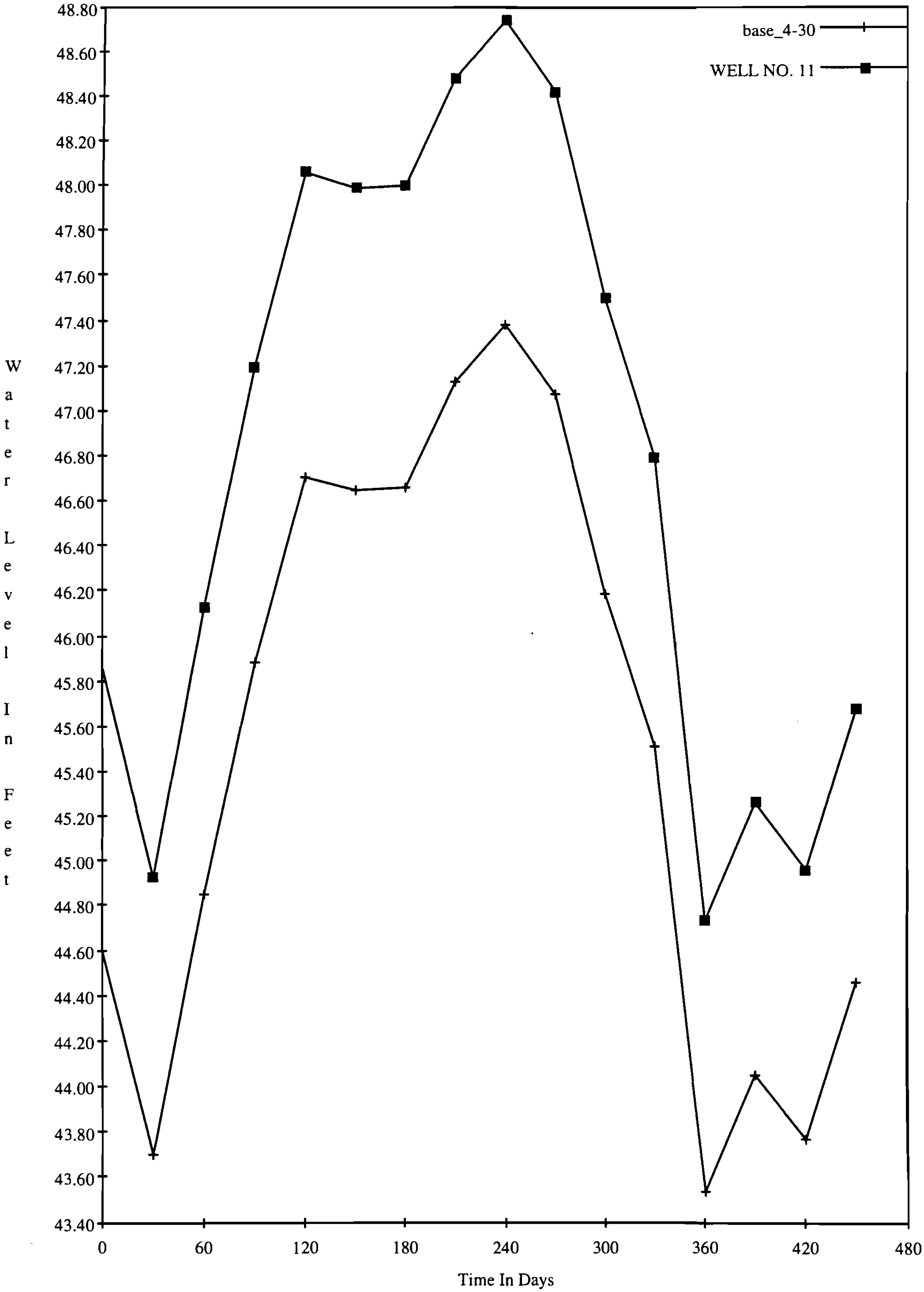


Figure 11: Obs. Well No. 3: Computed vs. Obs. Head

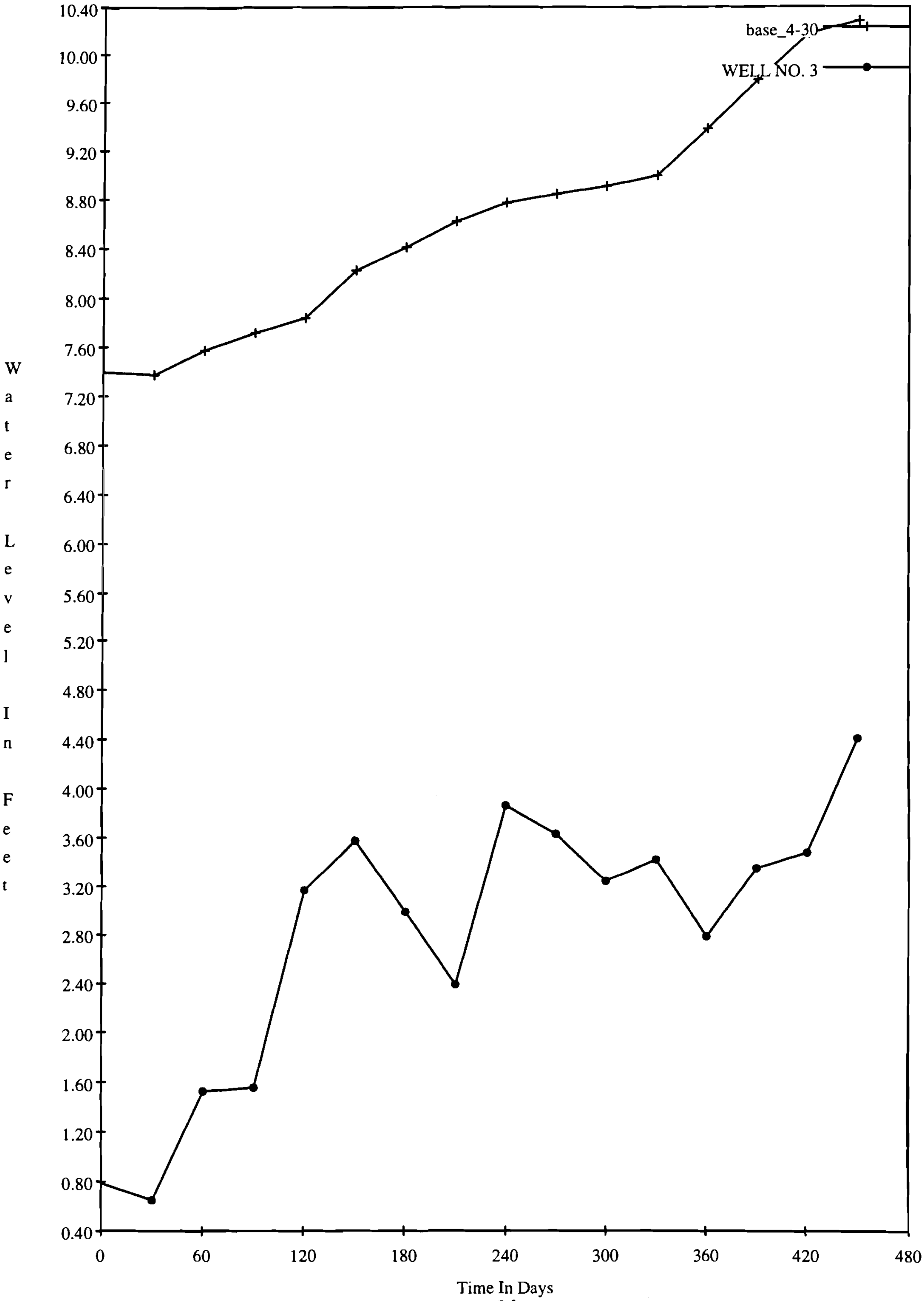
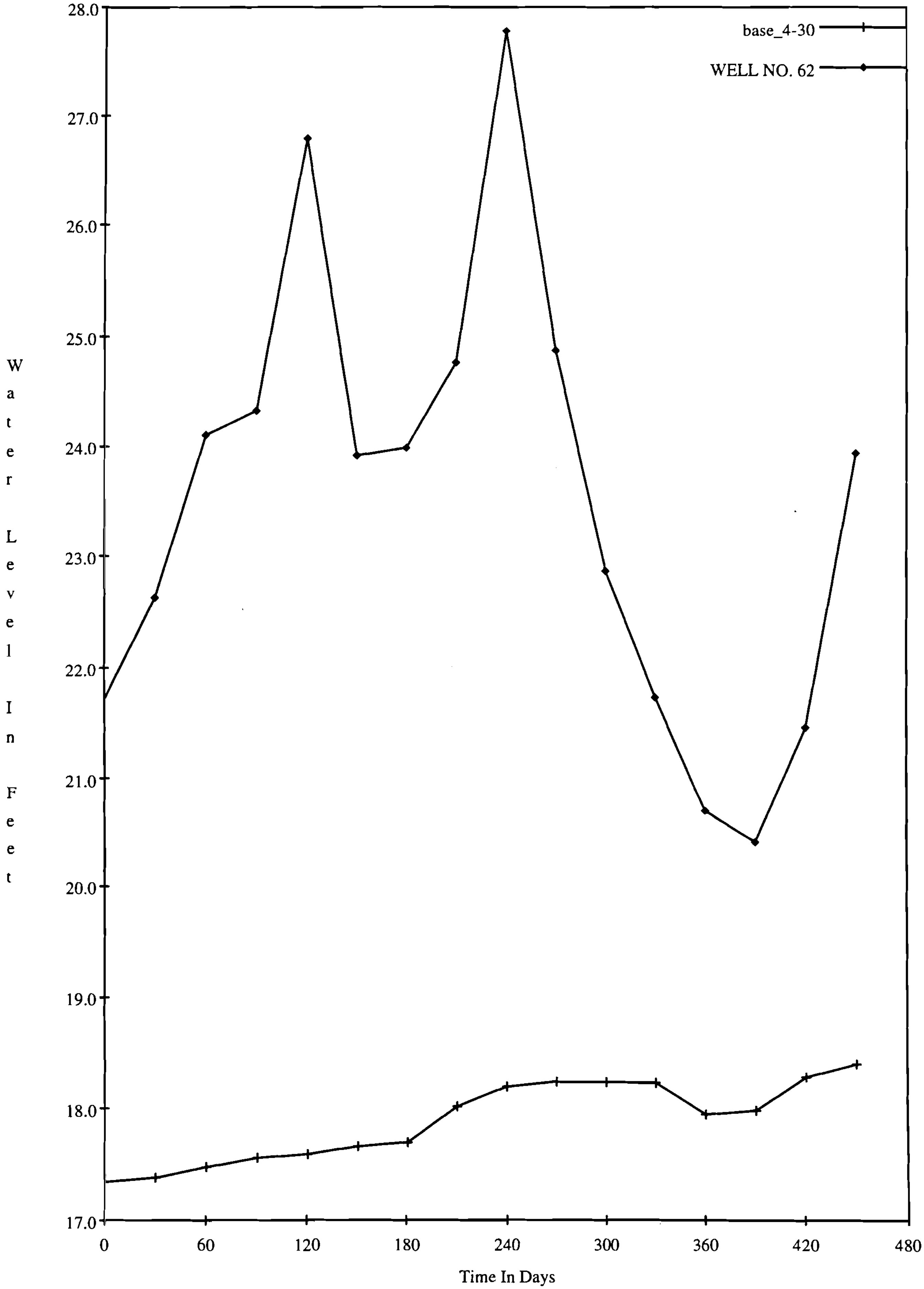


Figure 12: Obs. Well No. 62: Computed vs. Obs. Head



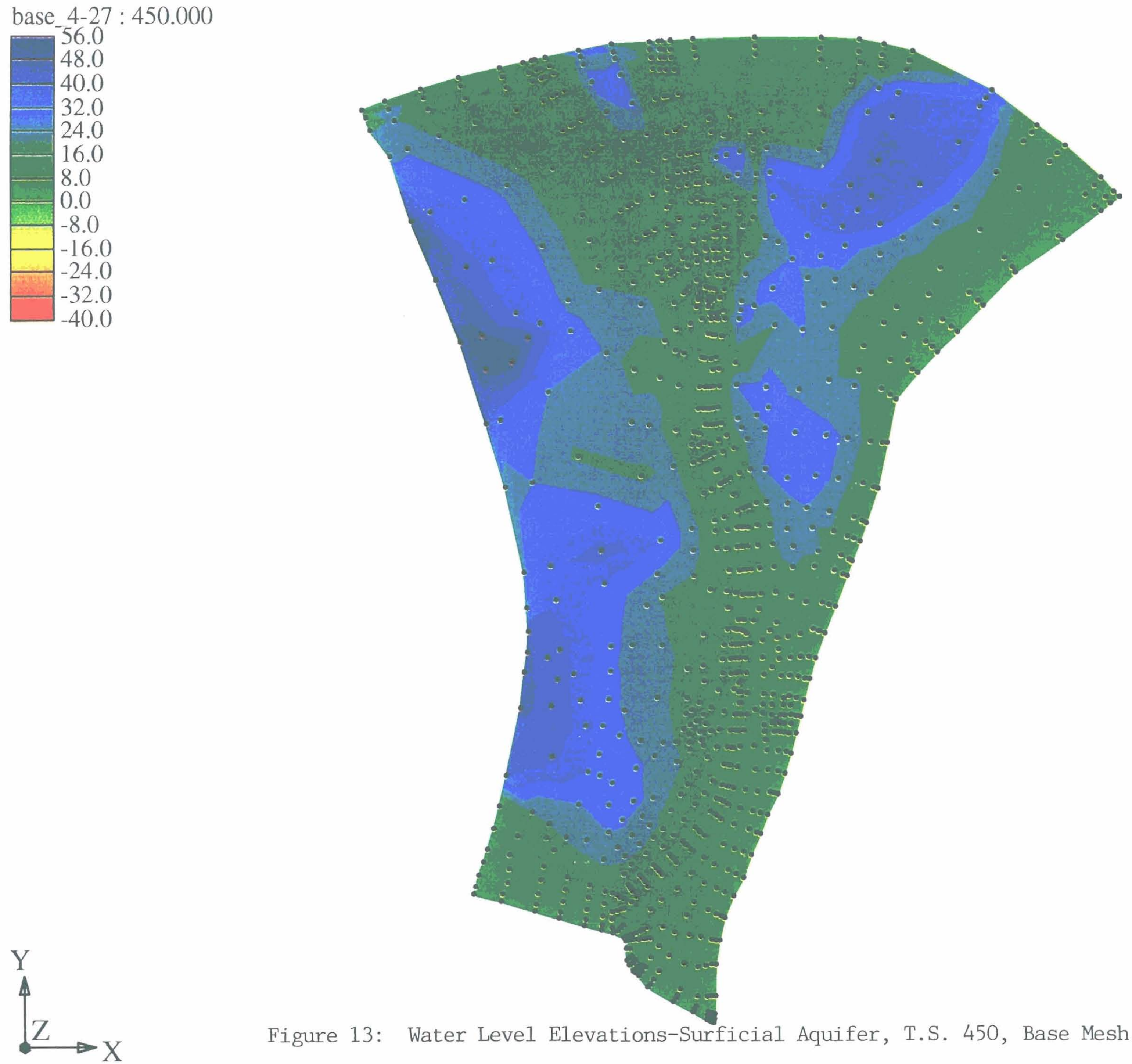


Figure 13: Water Level Elevations-Surficial Aquifer, T.S. 450, Base Mesh

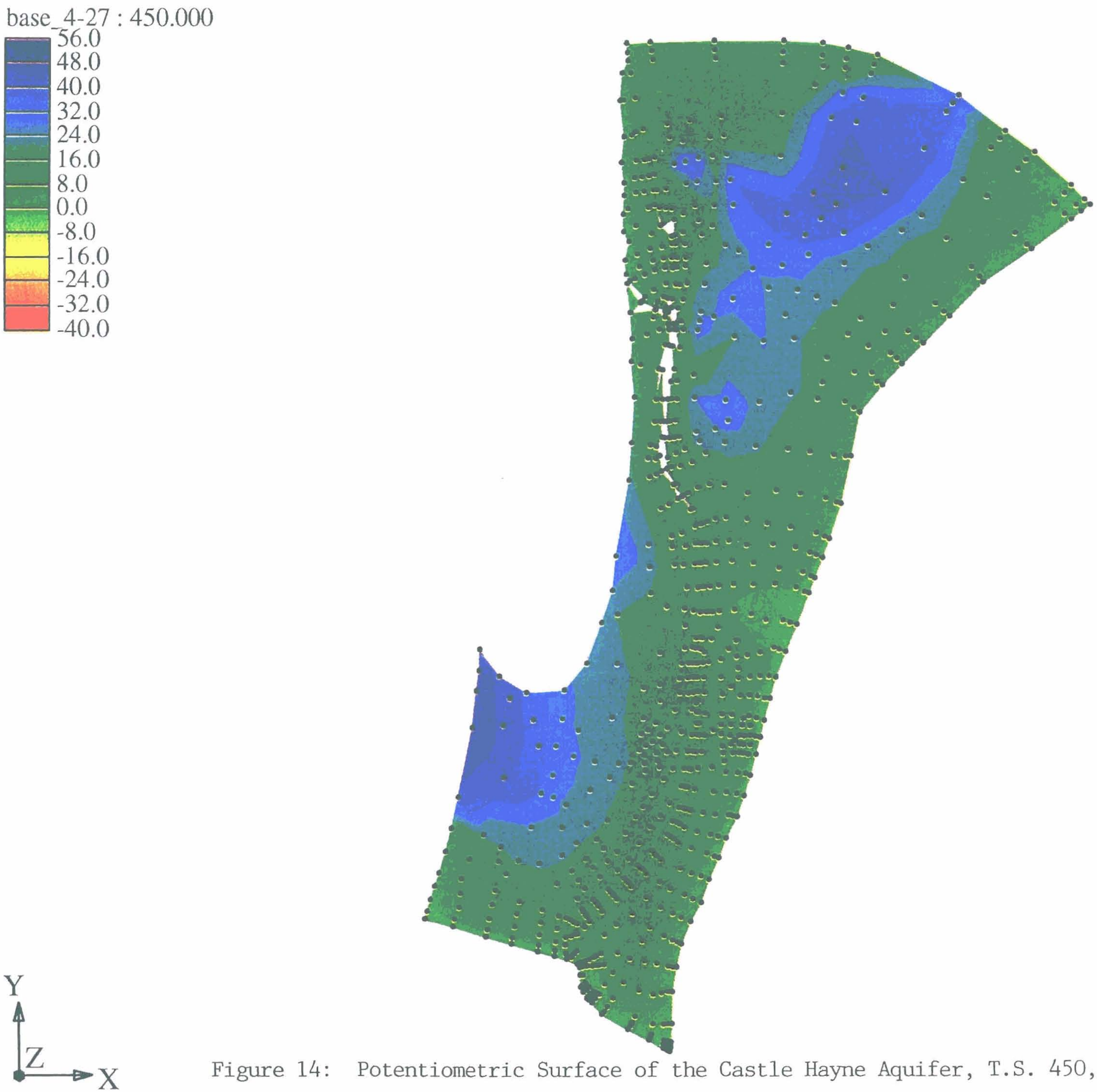


Figure 14: Potentiometric Surface of the Castle Hayne Aquifer, T.S. 450, Base Mesh

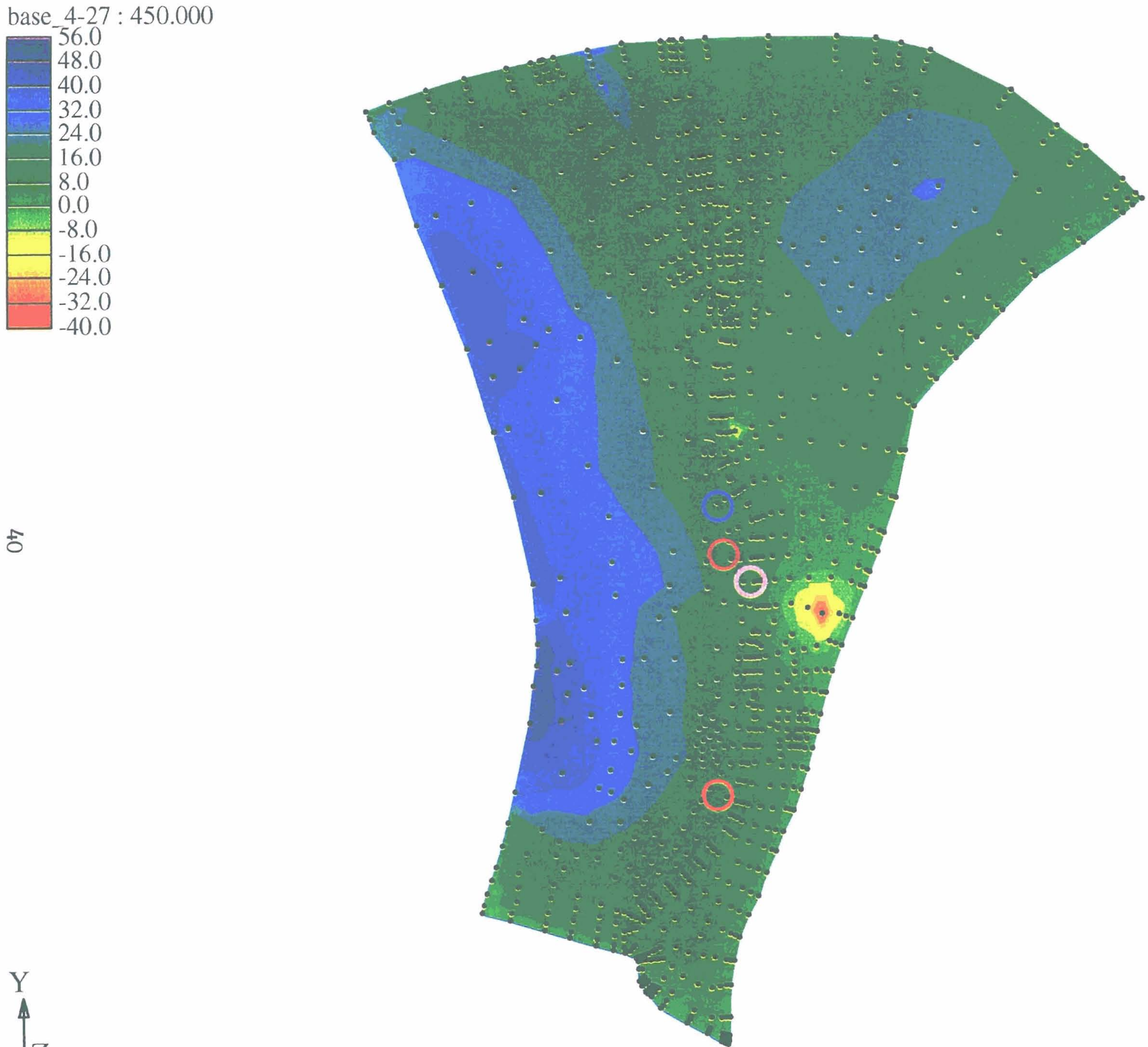


Figure 15: Potentiometric Surface of the Peedee Aquifer, T.S. 450, Base Mesh

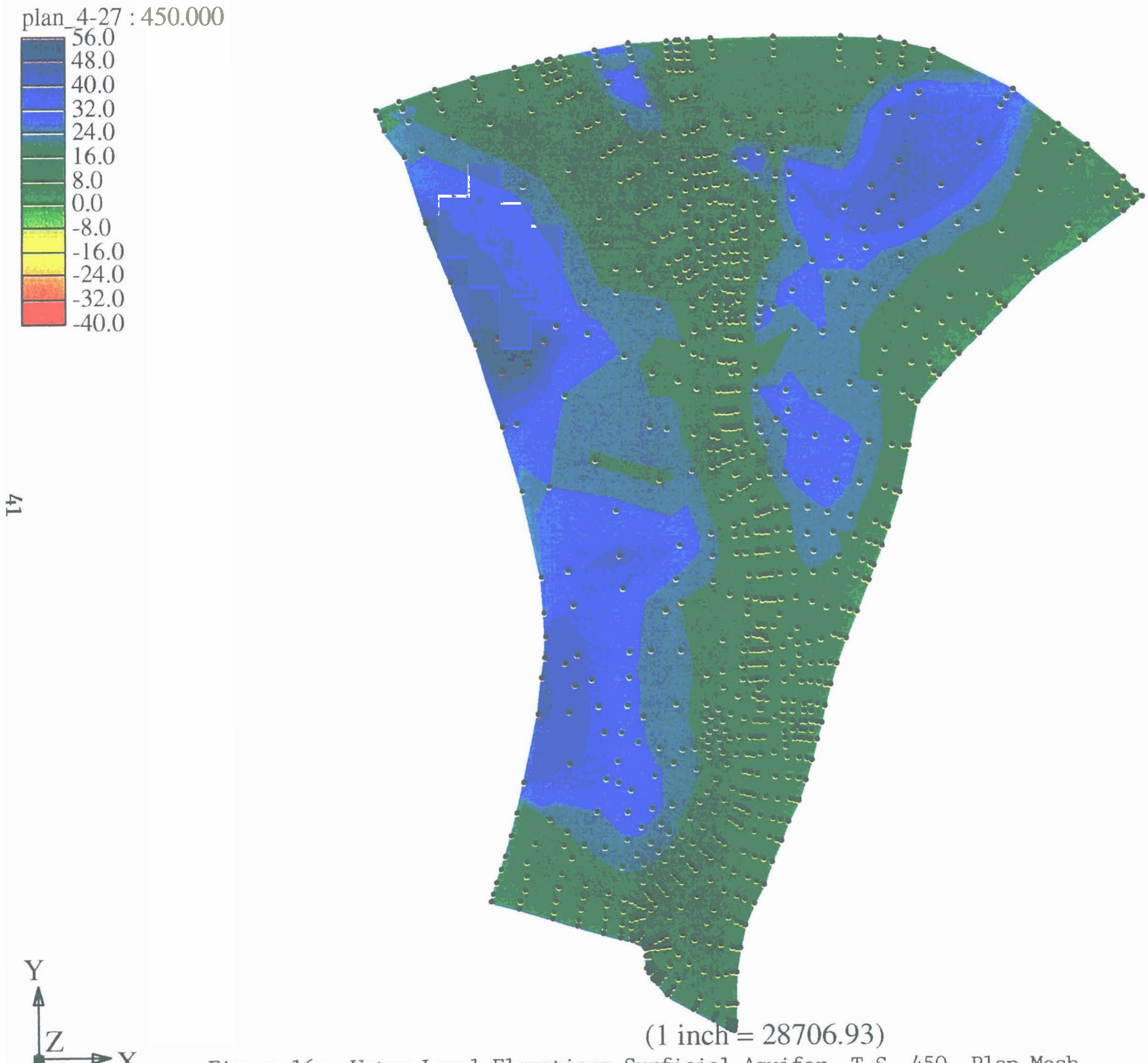


Figure 16: Water Level Elevations-Surficial Aquifer, T.S. 450, Plan Mesh

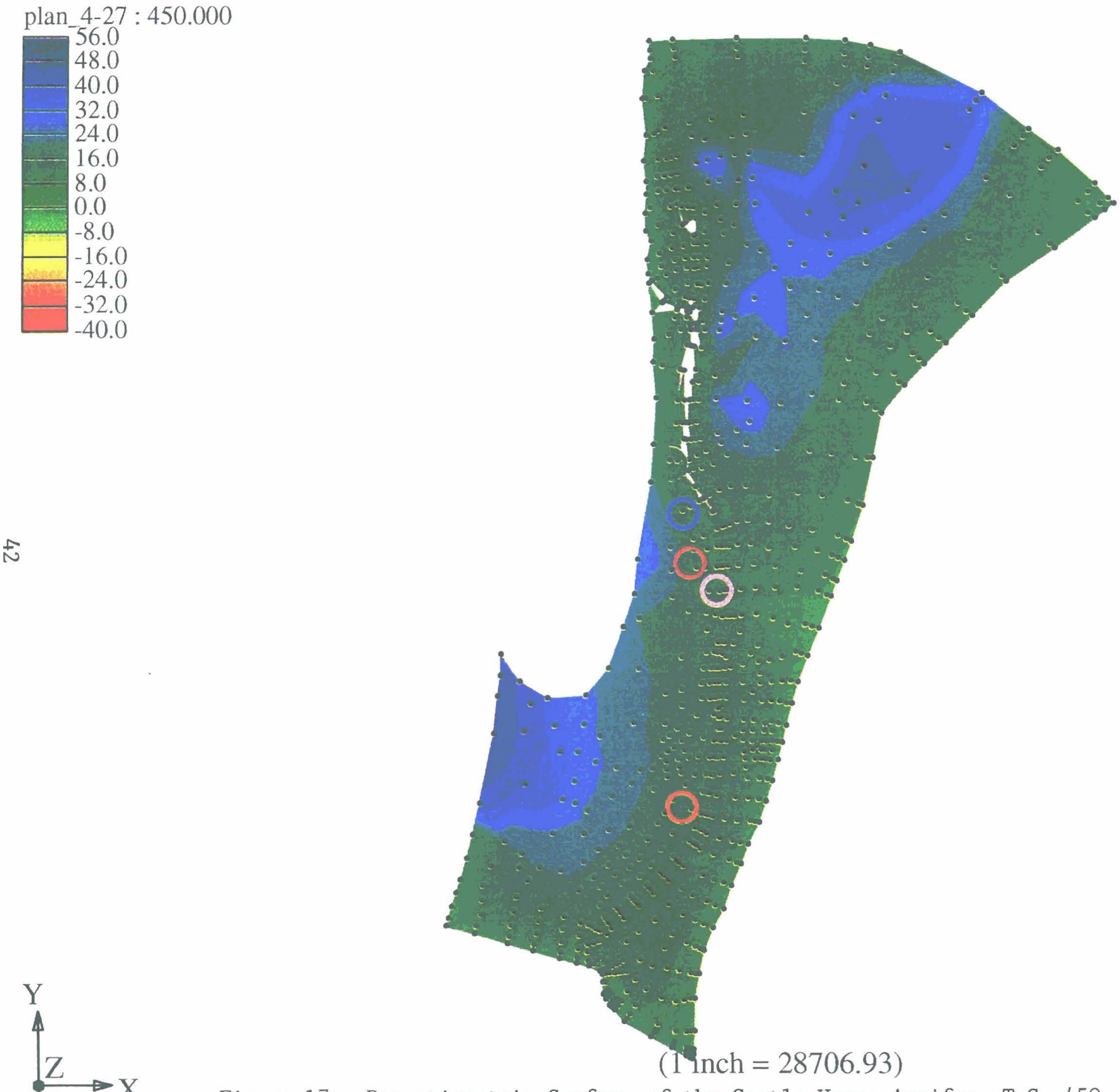


Figure 17: Potentiometric Surface of the Castle Hayne Aquifer, T.S. 450, Plan Mesh

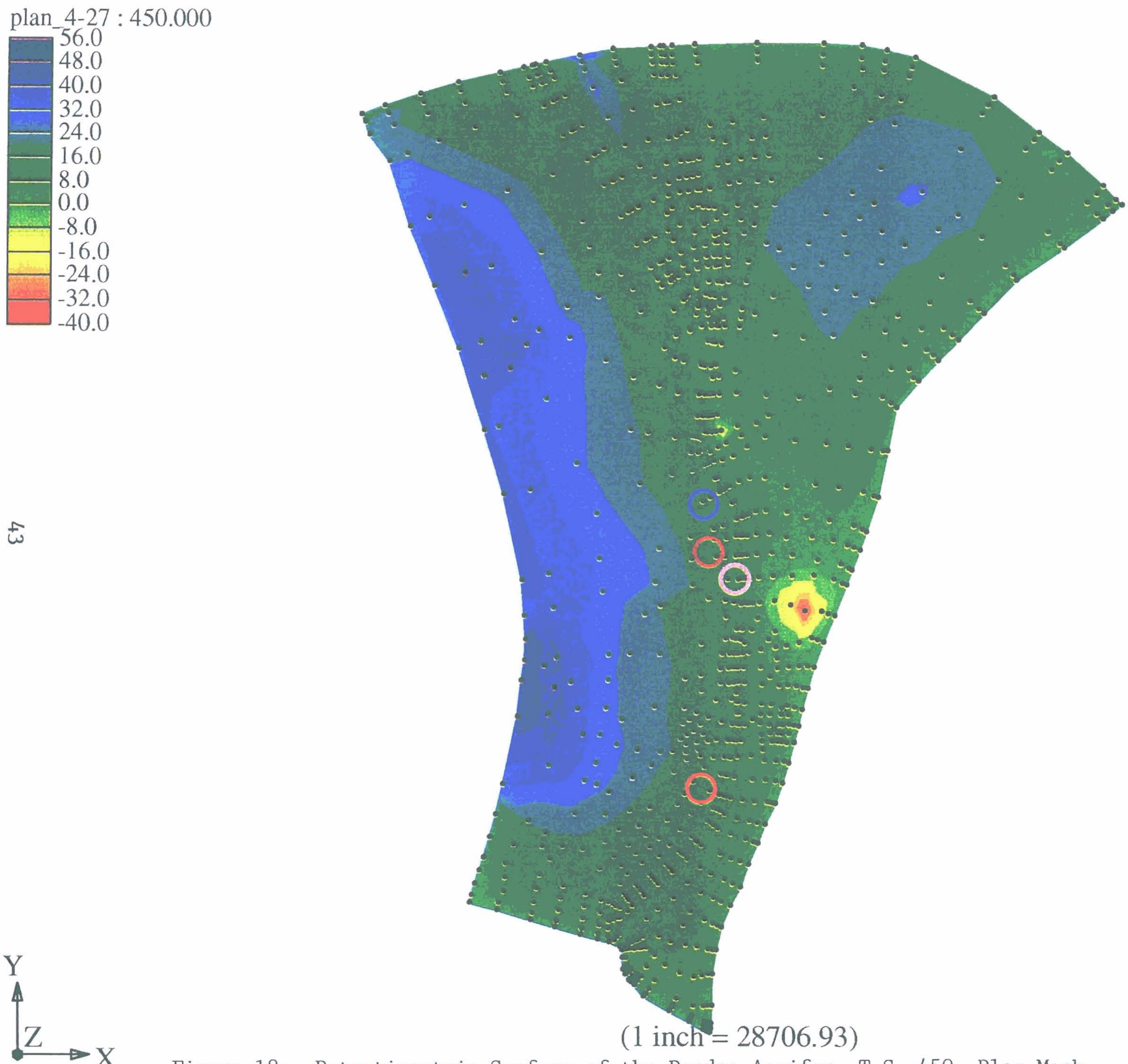


Figure 18: Potentiometric Surface of the Peedee Aquifer, T.S. 450, Plan Mesh

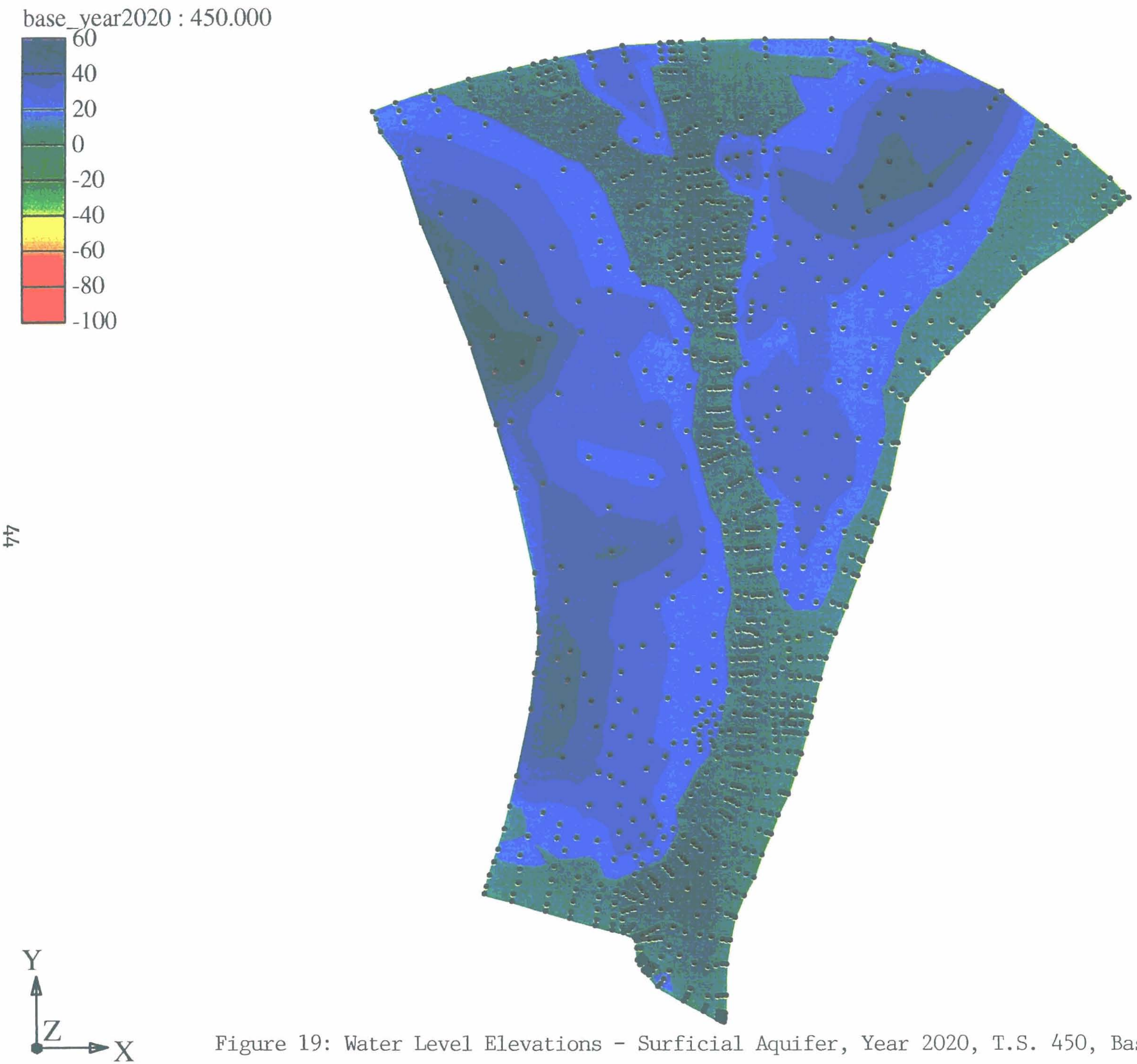


Figure 19: Water Level Elevations - Surficial Aquifer, Year 2020, T.S. 450, Base Mesh

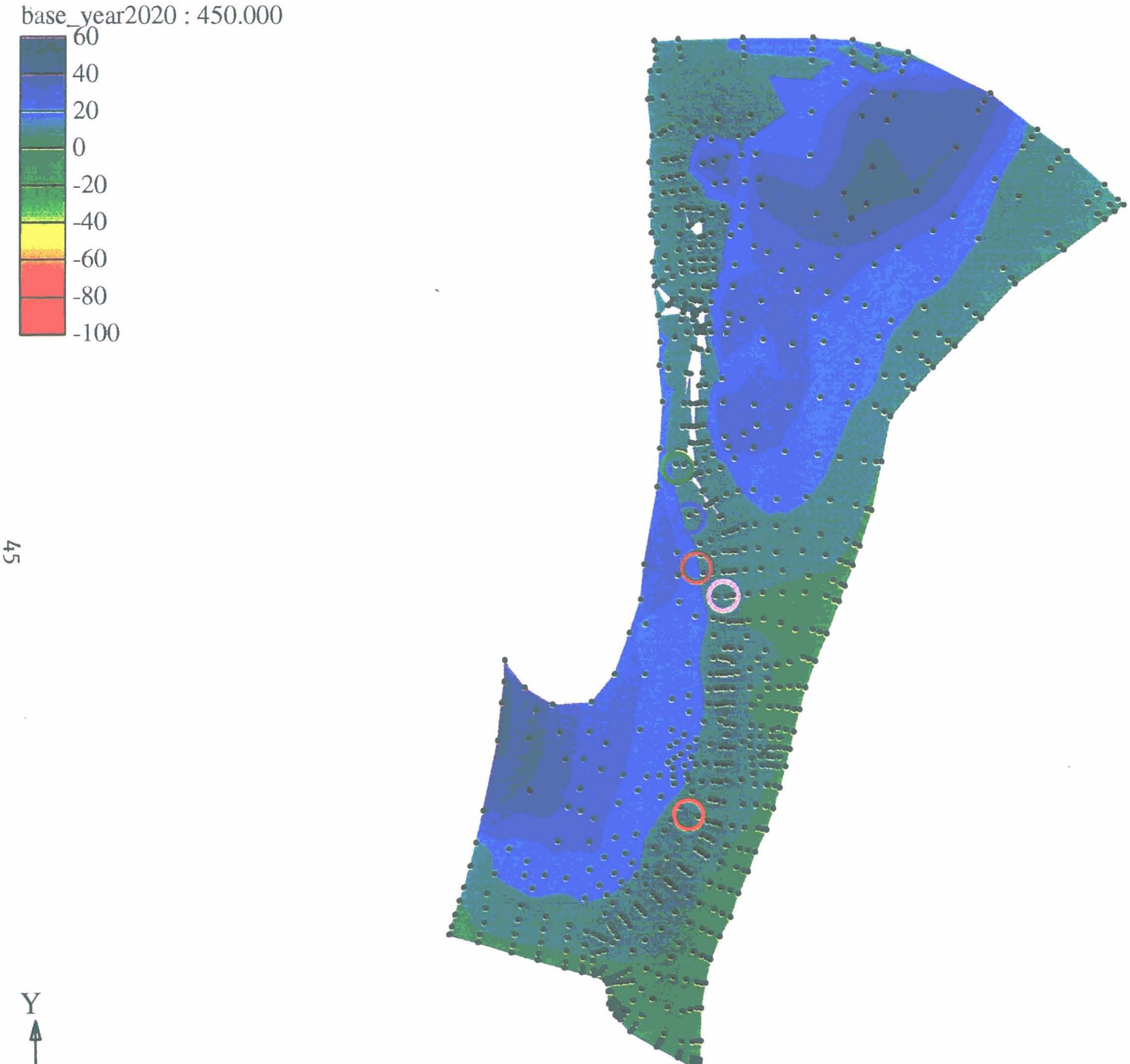


Figure 20: Potentiometric Surface of the Castle Hayne Aquifer, Year 2020, T.S. 450, Base Mesh

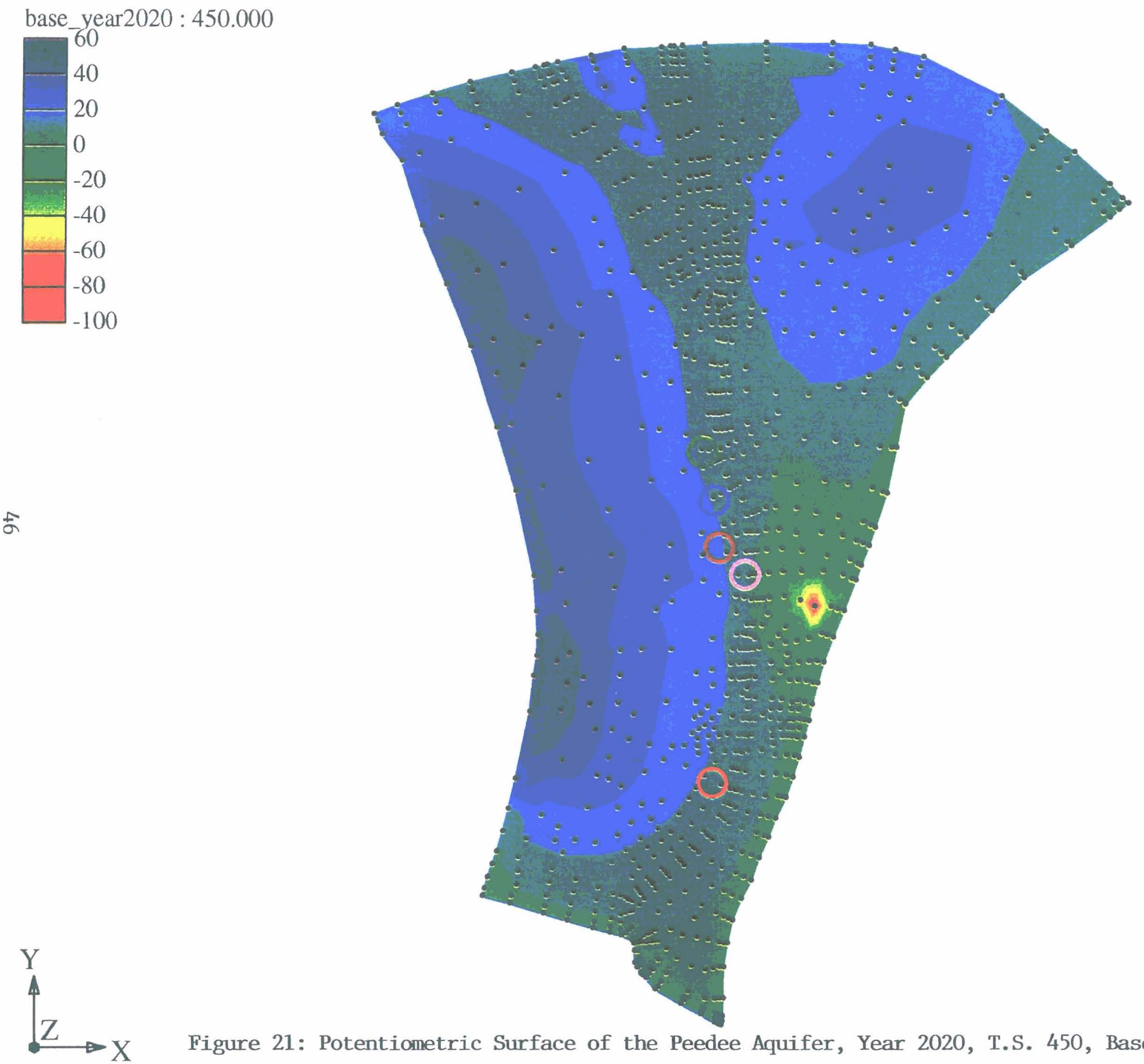


Figure 21: Potentiometric Surface of the Peedee Aquifer, Year 2020, T.S. 450, Base Mesh

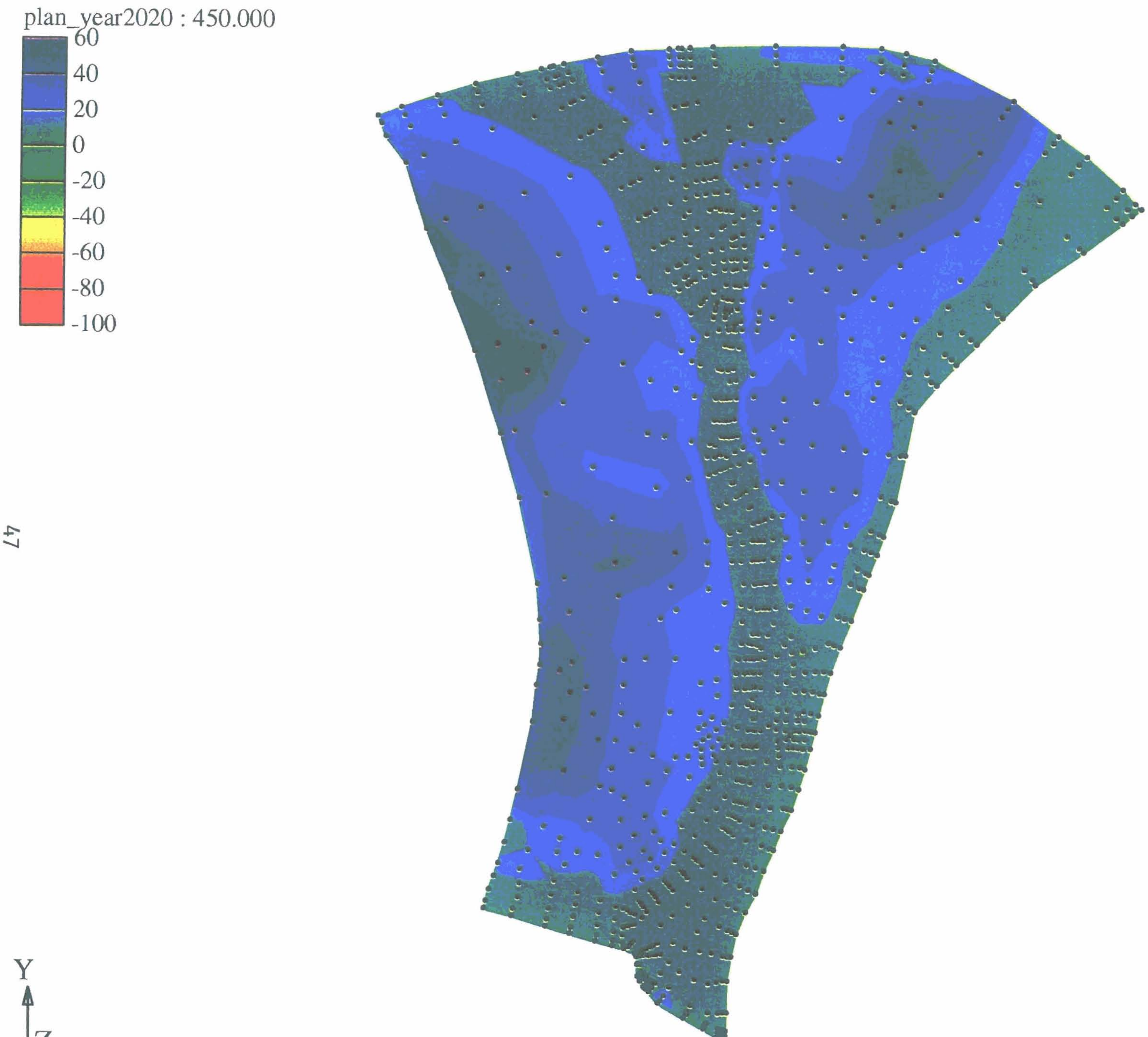


Figure 22: Water Level Elevations - Surficial Aquifer, Year 2020, T.S. 450, Plan Mesh

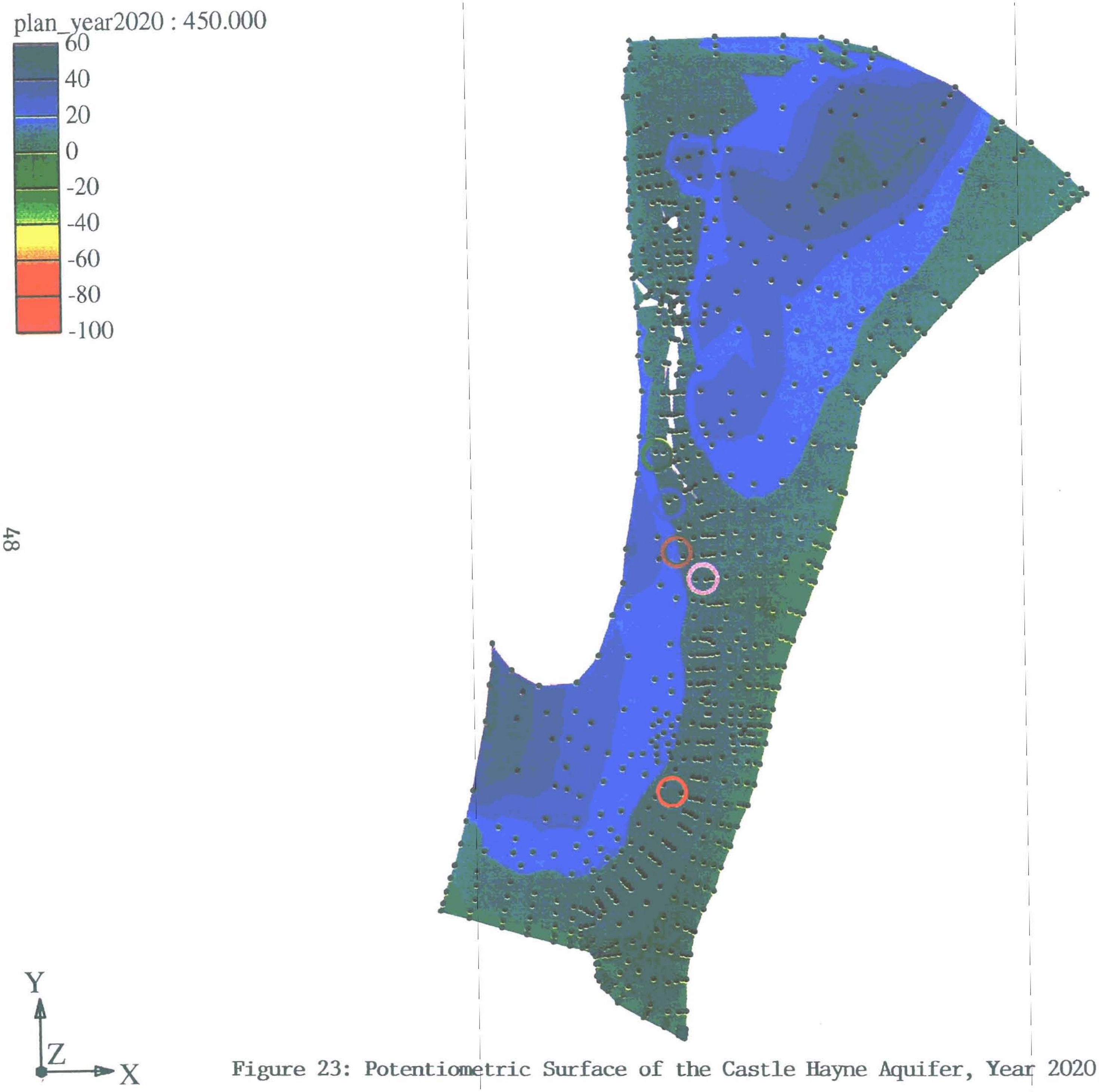


Figure 23: Potentiometric Surface of the Castle Hayne Aquifer, Year 2020, T.S. 450, Plan Mesh

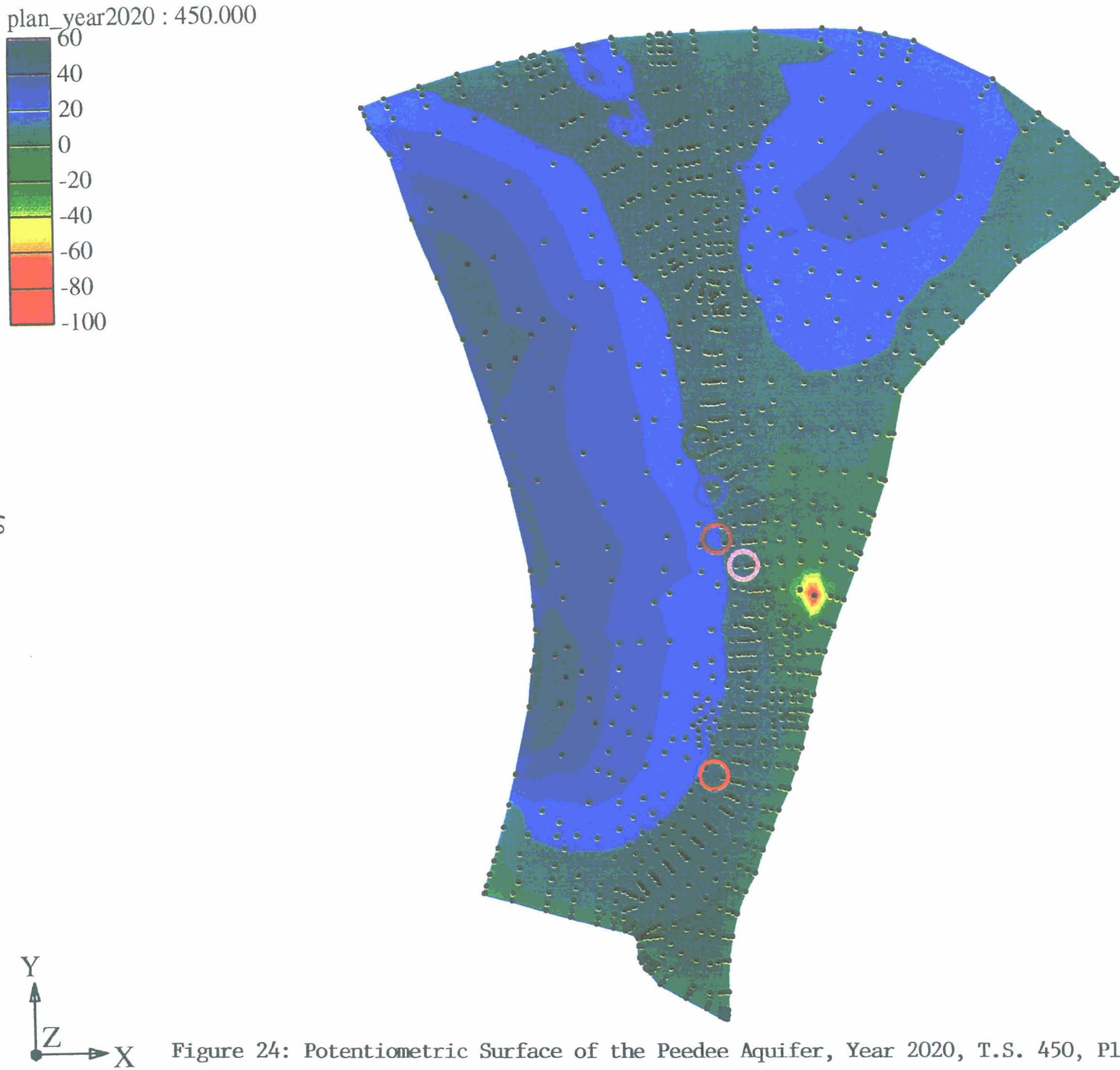


Figure 24: Potentiometric Surface of the Peedee Aquifer, Year 2020, T.S. 450, Plan Mesh

FIGURE 25: WATER BUDGET ANALYSIS/ WILMINGTON HARBOR MODEL

TIME STEP	PUMPING	SOUTH (OCEAN/CONS.HEAD)	EAST (OCEAN)	NORTH (SPEC.HEAD)	WEST(SPEC.HEAD)	RIVER	TOP	BASE
DAYS								
0.0	-3.169	-0.631	-1.584	0.197	0.92	-1.471	26.583	0.107
30.0	-3.264	-0.628	-1.646	0.071	0.718	-1.476	27.677	0.048
60.0	-2.931	-0.64	-1.715	0.15	0.949	-1.491	29.867	0.113
90.0	-3.207	-0.65	-1.726	0.204	1.125	-1.452	27.764	0.137
120.0	-2.922	-0.654	-1.639	0.291	1.26	-1.381	9.573	0.203
150.0	-2.759	-0.659	-1.792	0.24	1.205	-1.296	21.509	0.174
180.0	-2.614	-0.666	-1.952	0.195	1.188	-1.299	31.614	0.147
210.0	-4.551	-0.686	-2.091	0.114	1.213	-1.366	33.037	0.138
240.0	-2.447	-0.693	-2.156	0.105	1.222	-1.451	23.855	0.142
270.0	-2.495	-0.691	-2.197	0.058	1.142	-1.497	16.034	0.124
300.0	-2.528	-0.682	-2.141	-0.033	0.947	-1.559	-1.106	0.081
330.0	-2.6	-0.677	-2.15	-0.118	0.794	-1.556	-1.515	0.04
360.0	-3.353	-0.647	-1.685	-0.191	0.479	-1.555	-0.78	-0.036
390.0	-3.61	-0.656	-1.76	-0.173	0.586	-1.459	28.868	-0.026
420.0	-2.666	-0.667	-2.288	-0.319	0.488	-1.485	29.157	-0.058
450.0	-2.726	-0.674	-2.309	-0.275	0.612	-1.519	29.995	-0.046

negative=outflow
positive=inflow
all units are in million cubic feet per day

- Head differentials between aquifers are small over most of the model area, with the exception of a few locations as mentioned in the framework study. This is apparently due to the lithologies of the confining units, which consist in much of the area of sandy to silty clays or siltstones. Sand and silt content in clay units will produce higher vertical hydraulic conductivities than would be observed in a pure clay.

- A cone of depression is apparent in the Peedee Aquifer, as shown in both the base and plan water level maps at an east-central location in the mesh (figure 15 and 18). This is due to the assignment of several high volume pumping wells to one node position. In fact, the wells are much more widely distributed. Therefore, the observed drawdown at this position is greatly exaggerated. Due to the lack of fine resolution in the mesh around the pumping nodes, localized drawdown effects for the most part could not be indicated in model output. The focus of the modeling effort was primarily to study the regional effects of deepening the channel on the aquifer system, and not to concentrate on effects on localized areas.

In order to test the sensitivity of the system to the combined effects of dredging and future increases in pumping, another simulation was performed using projected pumping rates from the year 2020, as well as average recharge rates for the Wilmington area. In the same manner as before, both base and plan simulations were run, and a comparison was made of water levels from each of the three aquifers. No changes were observed to occur between base and plan model output results (figures 19-24). A comparison was then made between the 1993-1994 base simulation and the 2020 base simulation, and between the corresponding plan simulations to determine if the combined effects of dredging and increased pumping rates would produce changes in water levels. A comparison of base simulations indicates changes in water levels in all three aquifers (figures 13-15 and 19-21). A comparison of plan simulations from both runs indicates that the changes in water level distribution are identical to those observed in the base runs (figures 16-18 and 22-24). This is indicative that the changes in water level distribution are caused entirely by pumping rate increases, and not by channel deepening.

In view of the fact that base and plan modeling results do not indicate changes in water level distribution in the aquifer system induced by channel deepening, it was considered superfluous for the purposes of this study to conduct coupled flow and transport simulations. Advection is the primary mechanism by which dredging would affect the position of the fresh water/salt water interface. Changes in the advection process would not occur as a result of dredging if comparative changes do not occur in water levels from base to plan flow simulations.

A water budget analysis was performed using model output results from the 1993-1994 simulation. Included in the summary (figure 25) are estimates of outflow of ground water to the Cape Fear River, outflow to the ocean via the eastern and southern boundaries, inflow/outflow through the northern boundary and through the base, outflow through ground water pumpage, and inflow through the top of the mesh, which represents recharge to the ground water system by precipitation. Since the Femwater model is a dynamic model, the flux values through the top boundary represent an increase of the overall volume in million cubic feet per day as water levels rise. The model predicts an average rise of the water table of 5.17 inches for the 450 day modeling period. The total simulation covered a time period of 1450 days, with all boundaries set for constant head during the first 1000 days. The water budget summary shown in figure 25 covers the last 450 days of the simulation, and thus indicates flux values beginning at time step 0.

PART 2: SUMMARY AND CONCLUSIONS

The primary objective of the ground water modeling phase of the Wilmington Harbor study was to determine if deepening the shipping channel will cause detrimental alterations to the adjoining aquifer system in New Hanover and Brunswick Counties. Possible impacts investigated by modeling include changes in water levels or ground water flow directions in the aquifer system, and salt water intrusion as a result of changes in the hydraulics of the aquifer system.

The modeling study was designed to test the significance of removal of confining beds by dredging, as well as the removal and resultant increase in surface area of aquifer material exposed in the shipping channel. The model was also designed to predict the combined effects on the aquifer system of deepening the channel in conjunction with present and projected future pumping rates from nearby municipal and industrial well systems.

The ground water model chosen for the study is a three dimensional finite element model called FEMWATER. FEMWATER was used in combination with a preprocessor/postprocessor called GMS (Ground Water Modeling System) developed by the Army Corps of Engineers Waterways Experiment Station.

The process of development and application of the FEMWATER model to the Wilmington Harbor study site involved several key steps which included design and construction of the 3-d finite element mesh, assignment of model boundary conditions, model calibration and sensitivity analysis, applied flow simulations, and analysis of simulation results.

Transient, flow only model simulations were performed using both base and plan meshes. A comparison of water levels produced over two, 450 day simulations using both base and plan meshs and 1993-1994 pumping data indicated no difference in distribution of water levels in the Peedee, Castle Hayne and surficial aquifers. Using increased pumping rates projected to the year 2020, comparison of water levels from the base 1993-1994 and base 2020 simulations showed slight decreases in water levels. Comparison of results from the corresponding plan simulations showed identical changes as found in the two base simulations. This indicated that the changes in water level distribution were caused by increased pumping rates and not by channel deepening.

Advection is the primary process by which dredging would affect the position of the fresh water/salt water interface. In view of the fact that modeling results do not indicate that water level changes will occur as a result of dredging, it may be safely assumed that salt water intrusion will not be induced by deepening the shipping channel. Therefore it is apparent by analysis of model output results that dredging of the Wilmington Harbor shipping channel to the proposed depths will not produce detrimental changes to the aquifer system.

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APPENDIX

Well Data Base:	Latitude-Longitude Coordinates, Well Name and Number, Ground Level Elev., Altitudes and Thicknesses of Hydrogeologic Units

GUIDE TO ABBREVIATIONS AND SYMBOLS USED IN APPENDIX

1. All depths and elevations are expressed in feet.
   (-) indicates sub-sea level depth.
   > -100; Base of aquifer or confining unit is probably present below the total depth of the boring.
   ? Uncertain correlation

2. NH= New Hanover County, NC
   BW= Brunswick County, NC
   Glelev.= Ground Level Elevation
   SAQ= Surficial Aquifer
   TOPCHAQ= Top of Castle Hayne Aquifer
   TOPPDAQ= Top of Pee Dee Aquifer
   TOPBCAQ= Top of Black Creek Aquifer
   Missing= Unit not present
   CU= Confining Unit
   NP= Not Penetrated
   Not Logged= No geophysical or lithologic data available
   Undiff.= Undifferentiated

Well No: NH-49 Latitude: 34.283333
Well Name: C.P.AND L Sutton Plant No.5 Longitude: 77.976667

County: NH
Total Depth: 105 GL Elev: 5 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -55	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -100	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-50 Latitude: 34.060278
Well Name: SUGGS&HARR. DEVE. Longitude: 77.917500

County: NH
Total Depth: 200 GL Elev: 10 Monitor Well Network No.:

Top chaq: UNDIFF.	Top cuno3: NP	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a -30	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: -40	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-51 Latitude: 33.962778
Well Name: MARINE SCIENCE CENTER Longitude: 77.931389

County: NH
Total Depth: 158 GL Elev: 7 Monitor Well Network No.: 38

Top chaq: -114	Top cuno3: NP	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -91	Base cuno4a:	Base cuno6a:	
Base cuno2: -114			

Well No: NH-53 Latitude: 34.324167
Well Name: GENERAL ELECTRIC 4-A Longitude: 77.924722

County: NH
Total Depth: 110 GL Elev: 6 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -10	Top cuno5:	Top cuno7:
Top pdaq: -20	Base cuno3: -20	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -63	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -104	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-54
Well Name: ALLIED CHEMICAL

Latitude: 34.143056
Longitude: 77.905

County: NH
Total Depth: 148 | GL Elev: 25 | Monitor Well Network No.:

Top chaq: -44	Top cuno3: -82	Top cuno5:	Top cuno7:
Top pdaq: -107	Base cuno3: -107	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -16	Base cuno4a:	Base cuno6a:	
Base cuno2: -44			

Well No: NH-55
Well Name: UNNAMED

Latitude: 34.076111
Longitude: 77.913056

County: NH
Total Depth: 200 | GL Elev: 12 | Monitor Well Network No.:

Top chaq: -78	Top cuno3: NO DATA	Top cuno5:	Top cuno7:
Top pdaq: UNKNOWN	Base cuno3: NO DATA	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: NO DATA	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: NO DATA	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -48	Base cuno4a:	Base cuno6a:	
Base cuno2: -78			

Well No: NH-57
Well Name: TOWN OF CAROLINA BEACH

Latitude: 34.053889
Longitude: 77.9

County: NH
Total Depth: 220 | GL Elev: 5 | Monitor Well Network No.: 35

Top chaq: UNCONFINED	Top cuno3: -195	Top cuno5:	Top cuno7:
Top pdaq: -213	Base cuno3: -213	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-58
Well Name: TOWN OF CAROLINA BEACH No. 9

Latitude: 34.046111
Longitude: 77.901389

County: NH
Total Depth: 223 | GL Elev: 30 | Monitor Well Network No.: 34

Top chaq: -130	Top cuno3: -172	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3: NP	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -116	Base cuno4a:	Base cuno6a:	
Base cuno2: -130			

Well No: NH-59
Well Name: TOWN OF KURE BEACH No. 5

Latitude: 34.010278
Longitude: 77.910833

County: NH
Total Depth: 203 GL Elev: 22 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: NP	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-60
Well Name: TOWN OF CAROLINA BEACH

Latitude: 34.035556
Longitude: 77.896944

County: NH
Total Depth: 190 GL Elev: 10 Monitor Well Network No.: 33

Top chaq: -120	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNDIFF.	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -100	Base cuno4a:	Base cuno6a:	
Base cuno2: -120			

Well No: NH-61
Well Name: TOWN OF CAROLINA BEACH No. 3

Latitude: 34.058056
Longitude: 77.888611

County: NH
Total Depth: 202 GL Elev: 5 Monitor Well Network No.: 28

Top chaq: -123	Top cuno3: -145	Top cuno5:	Top cuno7:
Top pdaq: -175	Base cuno3: -175	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -103	Base cuno4a:	Base cuno6a:	
Base cuno2: -123			

Well No: NH-63
Well Name: MASONBORO UTILITIES

Latitude: 34.133889
Longitude: 77.877222

County: NH
Total Depth: 203 GL Elev: 26 Monitor Well Network No.: 57

Top chaq: -81	Top cuno3: -130	Top cuno5:	Top cuno7:
Top pdaq: -150	Base cuno3: -150	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: 6	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: -9	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -62	Base cuno4a:	Base cuno6a:	
Base cuno2: -81			

Well No: NH-64 Latitude: 34.295278
Well Name: NORTH CHASE DEVELOPMENT Longitude: 77.874722

County: NH
Total Depth: 252 GL Elev: 40 Monitor Well Network No.:

Top chaq:	MISSING	Top cuno3:	-20	Top cuno5:	-180	Top cuno7:	
Top pdaq:	-32	Base cuno3:	-32	Base cuno5:	> -212	Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:	NP	Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:	MISSING	Base cuno6a:			
Base cuno2:	MISSING						

Well No: NH-65 Latitude: 34.303056
Well Name: NORTH CHASE DEVELOPMENT Longitude: 77.8725

County: NH
Total Depth: 251 GL Elev: 36 Monitor Well Network No.:

Top chaq:	MISSING	Top cuno3:	-16	Top cuno5:	-184	Top cuno7:	
Top pdaq:	-32	Base cuno3:	-32	Base cuno5:	> -215	Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:	NP	Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:	MISSING	Base cuno6a:			
Base cuno2:	MISSING						

Well No: NH-66 Latitude: 34.296111
Well Name: N.HANOVER SCHOOLS/LANEY Longitude: 77.870833

County: NH
Total Depth: 212 GL Elev: 30 Monitor Well Network No.:

Top chaq:	MISSING	Top cuno3:	-26	Top cuno5:	MISSING	Top cuno7:	
Top pdaq:	-41	Base cuno3:	-41	Base cuno5:	MISSING	Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:	NP	Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:	MISSING	Base cuno6a:			
Base cuno2:	MISSING						

Well No: NH-67 Latitude: 34.251111
Well Name: CORNING GLASS Longitude: 77.869167

County: NH
Total Depth: 160 GL Elev: 36 Monitor Well Network No.: 51

Top chaq:	UNCONFINED	Top cuno3:	MISSING	Top cuno5:		Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	NP	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:		Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: NH-68 Latitude: 34.295
Well Name: USGS C-1 79 Longitude: 77.86

County: NH
Total Depth: 77 GL Elev: 28 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -32	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3: > -46	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-69 Latitude: 34.213611
Well Name: UNNAMED Longitude: 77.833889

County: NH
Total Depth: 160 GL Elev: 12 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-70 Latitude: 34.221389
Well Name: TWN. OF WRIGHTSVILLE BCH. Longitude: 77.825278

County: NH
Total Depth: 185 GL Elev: 21 Monitor Well Network No.: 48

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-71 Latitude: 34.226389
Well Name: D.G. ENTERPRISES, INC. Longitude: 77.783333

County: NH
Total Depth: 170 GL Elev: 10 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: NP	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-72 Latitude: 34.315556
Well Name: HERCULES, INC. Longitude: 77.980833

County: NH
Total Depth: 1060 GL Elev: 25 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 7	Top cuno5: -90	Top cuno7: MISSING
Top pdaq: 1	Base cuno3: 1	Base cuno5: -180	Base cuno7: MISSING
Top bcaq: -398	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -343
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -398
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: NH-73 Latitude: 34.3
Well Name: USGS T-1 65 Longitude: 77.861111

County: NH
Total Depth: 684 GL Elev: 25 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -34	Top cuno5: -210	Top cuno7: MISSING
Top pdaq: -50	Base cuno3: -50	Base cuno5: --283	Base cuno7: MISSING
Top bcaq: -509	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: NOT LOGGED	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: NOT LOGGED	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -415
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -509
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: NH-74 Latitude: 34.033333
Well Name: TOWN OF CAROLINA BEACH Longitude: 77.908889

County: NH
Total Depth: 200 GL Elev: 18 Monitor Well Network No.: 29

Top chaq: -104	Top cuno3: NP	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -70	Base cuno4a:	Base cuno6a:	
Base cuno2: -104			

Well No: NH-75 Latitude: 33.973611
Well Name: NC OIL AND GAS, FT.FISHER1 Longitude: 77.919444

County: NH
Total Depth: 1303 GL Elev: 5 Monitor Well Network No.:

Top chaq: -113	Top cuno3: -171	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: -219	Base cuno3: -219	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -539	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -461
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -539
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: -95	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: -113			

Well No: NH-76 Latitude: 34.258333
Well Name: C.P. AND L. Longitude: 77.824722

County: NH
Total Depth: 123 GL Elev: 25 Monitor Well Network No.:

Top chaq: UNCONFINED
Top pdaq: UNCONFINED
Top bcaq: NP
Top cuno1: MISSING
Base cuno1: MISSING
Top cuno1a MISSING
Base cuno1a: MISSING
Top cuno2: MISSING
Base cuno2: MISSING
Top cuno3: MISSING
Base cuno3: MISSING
Top cuno3a: MISSING
Base cuno3a: MISSING
Top cuno4: NP
Base cuno4:
Top cuno4a:
Base cuno4a:
Top cuno5:
Base cuno5:
Top cuno5a:
Base cuno5a:
Top cuno6:
Base cuno6:
Top cuno6a:
Base cuno6a:
Top cuno7:
Base cuno7:
Top cuno7a:
Base cuno7a:
Top cuno8:
Base cuno8:

Well No: NH-77 Latitude: 34.304166
Well Name: NH-T-16/USGS PP. 796 Longitude: 77.975

County: NH
Total Depth: >1000 GL Elev: 50 Monitor Well Network No.:

Top chaq: MISSING
Top pdaq: UNCONFINED
Top bcaq: -415
Top cuno1: MISSING
Base cuno1: MISSING
Top cuno1a MISSING
Base cuno1a: MISSING
Top cuno2: MISSING
Base cuno2: MISSING
Top cuno3: MISSING
Base cuno3: MISSING
Top cuno3a: MISSING
Base cuno3a: MISSING
Top cuno4: MISSING
Base cuno4: MISSING
Top cuno4a: MISSING
Base cuno4a: MISSING
Top cuno5: -115
Base cuno5: -205
Top cuno5a: MISSING
Base cuno5a: MISSING
Top cuno6: MISSING
Base cuno6: MISSING
Top cuno6a: MISSING
Base cuno6a: MISSING
Top cuno7: MISSING
Base cuno7: MISSING
Top cuno7a: MISSING
Base cuno7a: MISSING
Top cuno8: -367
Base cuno8: -415

Well No: NH-78 Latitude: 34.220278
Well Name: TOWN OF WRIGHTSVILLE BCH. Longitude: 77.811111

County: NH
Total Depth: 165 GL Elev: 10 Monitor Well Network No.: 45

Top chaq: UNCONFINED
Top pdaq: UNCONFINED
Top bcaq: NP
Top cuno1: MISSING
Base cuno1: MISSING
Top cuno1a MISSING
Base cuno1a: MISSING
Top cuno2: MISSING
Base cuno2: MISSING
Top cuno3: MISSING
Base cuno3: MISSING
Top cuno3a: MISSING
Base cuno3a: MISSING
Top cuno4: NP
Base cuno4:
Top cuno4a:
Base cuno4a:
Top cuno5:
Base cuno5:
Top cuno5a:
Base cuno5a:
Top cuno6:
Base cuno6:
Top cuno6a:
Base cuno6a:
Top cuno7:
Base cuno7:
Top cuno7a:
Base cuno7a:
Top cuno8:
Base cuno8:

Well No: NH-79 Latitude: 34.318056
Well Name: HERCOFINA Longitude: 77.976667

County: NH
Total Depth: 80 GL Elev: 27 Monitor Well Network No.:

Top chaq: MISSING
Top pdaq: 1
Top bcaq: NP
Top cuno1: MISSING
Base cuno1: MISSING
Top cuno1a MISSING
Base cuno1a: MISSING
Top cuno2: MISSING
Base cuno2: MISSING
Top cuno3: 7
Base cuno3: 1
Top cuno3a: MISSING
Base cuno3a: MISSING
Top cuno4: NP
Base cuno4:
Top cuno4a:
Base cuno4a:
Top cuno5:
Base cuno5:
Top cuno5a:
Base cuno5a:
Top cuno6:
Base cuno6:
Top cuno6a:
Base cuno6a:
Top cuno7:
Base cuno7:
Top cuno7a:
Base cuno7a:
Top cuno8:
Base cuno8:

Well No: NH-80 Latitude: 34.032778
Well Name: TOWN OF CAROLINA BEACH Longitude: 77.897222

County: NH
Total Depth: 197 GL Elev: 10 Monitor Well Network No.: 26

Top chaq: -132	Top cuno3: NP	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -106	Base cuno4a:	Base cuno6a:	
Base cuno2: -132			

Well No: NH-82 Latitude: 33.9625
Well Name: MARINE SCIENCE CENTER Longitude: 77.931389

County: NH
Total Depth: 204 GL Elev: 7 Monitor Well Network No.: 37

Top chaq: -123	Top cuno3: NP	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -93	Base cuno4a:	Base cuno6a:	
Base cuno2: -123			

Well No: NH-84 Latitude: 34.276667
Well Name: GW SECTION, FLEM. LANDFILL r25 Longitude: 77.964444

County: NH
Total Depth: 120 GL Elev: 14 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -76	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -106	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-85 Latitude: 34.273889
Well Name: GW SECTION, FLEM. LANDFILL r29 Longitude: 77.963333

County: NH
Total Depth: 112 GL Elev: 11 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -76	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -101	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-86 | Latitude: 34.273056
Well Name: GW SECTION, FLEM. LANDFILL r38 | Longitude: 77.960556

County: NH
Total Depth: 100 | GL Elev: 11 | Monitor Well Network No.:

Top chaq:	MISSING	Top cuno3:	MISSING	Top cuno5:		Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	-73	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	> -89	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	NP	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: NH-87 | Latitude: 34.274167
Well Name: OLIVER C. HUTAFF | Longitude: 77.920278

County: NH
Total Depth: 84 | GL Elev: 25 | Monitor Well Network No.:

Top chaq:	MISSING	Top cuno3:	MISSING	Top cuno5:		Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	NP	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:		Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: NH-88 | Latitude: 34.279167
Well Name: GW SECTION, FLEM. LANDFILL | Longitude: 77.965833

County: NH
Total Depth: 112 | GL Elev: 14 | Monitor Well Network No.:

Top chaq:	MISSING	Top cuno3:	MISSING	Top cuno5:		Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	-74	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	> -98	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	NP	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: NH-89 | Latitude: 34.061666
Well Name: COASTAL STATES, SUGGS NO.1 | Longitude: 77.907777

County: NH
Total Depth: 1183 | GL Elev: 10 | Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	-154	Top cuno5:	MISSING	Top cuno7:	MISSING
Top pdaq:	-172	Base cuno3:	-172	Base cuno5:	MISSING	Base cuno7:	MISSING
Top bcaq:	-600	Top cuno3a:	MISSING	Top cuno5a:	-358	Top cuno7a:	MISSING
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:	-372	Base cuno7a:	MISSING
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:	MISSING	Top cuno8:	-534
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:	MISSING	Base cuno8:	-600
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:	MISSING		
Top cuno2:	MISSING	Base cuno4a:	MISSING	Base cuno6a:	MISSING		
Base cuno2:	MISSING						

Well No: NH-91
Well Name: COASTAL STATES, J.H. FOY NO.1

Latitude: 34.3
Longitude: 77.780555

County: NH
Total Depth: 1304
GL Elev: 29
Monitor Well Network No.:

Top chaq: NOT LOGGED	Top cuno3: MISSING	Top cuno5: ?	Top cuno7: ?
Top pdaq: ?	Base cuno3: MISSING	Base cuno5: ?	Base cuno7: ?
Top bcaq: -577	Top cuno3a: MISSING	Top cuno5a: ?	Top cuno7a: ?
Top cuno1: NOT LOGGED	Base cuno3a: MISSING	Base cuno5a: ?	Base cuno7a: ?
Base cuno1: NOT LOGGED	Top cuno4: ?	Top cuno6: ?	Top cuno8: -495
Top cuno1a NOT LOGGED	Base cuno4: ?	Base cuno6: ?	Base cuno8: -577
Base cuno1a: NOT LOGGED	Top cuno4a: ?	Top cuno6a: ?	
Top cuno2: NOT LOGGED	Base cuno4a: ?	Base cuno6a: ?	
Base cuno2: NOT LOGGED			

Well No: NH-92
Well Name: UNNAMED

Latitude: 34.236944
Longitude: 77.938333

County: NH
Total Depth: 82
GL Elev: 53
Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 2	Top cuno5:	Top cuno7:
Top pdaq: -36	Base cuno3: -36	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-93
Well Name: BRIGADE BOYS CLUB

Latitude: 34.225277
Longitude: 77.946111

County: NH
Total Depth: 115
GL Elev: 47
Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 0	Top cuno5:	Top cuno7:
Top pdaq: -37	Base cuno3: -37	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: NH-94
Well Name: E.J. BELLAMY

Latitude: 34.176111
Longitude: 77.9275

County: NH
Total Depth: 108
GL Elev: 30
Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: -20	Top cuno5:	Top cuno7:
Top pdaq: -70	Base cuno3: -70	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: | Latitude:
Well Name: | Longitude:

County:
Total Depth: | GL Elev: | Monitor Well Network No.:

Top chaq:	Top cuno3:	Top cuno5:	Top cuno7:
Top pdaq:	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1:	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1:	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a:	Top cuno4a:	Top cuno6a:	
Top cuno2:	Base cuno4a:	Base cuno6a:	
Base cuno2:			

Well No: B-2 | Latitude: 34.063056
Well Name: NC DIVISION OF GW | Longitude: 78.515833

County: BW
Total Depth: 400 | GL Elev: 73 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 31	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: 31	Base cuno3: 15	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: 61	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: 49	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: NP
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-3 | Latitude: 33.960556
Well Name: GW SECTION GG38 k-3 | Longitude: 78.494444

County: BW
Total Depth: 500 | GL Elev: 42 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 15	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: 2	Base cuno3: 2	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -405	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: -192	Top cuno8: -361
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: -214	Base cuno8: -405
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: -231	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: -260	
Base cuno2: MISSING			

Well No: | Latitude:
Well Name: | Longitude:

County:
Total Depth: | GL Elev: | Monitor Well Network No.:

Top chaq:	Top cuno3:	Top cuno5:	Top cuno7:
Top pdaq:	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1:	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1:	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a:	Top cuno4a:	Top cuno6a:	
Top cuno2:	Base cuno4a:	Base cuno6a:	
Base cuno2:			

Well No:
Well Name:

Latitude:
Longitude:

County:
Total Depth:
GL Elev:
Monitor Well Network No.:

Top chaq:	Top cuno3:	Top cuno5:	Top cuno7:
Top pdaq:	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1:	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1:	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a:	Top cuno4a:	Top cuno6a:	
Top cuno2:	Base cuno4a:	Base cuno6a:	
Base cuno2:			

Well No: B-6
Well Name: GW SECTION Bear Pen RS EE36 k-2

Latitude: 34.128611
Longitude: 78.339444

County: BW
Total Depth: 1118
GL Elev: 61
Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 10	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: 3	Base cuno3: 3	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -373	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: -161	Top cuno8: -307
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: -215	Base cuno8: -375
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-7
Well Name: GW SECTION

Latitude: 34.148611
Longitude: 78.338056

County: BW
Total Depth: 136
GL Elev: 62
Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: ?	Top cuno5:	Top cuno7:
Top pdaq: ?	Base cuno3: ?	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: ?	Top cuno5a:	Top cuno7a:
Top cuno1: NOT LOGGED	Base cuno3a: ?	Base cuno5a:	Base cuno7a:
Base cuno1: NOT LOGGED	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a NOT LOGGED	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: NOT LOGGED	Top cuno4a:	Top cuno6a:	
Top cuno2: NOT LOGGED	Base cuno4a:	Base cuno6a:	
Base cuno2: NOT LOGGED			

Well No: B-8
Well Name: NC DIVISION OF GW FF35 g-1

Latitude: 34.061944
Longitude: 78.311667

County: BW
Total Depth: 1175
GL Elev: 57
Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5: MISSING	Top cuno7: -215
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5: MISSING	Base cuno7: -243
Top bcaq: -403	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -335
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -403
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-9 | Latitude: 33.9425
Well Name: NC DIVISION OF GW GG 35 R-2 | Longitude: 78.268889

County: BW
Total Depth: 160 | GL Elev: 35 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -5	Top cuno5: NP	Top cuno7:
Top pdaq: -17	Base cuno3: -17	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -105	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: > -125	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-10 | Latitude: 33.919167
Well Name: NC DIVISION OF GW HH35 b-2 | Longitude: 78.272778

County: BW
Total Depth: 200 | GL Elev: 11 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -25	Top cuno5: NP	Top cuno7:
Top pdaq: -29	Base cuno3: -29	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -129	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: -166	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-11 | Latitude: 34.052222
Well Name: NC DIVISION OF GW FF34 g-1 | Longitude: 78.235

County: BW
Total Depth: 152 | GL Elev: 41 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 13	Top cuno5:	Top cuno7:
Top pdaq: 7	Base cuno3: 7	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-12 | Latitude: 34.04
Well Name: BRUNSWICK TECH | Longitude: 78.229167

County: BW
Total Depth: 212 | GL Elev: 20 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 6	Top cuno5: -138	Top cuno7:
Top pdaq: 0	Base cuno3: 0	Base cuno5: > -192	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: NP	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-14 Latitude: 33.916667
Well Name: NC DIV. OF GW SUNSET HARB. RS GG34 w-6 Longitude: 78.2

County: BW
Total Depth: 1279 GL Elev: 20 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5: -216	Top cuno7: -335
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5: -244	Base cuno7: -362
Top bcaq: -492	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -414
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -492
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-16 Latitude: 33.977222
Well Name: USGS, INT'L PAPER C-2 79 Longitude: 78.160278

County: BW
Total Depth: 157 GL Elev: 46 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -82	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -111	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-17 Latitude: 34.2875
Well Name: MACO FIRE TOWER RS CC33 o-3 Longitude: 78.155556

County: BW
Total Depth: 251 GL Elev: ~~18~~ 60 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 5	Top cuno5: -122	Top cuno7:
Top pdaq: -2	Base cuno3: -2	Base cuno5: -140	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: -196	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: -220	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: NP	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-19 Latitude: 34.070556
Well Name: NC DIVISION OF GW Town of Bolivia Longitude: 78.145833

County: BW
Total Depth: 299 GL Elev: 41 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 5	Top cuno5: MISSING	Top cuno7: NP
Top pdaq: -11	Base cuno3: -11	Base cuno5: MISSING	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: -173	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: -193	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-21 Latitude: 34.308333
Well Name: UNNAMED Longitude: 78.141667

County: BW
Total Depth: 370 GL Elev: 50 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: NP	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-22 Latitude: 34.2825
Well Name: OAKWOOD TRAILER PARK Longitude: 78.138056

County: BW
Total Depth: 322 GL Elev: 40 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5: -98	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5: -118	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a:
Top cuno1: NOT LOGGED	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a:
Base cuno1: NOT LOGGED	Top cuno4: MISSING	Top cuno6: NP	Top cuno8:
Top cuno1a NOT LOGGED	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: NOT LOGGED	Top cuno4a: MISSING	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-23 Latitude: 34.051111
Well Name: USGS, C-3 79 Longitude: 78.123333

County: BW
Total Depth: 82.5 GL Elev: 40 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B- 24 Latitude: 33.991667
Well Name: BRUNSWICK CO. WELL No. 7 Longitude: 78.119167

County: BW
Total Depth: 242 GL Elev: 52 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -98	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -190	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-25 — Latitude: 33.986389
Well Name: BRUNSWICK CO. WELL No. 6 — Longitude: 78.112778

County: BW
Total Depth: 254 GL Elev: 52 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -120	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: -174	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-26 — Latitude: 33.965278
Well Name: BRUNSWICK COUNTY WELL NO. P-6 — Longitude: 78.1125

County: BW
Total Depth: 177 GL Elev: 50 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-27 — Latitude: 33.952778
Well Name: BRUNSWICK COUNTY WELL No. 4 — Longitude: 78.107222

County: BW
Total Depth: 259 GL Elev: 54 Monitor Well Network No.:

Top chaq: 14	Top cuno3: MISSING	Top cuno5: NP	Top cuno7:
Top pdaq: UNDIFF.	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: 24	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: 14	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -176	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: > -205	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-28 — Latitude: 33.972778
Well Name: BRUNSWICK COUNTY WELL No. 9 — Longitude: 78.107222

County: BW
Total Depth: 251 GL Elev: 54 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5: NP	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -146	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: -166	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-29 Latitude: 33.944444
Well Name: BRUNSWICK COUNTY WELL No. P-4 Longitude: 78.094444

County: BW
Total Depth: 156 GL Elev: 45 Monitor Well Network No.:

Top chaq: -9	Top cuno3: -42	Top cuno5:	Top cuno7:
Top pdaq: -51	Base cuno3: -51	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: 25	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: 10	Top cuno4: -105	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -111	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: 9	Base cuno4a:	Base cuno6a:	
Base cuno2: -9			

Well No: B-30 Latitude: 33.974722
Well Name: UNNAMED Longitude: 78.0925

County: BW
Total Depth: 258 GL Elev: 52 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5: NP	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -162	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: -186	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-32 Latitude: 34.044444
Well Name: GW SECTION RS FF32 m-2 Longitude: 78.037778

County: BW
Total Depth: 100 GL Elev: 36 Monitor Well Network No.:

Top chaq: -4	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNDIFF.	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: 26	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: 6	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: 1	Base cuno4a:	Base cuno6a:	
Base cuno2: -4			

Well No: B-34 Latitude: 34.045833
Well Name: GW SECTION BOILING SPRINGS RS FF32 m-1 Longitude: 78.036111

County: BW
Total Depth: 98 GL Elev: 25 Monitor Well Network No.:

Top chaq: -1	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNDIFF.	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: 3	Base cuno4a:	Base cuno6a:	
Base cuno2: -1			

Well No: B-36 | Latitude: 33.925833
Well Name: GW SECTION SOUTHPORT RS GG32 w-2 | Longitude: 78.034444

County: BW
Total Depth: 240 | GL Elev: 20 | Monitor Well Network No.:

Top chaq: -29	Top cuno3: -74	Top cuno5: -200	Top cuno7:
Top pdaq: -80	Base cuno3: -80	Base cuno5: > -219	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: NP	Top cuno7a:
Top cuno1: -10	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: -20	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a:	
Top cuno2: -16	Base cuno4a: MISSING	Base cuno6a:	
Base cuno2: -29			

Well No: B-37 | Latitude: 34.097222
Well Name: COLONIAL OIL&GAS, HORNE NO.2 | Longitude: 78.032777

County: BW
Total Depth: 640 | GL Elev: 45 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -15	Top cuno5: -169	Top cuno7: MISSING
Top pdaq: -23	Base cuno3: -23	Base cuno5: -221	Base cuno7: MISSING
Top bcaq: -507	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: -365
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: -392
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -425
Top cuno1a 25	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -507
Base cuno1a: 17	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-38 | Latitude: 34.250556
Well Name: NCGS | Longitude: 78.029167

County: BW
Total Depth: 400 | GL Elev: 20 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5: -106	Top cuno7: NP
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5: -198	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a:
Top cuno1: NOT LOGGED	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a:
Base cuno1: NOT LOGGED	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8:
Top cuno1a NOT LOGGED	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8:
Base cuno1a: NOT LOGGED	Top cuno4a: MISSING	Top cuno6a: -258	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: -294	
Base cuno2: MISSING			

Well No: B-39 | Latitude: 34.006944
Well Name: NCGS | Longitude: 78.03

County: BW
Total Depth: 185 | GL Elev: 30 | Monitor Well Network No.:

Top chaq: ?	Top cuno3: -54	Top cuno5:	Top cuno7:
Top pdaq: -60	Base cuno3: -60	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: ?	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: ?	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a ?	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: ?	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-40 | Latitude: 34.090833
Well Name: GW SECTION BOILING SPRINGS RS EE32 v-1 | Longitude: 78.0175

County: BW
Total Depth: 111 GL Elev: 18 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: MISSING	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a 22	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: 2	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-41 | Latitude: 33.931389
Well Name: GW SECTION SOUTHPORT RS GG32 u-1 | Longitude: 78.015278

County: BW
Total Depth: 103 GL Elev: 22 Monitor Well Network No.: 6

Top chaq: -36	Top cuno3: -58	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3: > -81	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -22	Base cuno4a:	Base cuno6a:	
Base cuno2: -36			

Well No: B-42 | Latitude: 33.945
Well Name: NC DIVISION OF GW SOUTHPORT RS GG32 | Longitude: 78.011667

County: BW
Total Depth: 190 GL Elev: 26 Monitor Well Network No.:

Top chaq: -36	Top cuno3: -65	Top cuno5:	Top cuno7:
Top pdaq: -91	Base cuno3: -91	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: -11	Base cuno4a:	Base cuno6a:	
Base cuno2: -36			

Well No: B-45 | Latitude: 33.958333
Well Name: NC DIVISION OF GW SOUTHPORT RS GG32 | Longitude: 77.995833

County: BW
Total Depth: 189 GL Elev: 20 Monitor Well Network No.:

Top chaq: -42	Top cuno3: -64	Top cuno5:	Top cuno7:
Top pdaq: -96	Base cuno3: -96	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: -24	Base cuno4a:	Base cuno6a:	
Base cuno2: -42			

Well No: B-46 Latitude: 33.944444
Well Name: VPI/DEPT.OF ENERGY Longitude: 77.997777

County: BW
Total Depth: 1532 GL Elev: 25 Monitor Well Network No.:

Top chaq: -43	Top cuno3: -65	Top cuno5: MISSING	Top cuno7: -375
Top pdaq: -89	Base cuno3: -89	Base cuno5: MISSING	Base cuno7: -415
Top bcaq: NO LOG	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -451
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: NO LOG
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: -27	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: -43			

Well No: B-47 Latitude: 34.196667
Well Name: USGS, NC BRUNS. C-1 79 Longitude: 77.978333

County: BW
Total Depth: 83 GL Elev: 20 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -11	Top cuno5:	Top cuno7:
Top pdaq: -28	Base cuno3: -28	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-48 Latitude: 34.2625
Well Name: TOWN OF NAVASSA Longitude: 78.003333

County: BW
Total Depth: 160 GL Elev: 20 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -70	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -100	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-49 Latitude: 33.978333
Well Name: BRUNSWICK COUNTY Longitude: 78.103333

County: BW
Total Depth: 300 GL Elev: 50 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5: NP	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -126	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: -180	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-50 Latitude: 33.990556
Well Name: NC DIVISION OF GW SHALLOTTE RS GG37 Longitude: 78.44

County: BW
Total Depth: 197 GL Elev: 70 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 18	Top cuno5: NP	Top cuno7:
Top pdaq: 8	Base cuno3: 8	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-51 Latitude: 33.908333
Well Name: TOWN OF YAUPON BEACH Longitude: 78.0725

County: BW
Total Depth: 110 GL Elev: 15 Monitor Well Network No.:

Top chaq: -41	Top cuno3: -90	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3: > -95	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: -22	Base cuno4a:	Base cuno6a:	
Base cuno2: -41			

Well No: B-52 Latitude: 33.913333
Well Name: TOWN OF LONG BEACH Longitude: 78.133055

County: BW
Total Depth: 147 GL Elev: 15 Monitor Well Network No.:

Top chaq: -25	Top cuno3: -43	Top cuno5:	Top cuno7:
Top pdaq: -65	Base cuno3: -65	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: -17	Base cuno4a:	Base cuno6a:	
Base cuno2: -25			

Well No: Latitude:
Well Name: Longitude:

County:
Total Depth: GL Elev: Monitor Well Network No.:

Top chaq:	Top cuno3:	Top cuno5:	Top cuno7:
Top pdaq:	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1:	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1:	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a:	Top cuno4a:	Top cuno6a:	
Top cuno2:	Base cuno4a:	Base cuno6a:	
Base cuno2:			

Well No: B-57 | Latitude: 33.939722
Well Name: NC DIVISION OF GW | Longitude: 78.198333

County: BW
Total Depth: 107 | GL Elev: 29 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-58 | Latitude: 33.939722
Well Name: NC DIVISION OF GW | Longitude: 78.198333

County: BW
Total Depth: 104 | GL Elev: 30 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: NP	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-59 | Latitude: 33.939722
Well Name: NC DIVISION OF GW | Longitude: -78.198333

County: BW
Total Depth: 1367 | GL Elev: 25 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: MISSING	Top cuno5: -163	Top cuno7: -335
Top pdaq: UNDIFF.	Base cuno3: MISSING	Base cuno5: -247	Base cuno7: -367
Top bcaq: -499	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -421
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -499
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-60 | Latitude: 33.955556
Well Name: CP&L | Longitude: 78.0125

County: BW
Total Depth: 240 | GL Elev: 24 | Monitor Well Network No.:

Top chaq: -34	Top cuno3: ?	Top cuno5: NP	Top cuno7:
Top pdaq: ?	Base cuno3: ?	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -172	Top cuno6a:	
Top cuno2: -19	Base cuno4a: > -216	Base cuno6a:	
Base cuno2: -34			

Well No: B-61 Latitude: 33.943611
Well Name: NC DIVISION OF GW SOUTHPORT RS GG32 Longitude: 78.010556

County: BW
Total Depth: 199 GL Elev: 28 Monitor Well Network No.: 3

Top chaq: -32	Top cuno3: -67	Top cuno5: NP	Top cuno7:
Top pdaq: -88	Base cuno3: -88	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -152	Top cuno6a:	
Top cuno2: -12	Base cuno4a: > -171	Base cuno6a:	
Base cuno2: -32			

Well No: B-62 Latitude: 33.943611
Well Name: NC DIVISION OF GW SOUTHPORT RS GG32 Longitude: 78.010556

County: BW
Total Depth: 199 GL Elev: 27 Monitor Well Network No.:

Top chaq: -33	Top cuno3: -70	Top cuno5: NP	Top cuno7:
Top pdaq: -88	Base cuno3: -88	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -163	Top cuno6a:	
Top cuno2: -13	Base cuno4a: > -172	Base cuno6a:	
Base cuno2: -33			

Well No: B-63 Latitude: 33.955556
Well Name: NC DIVISION OF GW SOUTHPORT GG32 k-4 Longitude: 78.0125

County: BW
Total Depth: 189 GL Elev: 24 Monitor Well Network No.:

Top chaq: -32	Top cuno3: -68	Top cuno5: NP	Top cuno7:
Top pdaq: -93	Base cuno3: -93	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -152	Top cuno6a:	
Top cuno2: -12	Base cuno4a: > -165	Base cuno6a:	
Base cuno2: -32			

Well No: B-66 Latitude: 34.008333
Well Name: BRUNSWICK CO. HOSPITAL Longitude: 78.291667

County: BW
Total Depth: 263 GL Elev: 25 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 13	Top cuno5: MISSING	Top cuno7:
Top pdaq: 5	Base cuno3: 5	Base cuno5: MISSING	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: NP	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -55	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: -71	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-67
Well Name: BRUNSWICK CO. HOSPITAL

Latitude: 34.008333
Longitude: 78.291667

County: BW
Total Depth: 180
GL Elev: 25
Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 13	Top cuno5: NP	Top cuno7:
Top pdaq: 7	Base cuno3: 7	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -55	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: -71	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-68
Well Name: NC DIVISION OF GW FF35 v-1

Latitude: 34.016667
Longitude: 78.271667

County: BW
Total Depth: 42
GL Elev: 34
Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 10	Top cuno5:	Top cuno7:
Top pdaq: 2	Base cuno3: 2	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-69
Well Name: GW SECTION BOILING SPRINGS RS FF32 y-1

Latitude: 34.008889
Longitude: 78.082778

County: BW
Total Depth: 151
GL Elev: 54
Monitor Well Network No.: 11

Top chaq: UNCONFINED	Top cuno3: -18	Top cuno5:	Top cuno7:
Top pdaq: -22	Base cuno3: -22	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-72
Well Name: M. WILLETS

Latitude: 34.280278
Longitude: 78.127778

County: BW
Total Depth: 140
GL Elev: 50
Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: NP	Top cuno5:	Top cuno7:
Top pdaq: NP	Base cuno3:	Base cuno5:	Base cuno7:
Top bcaq:	Top cuno3a:	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-73 Latitude: 33.951389
Well Name: NC DIVISION OF GW SOUTHPORT RS GG32 Longitude: 78.011667

County: BW
Total Depth: 186 GL Elev: 26 Monitor Well Network No.: 1

Top chaq: -36	Top cuno3: -66	Top cuno5:	Top cuno7:
Top pdaq: -84	Base cuno3: -84	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: -18	Base cuno4a:	Base cuno6a:	
Base cuno2: -36			

Well No: B-75 Latitude: 34.132778
Well Name: GW SECTION BEAR PEN RS EE36 k-6 Longitude: 78.335556

County: BW
Total Depth: 112 GL Elev: 61 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 15	Top cuno5:	Top cuno7:
Top pdaq: 9	Base cuno3: 9	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-77 Latitude: 34.141667
Well Name: COLONIAL OIL&GAS, TRASK NO.1 Longitude: 77.964722

County: BW
Total Depth: 1189 GL Elev: 15 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: -25	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: -33	Base cuno3: -33	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -507	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: -357
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: -385
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -435
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -507
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-78 Latitude: 34.097222
Well Name: COLONIAL OIL&GAS, JEFFRIES NO.3 Longitude: 78.032777

County: BW
Total Depth: 1124 GL Elev: 18 Monitor Well Network No.:

Top chaq: NOT LOGGED	Top cuno3: NOT LOGGED	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: NOT LOGGED	Base cuno3: NOT LOGGED	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -506	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: -354
Top cuno1: NOT LOGGED	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: -384
Base cuno1: NOT LOGGED	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -432
Top cuno1a NOT LOGGED	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -506
Base cuno1a: NOT LOGGED	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: NOT LOGGED	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: NOT LOGGED			

Well No: B-79 Latitude: 34.193611
Well Name: COLONIAL OIL&GAS, RABON NO.2 Longitude: 77.989444

County: BW
Total Depth: 338 GL Elev: 50 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -10	Top cuno5: MISSING	Top cuno7: NP
Top pdaq: -14	Base cuno3: -14	Base cuno5: MISSING	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: -210	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: -235	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: -254	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: -300	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-80 Latitude: 34.196389
Well Name: COLONIAL OIL&GAS, RABON NO.4 Longitude: 77.9925

County: BW
Total Depth: 1210 GL Elev: 18 Monitor Well Network No.:

Top chaq: NOT LOGGED	Top cuno3: UNKNOWN	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: UNKNOWN	Base cuno3: UNKNOWN	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -479	Top cuno3a: MISSING	Top cuno5a: -212	Top cuno7a: MISSING
Top cuno1: NOT LOGGED	Base cuno3a: MISSING	Base cuno5a: -232	Base cuno7a: MISSING
Base cuno1: NOT LOGGED	Top cuno4: MISSING	Top cuno6: -252	Top cuno8: -434
Top cuno1a NOT LOGGED	Base cuno4: MISSING	Base cuno6: -268	Base cuno8: -479
Base cuno1a: NOT LOGGED	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: NOT LOGGED	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: NOT LOGGED			

Well No: B-81 Latitude: 34.193333
Well Name: COLONIAL OIL&GAS, RABON NO.3 Longitude: 77.989444

County: BW
Total Depth: 1188 GL Elev: 12 Monitor Well Network No.:

Top chaq: NOT LOGGED	Top cuno3: NOT LOGGED	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: NOT LOGGED	Base cuno3: NOT LOGGED	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -492	Top cuno3a: MISSING	Top cuno5a: -228	Top cuno7a: MISSING
Top cuno1: NOT LOGGED	Base cuno3a: MISSING	Base cuno5a: -240	Base cuno7a: MISSING
Base cuno1: NOT LOGGED	Top cuno4: MISSING	Top cuno6: -258	Top cuno8: -438
Top cuno1a NOT LOGGED	Base cuno4: MISSING	Base cuno6: -260	Base cuno8: -492
Base cuno1a: NOT LOGGED	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: NOT LOGGED	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: NOT LOGGED			

Well No: B-82 Latitude: 34.140278
Well Name: COLONIAL OIL&GAS, TRASK NO.3 Longitude: 77.960833

County: BW
Total Depth: 1254 GL Elev: 14 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: -26	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: -42	Base cuno3: -42	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -506	Top cuno3a: MISSING	Top cuno5a: -274	Top cuno7a: -370
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: -288	Base cuno7a: -398
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -436
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: -506
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: MISSING			

Well No: B-83 Latitude: 34.143889
Well Name: COLONIAL OIL&GAS, H.MACRAE NO. 3 Longitude: 77.976944

County: BW
Total Depth: 1261 GL Elev: 15 Monitor Well Network No.:

Top chaq: -7	Top cuno3: -29	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: -35	Base cuno3: -35	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -525	Top cuno3a: -74	Top cuno5a: -245	Top cuno7a: MISSING
Top cuno1: MISSING	Base cuno3a: -87	Base cuno5a: -265	Base cuno7a: MISSING
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: -285	Top cuno8: -439
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: -311	Base cuno8: -525
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: -2	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: -7			

Well No: B-84 Latitude: 34.143889
Well Name: COLONIAL OIL&GAS, JEFFRIES NO. 1 Longitude: 77.968889

County: BW
Total Depth: 1221 GL Elev: 15 Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: -25	Top cuno5: MISSING	Top cuno7: MISSING
Top pdaq: -33	Base cuno3: -33	Base cuno5: MISSING	Base cuno7: MISSING
Top bcaq: -510	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: -363
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: -391
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6: -281	Top cuno8: -443
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6: -305	Base cuno8: -510
Base cuno1a: MISSING	Top cuno4a: MISSING	Top cuno6a: -317	
Top cuno2: MISSING	Base cuno4a: MISSING	Base cuno6a: -341	
Base cuno2: MISSING			

Well No: B-85 Latitude: 34.171666
Well Name: ALBERT GLENN Longitude: 78.165

County: BW
Total Depth: 400 GL Elev: 25 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 15	Top cuno5: MISSING	Top cuno7: -220
Top pdaq: -1	Base cuno3: -1	Base cuno5: MISSING	Base cuno7: -250
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: MISSING	Top cuno7a: MISSING
Top cuno1: NOT LOGGED	Base cuno3a: MISSING	Base cuno5a: MISSING	Base cuno7a: MISSING
Base cuno1: NOT LOGGED	Top cuno4: MISSING	Top cuno6: MISSING	Top cuno8: -330
Top cuno1a NOT LOGGED	Base cuno4: MISSING	Base cuno6: MISSING	Base cuno8: > -375
Base cuno1a: NOT LOGGED	Top cuno4a: MISSING	Top cuno6a: MISSING	
Top cuno2: NOT LOGGED	Base cuno4a: MISSING	Base cuno6a: MISSING	
Base cuno2: NOT LOGGED			

Well No: B-90 Latitude: 34.181388
Well Name: WOODWARD CLYDE CONSULTANTS Longitude: 78.010277

County: BW
Total Depth: 150 GL Elev: 22 Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 1	Top cuno5:	Top cuno7:
Top pdaq: -8	Base cuno3: -8	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: -22	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: -36	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: -86	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: > -128	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-91 Latitude: 33.971944
Well Name: CO. OF BRUNSWICK P-1 Longitude: 78.1075

County: BW
Total Depth: 300 GL Elev: 50 Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	MISSING	Top cuno5:		Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	-110	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	-174	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-92 Latitude: 34.222222
Well Name: CO. OF BRUNSWICK P-2 Longitude: 77.986388

County: BW
Total Depth: 300 GL Elev: 26.53 Monitor Well Network No.: 9

Top chaq:	MISSING	Top cuno3:	?	Top cuno5:	MISSING	Top cuno7:	
Top pdaq:	-20	Base cuno3:	-20	Base cuno5:	MISSING	Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:	-174	Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:	>-274	Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:	NP	Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:	MISSING	Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-95 Latitude: 33.944166
Well Name: CO. OF BRUNSWICK P-7 Longitude: 78.084444

County: BW
Total Depth: 176 GL Elev: 33 Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	MISSING	Top cuno5:		Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	NP	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:		Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-96 Latitude: 33.951666
Well Name: CO. OF BRUNSWICK P-8 Longitude: 78.084166

County: BW
Total Depth: 176 GL Elev: 46 Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	MISSING	Top cuno5:		Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	NP	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-97 Latitude: 33.955
Well Name: CO. OF BRUNSWICK P-9 Longitude: 78.106666

County: BW
Total Depth: 174 GL Elev: 50 Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	MISSING	Top cuno5:		Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	NP	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-98 Latitude: 33.971944
Well Name: BRUNSWICK CO. WELL 0-1 Longitude: 78.1075

County: BW
Total Depth: 300 GL Elev: 50 Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	MISSING	Top cuno5:	NP	Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	-110	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	-146	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:	MISSING	Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-99 Latitude: 33.973333
Well Name: BRUNSWICK CO. 0-2 Longitude: 78.107222

County: BW
Total Depth: 220 GL Elev: 45 Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	MISSING	Top cuno5:	-141	Top cuno7:	
Top pdaq:	UNCONFINED	Base cuno3:	MISSING	Base cuno5:	> -171	Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:	NP	Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:	MISSING	Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-100 Latitude: 34.221944
Well Name: BRUNSWICK COUNTY WELL 0-3 Longitude: 77.988055

County: BW
Total Depth: 300 GL Elev: 25 Monitor Well Network No.:

Top chaq:	MISSING	Top cuno3:	13	Top cuno5:	-149	Top cuno7:	
Top pdaq:	-15	Base cuno3:	-15	Base cuno5:	-205	Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:	MISSING	Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:	MISSING	Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:	MISSING	Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:	MISSING	Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:	NP		
Top cuno2:	MISSING	Base cuno4a:	MISSING	Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-101 — Latitude: 34.222222
Well Name: BRUNSWICK CO. WELL 0-4 — Longitude: 77.986388

County: BW
Total Depth: 67 — GL Elev: 26.53 — Monitor Well Network No.: 10

Top chaq: MISSING	Top cuno3: 11	Top cuno5:	Top cuno7:
Top pdaq: -14	Base cuno3: -14	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: NP	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-102 — Latitude: 34.221944
Well Name: BRUNSWICK CO. WELL 0-6 — Longitude: 77.989722

County: BW
Total Depth: 300 — GL Elev: 15 — Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: 9	Top cuno5: NP	Top cuno7:
Top pdaq: -14	Base cuno3: -14	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -151	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: > -285	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-103 — Latitude: 33.944166
Well Name: BRUNSWICK CO. WELL 0-7 — Longitude: 78.084444

County: BW
Total Depth: 300 — GL Elev: 35 — Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5: NP	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -169	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: > -265	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-104 — Latitude: 33.943611
Well Name: BRUNSWICK CO. WELL 0-8 — Longitude: 78.086111

County: BW
Total Depth: 157 — GL Elev: 35 — Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: NP	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-105 | Latitude: 33.946111
Well Name: BRUNSWICK CO. WELL 0-9 | Longitude: 78.254722

County: BW
Total Depth: 307 | GL Elev: 25 | Monitor Well Network No.:

Top chaq: MISSING	Top cuno3: -15	Top cuno5: -209	Top cuno7:
Top pdaq: -27	Base cuno3: -27	Base cuno5: -247	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a: NP	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -109	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: -171	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-107 | Latitude: 33.963056
Well Name: BRUNSWICK CO. WELL 0-11 | Longitude: 78.107778

County: BW
Total Depth: 300 | GL Elev: 48 | Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5: NP	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: -134	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a: -190	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-108 | Latitude: 33.963333
Well Name: BRUNSWICK CO WELL 0-12 | Longitude: 78.1075

County: BW
Total Depth: 187 | GL Elev: 48 | Monitor Well Network No.:

Top chaq: UNCONFINED	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNCONFINED	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: MISSING	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a: MISSING	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4: MISSING	Top cuno6:	Top cuno8:
Top cuno1a MISSING	Base cuno4: MISSING	Base cuno6:	Base cuno8:
Base cuno1a: MISSING	Top cuno4a: NP	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-109 | Latitude: 34.03717
Well Name: US ARMY SUNNY POINT NO.2-5 | Longitude: 77.973095

County: BW
Total Depth: 134 | GL Elev: 25 | Monitor Well Network No.: 13

Top chaq: UNDIFF.	Top cuno3: MISSING	Top cuno5:	Top cuno7:
Top pdaq: UNDIFF	Base cuno3: MISSING	Base cuno5:	Base cuno7:
Top bcaq: NP	Top cuno3a: NP	Top cuno5a:	Top cuno7a:
Top cuno1: MISSING	Base cuno3a:	Base cuno5a:	Base cuno7a:
Base cuno1: MISSING	Top cuno4:	Top cuno6:	Top cuno8:
Top cuno1a 17	Base cuno4:	Base cuno6:	Base cuno8:
Base cuno1a: 4	Top cuno4a:	Top cuno6a:	
Top cuno2: MISSING	Base cuno4a:	Base cuno6a:	
Base cuno2: MISSING			

Well No: B-110
Well Name: US ARMY SUNNY POINT NO.9

Latitude: 34.020625
Longitude: 77.973433

County: BW
Total Depth: 100
GL Elev: 25
Monitor Well Network No.: 20

Top chaq:	UNCONFINED	Top cuno3:	NP	Top cuno5:		Top cuno7:	
Top pdaq:	NP	Base cuno3:		Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:		Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:		Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:		Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:		Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-111
Well Name: US ARMY SUNNY POINT NO.8

Latitude: 34.018033
Longitude: 77.959192

County: BW
Total Depth: 100
GL Elev: 14
Monitor Well Network No.: 17

Top chaq:	UNCONFINED	Top cuno3:	NP	Top cuno5:		Top cuno7:	
Top pdaq:	NP	Base cuno3:		Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:		Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:		Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:		Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:		Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-112
Well Name: US ARMY SUNNY POINT NO.4-3

Latitude: 34.034255
Longitude: 77.959088

County: BW
Total Depth: 100
GL Elev: 22
Monitor Well Network No.: 14

Top chaq:	UNDIFF.	Top cuno3:	NP	Top cuno5:		Top cuno7:	
Top pdaq:	NP	Base cuno3:		Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:		Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:		Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:		Top cuno6:		Top cuno8:	
Top cuno1a	1	Base cuno4:		Base cuno6:		Base cuno8:	
Base cuno1a:	-8	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-113
Well Name: CAROLINA CAPE FEAR CORP. NO.8

Latitude: 33.873611
Longitude: 78.000833

County: BW
Total Depth: 305
GL Elev: 13
Monitor Well Network No.:

Top chaq:	-81	Top cuno3:	-145	Top cuno5:	NP	Top cuno7:	
Top pdaq:	-165	Base cuno3:	-165	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	MISSING	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	MISSING	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	MISSING	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	MISSING	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:	MISSING	Top cuno6a:			
Top cuno2:	-51	Base cuno4a:	MISSING	Base cuno6a:			
Base cuno2:	-81						

Well No: B-114
Well Name: BRUNSWICK CO. MIDDLE SCHOOL

Latitude: 34.008333
Longitude: 78.05

County: BW
Total Depth: 250
GL Elev: 43
Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	-37	Top cuno5:		Top cuno7:	
Top pdaq:	-41	Base cuno3:	-41	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:	?	Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:	?	Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:	?	Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:	?	Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

Well No: B-115
Well Name: DGW/D. SHERRILL

Latitude: 34.211666
Longitude: 77.9855555

County: BW
Total Depth: 56
GL Elev: 23
Monitor Well Network No.:

Top chaq:	MISSING	Top cuno3:	3	Top cuno5:		Top cuno7:	
Top pdaq:	-13	Base cuno3:	-13	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:		Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:		Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:		Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:		Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

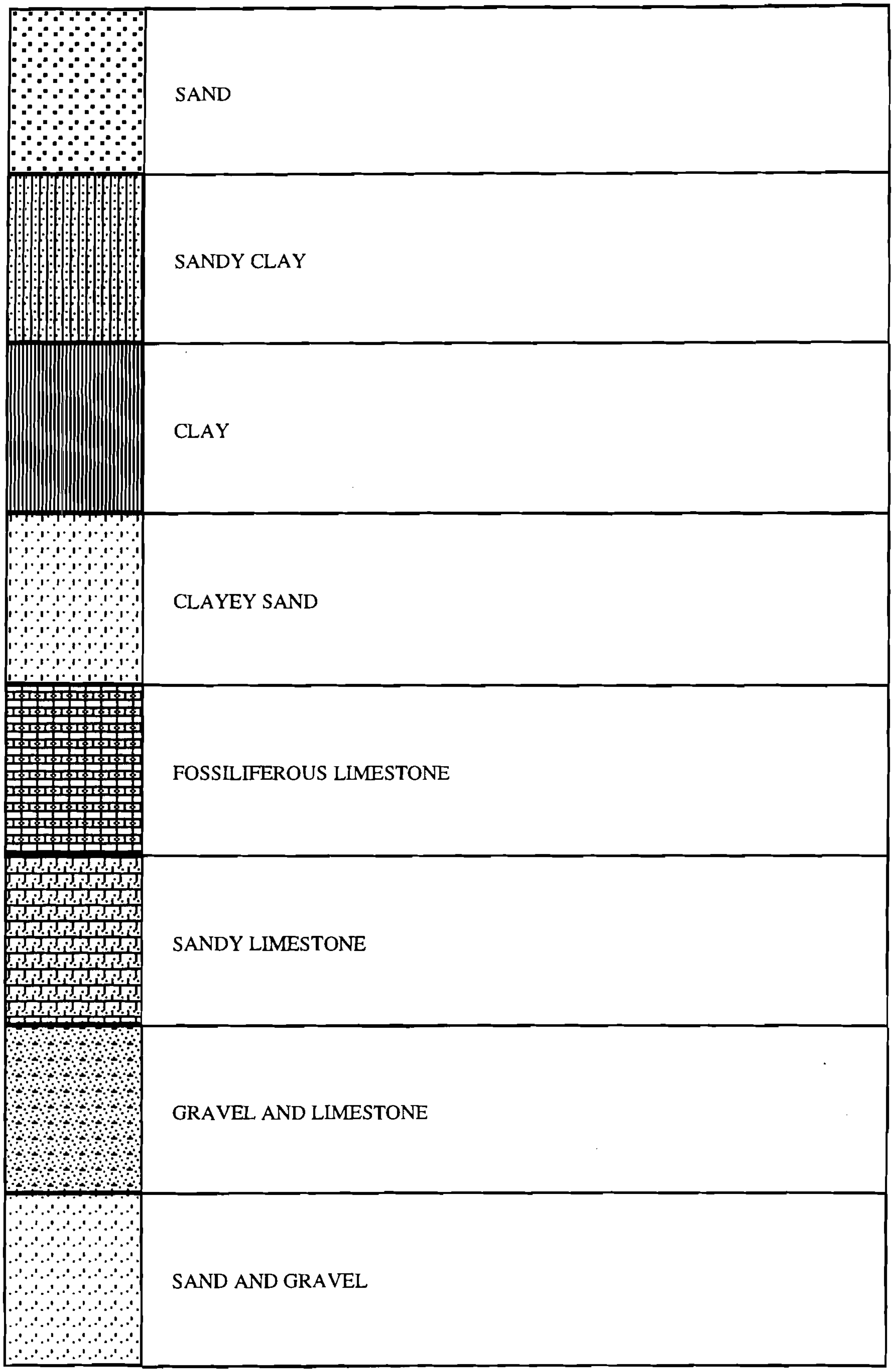
Well No: B-116
Well Name: DGW/WHITE SPRING TRAILER PARK

Latitude: 33.9925
Longitude: 78.030555

County: BW
Total Depth: 165
GL Elev: 40
Monitor Well Network No.:

Top chaq:	UNCONFINED	Top cuno3:	-44	Top cuno5:		Top cuno7:	
Top pdaq:	-48	Base cuno3:	-48	Base cuno5:		Base cuno7:	
Top bcaq:	NP	Top cuno3a:		Top cuno5a:		Top cuno7a:	
Top cuno1:	MISSING	Base cuno3a:		Base cuno5a:		Base cuno7a:	
Base cuno1:	MISSING	Top cuno4:		Top cuno6:		Top cuno8:	
Top cuno1a	MISSING	Base cuno4:		Base cuno6:		Base cuno8:	
Base cuno1a:	MISSING	Top cuno4a:		Top cuno6a:			
Top cuno2:	MISSING	Base cuno4a:		Base cuno6a:			
Base cuno2:	MISSING						

FIGURE A-1: GUIDE TO LITHOLOGIC SYMBOLS USED IN CROSS-SECTIONS



WILMINGTON HARBOR GROUNDWATER STUDY

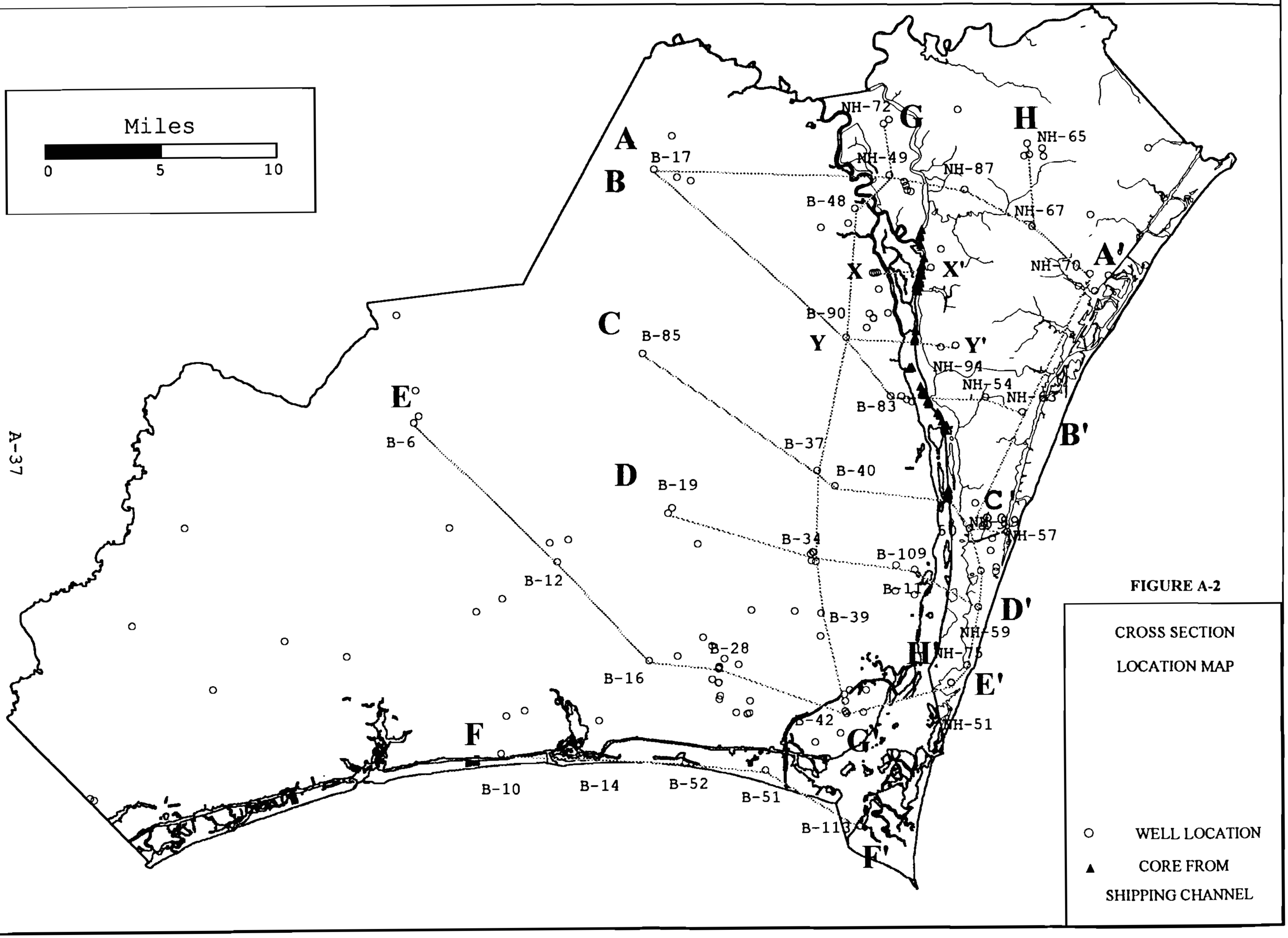


FIGURE A-2

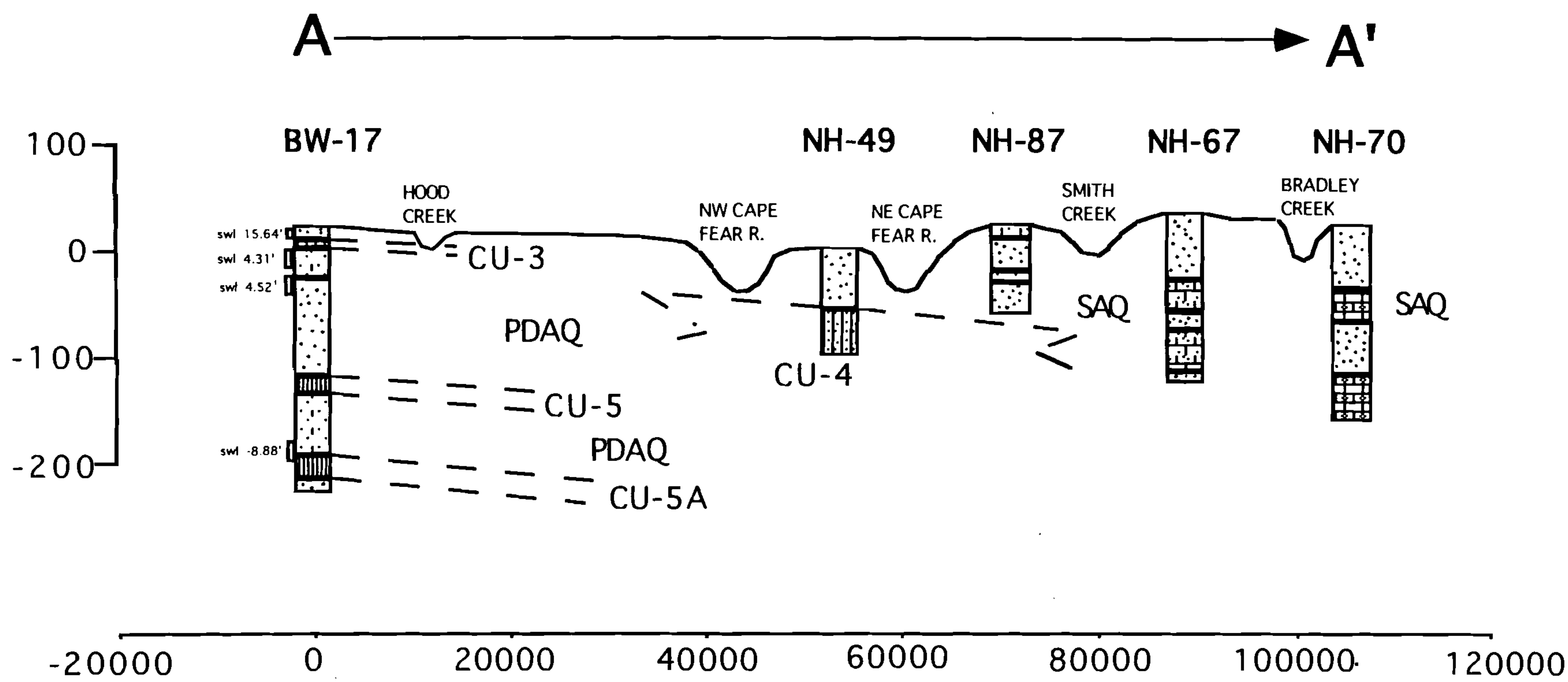


FIGURE A-3

NW-SE HYDROGEOLOGIC CROSS SECTION A-A'
DATUM: SEA LEVEL, NEW HANOVER AND BRUNSWICK COS., NORTH CAROLINA

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

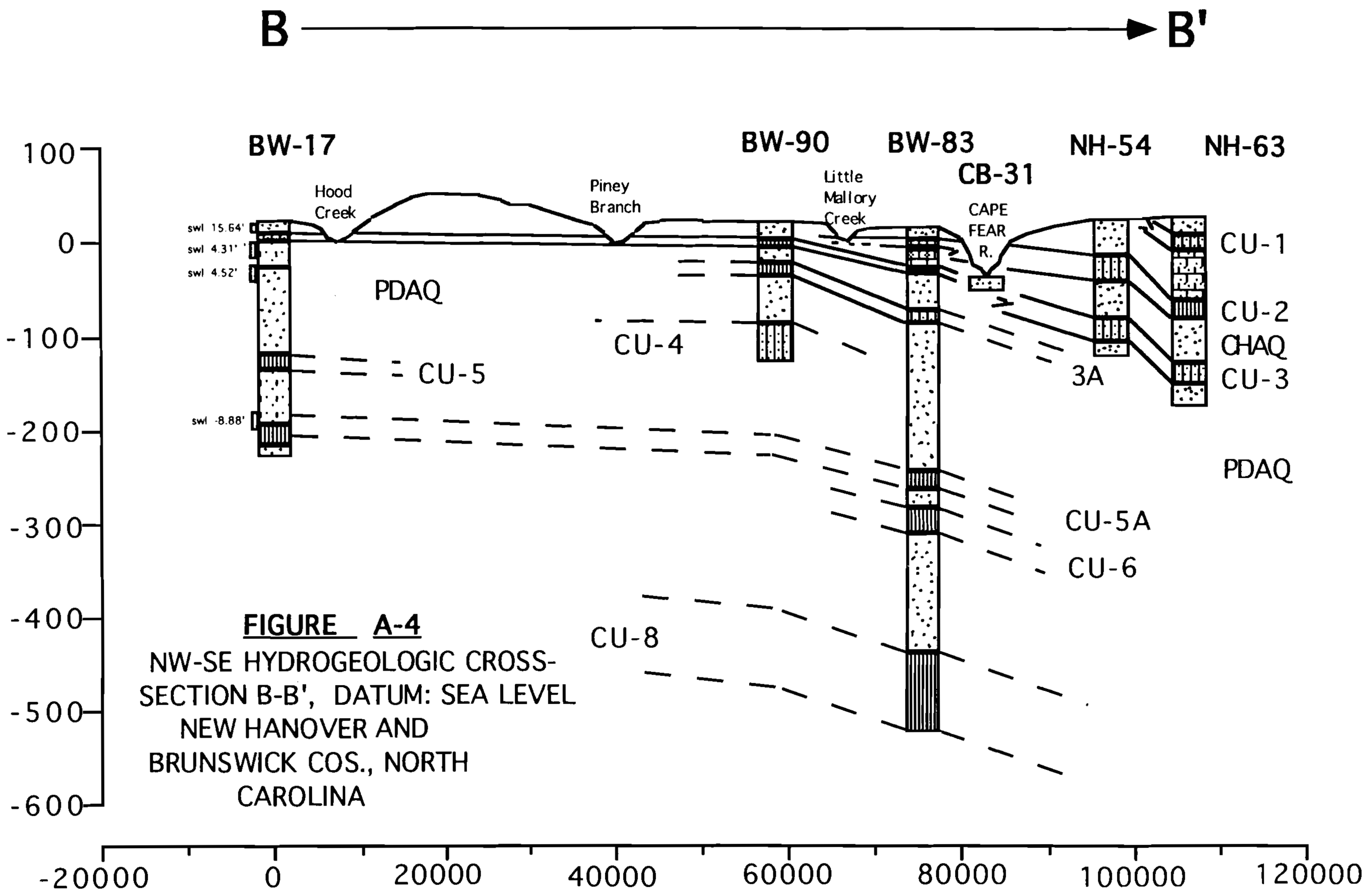


FIGURE A-4

NW-SE HYDROGEOLOGIC CROSS-SECTION B-B', DATUM: SEA LEVEL NEW HANOVER AND BRUNSWICK COS., NORTH CAROLINA

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

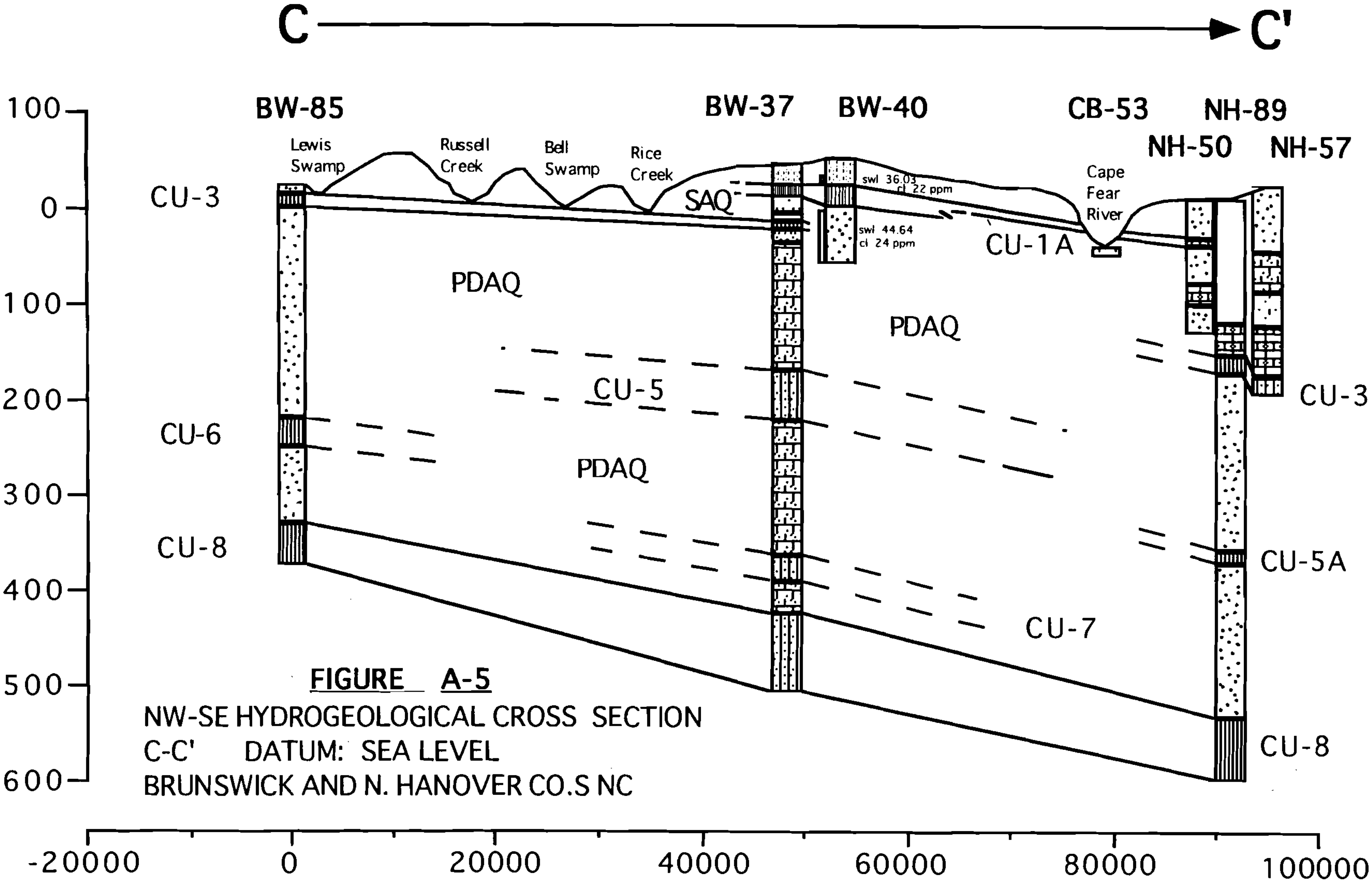


FIGURE A-5

NW-SE HYDROGEOLOGICAL CROSS SECTION
C-C' DATUM: SEA LEVEL
BRUNSWICK AND N. HANOVER CO.S NC

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer

PDAQ: Peedee aquifer
CU: Confining unit

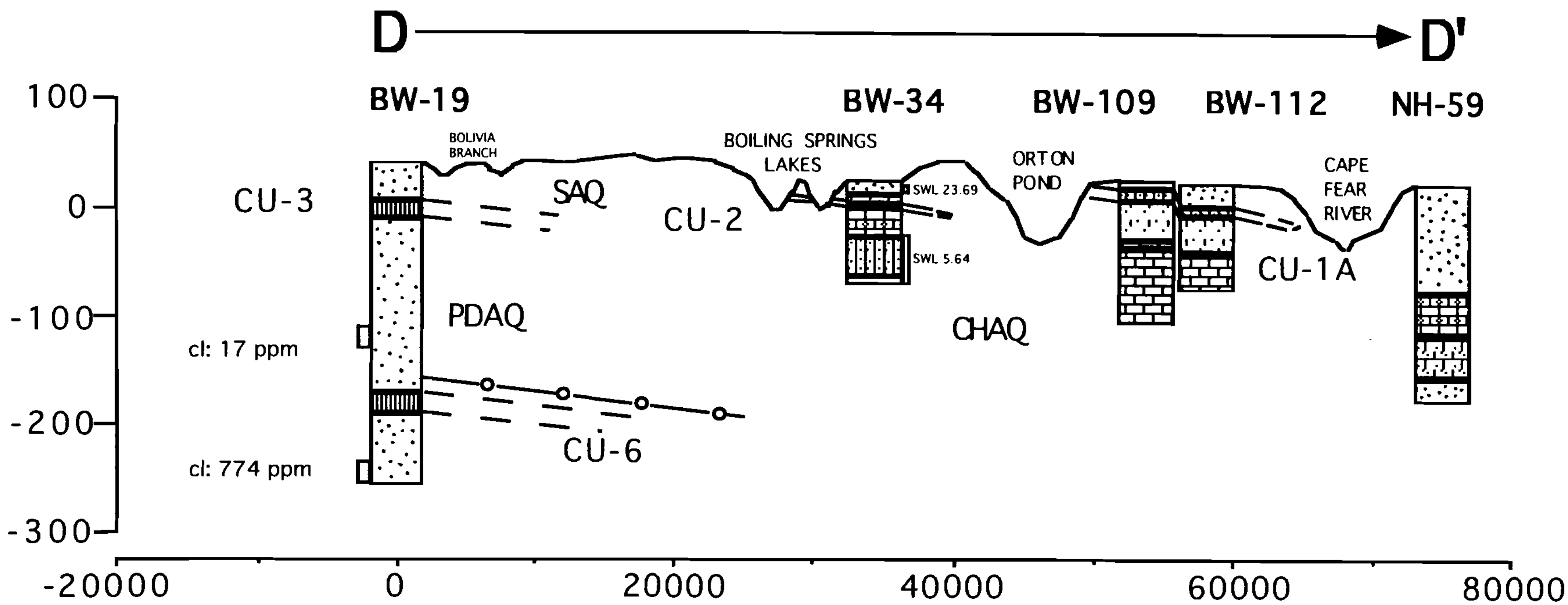


FIGURE A-6

NW-SE HYDROGEOLOGICAL CROSS SECTION
D-D' DATUM: SEA LEVEL
N. HANOVER AND BRUNSWICK CO.S, NC

o—o—o— Line of equal chloride concentration 250 ppm

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

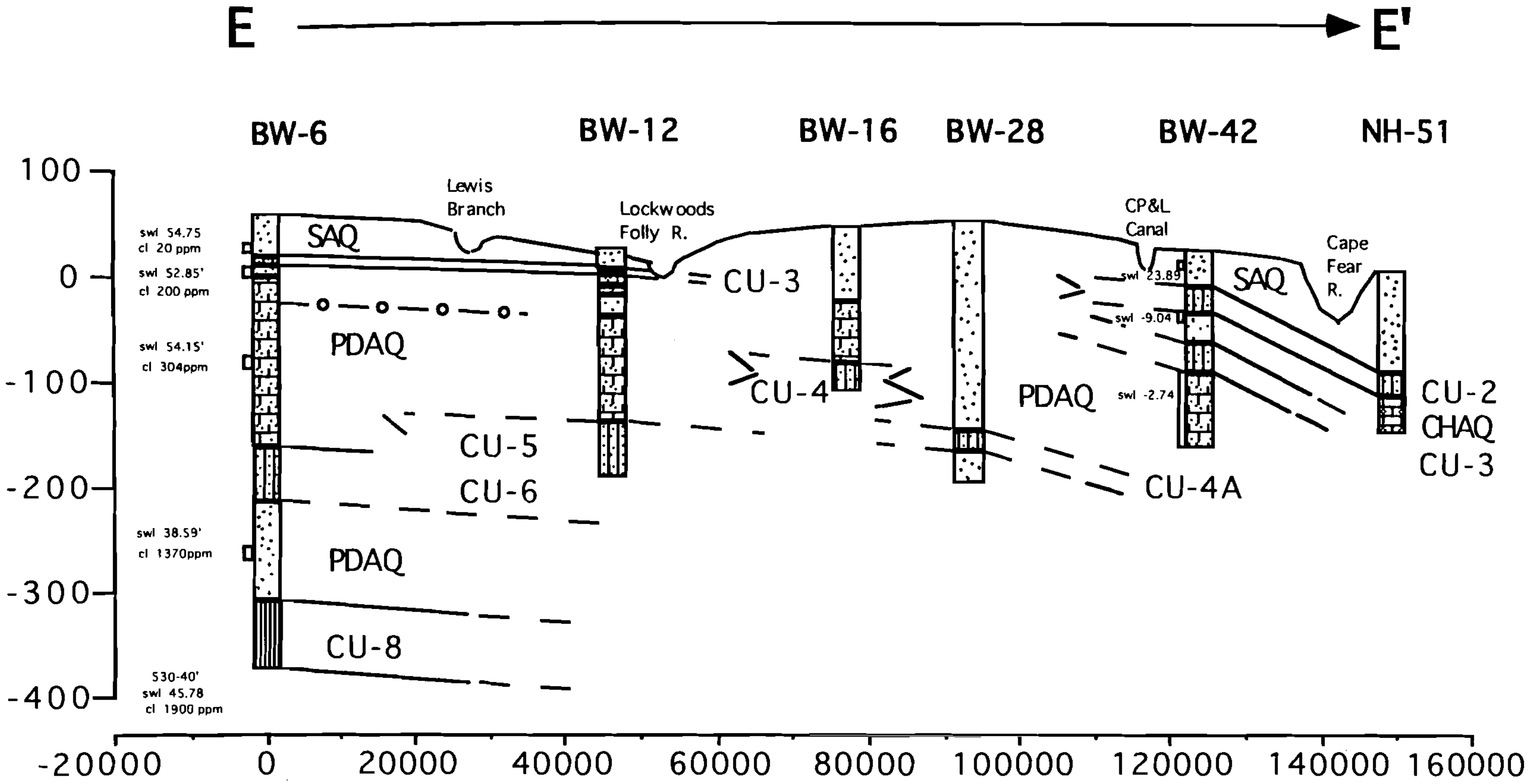


FIGURE A-7

NW-SE HYDROGEOLOGICAL CROSS SECTION E-E'
DATUM: SEA LEVEL, BRUNSWICK AND
NEW HANOVER COS., NORTH CAROLINA

o — o — o - Line of equal chloride concentration 250 ppm

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

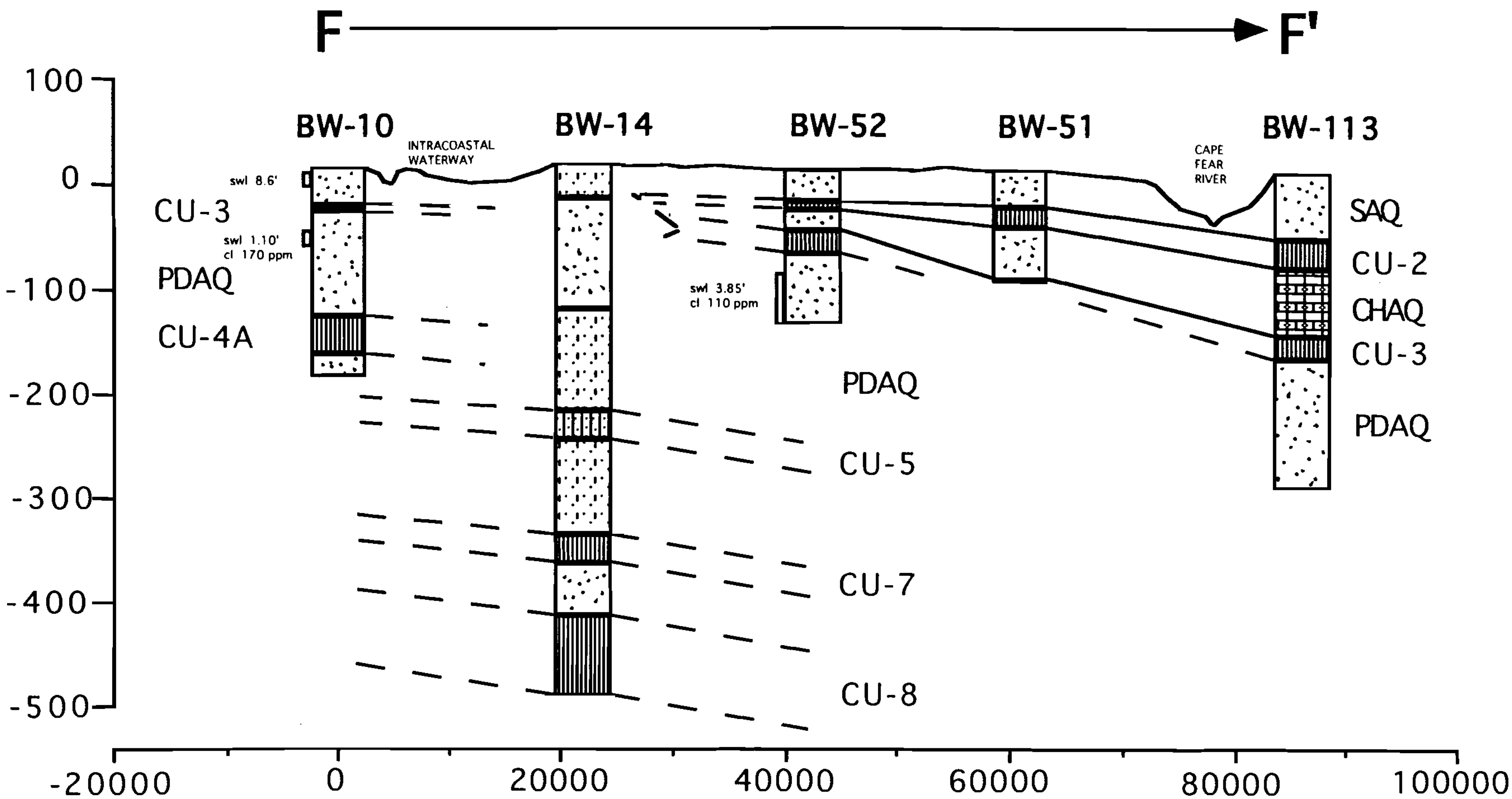


FIGURE A-8

WEST-EAST HYDROGEOLOGICAL CROSS
SECTION F-F' DATUM: SEA LEVEL
BRUNSWICK AND N. HANOVER CO.S
NORTH CAROLINA

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

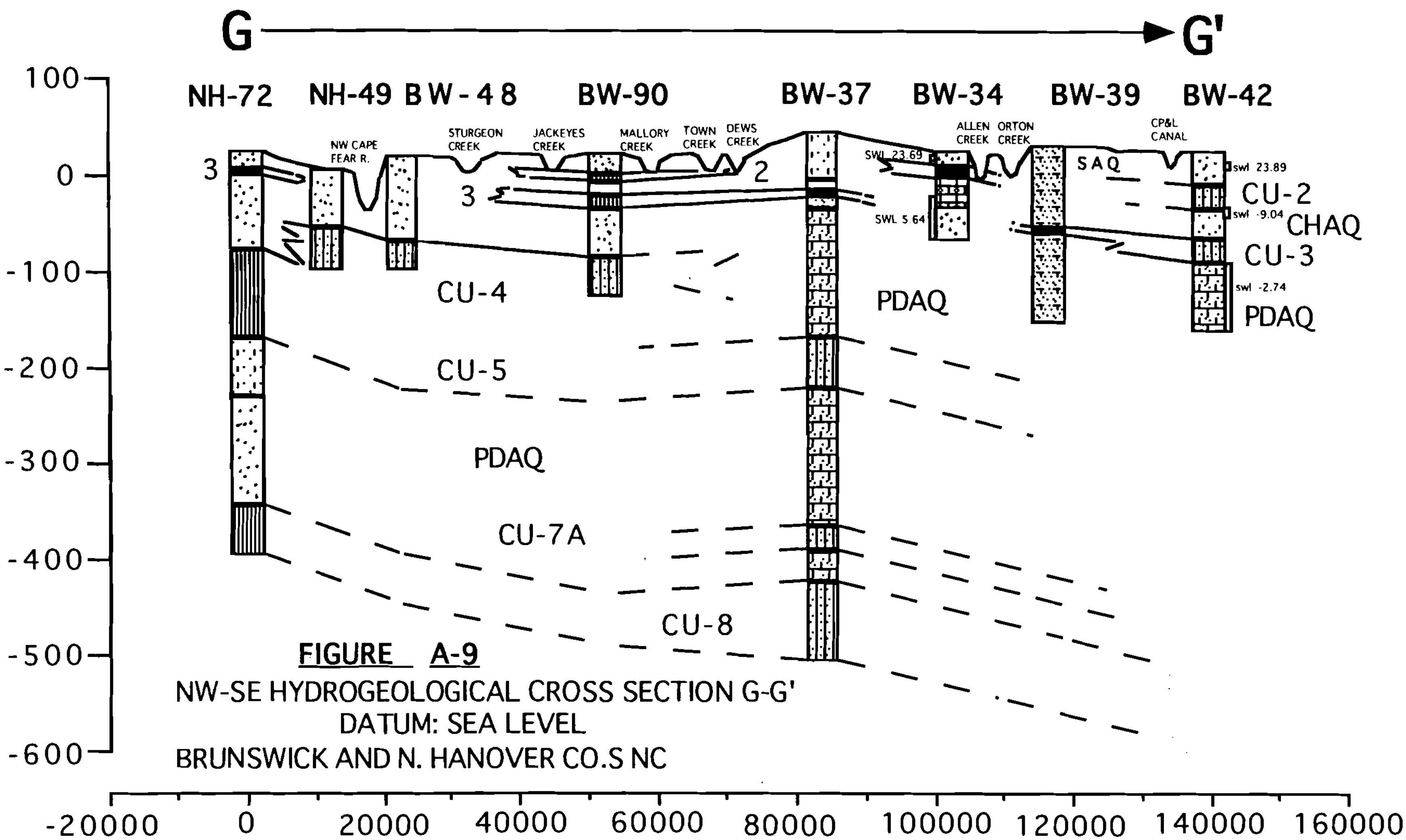


FIGURE A-9

NW-SE HYDROGEOLOGICAL CROSS SECTION G-G'
DATUM: SEA LEVEL
BRUNSWICK AND N. HANOVER CO.S NC

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

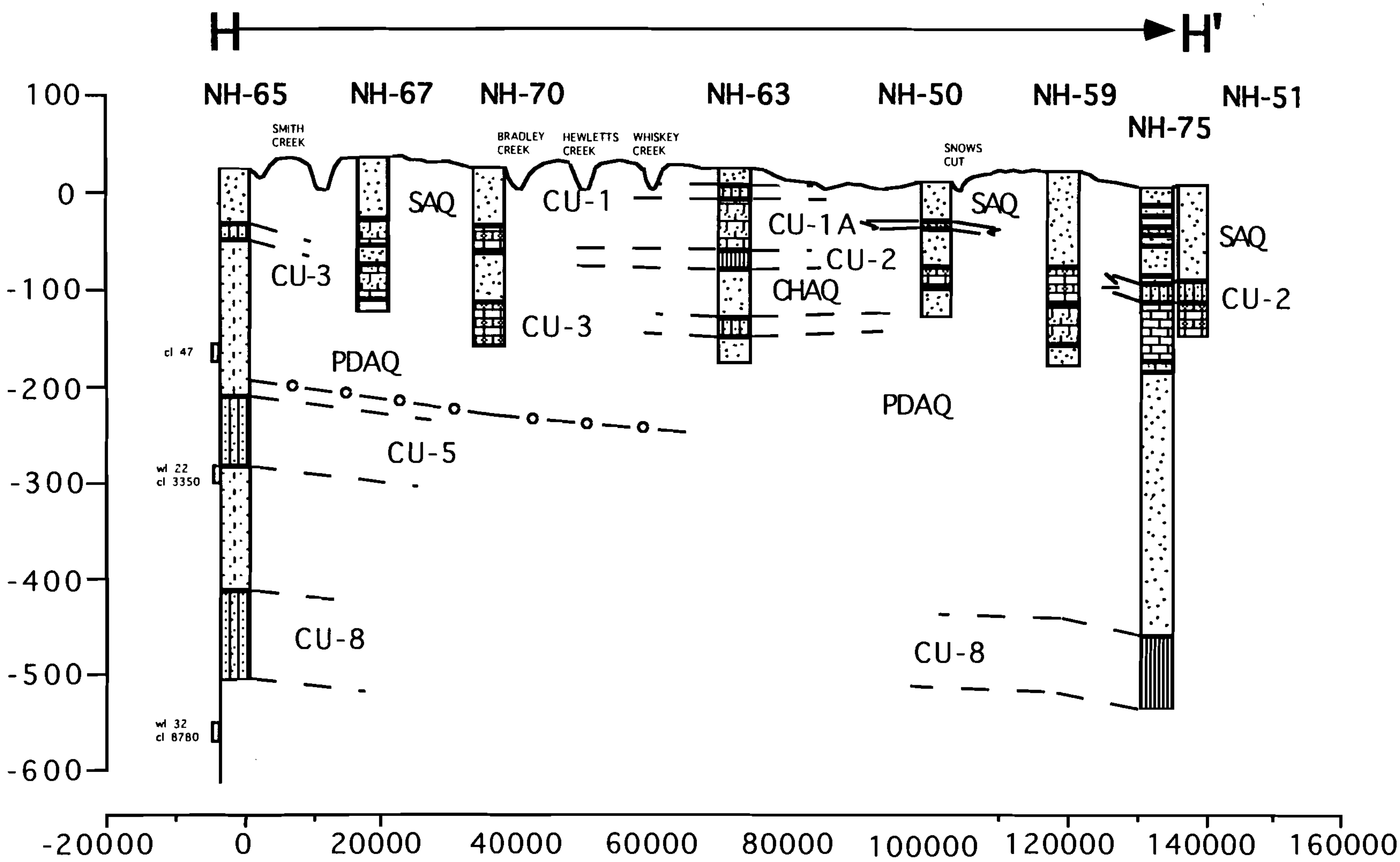


FIGURE A-10

NORTH-SOUTH HYDROGEOLOGICAL CROSS SECTION H-H' DATUM: SEA LEVEL
N. HANOVER AND BRUNSWICK CO.S NC

o—o—o Line of Equal Chloride Concentration 250 ppm

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

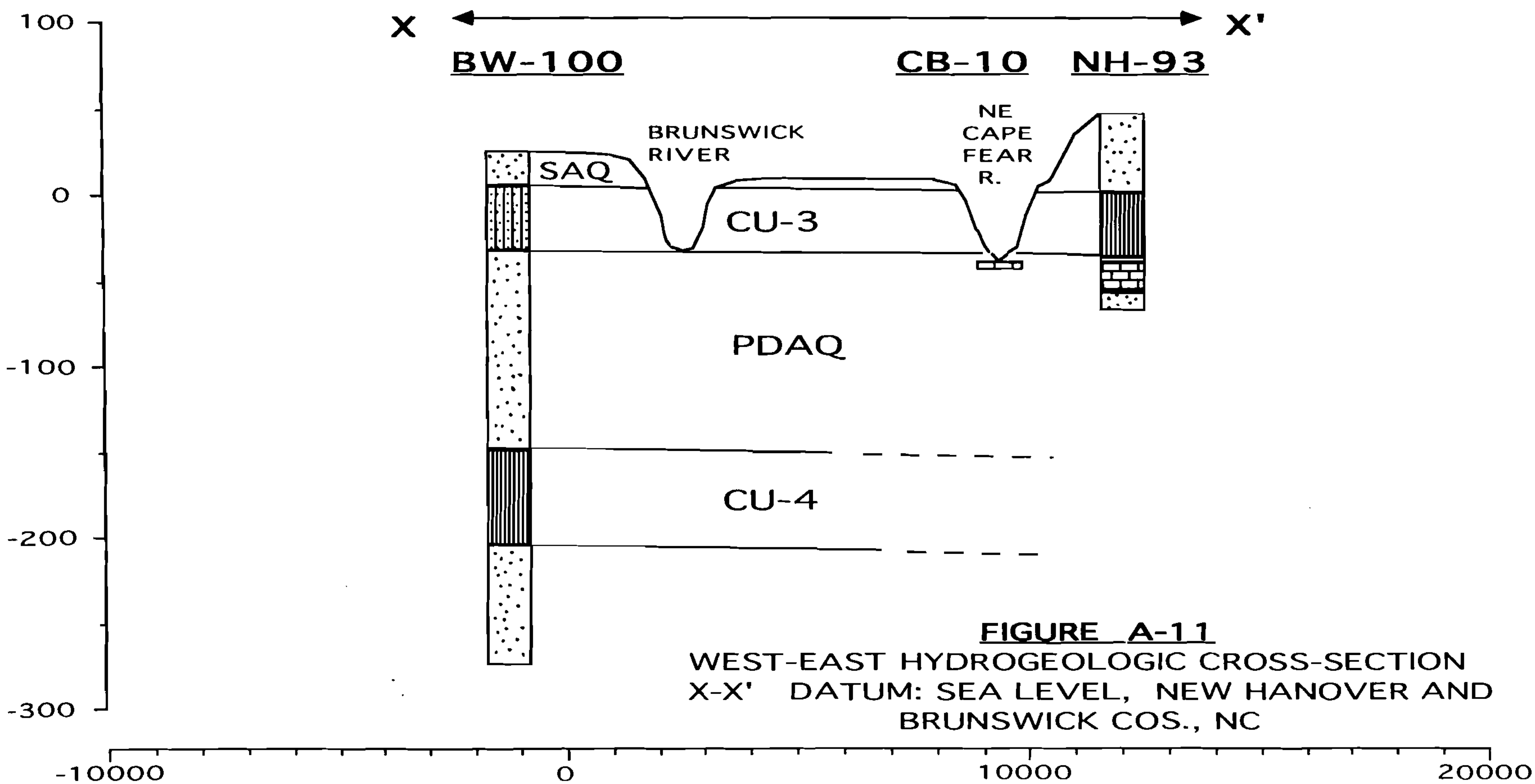


FIGURE A-11
WEST-EAST HYDROGEOLOGIC CROSS-SECTION
X-X' DATUM: SEA LEVEL, NEW HANOVER AND BRUNSWICK COS., NC

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

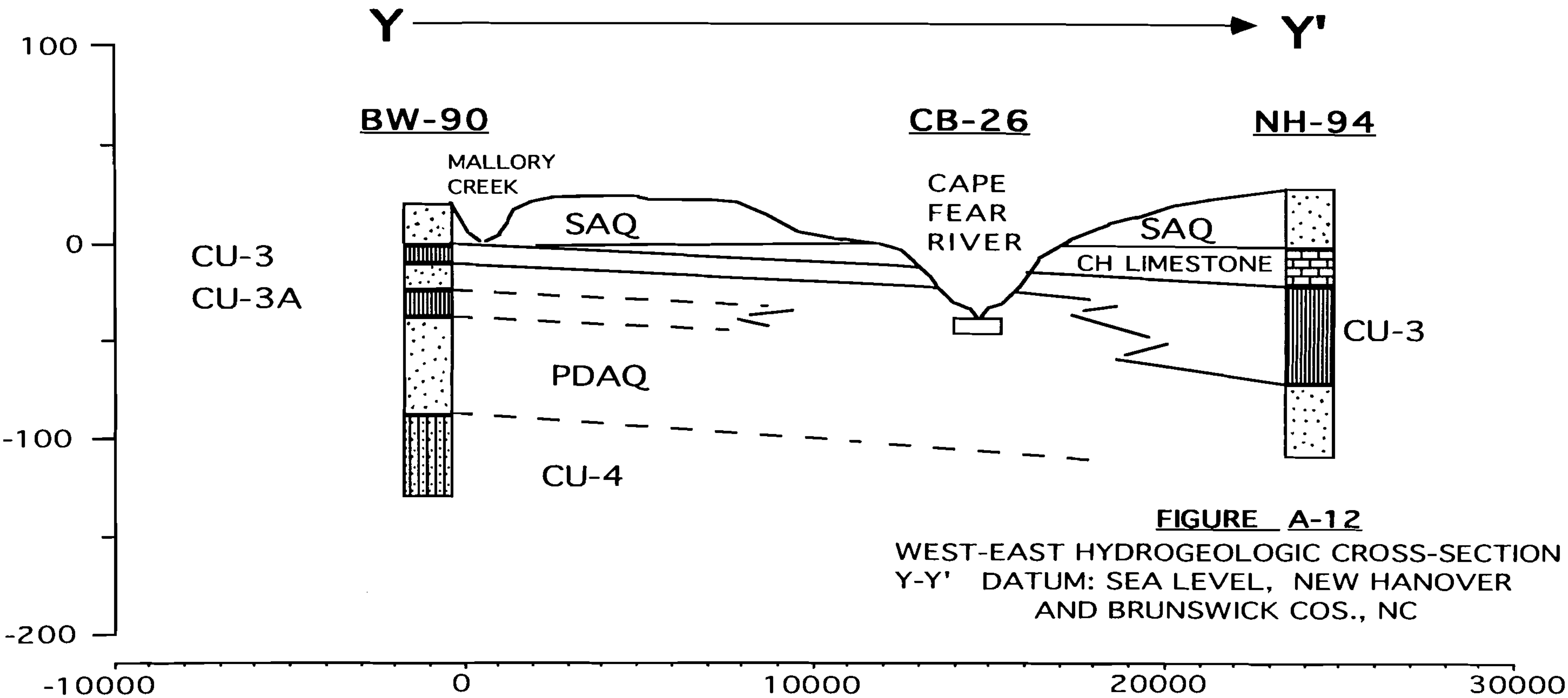


FIGURE A-12

WEST-EAST HYDROGEOLOGIC CROSS-SECTION
Y-Y' DATUM: SEA LEVEL, NEW HANOVER AND BRUNSWICK COS., NC

SAQ: Surficial aquifer
CHAQ: Castle Hayne aquifer
PDAQ: Peedee aquifer
CU: Confining unit

WILMINGTON HARBOR GROUNDWATER STUDY

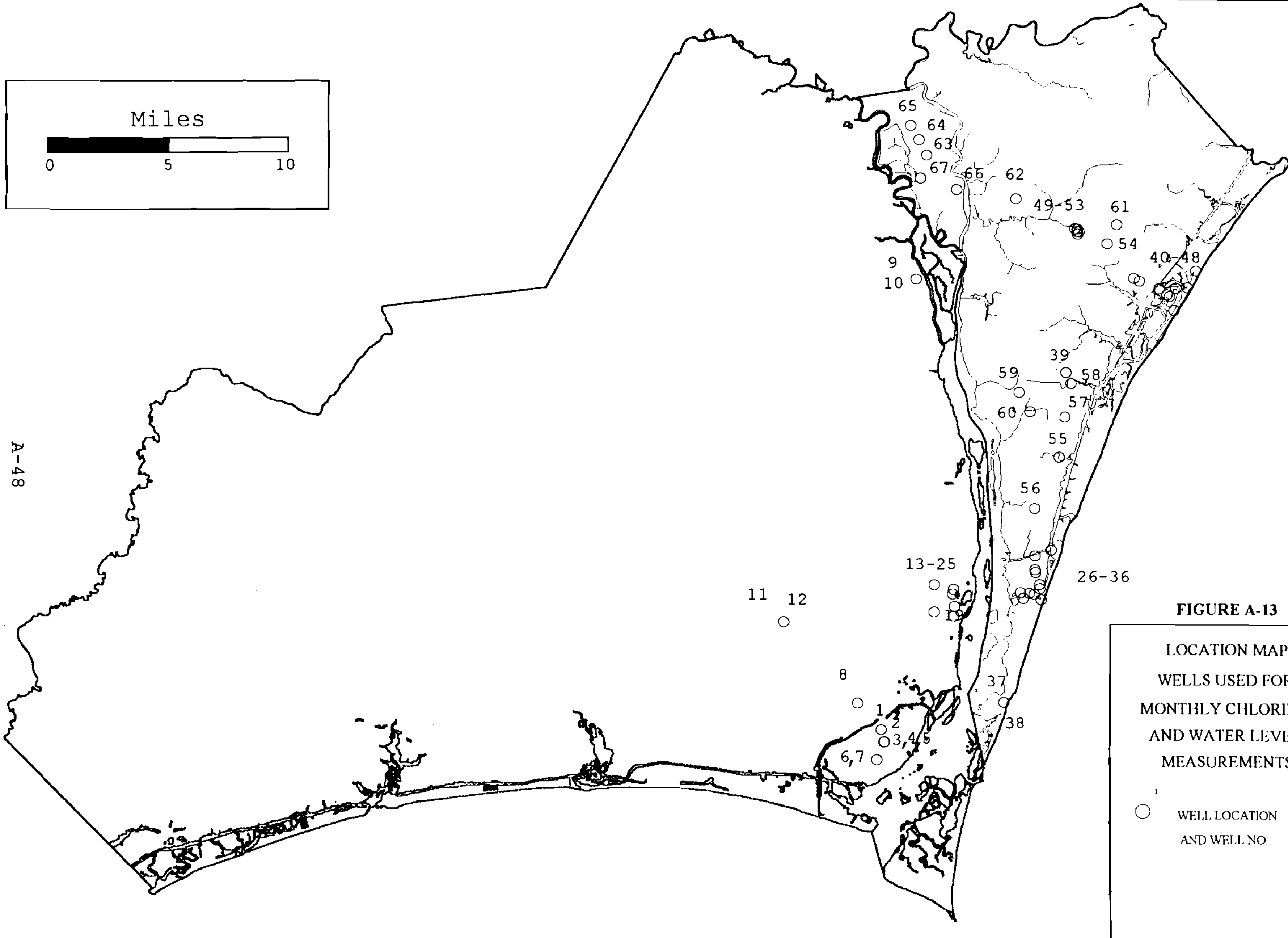


FIGURE A-13

LOCATION MAP:
WELLS USED FOR
MONTHLY CHLORIDE
AND WATER LEVEL
MEASUREMENTS

WELL LOCATION
AND WELL NO.

WILMINGTON HARBOR GROUNDWATER STUDY

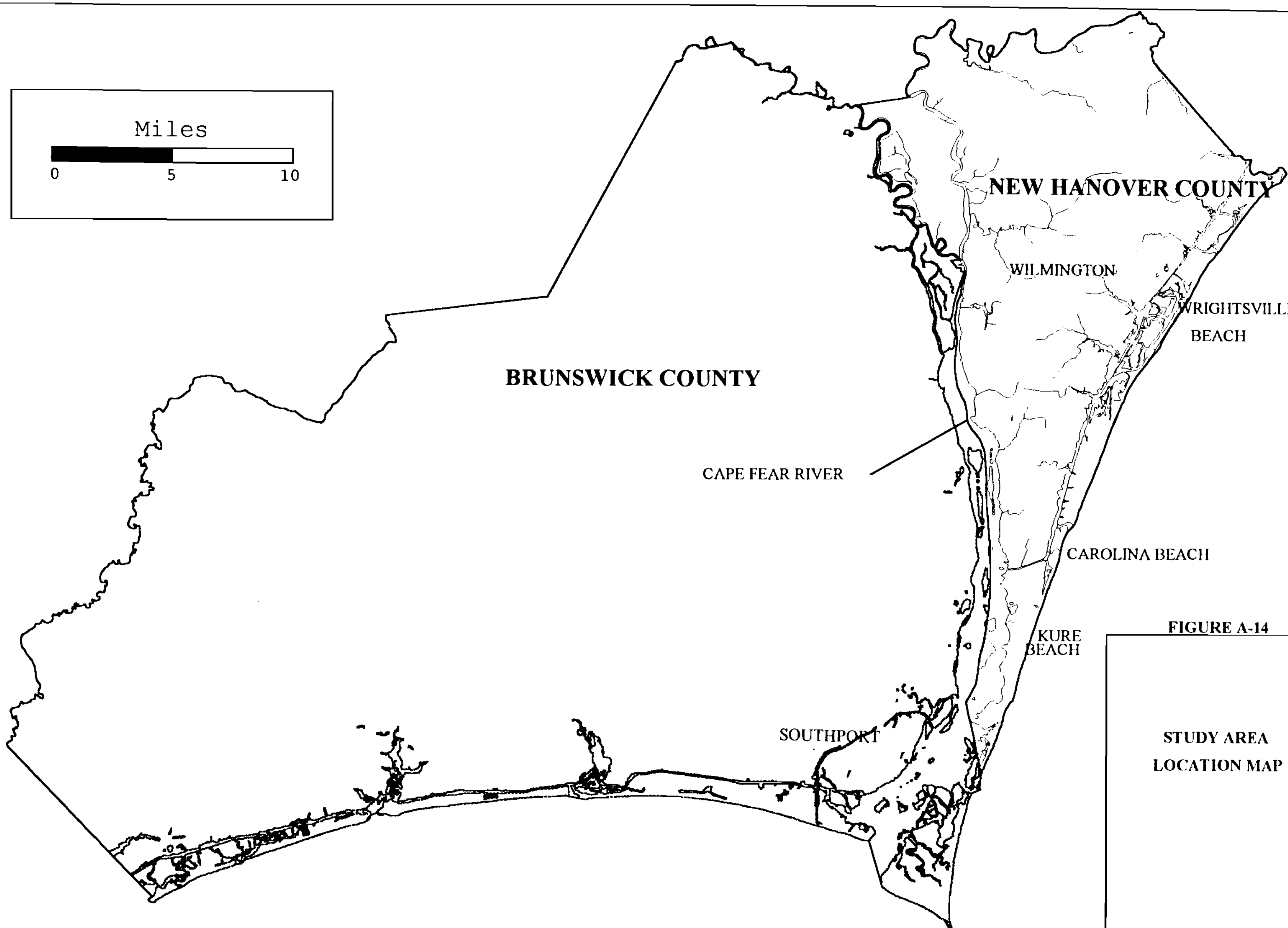


FIGURE A-14

STUDY AREA LOCATION MAP

WILMINGTON HARBOR GROUNDWATER STUDY

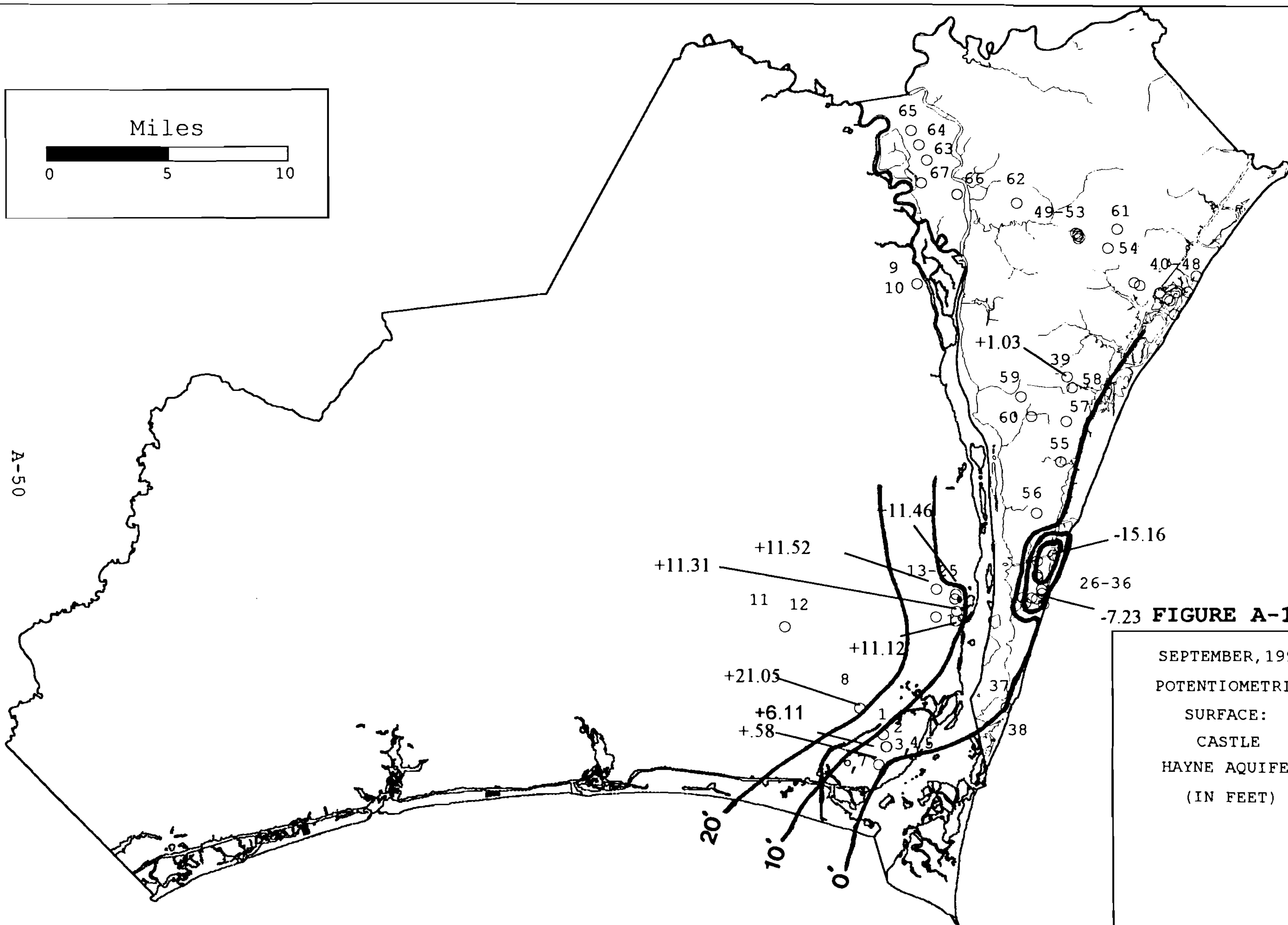


FIGURE A-15

SEPTEMBER, 1993
POTENTIOMETRIC SURFACE: CASTLE HAYNE AQUIFER (IN FEET)

WILMINGTON HARBOR GROUNDWATER STUDY

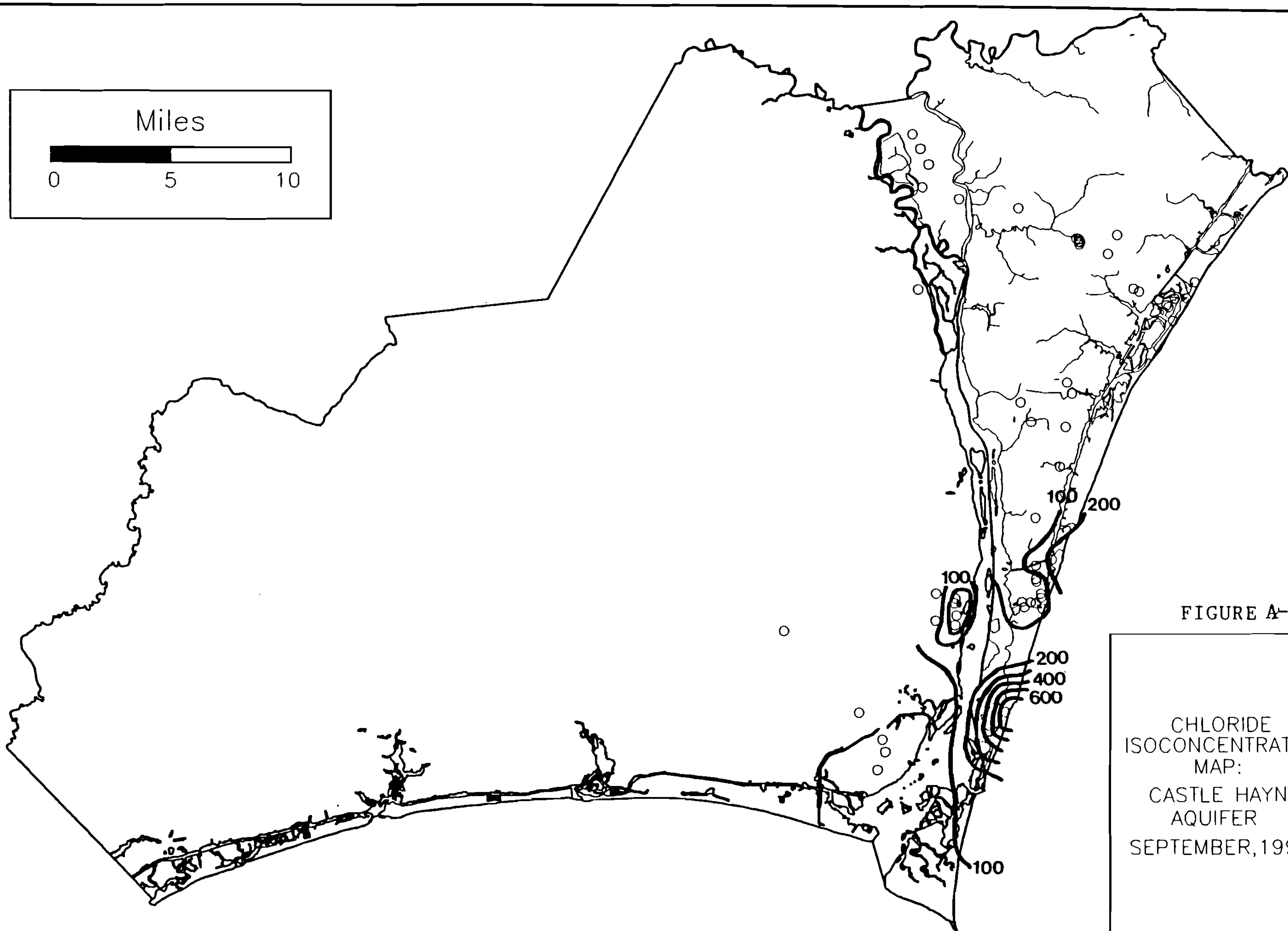


FIGURE A-16

CHLORIDE ISOCONCENTRATION MAP:
CASTLE HAYNE AQUIFER
SEPTEMBER, 1993

WILMINGTON HARBOR GROUNDWATER STUDY

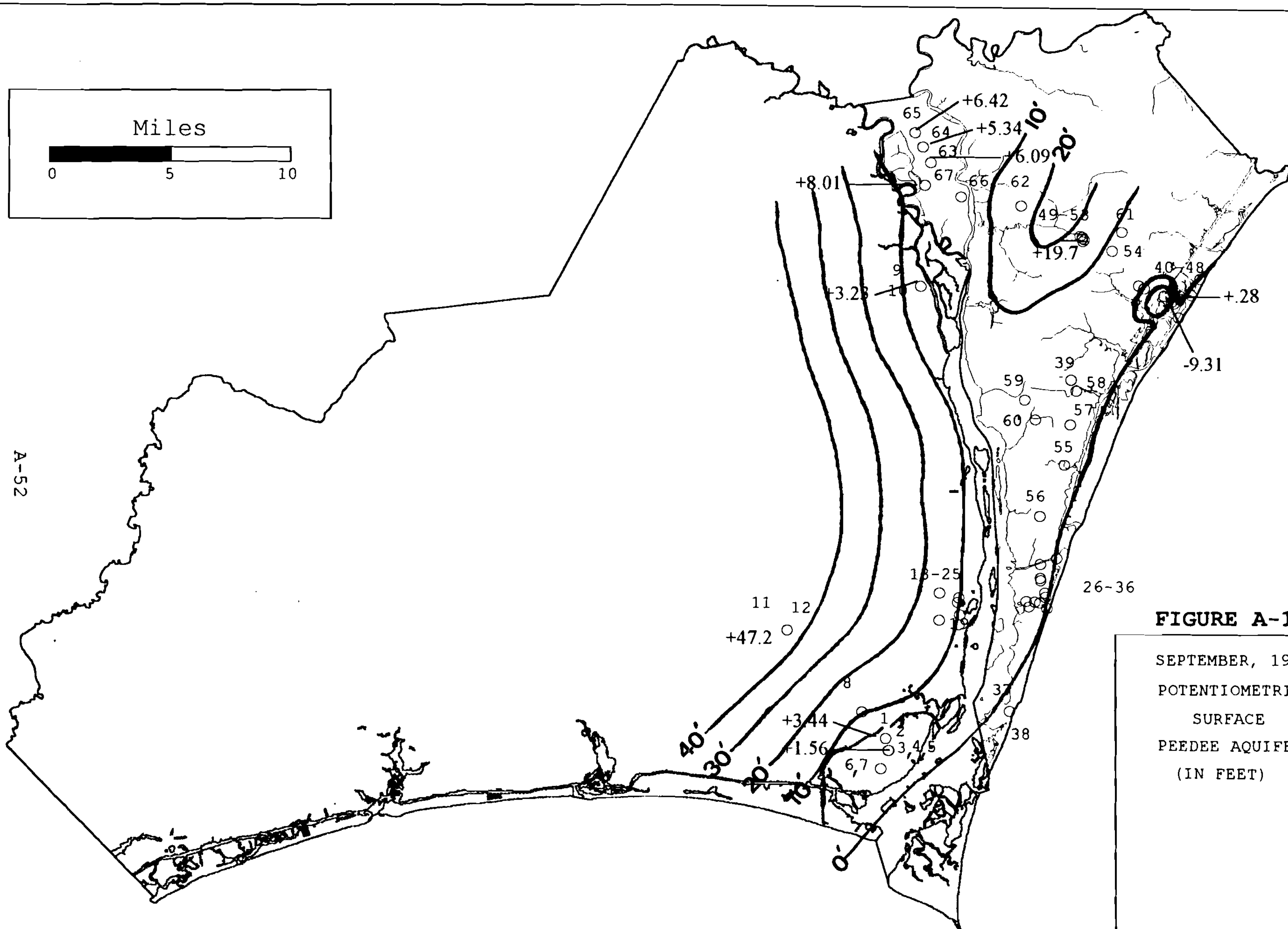


FIGURE A-17

SEPTEMBER, 1993
POTENTIOMETRIC
SURFACE
PEEDEE AQUIFER
(IN FEET)

WILMINGTON HARBOR GROUNDWATER STUDY

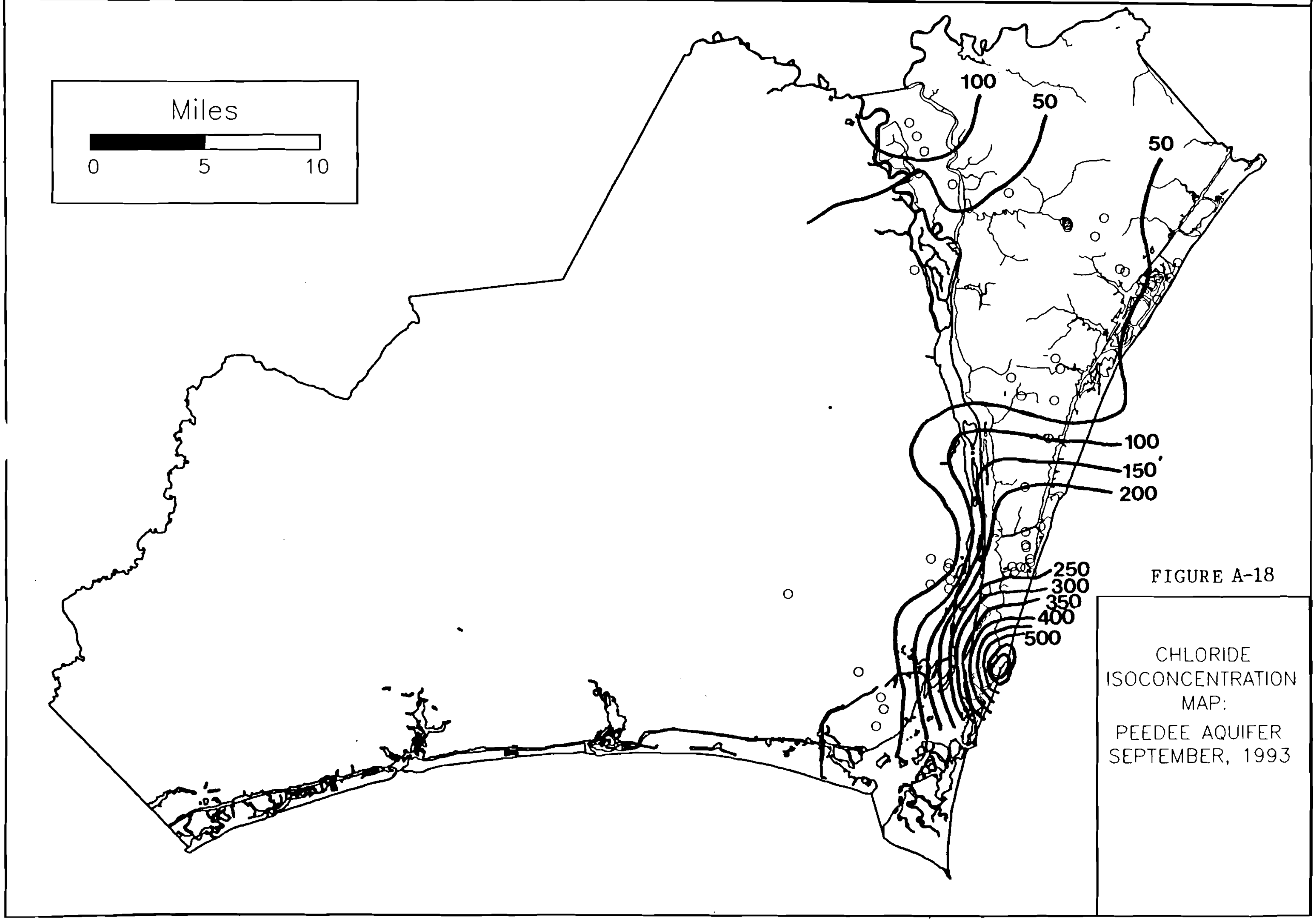


FIGURE A-18

CHLORIDE ISOCONCENTRATION MAP:
PEEDEE AQUIFER
SEPTEMBER, 1993

WILMINGTON HARBOR GROUNDWATER STUDY

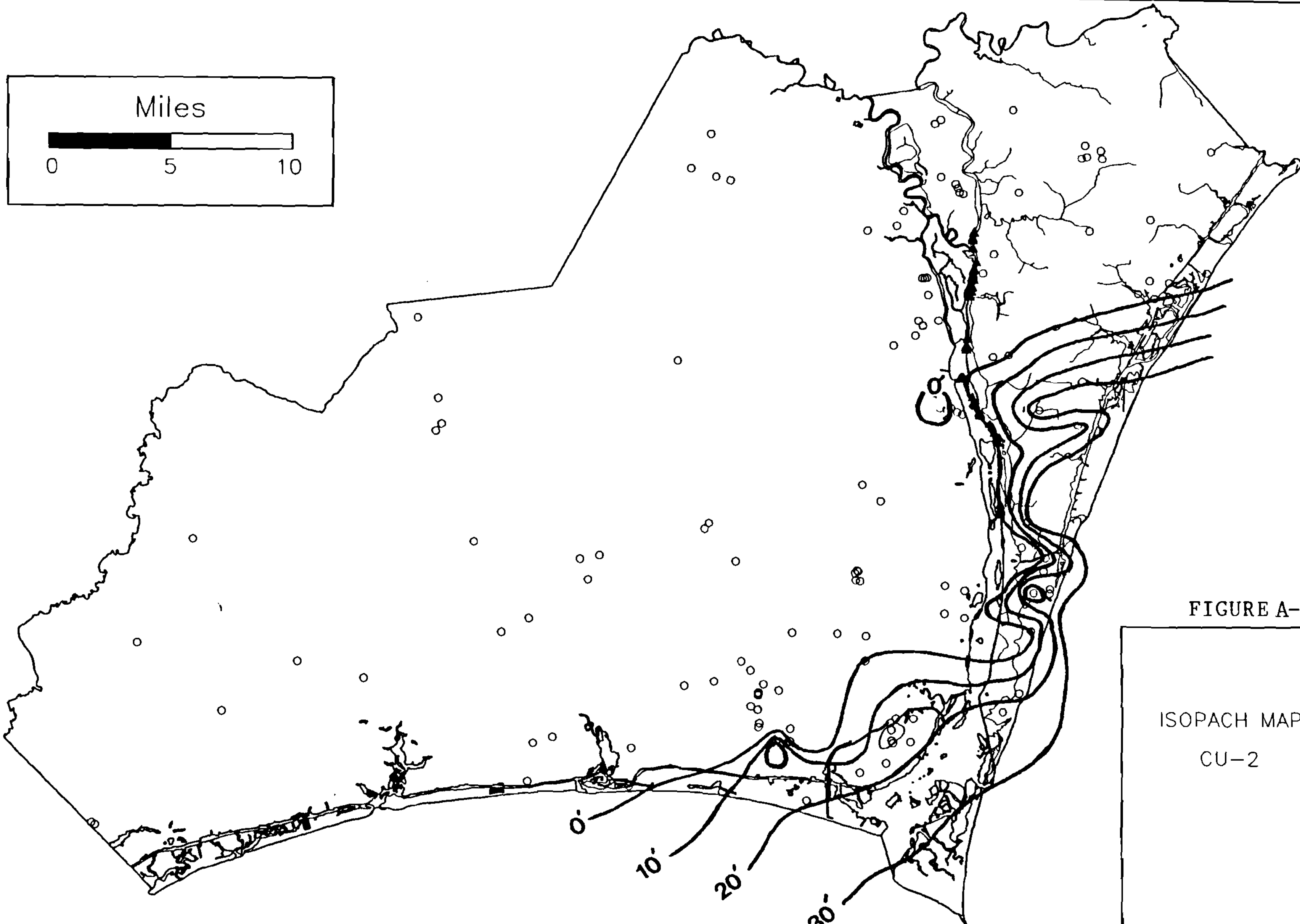


FIGURE A-19

ISOPACH MAP:
CU-2

WILMINGTON HARBOR GROUNDWATER STUDY

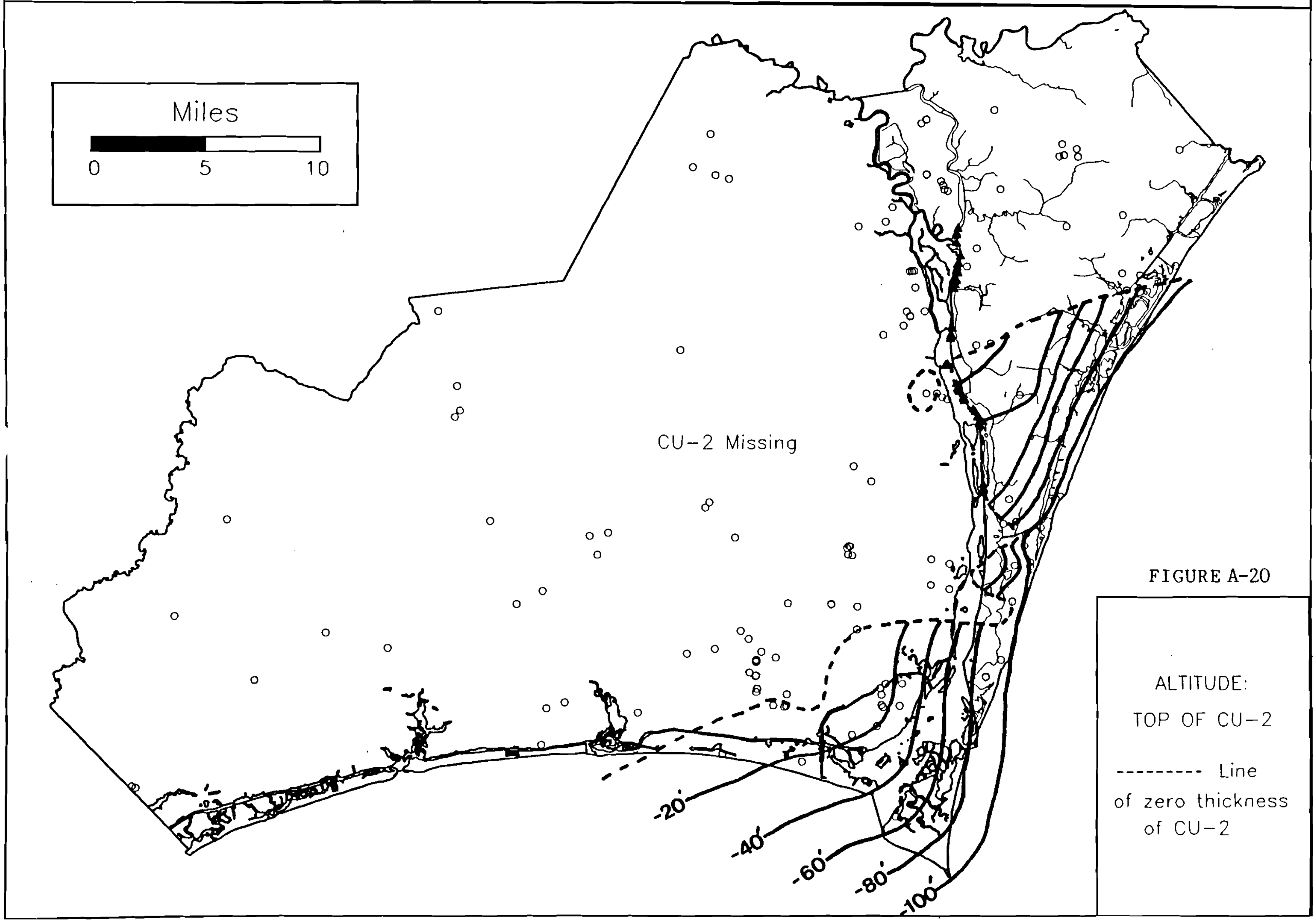


FIGURE A-20

WILMINGTON HARBOR GROUNDWATER STUDY

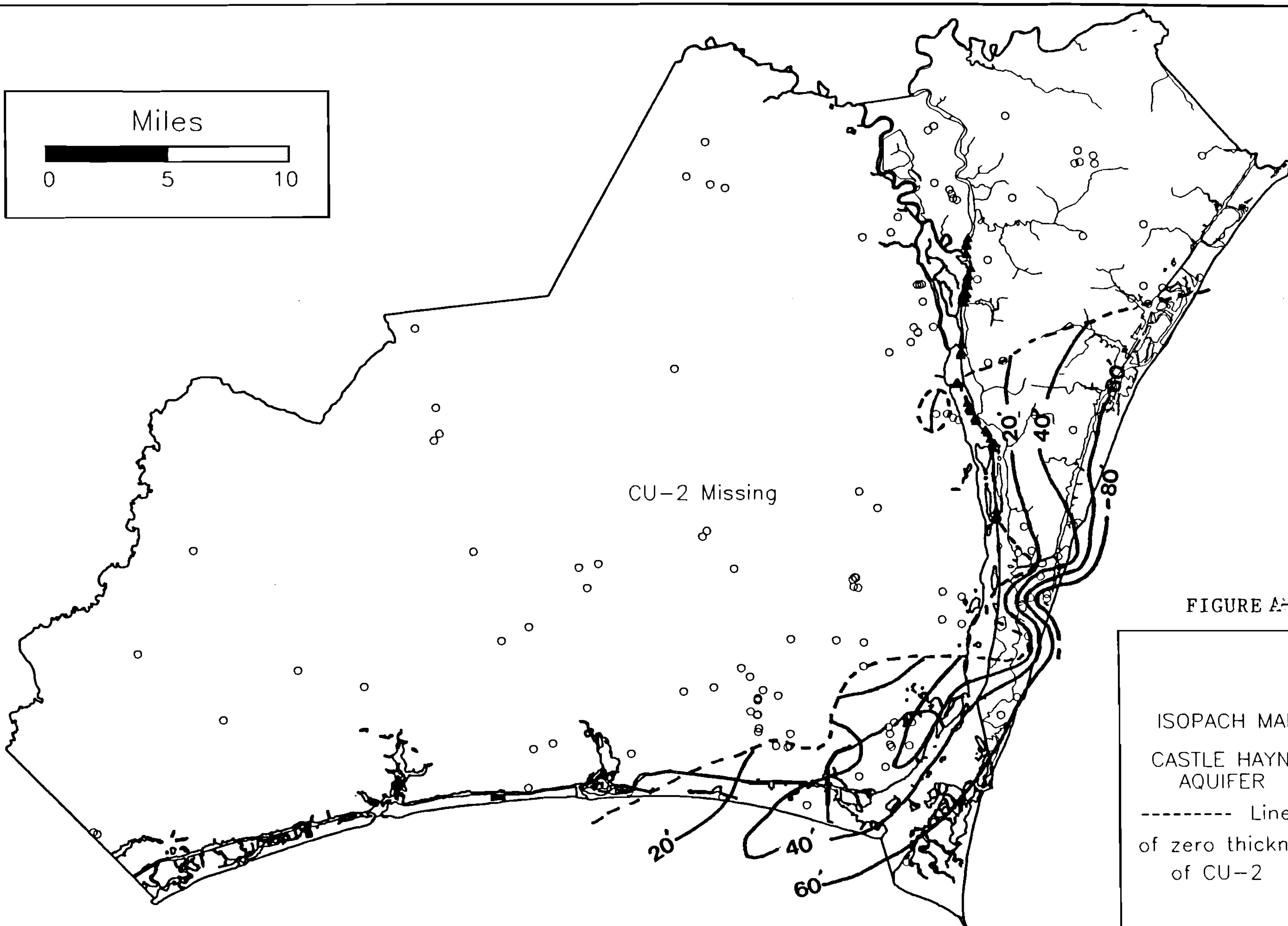


FIGURE A-21

ISOPACH MAP:

CASTLE HAYNE AQUIFER

--------- Line of zero thickness of CU-2

WILMINGTON HARBOR GROUNDWATER STUDY

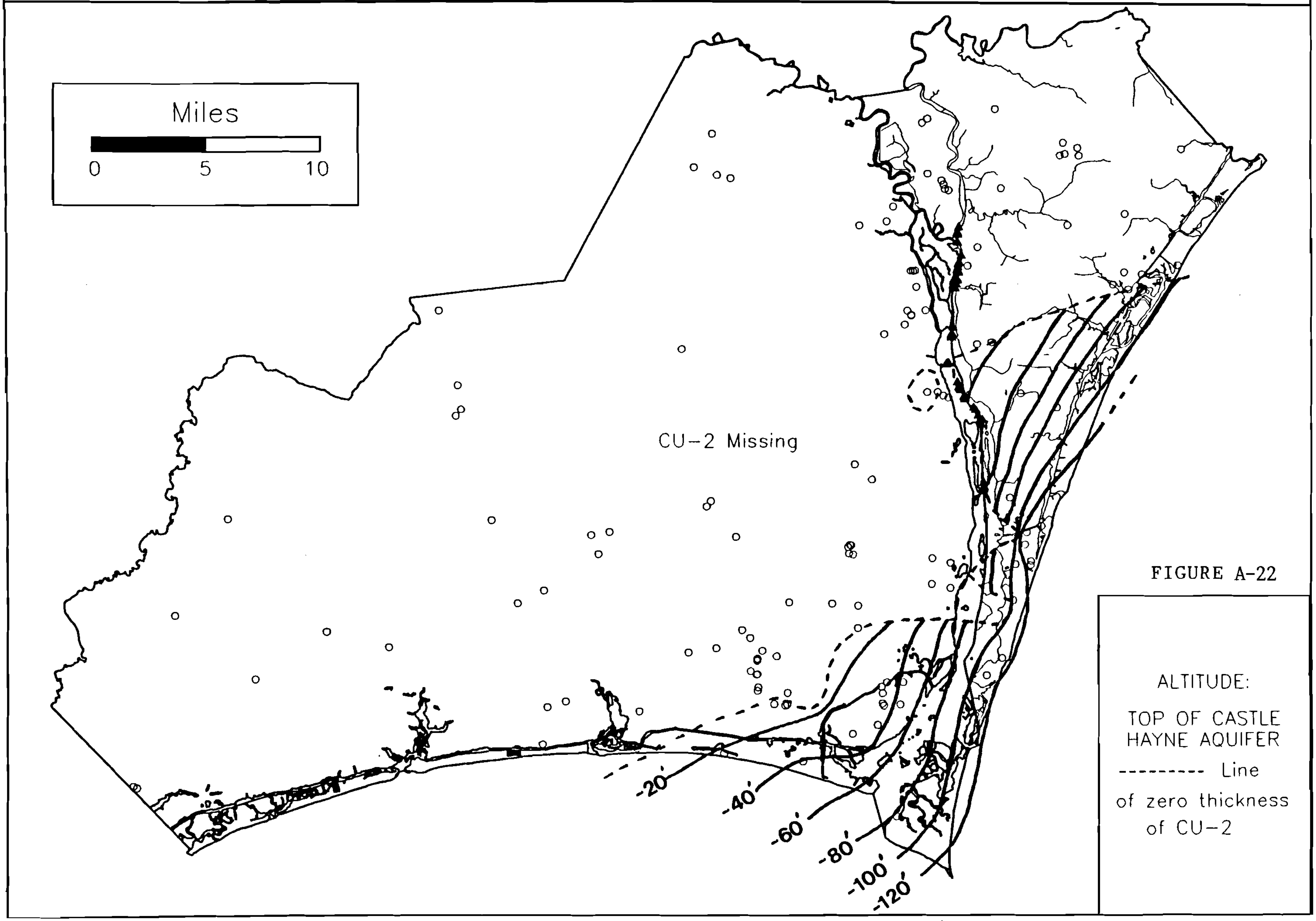


FIGURE A-22

WILMINGTON HARBOR GROUNDWATER STUDY

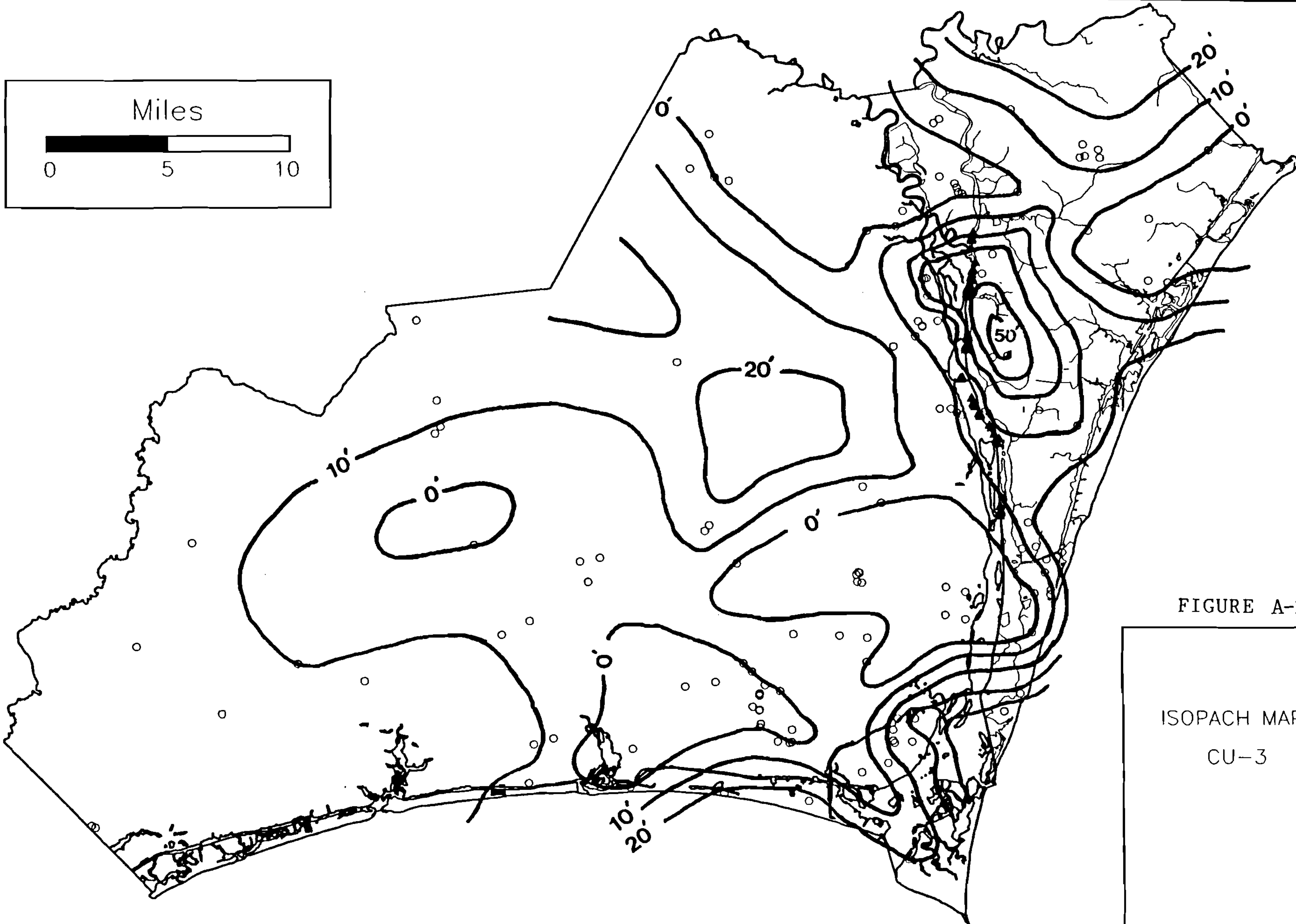


FIGURE A-23

ISOPACH MAP:
CU-3

WILMINGTON HARBOR GROUNDWATER STUDY

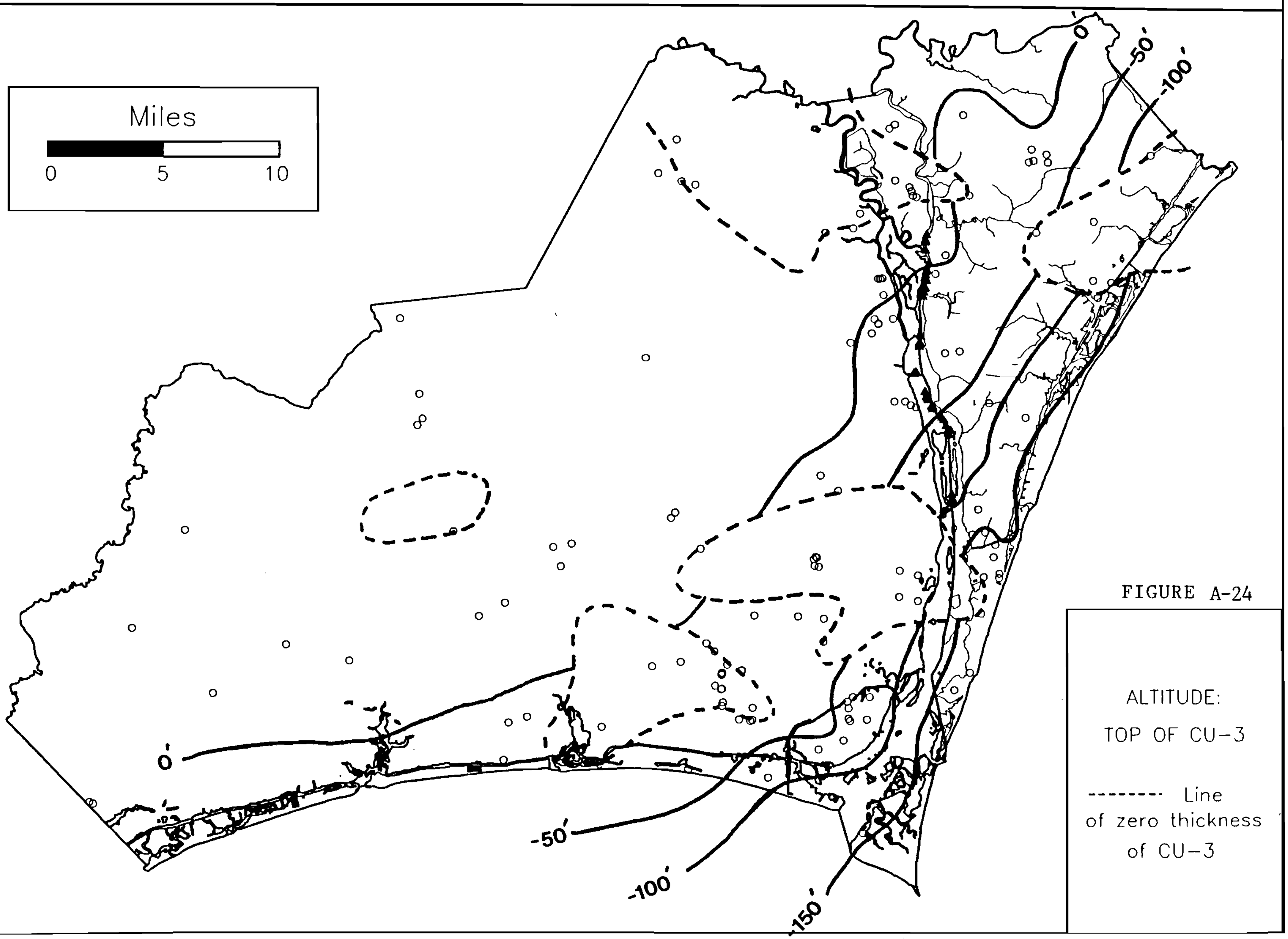


FIGURE A-24

WILMINGTON HARBOR GROUNDWATER STUDY

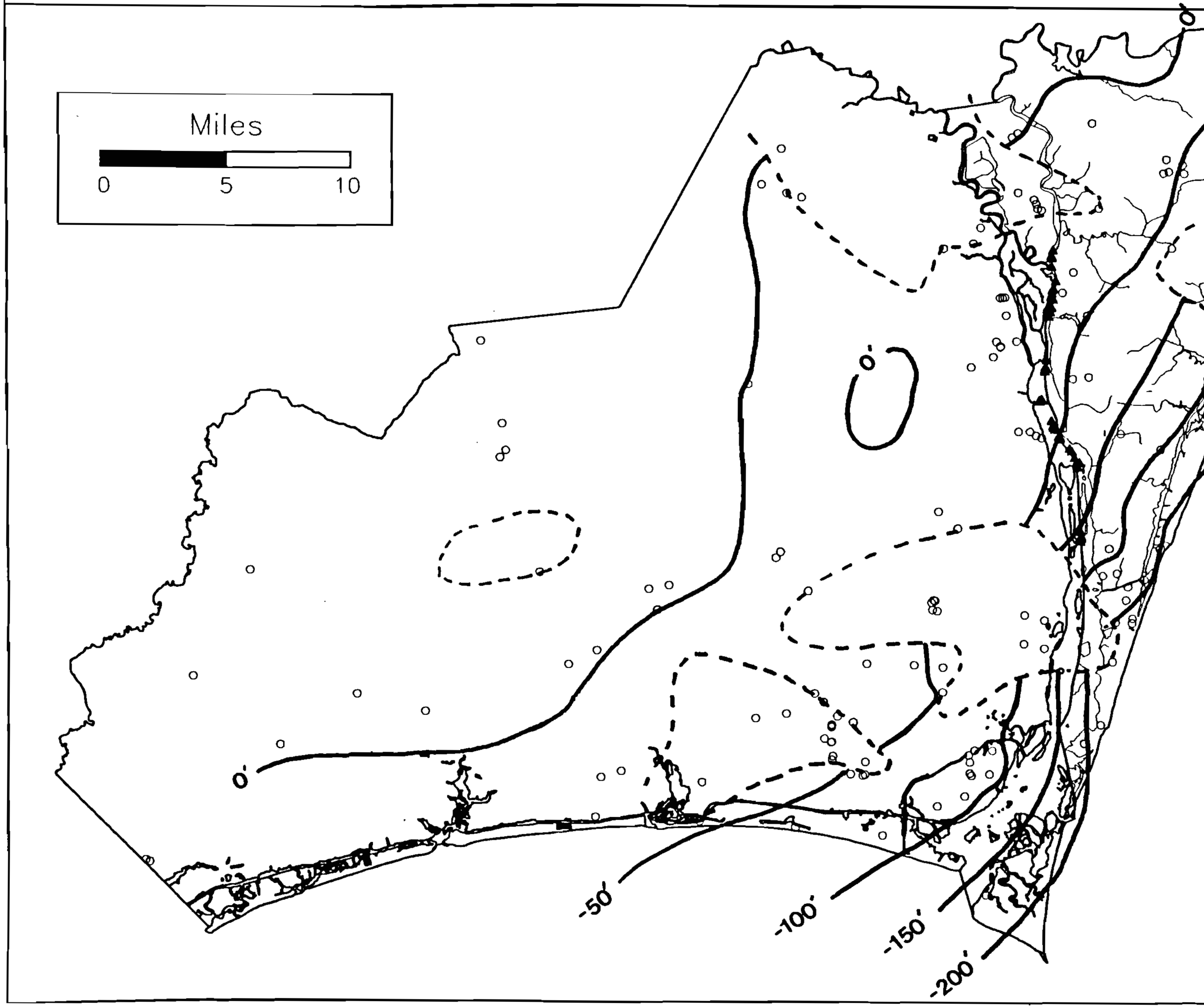


FIGURE A-25

ALTITUDE:

TOP OF PEEDEE AQUIFER

--------- Line of zero thickness of CU-3

WILMINGTON HARBOR GROUNDWATER STUDY

FIGURE A-26

ISOPACH MAP:
CU-3A

WILMINGTON HARBOR GROUNDWATER STUDY

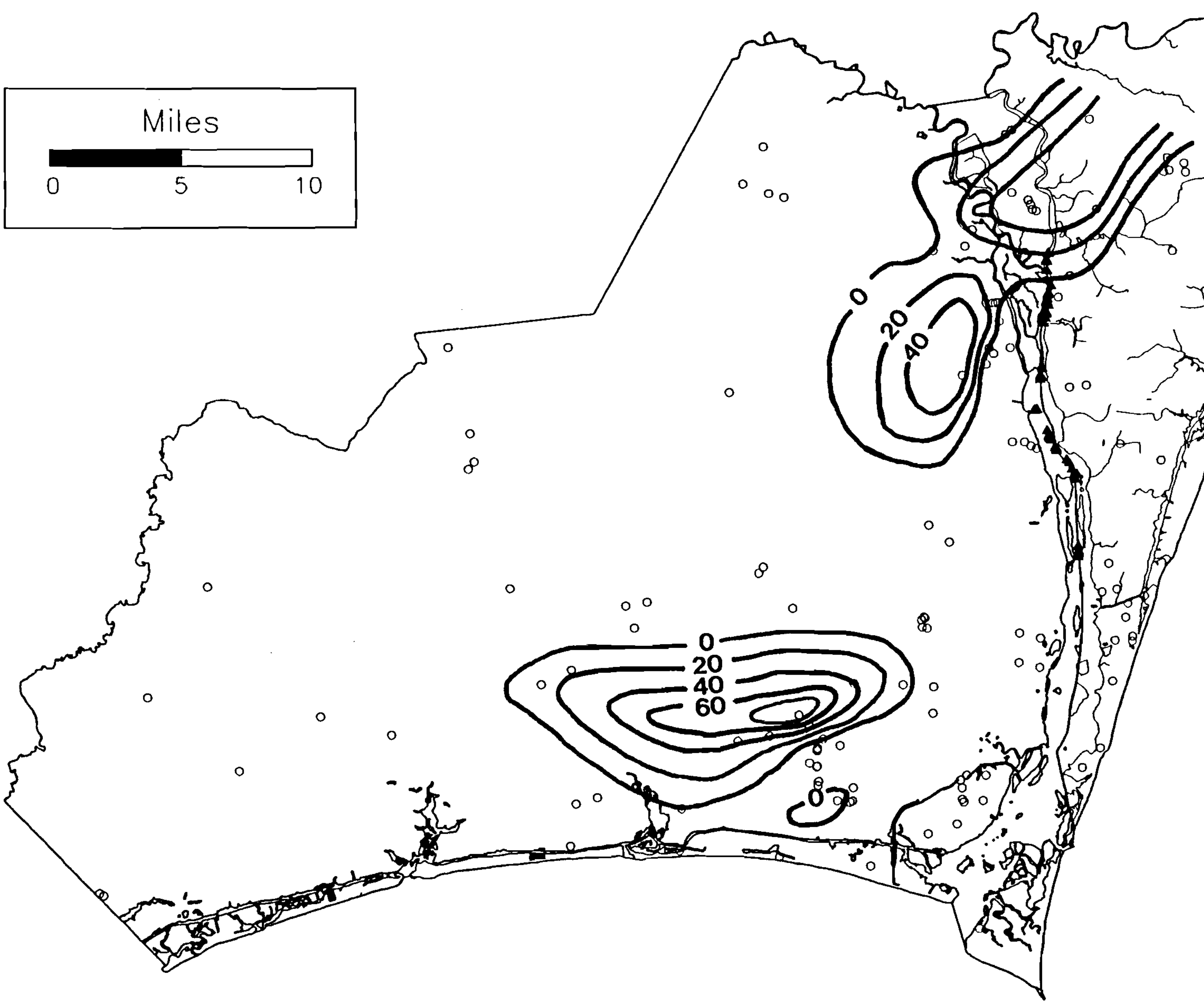


FIGURE A-27

ISOPACH MAP:
CU-4

WILMINGTON HARBOR GROUNDWATER STUDY

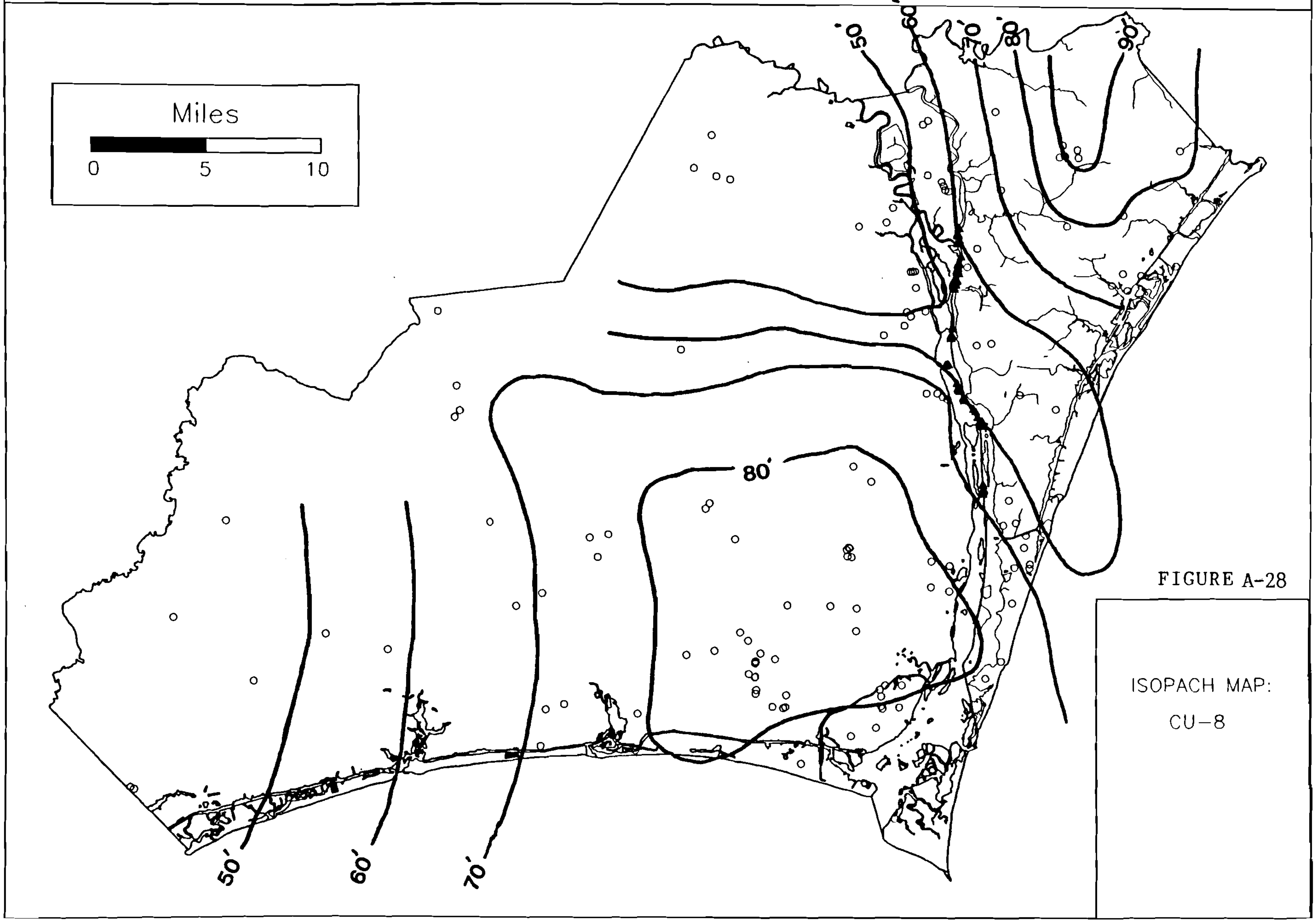


FIGURE A-28

WILMINGTON HARBOR GROUNDWATER STUDY

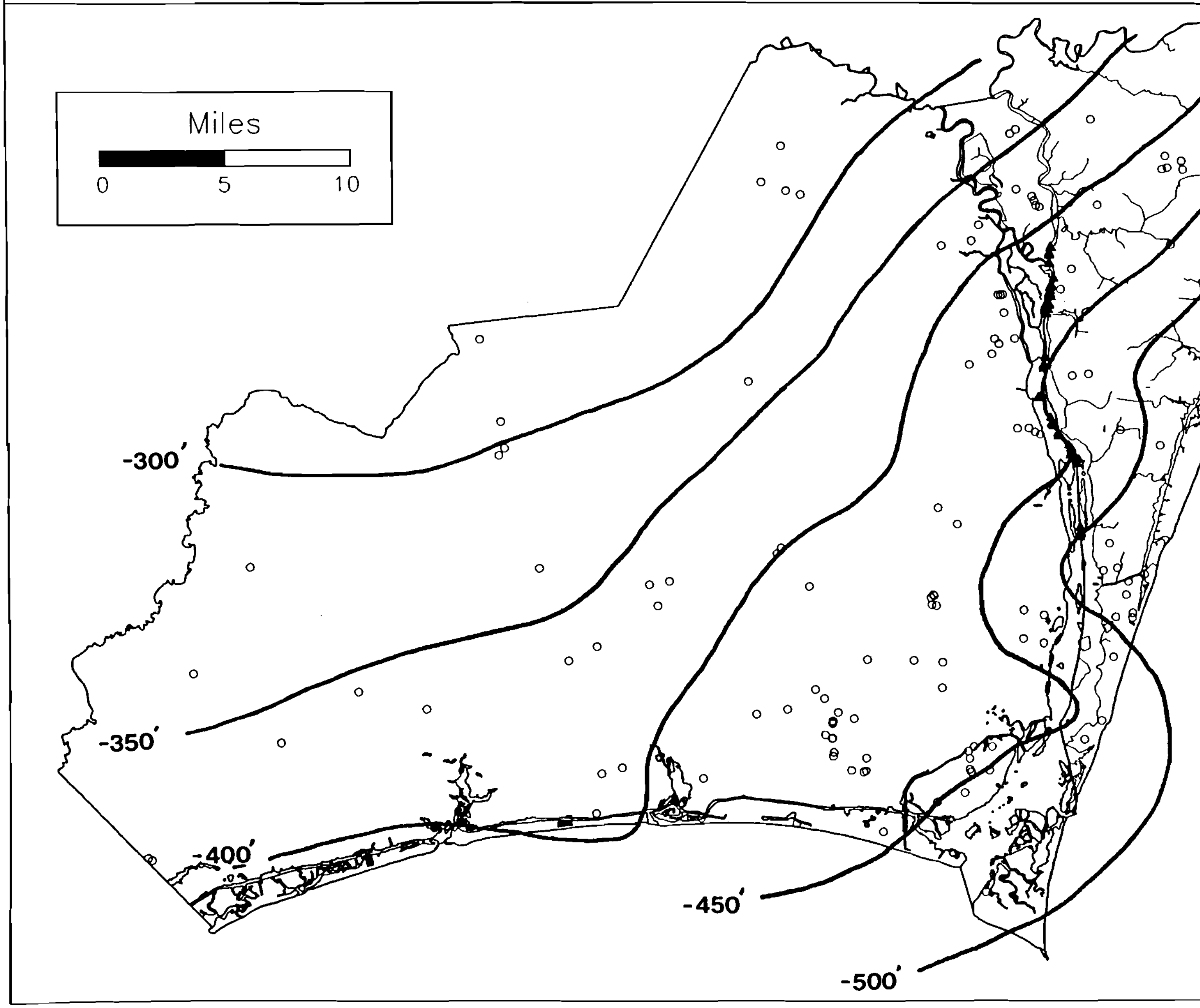


FIGURE A-29

ALTITUDE:
TOP OF CU-8

WILMINGTON HARBOR GROUNDWATER STUDY

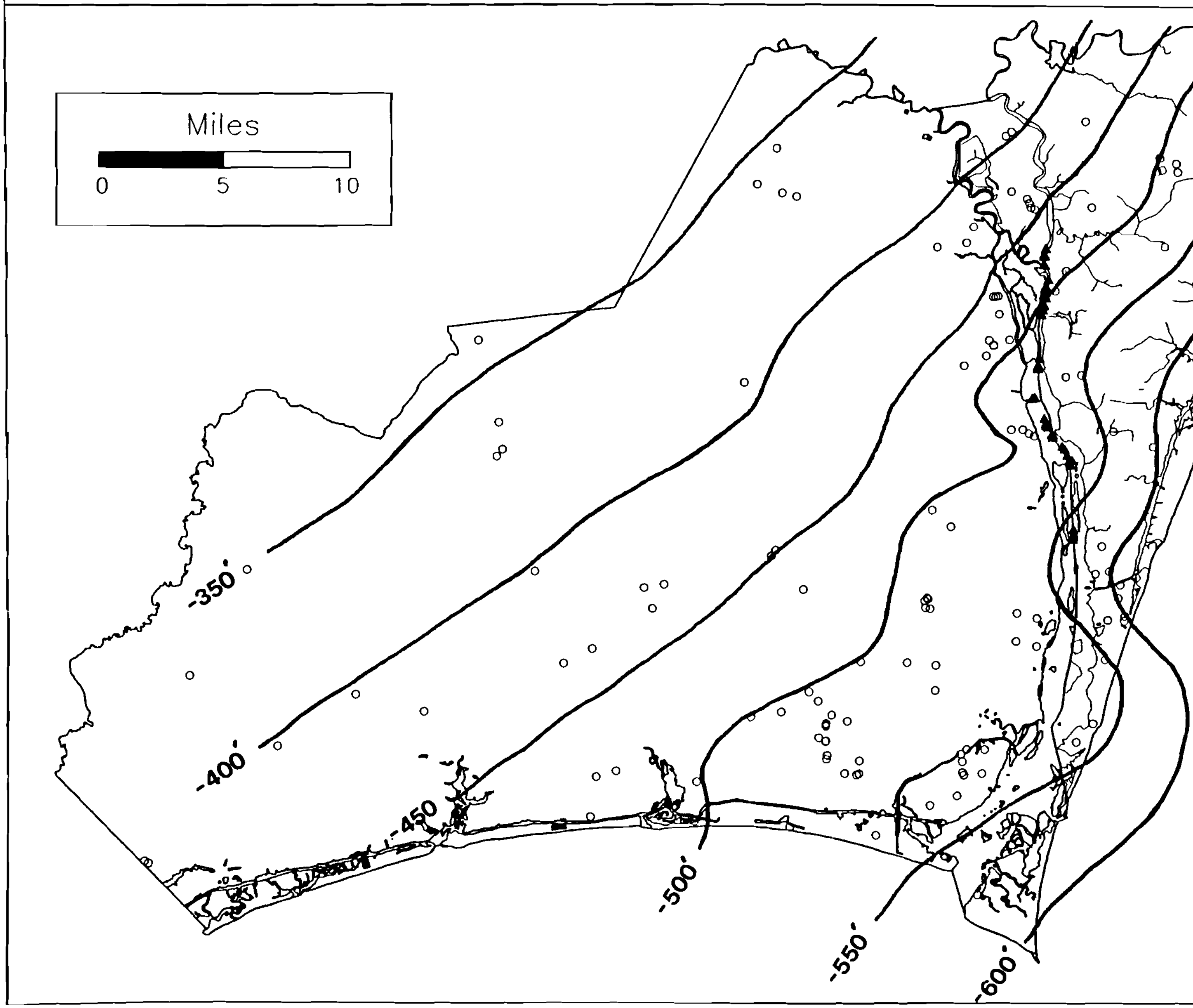


FIGURE A-30

ALTITUDE:
TOP OF BLACK
CREEK AQUIFER

TABLE A-1: WATER LEVEL NETWORK WELL CONSTRUCTION DATA

NETWORK WELL NO.	WELL NAME/FACILITY	LATITUDE	LONGITUDE	AQUIFER	WELL DIAM. (inches)	TOTAL DEPTH (ft.)	SCREENED INTERVAL (ft.)	G.L. ELEV. (ft.)	HEIGHT OF MP ABOVE LS (ft.)	M.P. ELEV. (ft.)
	SOUTHPORT RESEARCH STATION NO. 2									
1	GG-32 K5	33.949308	78.01204	PDAQ	6	190	83.3-190	26.2	1.73	27.93
2	GG-32 K7	33.94926	78.011974	SURFICIAL	4	20	10-20	26.22	0.82	27.04
	SOUTHPORT RESEARCH STATION NO.4									
3	GG-32 T4	33.9419644	78.009844	PDAQ	6	200	93.5-200	28.08	0	28.08
4	GG-32 T5	33.942009	78.009791	CHAQ	4	74	64-74	28.26	0	28.26
5	GG-32 T6	33.9421055	78.009695	SURFICIAL	4	23	11-21	28	0	28
	SOUTHPORT RESEARCH STATION NO.5									
6	GG-32 U1	33.9311575	78.015518	CHAQ/PDAQ	6	191	61.5-191	22.2	0.24	22.44
7	GG-32 U3	33.93114361	78.015446	SURFICIAL	4	21	11-21	21.85	0.15	22
	SOUTHPORT RESEARCH STATION									
8	GG-32 i-1	33.9654375	78.029013	CHAQ/PDAQ	8	198	54-198	33.05	2.15	35.05
	BELVILLE RESEARCH STATION									
9	DD-31 F8	34.222222	77.986388	PDAQ	17.25 X 8	300	42-88	26.53	0.96	27.49
10	DD-31 F7	34.222222	77.986388	PDAQ	8 X 4	67	39-59	26.53	1.85	28.38
	BOILING SPRINGS RESEARCH STA. NO.5									
11	FF-32 Y1	34.014388	78.082971	PDAQ	4	150	67-150	51.66	2.66	54.32
12	FF-32 Y2	34.014381	78.083033	SURFICIAL	4	14	9-14	52.72	1.74	54.46
	US ARMY SUNNY POINT TERMINAL									
13	2-5	34.03717	77.973095	CHAQ/PDAQ	12 X 6 X 5	134.5	62.2-134.5	28.4	1.75	30.15
14	4-3	34.034255	77.959088	CHAQ	5.5	100		22	3.19	25.19
15	4-1	34.031385	77.959816	TERTIARY SANI	4	52.5		25.5	3.2	28.7
16	*4-2(NEAR 4-1)*	34.031385	77.959816						3.55	
17	8	34.018033	77.959192	CHAQ	5.5	100		14	2.22	16.22
18	*11-1(NEAR 8)*	34.018033	77.959192						1.11	
19	*11-2(NEAR 8)*	34.018033	77.959192						2.16	
20	9 (G-5)	34.020625	77.973433	CHAQ	5.5	100		25	2.76	27.76
21	*12-1(NEAR 9)*	34.020625	77.973433						2.4	
22	*12-2(NEAR 9)*	34.020625	77.973433						2.6	
23	5-5	34.02395	77.958299	CHAQ	12.25 X 8	100	55-100	28.4	0.86	29.26
24	*5-1(NEAR 5-5)*	34.02395	77.958299	TERTIARY SAND		51.5		27.45	3.3	
25	*5-2(NEAR 5-5)*	34.02395	77.958299	SURFICIAL		25		28.5	2.4	
	TOWN OF CAROLINA BEACH									
26	WELL NO. 1	34.031388	77.900277	CHAQ	8 X 6	197	142-197	5	1	6
27	2	34.028044	77.895255	CHAQ	8	185	125-185	15	2.35	17.35
28	3	34.05808	77.888416	CHAQ/PDAQ	8 X 4	202	105-202	5	1.92	6.92
29	4	34.032222	77.910277	CHAQ	8 X 4	200	40-200	18	1.2	19.2
30	5	34.037222	77.896519	CHAQ	8	201	96-201	8	2.5	10.5
31	6	34.031944	77.903888	CHAQ	10	191	135-191	15	?	?
32	7	34.028888	77.908333	CHAQ	8	200	126-178	18	0.75	18.75
33	8	34.034722	77.896388	CHAQ	8 X 6	203	162-203	8	1.26	9.26
34	9	34.046111	77.9	CHAQ	8 X 4	223	84-223	24	1.2	25.2
35	10	34.05453	77.900099	CHAQ	8 X 4	220	126-220	23	0.72	23.72
36	11	34.044608	77.899615	CHAQ	12	220	155-220	24	2	26
	NC STATE AQUARIUM									
37	WELL NO. 1	33.9660258	77.922454	CHAQ	6	204	?	7	0.95	7.95
38	WELL NO. 2			CHAQ	?	?	?	7	0.5	7.5
39	**WALTER J. HODDER WELL**	34.166111	77.8775	CHAQ/PDAQ	4	170	?-170	21	1.85	22.85
	TOWN OF WRIGHTSVILLE BEACH									
40	WELL NO. 1	34.217806	77.788925		10	179	163-179			
41	2	34.227594	77.782744		4	175	140-175	11.91	0.54	12.45
42	4	34.204166	77.798888			180	150-180			
43	5	34.2125	77.802222		12 X 10 X 8	157	145-157			
44	6	34.213611	77.803611			163	141-163	8.02	1.91	9.93
45	7	34.217222	77.809444	PDAQ		163	141-163	10.79	0	10.79
46	8	34.2175	77.7975		10 x 16	171	137-167	11.3	2.66	13.96
47	11	34.221666	77.823888			178	148-178	21.87	1.41	23.28
48	12	34.223333	77.8280555	CHAQ/PDAQ		185	63-185			
	CORNING, INC.									
49	WELL NO. 1	34.253055	77.870785	CHAQ/PDAQ		120	100-120	24	2	26
50	2	34.252611	77.869055	CHAQ/PDAQ		126	106-126	31	2	33
51	3	34.251361	77.869083	CHAQ/PDAQ		160	120-160	34	1.5	35.5
52	4	34.250965	77.867954	CHAQ/PDAQ		142	117-142	35	1.5	36.5
53	5	34.249648	77.868663	CHAQ/PDAQ		150	125-150	37	1.5	38.5
	UTILITY CO. WELLS									
54	LONG LEAG ACRES	34.244166	77.847222		8	160	124-160	40		
55	HICKORY KNOLL	34.114677	77.882541	CHAQ/PDAQ				26	1.25	27.25
56	HILLSIDE	34.08352	77.90038		10 X 8	125	105-125	25	2	27
57	MASONBORO PROPERTIES/WATERFORD	34.139041	77.878286	CHAQ/PDAQ	6	183	147-183	27	1.5	28.5
58	TANGLEWOOD	34.159501	77.873787		8	160	139-160	33	2	35

TABLE A-1: WATER LEVEL NETWORK WELL CONSTRUCTION DATATA (continued)

59	SILVA TERRA	34.15388	77.911481		8	160	126-160	10	2	12
60	MARQUIS HILLS	34.142118	77.903756		8 X 10	180	168-180	4	2	6
61	GREEN MEADOWS	34.255523	77.840361		6 X 8	165	153-165	36	1.5	37.5
	NEW HANOVER AIRPORT RESEARCH STATION									
62	CC-31, p-1	34.271111	77.913611	SURFICIAL	4	12	7-12	29	2.73	31.73
	CAPE INDUSTRIES									
63	WELL "W"	34.297027	77.978663	PDAQ				11	2	13
64	WELL "DD"	34.30635	77.984569	PDAQ	24 X 10	51	28-48	14	2	16
65	WELL "GG"	34.315	77.990277	PDAQ	24 X 10	52		14	2	16
	ARCADIAN CORP.									
66	MW-G-1 different well from June, July, August 93	need coordinates	need coordinates	SURFICIAL	6	33	23-33			
	CP & L SUTTON LAKE									
67	MW-4	34.283333	77.983333	PDAQ	2	45	40-45	16.61	0.833	17.443

TABLE A-2: WATER LEVEL AND CHLORIDE MEASUREMENTS

WELL NO.	WELL NAME/FACILITY	JUNE, 1993		JULY,1993		AUGUST, 1993		SEPT., 1993		OCT., 1993		NOV., 1993	
		WATER LEVEL	CL (PPM)	WATER LEVEL	CL (PPM)	WATER LEVEL	CL (PPM)	WATER LEVEL	CL (PPM)	WATER LEVEL	CL (PPM)	WATER LEVEL	CL (PPM)
	SOUTHPORT RESEARCH STATION NO	FT/MSL		FT/MSL		FT/MSL		FT/MSL		FT/MSL		FT/MSL	
1	GG-32 K5	2.98 SWL	25	2.84 SWL	75	3.63 SWL	21	3.44 SWL	17.5	4.4 SWL	19	4.64 SWL	26.4
2	GG-32 K7	5.65 SWL	25	5.59 SWL	30	5.88 SWL	17.5	5.76 SWL	16.2	6.54 SWL	17	6.49 SWL	18.8
	SOUTHPORT RESEARCH STATION NO.4												
3	GG-32 T4	0.79 SWL	50	0.65 SWL	50	1.53 SWL	50	1.56 SWL	40.2	3.18 SWL	23	3.59 SWL	44
4	GG-32 T5	5.85 SWL	15	5.62 SWL	15	5.83 SWL	7.5	6.11 SWL	5.7	6.65 SWL	5.2	6.71 SWL	8.4
5	GG-32 T6	21.02 SWL	25	20.18 SWL	5	20.99 SWL	18	21.2 SWL	18.5	22.92 SWL	41	23.48 SWL	22.4
	SOUTHPORT RESEARCH STATION NO.5												
6	GG-32 U1	-4.71 SWL	25	-0.82 SWL	25	0.26 SWL	20	.58 SWL	16.6	2.7 SWL	14.2	3.59 SWL	20
7	GG-32 U3	17.5 SWL	30	16.91 SWL	30	16.85 SWL	26	16.59 SWL	24.5	17.63 SWL	24.9	17.7 SWL	26.8
	SOUTHPORT RESEARCH STATION												
8	GG-32 i-1	21.45 SWL	15	20.4 SWL	15	20.87 SWL	10.7	21.05 SWL	7	22.49 SWL	8.5	22.92 SWL	9
	BELVILLE RESEARCH STATION												
9	DD-31 F8	3.29 SWL		3.27 SWL		2.99 SWL		3.23 SWL		3.64 SWL		4.0 SWL	
10	DD-31 F7			2.68 SWL	15	2.64 SWL	16	2.78 SWL	12	3.11 SWL	9.6	3.53 SWL	8
	BOILING SPRINGS RESEARCH STA. NO.5												
11	FF-32 Y1	45.87 SWL	25	44.93 SWL	25	46.13 SWL	18.6	47.2 SWL	19	48.06 SWL	19	47.99 SWL	17
12	FF-32 Y2	46.65 SWL	25	45.92 SWL	25	47.51 SWL	16.8	47.65 SWL	18.5	50.17 SWL	16	48.34 SWL	16
	US ARMY SUNNY POINT TERMINAL												
13	2-5	11.51 SWL	35	11.2 SWL	30	11.5 SWL	20.7	11.46 SWL	23.5	12.59 SWL	20	12.43 SWL	18
14	4-3	11.69 SWL	65	11.23 SWL	65	11.52 SWL	64	11.31 SWL	56	12.17 SWL	64	12.26 SWL	56
15	4-1	16.49 SWL	>400	15.84 SWL	>400	16.28 SWL	900	15.6 SWL	740	16.48 SWL	686	16.65 SWL	684
16	*4-2(NEAR 4-1)*				45		74.8		44		36		68
17	8	11.95 SWL	250	11.41 SWL	280	11.57 SWL	239	11.12 SWL	232	11.53 SWL	290	11.93 SWL	257
18	*11-1(NEAR 8)*				240		199		197		199		199
19	*11-2(NEAR 8)*				280		231		203		186		242
20	9 (G-5)	12 SWL		11.445 SWL	35	11.88 SWL	24	11.52 SWL	22.5	12.65 SWL	36	12.68 SWL	32
21	*12-1(NEAR 9)*				35		30.5		33.5		44		36
22	*12-2(NEAR 9)*				>400		464		480		515		460
23	5-5	17.78 SWL	390	16.94 SWL	380	17.02 SWL	330	16.37 SWL	258	17.16 SWL	230	17.42 SWL	180
24	*5-1(NEAR 5-5)*			15.89 SWL	>400		500		516		538		470
25	*5-2(NEAR 5-5)*			19.75 SWL	200		180		150		178		176
	TOWN OF CAROLINA BEACH												
26	WELL NO. 1	-78.3 PUMPING	50	-82.46 PUMPING	45	-26.43 SWL	52	-80.3 PUMPING	34	-78.4 PUMPING	38	-16.67 SWL	42
27	2			-13.15 SWL	85	-12.56 SWL	76	-7.23 SWL	68	-3.07 SWL	49.5	-3.65 SWL	92
28	3					-15.41 SWL	185	-15.16 SWL	210.4	-12.08 SWL	192	-13.08 SWL	190
29	4	-86.2 PUMPING	65	-21.7 SWL		-10.8 SWL	60	-14.8 SWL	36	-13.05 SWL	20	-11.8 SWL	57.2
30	5	-64.92 PUMPING	65	-64.6 PUMPING	35								
31	6												
32	7					-50.33 PUMPING	74	-47.25 PUMPING	66	-48.95 SWL	68	-44.71 PUMPING	72
33	8	-31.49 PUMPING	60	-7.24 PUMPING	65	-27.28 PUMPING	64						
34	9	-53.62 PUMPING	55	-47.2 PUMPING	60	-32.34 SWL	56	-26.21 PUMPING	47	-23.22 SWL	49.5	-26.45 PUMPING	53.6
35	10	-88.53 PUMPING	170	-30.78 PUMPING	160	-13.94 SWL	152	-18.94 PUMPING	143.2	-8.78 SWL	142	-14.07 SWL	136
36	11	-101.55 PUMPING	35	-29.36 SWL	40	-26.16 SWL	36	-21.0 PUMPING	24.5	-18.09 SWL	26	-14.0 SWL	26.4
	NC STATE AQUARIUM												
37	WELL NO. 1	1.94 SWL	370	-13.76 PUMPING	>400	-5.06 PUMPING	862	-0.5 PUMPING		3.65 PUMPING	880	.4 PUMPING	925
38	WELL NO. 2			-11.05 PUMPING	>400	-14.65 PUMPING	498	-15.28 PUMPING	644	-15.1 PUMPING	506	-16.19 PUMPING	530
39	**WALTER J. HODDER WELL**	1.58 SWL	25	0.25 SWL	25	1.08 SWL	10	1.03 SWL	18.7	3.04 SWL	17.5	5.18 SWL	22
	TOWN OF WRIGHTSVILLE BEACH												
40	WELL NO. 1				110		102						
41	2	-19.25 PUMPING		-17.05 PUMPING	114	-16.66 PUMPING	18	-8.55 SWL	102	-3.55 SWL		-4.55 SWL	
42	4				178		178						
43	5						124						
44	6			-40.87 PUMPING		-45.07 PUMPING	86	-6.97 SWL	70				80
45	7			-13.21 SWL		-13.31 SWL	58	-9.31 SWL	17	-5.63 SWL	28	-5.21 SWL	59
46	8			-13.34 SWL		-37.79 SWL	121	-10.94 SWL	125	-8.29 PUMPING	30	-26.04 PUMPING	65
47	11				50	-80.47 PUMPING	22	.28 SWL	45	-91.72 PUMPING	16	-81.72 PUMPING	51
48	12				36		47						
	CORNING, INC.												
49	WELL NO. 1	11.3 SWL		11.37 SWL	35	12.74 SWL	33	12.73 SWL	29	10.4 SWL	33	10.67 SWL	38
50	2	19.56 SWL	50	18.94 SWL	85	20.41 SWL	70	19.76 SWL	50	20.5 SWL	47.5	19.98 SWL	52
51	3												
52	4	12.5 SWL	35	11.41 SWL	35	1.5 SWL	23.3	11.5 SWL	22.5	-63.5 PUMPING	23.5	-48.5 PUMPING	30.8
53	5	-16.5 PUMPING	35	23.66 PUMPING	35	-26.5 PUMPING	28	3.5 PUMPING	25.5	-79.5 PUMPING	32	-66.5 PUMPING	33.6
	UTILITY CO. WELLS												
54	LONG LEAG ACRES												
55	HICKORY KNOLL	8.25 PUMPING	25			23.25 SWL	17.2			15.78 SWL	28		
56	HILLSIDE									-36.3 PUMPING	14.5		
57	MASONBORO PROPERTIES/WATERFORD												
58	TANGLEWOOD									6.1 PUMPING	57.5		
59	SILVA TERRA	-49.1 PUMPING	70			-23.1 PUMPING	75.2			-30.02 PUMPING	74		
60	MARQUIS HILLS	-65.8 PUMPING	150			-58.0 PUMPING	120.8			-53.92 PUMPING	122		
61	GREEN MEADOWS									13.1 PUMPING	22.5		
	NEW HANOVER AIRPORT RESEARCH STATION												
62	CC-31, p-1	21.72 SWL		22.64 SWL		24.11 SWL		24.33 SWL	11	26.8 SWL	16	23.93 SWL	14.5
	CAPE INDUSTRIES												
63	WELL "W"	6.56 SWL	120	6.02 SWL	120	6.15 SWL	108	6.42 SWL	169	6.37 SWL	112	6.45 SWL	
64	WELL "DD"	5.7 SWL	140	5.29 SWL	160	5.39 SWL	138.4	5.34 SWL	115	5.22 SWL	120	5.15 SWL	77.5
65	WELL "GG"	5.8 SWL	160	5.66 SWL	140	6.15 SWL	121.2	6.09 SWL	101	6.01 SWL	104	5.98 SWL	65
	ARCADIAN CORP.												
66	MW-G-1	9.27 SWL	60	9.72 SWL	20	9.32 SWL	13		10.2		12.5		14.4
	CP & L SUTTON LAKE												
67	MW-4	7.59 SWL	10	7.263 SWL	15	7.69 SWL	6.1	8.01 SWL	5	7.79 SWL	8	12.52 SWL	6.6

TABLE A-2: WATER LEVEL AND CHLORIDE MEASUREMENTS continued

WELL	JAN., 1994		FEB, 1994		MARCH, 1994		APRIL, 1994		MAY, 1994		JUNE, 1994		JULY, 1994		AUGUST, 1994		SEPT., 1994	
NO.	WATER LEVEL FT/MSL	CL (PPM)	WATER LEVEL FT/MSL	CL (PPM)	WATER LEVEL FT/MSL	CL (PPM)	WATER LEVEL FT/MSL	CL (PPM)	WATER LEVEL FT/MSL	CL (PPM)	WATER LEVEL FT/MSL	CL (PPM)	WATER LEVEL FT/MSL	CL (PPM)	WATER LEVEL FT/MSL	CL (PPM)	WATER LEVEL FT/MSL	CL (PPM)
1	4.01 SWL	18	5.08 SWL	22.5	4.94 SWL	17	4.68 SWL	18.1	4.6 SWL	19.2	3.71 SWL	21.9	4.14 SWL	16	4.35 SWL	18	4.85 SWL	19.7
2	6.17 SWL	17	6.7 SWL	16	6.62 SWL	16.2	6.31 SWL	15.1	6.52 SWL	15.5	5.44 SWL	16	5.79 SWL	15.6	5.96 SWL	13.8	6.09 SWL	14.2
3	2.4 SWL	40.2	3.88 SWL	39.6	3.65 SWL	41	3.26 SWL	40.6	3.44 SWL	41.6	2.8 SWL	41.2	3.37 SWL	40.9	3.5 SWL	56.8	4.43 SWL	44
4	6.76 SWL	5.6	7.05 SWL	4.7	7.09 SWL	5.2	6.76 SWL	4.6	6.57 SWL	4.4	5.91 SWL	5.1	6.21 SWL	4	6.24 SWL	5	6.43 SWL	4.8
5	24.57 SWL	16.4	26.2 SWL	19.5	25.4 SWL	23.8	23.88 SWL	20	22.04 SWL	15	20.25 SWL	14.2	21.23 SWL	14.4	19.86 SWL	18.2	19.58 SWL	22.4
6	1.13 SWL	14.5	3.66 SWL	14.2	3.22 SWL		2.1 SWL	12.3	2.66 SWL	12.8	2.84 SWL	13	3.37 SWL	14	3.5 SWL	12.2	5.04 SWL	12.8
7	18.63 SWL	21	20.19 SWL	19.5	19.91 SWL		18.95 SWL	13.5	17.86 SWL	12.8	16.75 SWL	13.3	16.57 SWL	13.5	16.17 SWL	12.8	15.74 SWL	16.8
8	23.13 SWL	11.2	23.83 SWL	8	24.17 SWL	8	23.13 SWL	7.5	22.12 SWL	6.9	20.53 SWL	8.7	21.3 SWL	6.7	20.3 SWL	8	19.94 SWL	7.3
9	4.98 SWL		6.13 SWL		5.84 SWL		4.82 SWL		4.17 SWL		3.29 SWL		3.18 SWL		3.14 SWL		4.38 SWL	
10	4.49 SWL	9	5.6 SWL	7	5.28 SWL	8.1	4.08 SWL	13	3.76 SWL	6.5	2.64 SWL	7	2.63 SWL	6.5	2.68 SWL	6.1	3.82 SWL	6.4
11	48.48 SWL	17.3	48.74 SWL	16	48.42 SWL	15.9	47.5 SWL	15.1	46.8 SWL	14	44.74 SWL	14.9	45.27 SWL	16.4	44.97 SWL	12.1	45.69 SWL	13.7
12	49 SWL	16.6	50.16 SWL	15	49.235 SWL	18.8	47.74 SWL	15.1	46.71 SWL	14.8	45.54 SWL	12.5	46.26 SWL	12.9	45.81 SWL	11.3	46.48 SWL	11.6
13	12.52 SWL	19	12.09 SWL	19.2	12.92 SWL	24.4	12.49 SWL	22.2	11.9 SWL	18.8	11.2 SWL	17.5	11.71 SWL	16.8	11.45 SWL	15	11.43 SWL	14
14	12.52 SWL	55	12.26 SWL	54.7	13.15 SWL	59.6	12.73 SWL	56.5	20.89 SWL	56.5	11.16 SWL	60.8	11.51 SWL	56	11.2 SWL	59.2	10.94 SWL	59.2
15	17.47 SWL	600	17.55 SWL	640	18.26 SWL	680	17.61 SWL	1150	16.69 SWL	750	15.62 SWL	732	15.82 SWL	698	15.52 SWL	830	15.15 SWL	310
16		52		41		44.9		52.3		36		25		21.8		23.4		23.9
17	12.46 SWL	240	12.71 SWL	247	13.33 SWL	240	12.82 SWL	265	12.26 SWL	229	11.3 SWL	229	11.42 SWL	200	11.04 SWL	214.4	10.71 SWL	240.4
18		190		198		171		240		235		192		194		185		213
19		200		190		229		135		140		141		177.2		139		131
20	13.24 SWL	22	13.09 SWL	20	13.58 SWL	38	13.16 SWL	20	12.37 SWL	19.8	11.14 SWL	19.9	11.77 SWL	19	11.51 SWL	17.9	11.19 SWL	16.8
21		25		27.5		29		26.8		23		26.2		25.9		25.4		23.5
22		480		490		430		430		402		143		368		378		351
23	18.32 SWL	330	18.71 SWL	310	19.45 SWL	340	18.9 SWL	385	17.96 SWL	315	16.66 SWL	299	16.82 SWL	244	16.4 SWL	190	15.99 SWL	149
24		420		400		500		409		421		396		330		408		401
25		115				120		98				99.2		64.8		40		192.4
26	-16.1 SWL	36				60	-23.09 PUMPING	34.5										
27	-3.07 SWL	975	-1.65 SWL	802	-3.61 SWL	110.4	-8.24 SWL	95	-9.98 SWL	72	-14.99 SWL	72.4	-16.15 SWL	92.8	-10.57 SWL	69.2	-7.65 SWL	73.2
28	-9.415 SWL	194	-12.297 SWL	197.6	-8 SWL	190.4	-12.58 SWL	190	-14.83 SWL	194	-19.67 SWL	196.4	-19.29 SWL	191	-16 SWL	195	-13.25 SWL	192
29	-11.9 SWL	55	-10.385 SWL	52.5	-11.885 SWL		-17.8 SWL											
30																		
31		42				40		40.5										
32	-9.09 SWL	70				63.2	-14.75 PUMPING	67.6										
33	-17.49 SWL	62	-15.957 SWL	33	-18.42 SWL	57	-23.99 PUMPING	54										
34	-19.47 SWL	54	-18.59 SWL	47	-20.595 SWL	48	5.7 SWL	51.2	-27.89 SWL	46.9	-34.8 SWL	52	-37.97 SWL	49.2	-29.72 SWL	46	-25.55 SWL	54
35	-8.95 SWL	136.8	-10.95 SWL	148.8	-11.865 SWL	198.4	-17.2 SWL	137.6	-16.2 SWL	54	-24.99 SWL	131.2	-26.62 SWL	124.4	-21.57 SWL	124.8	-17.57 SWL	133.2
36	-13.335 SWL	24	-12.5 SWL	24.9	-14.625 SWL	21.7	-19.92 SWL	23.8	-22.42 SWL	23.9	-29.92 SWL	28	-32.63 SWL	24	-24.67 SWL	20.6	-20.59 SWL	23.5
37	3.15 SWL	948	2.9 PUMPING	1012	2.97 SWL	950	1.25 SWL	880	0.4 SWL	968	1.3 SWL	928	-0.6 SWL	916	0.15 SWL	980	2 SWL	1000
38	17.25 SWL	454	-17.62 PUMPING	470	-19.2 PUMPING	425	-19.68 PUMPING	425	-20 PUMPING	444	-20.45 PUMPING	446	-20.7 PUMPING	424	-21 PUMPING	466	-20.9 PUMPING	468
39	5.18 SWL	18	5.35 SWL	18.6	3.77 SWL	25.3	1.28 SWL	19.5	0.03 SWL	17.7	0.6 SWL	18	0.54 SWL	21.2	1.8 SWL	17.3	3.43 SWL	17.8
40																		
41	-.05 SWL		0.45 SWL		0.2 SWL		-5.29 SWL		-11.61 PUMPING		-17.77 PUMPING		-16.05 PUMPING		-4.8 SWL		-4.65 SWL	
42																		
43																		
44							-28.27 PUMPING	75	-22.37 PUMPING	87	-40.87 PUMPING	114	-41.27 PUMPING		-37.57 PUMPING	118	-35.67 PUMPING	
45	-4.21 PUMPING		-1.21 SWL		-1.71 SWL	78	-62.11 PUMPING	78	-60.56 PUMPING	89	-15.91 PUMPING	105	-14.21 SWL		-9.96 SWL	110	-11.01 SWL	
46	-27.29 PUMPING		-4.04 SWL		-18.04 PUMPING	130	-30.58 PUMPING	130	-32.01 PUMPING	138	-33.69 PUMPING	42	-36.04 PUMPING		-31.04 PUMPING	46	-27.04 PUMPING	
47	-76.72 PUMPING		2.61 SWL		-81.72 PUMPING	48	-83.72 PUMPING	28	-71.72 PUMPING	26			-91.72 PUMPING		-81.72 PUMPING	55	-86.72 PUMPING	
48																		
49	15.62 SWL	30	17.2 SWL	32.5	16.8 SWL	30.6	12.96 SWL	28.8	10.18 SWL	29.2	10.9 SWL		10.91 SWL	26.4	10.7 SWL	26.6	12.02 SWL	30.8
50	20.39 SWL	79.8	21.8 SWL	77	20.85 PUMPING	55.2	19.82 SWL	65.6	19.48 SWL	80.8	19.1 SWL		19.25 SWL	78	19.18 SWL	30	19.76 SWL	61.2
51																		
52	-8.5 PUMPING	24	-3.5 PUMPING	24.8	11.5 PUMPING	26	-38.5 PUMPING	25.5	-33.5 PUMPING	24.8	6.5 SWL		4.5 SWL	22.6	-53.5 SWL	21.7	-68.5 SWL	32
53	18.5 SWL	16	14.5 SWL	23	6.5 PUMPING	26.9	-56.5 PUMPING	26.1	-61.5 SWL	25.2	-71.5 PUMPING		-71.5 PUMPING	22.6	-34.5 PUMPING	19.4	-70.5 PUMPING	33.2
54		48				47.6				39.6				41.2				42.8
55	16.15 SWL	15			17.2 SWL	13.6				42.6			11.34 SWL	44.8			1.01 SWL	53.6
56	48.59 PUMPING	13			-48.78 PUMPING	11.7				10.9			4.84 SWL				-16.75 PUMPING	16.8
57																		
58	-19.3 PUMPING	62			-19.9 PUMPING	60				56			-3 PUMPING	58.4			0 PUMPING	65.6
59	-30.2 PUMPING	74			-26.9 PUMPING	70.4				67.6			-23.85 PUMPING	68			4 SWL	
60	-59 PUMPING	114			-58.9 PUMPING	111.2				10.7			-63 PUMPING	47.2			-52 PUMPING	116
61																		
62	24.77 SWL	9	27.78 SWL	6.3	24.88 SWL	6	22.89 SWL	10.3	21.75 SWL	5.1	20.72 SWL	5.9	20.43 SWL	7.9	21.48 SWL	5.6	23.96 SWL	4.6
63	6.89 SWL	118.8	7.5 SWL	118	8.33 SWL	119.2	7.57 SWL	72	7.11 SWL	70	6.2 SWL	70	5.76 SWL	71	5.75 SWL	62	6.37 SWL	60.8
64	5.5 SWL	112	6.21 SWL	112	7.45 SWL	118.4	6.57 SWL	100	6.15 SWL	104	5.3 SWL	104.8	4.79 SWL	100.4	4.75 SWL	70.8	5.31 SWL	70
65	6.16 SWL	86.4	6.81 SWL	82	7.35 SWL		6.66 SWL	89	6.15 SWL	92.4	5.5 SWL	91.2	5.12 SWL		5.55 SWL	76	6.02 SWL	80
66		13.7		11.2		13		10.5		9.3		9.4	-27.45 SWL	9.8	-27.53 SWL	7.4	-27.31 SWL	9.6
67	8.273 SWL	6	9.063 SWL	5.2	9.703 SWL	4.6	8.673 SWL	4.3	7.963 SWL	4.7	6.993 SWL	5.1	6.843 SWL	3.9	7.243 SWL	7.6	8.323 SWL	5

TABLE A-3

SURFICIAL AQUIFER/PUMP TEST DATA						
LATITUDE	LONGITUDE	WELL NAME AND NO.	SCREENED INTERVAL(FT)	TRANSMISSIVITY FT2/DAY	STORATIVITY	HYDRAULIC CONDUCTIVITY FT/DAY
34.037912	77.958895	US ARMY SUNNY POINT TERMINAL WELL 4-4	10-15	1296		59
		US ARMY SUNNY POINT TERMINAL WELL OW-1	10-15	1831	0.32	83
		US ARMY SUNNY POINT TERMINAL WELL OW-2	10-15	1537	0.12	69
34.023172	77.955343	US ARMY SUNNY POINT TERMINAL WELL 5-4	16-21	869		54
		US ARMY SUNNY POINT TERMINAL WELL OW-1	16-21	695	0.00084	43
		US ARMY SUNNY POINT TERMINAL WELL OW-2	16-21	1069	0.00039	67
34.324444	77.994166	USGS	40-48	3342		151
34.325555	77.024166	USGS	18-20	401		18.22
34.308888	77.984444	USGS	62-65	5755		261
34.273888	77.878055	HARRELLS BLDG.	?-87	13369		607
34.125555	77.906388	USGS	63-65	534		24

TABLE A-4

CASTLE HAYNE AQUIFER/PUMP TEST DATA							
LATITUDE	LONGITUDE	WELL NAME AND NO.	WELL LOG DATABASE NO.	SCREENED INTERVAL(FT)	TRANSMISSIVITY FT2/DAY	STORATIVITY	HYDRAULIC CONDUCTIVITY FT/DAY
33.980555	77.9175	FORT FISHER AIR FORCE STATION		112-201	2673		46.08
33.959722	77.941111	FORT FISHER AIR FORCE STATION		?-170	668		8.35
33.994722	77.909722	KURE BEACH		120-180	2673		46.08
34.010278	77.910833	TOWN OF KURE BEACH	NH-59	?-170	10888		108.8
34.022777	77.916944	ETHYL DOW		?-158	4010	0.0001	50.12
34.030833	77.913055	CAROLINA BEACH RENOURISHMENT OW-5		?-145	5620	0.00017	70.25
34.030833	77.913055	CAROLINA BEACH RENOURISHMENT OW-6		?-145	8197	0.00006	102.46
34.058055	77.888888	CAROLINA BEACH		133-143; 185-205	2966		29.66
34.075833	77.911944	THE CAPE WELL NO. 2		127-200	2204		20.03
34.132222	77.8675	M.K. LOUGHLIN		119-185	802		13.82
34.138611	77.878611	MASONBORO PROPERTIES		147-183	250		5.1
34.1525	77.941111	ALLIED KENNECOTT OW-2		?-151	2215	0.0097	28.39
34.03	77.911666	ALLIED KENNECOTT	NH-54	16-208	1346		14.95
34.159722	77.859444	B.F. SUTHERLAND		86-124	1871		38.18
34.166111	77.8775	W.J. HODDER		?-170	1203		10.02
34.181666	77.895833	PINE VALLEY WATER CO.		?-185	440		3.66
33.944444	78.094444	BRUNSWICK CO. P-4/OW-7	B-29/B-103	62-72; 100-105 126-131	1275	0.0031	14.65
33.944166	78.084444	BRUNSWICK CO. P-7	B-95	54-114 132-152	2467		30.83
33.931389	78.015278	GW SECTION SOUTHPORT RS/UI	B-41	61.5-191	1750		13.46
33.955556	78.0125	GW SECTION SOUTHPORT RS/K4	B-63	79-191	3900		41.05
33.951388	78.011666	GW SECTION SOUTHPORT RS/K6		60-70	2579		88.93
33.951388	78.011666	GW SECTION SOUTHPORT RS/K8		60-70	2333	0.0003	80.44
33.955556	78.0125	GW SECTION SOUTHPORT RS/K1		74-190	1229		10.59

TABLE A-5

PEEDEE AQUIFER/PUMP TEST DATA							
LATITUDE	LONGITUDE	WELL NAME	WELL LOG DATABASE NO.	SCREENED INTERVAL (FT)	TRANSMISSIVITY FT2/DAY	STORATIVITY	HYDRAULIC CONDUCTIVITY FT/D
34.3775	77.846666	IDEAL CEMENT		23-160	1336	0.1	9.75
34.373611	77.846944	IDEAL CEMENT		?-164	2673		19.51
34.369722	77.8475	IDEAL CEMENT		?-160	1336		9.75
34.3425	77.890555	REASOR CHEMICAL		30-150	1069		8.9
34.345833	77.893333	REASOR CHEMICAL		34-148	2072		18.17
34.343055	77.89	REASOR CHEMICAL		33-150	3208		27.41
34.325833	77.868055	RAEFORD TRASK		?-87	2673	0.005	17.58
34.335277	77.917777	HUGH OOSTERWYK		?-71	1457		33.11
34.333333	77.923333	HUGH OOSTERWYK		?-74	1497		34.02
34.323888	77.949444	USGS		52-54	608		13.81
34.317777	77.868888	RAEFORD TRASK		?-119	1470		9.67
34.298333	77.744444	ORNESBY		159-165	534		3.33
34.289444	77.873055	ALEXANDER WEIDE		78-109	5347		38.74
34.292777	77.901666	RAEFORD TRASK		?-83	5347		121.5
34.286388	77.900277	RAEFORD TRASK		?-90	3342		75.95
34.284722	77.983888	CAROLINA POWER		33-53	13368		151.9
34.285	77.963333	USGS		53-56	534		8.9
34.278333	77.959444	CAROLINA NITRO		30-65	2005		33.41
34.276111	77.958888	CAROLINA NITRO		40-60	2673		44.55
34.275277	77.955833	CAROLINA NITRO		?-89	668		11.13
34.273333	77.914444	NEW HANOVER AIRPORT		65-105	10695		243.06
34.273055	77.915277	NEW HANOVER AIRPORT		93-102	4010		91.13
34.271111	77.918055	NEW HANOVER AIRPORT		?-170	8021		182.29
34.263888	77.898611	ADC DIS COMPLEX		?-170	6684		48.43
34.2625	77.894166	ADC DIS COMPLEX		74-96	9358		67.81
34.274444	77.899166	S.H. FEENSTRA		?-113	4010		29.05
34.030833	77.913055	HARRELLS BLDG.		?-87	13368		222.8
34.258611	77.832777	NC HIGHWAY PATROL		86-180	802		6.9
34.252222	77.870277	CORNING GLASS	NH-67	?-140	802		5.72
34.241666	77.913333	BNAI ISR SYNAGOGUE		15-94	1336		16.9
34.235277	77.945555	PEOPLES SAVINGS		108-122	1738		34.76
34.235277	77.934722	N. HANOVER HIGH SCHOOL		50-122	668		13.36
34.225	77.922777	PEPSI COLA BOTTLING		41-75	2673		33.8
34.226944	77.8775	WILMINGTON COLLEGE		80-165	802		8.02
34.226666	77.875555	WILMINGTON COLLEGE		80-180	1336		13.36
34.2225	77.847222	J.P. ELLINGTON		60-145	1069		9.54
34.214722	77.798055	JOHN ANDERSON		128-169	802	0.001	5.01
34.196666	77.803611	WRIGHTSVILLE BEACH		?-178	1470		9.18
34.188333	77.810277	WRIGHTSVILLE BEACH		160-174	534		3.33
34.201944	77.941666	SUNSET PARK METHODIST		?-82	1336		26.72
34.196111	77.950833	WILMINGTON SHIPYARD		70-123	1203		24.06
34.190833	77.935833	MOFFIT VILLAGE		?-175	935		11.98
34.186666	77.933055	HANOVER MILLS		79-157	1871		23.98
34.166111	77.8775	W.J. HODDER		?-170	1203		10.02
34.176666	77.935277	TENNY ENGINEERS		104-120	935		11.98
34.1525	77.438888	ALLIED KENNECOTT		?-142	5347		66.83
34.132222	77.8675	M.K. LOUGHLIN		119-185	802		13.82
34.1525	77.941111	ALLIED KENNECOTT OBS. WELL NO. 2		?-151	2215	0.0097	28.39
34.231388	77.825833	LANDFALL ASSOCIATES WELL NO.1			1100		9.82

TABLE A-5 continued

LATITUDE	LONGITUDE	WELL NAME	WELL LOG DATABASE NO.	SCREENED INTERVAL (FT)	TRANSMISSIVITY FT2/DAY	STORATIVITY	HYDRAULIC CONDUCTIVITY FT/D
34.229166	77.813055	LANDFALL ASSOCIATES WELL NO.2		63-73 155-175	2158		19.26
34.235833	77.814722	LANDFALL ASSOCIATES WELL NO.3			1280		11.42
34.224166	77.823055	LANDFALL ASSOCIATES WELL NO.4			608		5.42
34.221388	77.825277	KEYLAND/WRIGHTSVILLE BCH. WELL NO. 11 (NH-70)	NH-70	148-178	316		1.77
34.226666	77.782777	D-G ENTERPRISES/WRIGHTSVILLE BCH. WELL NO. 10	NH-71	152-174	3365		19.33
34.273055	77.960555	GW SECTION FLEMINGTON LDFL. WELL CC-31, R-30		30-40	13368		148.53
34.305277	77.986666	HERCOFINA WELL "P-1"			18620		211.59
34.305277	77.986666	HERCOFINA WELL "P-2"		24-54	15516		176.31
34.225555	77.923888	PEPSI-COLA BOTTLING CO.		85-110	820		10.37
34.058055	77.888888	CAROLINA BEACH		133-143 185-205	2966		29.66
34.315277	78.059722	DUPONT WELL NO. 1		?-38	204		3.4
34.314166	78.06	DUPONT WELL NO. 7		17-37	687.6		11.46
34.313333	78.059166	DUPONT WELL NO. 8		18-38	464.6		7.74
34.313888	78.061666	DUPONT WELL NO. 6		17-37	777		12.95
34.255555	78.084166	LELAND CHEMICAL CO./CC-32, Y4		31-62	3150		52.5
34.236666	78.033888	LELAND MIDDLE SCHOOL DD-32, C3		?-46	1306		10.36
34.2825	78.138056	OAKWOOD MHP CC-33, Q1		268-280	744.9		4.59
34.222222	77.986388	LELAND DD-31 F8	B-92	42-88	784		5.33
34.171666	78.165	GW SECTION TOWN CREEK RS/Y2	B-85	26-31;35-40 45-50	8829.83		40.31
34.008888	78.082777	GW SECTION BOILING SPRINGS RS/FF-32, Y1	B-69	67-150	1047.3		12.61
34.03717	77.973095	US ARMY SUNNY POINT WELL NO. 2-5/OW-2	B-109	?-85	3796	0.0014	61.26
34.037786	77.968257	GW SECTION HOLDEN BEACH RS/HH-35, B3		56-84	10500		105
33.955556	78.0125	GW SECTION SOUTHPORT RS/K4	B-63	74-191	3900		41.05
33.951389	78.011667	GW SECTION SOUTHPORT RS/K5	B-73	83-190	5051	0.0025	63.13
34.250277	78.011666	TOWN OF NAVASSA CC32 U5 NO. 3		42-62 67-77	3500		38.88
33.955	78.106666	BRUNSWICK CO. WELL P-9/OW-P-6	B-97/B-26	70-152	1555	0.00002	18.96
33.944444	78.094444	BRUNSWICK CO. WELL P-4/OW-7	B-29/B-103	62-72; 100-105 126-131	1275	0.0031	14.65
34.222222	77.986388	BRUNSWICK CO. WELL P-2/OW-3	B-92/B-100	42-52 72-80	918	0.0003	7.91
33.944166	78.084444	BRUNSWICK CO. WELL P-7	B-95	54-114; 132-152	2467		30.83
33.965278	78.1125	BRUNSWICK CO. WELL P-6/OW-11	B-26/B-107	68-83 145-150	2550	0.0012	31.09
33.951666	78.084166	BRUNSWICK CO. WELL P-8	B-96	68-148	1166		14.57
34.236111	78.034722	LELAND SCHOOL		30-50.5	128.8		1.02
33.931389	78.015278	GW SECTION SOUTHPORT RS/U1 (BW-41)	B-41	61.5-191	1750		13.46
33.96	78.010277	CP&L, SUPPLEMENTAL INFO. TO BSEP REPORT, P. 19		120-201	1337	0.0002	10.78
33.955556	78.0125	GW SECTION SOUTHPORT RS/K1		74-190	1229		10.59
34.006944	78.048055	BRUNSWICK MIDDLE SCHOOL FF-32 W1		?-105	1875		31.25

TABLE A-6: Well Owners and Average Daily Withdrawals Per Month in GPD
Projected Future Pumping Rates in Million GPD

WELL OWNERS	ADW-JUNE93	ADW-JULY93	ADW-AUG93	ADW-SEPT93	ADW-OCT93	ADW-NOV93	ADW-DEC93	ADW-JAN94
	GPD	GPD	GPD	GPD	GPD	GPD	GPD	GPD
Quality Water Supplies								
Combined	743,313.067	1,383,744.516	1,467,495.161	1,335,693 est	975,369 est	143,011.467	no data	499,500.677
New Hanover Co. Well System								
Combined	303,967	296,097	259,161	327,667	299,710	296,967	274,774	268,258
Coastal Plains Utility Co.								
Combined	5,837,300	6,211,400	1,727,700	1,865,000	813,200	813,200	813,200	975,200
SJS Utilities								
Combined	9,116,100	10,101,600	8,377,400	10,223,900	8,057,400	6,400,000	6,400,000	6,400,000
Gold Bond Building Products								
Combined	0	0	0	1,177,100	3,210,480	3,801,600	3,416,400	3,492,360
Wrightsville Beach								
Combined	1,484,801	1,642,081	1,334,839	1,218,699	985,697	721,800	611,839	775,162
Carolina Beach								
Combined	888,000	1,100,000	944,000	711,000	650,000	593,000	500,000	507,000
Corning, Inc.								
Combined	254,000	280,645	300,000	260,000	205,806	190,000	104,194	24,143
Kure Beach								
Combined	282,783.33	377,123.52	396,829.03	244,266.7	291,303.2	164,486.7	100,941.9	141,883.9
Cape Industries								
Combined	2,147,000	1,012,000	2,047,000	1,301,000	1,268,000	1,782,000	1,700,000	1,830,000
Kings Grant								
Combined	793,120	443,777.42	352,593.55	518,423.33	509,629.03	449,176.67	707,864.52	419,906.45
Brunswick Co. Well System								
Combined	2,746,290	2,396,774.19	3,738,967.74	2,775,566.666	1,566,451.61	1,251,333.33	0	0
Martin Marietta Quarry	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000
Oxy-Chem.								
Combined	254,000	280,645	300,000	260,000	205,806	190,000	104,194	24,143
General Electric								
Combined	1,090,000	850,000	850,000	1,060,000	1,180,000	1,160,000	95,000	1,030,000
Landfall Associates								
Combined	1,396,368	1,386,033	1,423,363	1,371,586	650,500	1,372,350	1,372,350	1,372,350
Bald Head Island								
Combined	93,724	104,720	99,993	0	0	79,778	0	81,465
Koch Sulfur Co.								
Combined	180,000	180,000	180,000	90,000	180,000	180,000	180,000	180,000
U.S. Army Sunny Point Military Ocean T.								
Combined	23,350	33,316	6,431	6,632	3,836	2,826	13,239	11,308
Southport								
Combined	627,707	706,774	574,819	549,303	551,487	402,420	345,539	420,835
CP&L Sutton Plant								
Combined	3,182,206	4,030,636	2,944,744	3,140,776	2,519,212	2,756,803	3,028,997	2,307,400

WELL OWNERS	ADW-FEB94	ADW-MAR94	ADW-APR94	ADW-MAY94	ADW-JUN94	ADW-JUL94	ADW-AUG94	ADW-SEPT94
	GPD	GPD	GPD	GPD	GPD	GPD	GPD	GPD
Quality Water Supplies								
Combined	251,523.893	1,278,909.677	21,354	129,429.032	743,313	1,771,118.097	1,467,495	1,335,693 est
New Hanover Co. Well System								
Combined	236,643	351,032	286,867	273,484	303,967 est	226484	246,613	327,667 est
Coastal Plains Utility Co.								
Combined	895,700	998,000	1,795,200	2,475,500	3,363,400	1920400	1,505,100	1,483,300
SJS Utilities								
Combined	5,400,000	5,450,000	5,500,000	5,700,000	9,116,200	10101600	5,377,400	7,223,900
Gold Bond Building Products								
Combined	3,400,000	3,400,000	3,400,000	3,400,000	3,400,000	3400000	3,400,000	3,400,000
Wrightsville Beach								
Combined	944,173	660,700	958,866	1,208,319	1,418,638	1512569	1,316,999	1,047,359
Carolina Beach								
Combined	560,000	593,000	761,000	781,000	888,000	1100000	805,000	962,000
Corning, Inc.								
Combined	230,000	170,000	193,333	230,000	270,000	271190	290,000	250,000
Kure Beach								
Combined	111,000	132,093.5	200,373.3	190,335.5	238,830	209288.06	335,080.65	290,053.3
Cape Industries								
Combined	1,746,000	1,746,000	1,725,000	1,622,000	1,424,000	1872000	1,897,000	1,502,000
Kings Grant								
Combined	456,364.29	437,212.9	525,393.33	727,116.13	793,120	542580.65	476,383.87	370,716.13
Brunswick Co. Well System								
Combined	0	0	1,705,666.660	333,000	3,280,870.968	5268225.8065	4,652,000	4,072,200
Martin Marietta Quarry	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000
Oxy-Chem.								
Combined	230,000	170,000	193,333	230,000	270,000	271,290	290,000	250,000
General Electric								
Combined	1,130,000	920,000	1,200,000	940,000	1,110,000	1,080,000	770000	680,000
Landfall Associates								
Combined	1,372,350	1,372,350	1,376,375	1,197,634	1,421,056	1,415,993	1,301,666	1,259,666
Bald Head Island								
Combined	63,751	93,601	101,742	94,246	134,854	329,613	260,289	237,902
Koch Sulfur Co.								
Combined	180,000	180,000	90,000	180,000	180,000	180,000	180,000	90,000
U.S. Army Sunny Point Military Ocean T.								
Combined	9,068	13,586	5,960	17,183	16,167	7,324	16,561	2,922
Southport								
Combined	441,107	454,600	433,117	189,580	341,080	132,471	118,045	121,700
CP&L Sutton Plant								
Combined	1,334,400	906,900	1,625,800	1,805,400	2,439,200	2,119,300	1,173,200	655,300

WELL OWNERS		YEAR 2000		YEAR 2010		YEAR 2020		Info. source
Town of Carolina Beach		0.97 MGD		1.240 MGD		1.590 MGD		SWSP*
Town of Wrightsville Beach		1.139 MGD		1.255 MGD		1.381 MGD		SWSP
Town of New Hanover Co./Flemington		0.217 MGD		.258 MGD		.308 MGD		SWSP
Town of Kure Beach		.63 MGD		.78 MGD		.96 MGD		SWSP
Brunswick Co. Water System		13.710 MGD		15.983 MGD		18.436 MGD		SWSP
City of Southport		1.057 MGD		1.236 MGD		1.336 MGD		SWSP
Bald Head Island		.2 MGD		.4 MGD		.8 MGD		Q*
Martin Marietta Castle Hayne Quarry		5 MGD		5 MGD		5 MGD		Q
Koch Sulfur		.1008 MGD		.1008 MGD		.1008 MGD		Q
U.S. Army, Sunny Point Terminal		0		0		0		Q
Corning Inc.		.440 MGD		.440 MGD		.440 MGD		Q
Kings Grant Water Co.								
General Electric		.5-.75 MGD		.5-.75 MGD		.5-.75 MGD		Q
Cape Industries		3 MGD		4 MGD		4 MGD		Q
Landfall Associates		.436076 MGD		.436076 MGD		.436076 MGD		Q
CP&L Sutton Plant								
OxyChem		.430 MGD		.470 MGD		.515 MGD		Q
Quality Water Supplies (Cape Fear Utilities)		Unknown		Unknown		Unknown		Q
Coastal Plains Utility Co.								
Gold Bond Building Products (Nat'l Gypsum)		.1428 MGD		.157 MGD		.173 MGD		Q
SJS Utilities		10 MGD		12 MGD		14 MGD		Q

*SWSP: State Water Supply Plan

*Q: Questionaire