DEVELOPMENT OF A WATER SUPPLY FROM THE TUSCALOOSA AQUIFER IN CHOCTAW COUNTY, MISSISSIPPI

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INTRODUCTION

During the last several years there has been a dramatic increase in interest in the development and expansion of electric power generating plants in the state. In the summer of 1998, the state of Mississippi entered a new era in industrial development, with the issuance of permits by the Mississippi Department of Environmental Quality (MDEQ) Permit Board for the first lignite mine and associated power plant to operate in the state. Issuance of these permits was the culmination of several years of intensive work on the part of representatives of the companies developing the lignite mine and power plant and the staff at MDEQ.

In 1995, representatives of Phillips Coal Co. contacted the MDEQ regarding the possibility of obtaining permits for the mining of lignite and construction of the 400 megawatt power plant in Choctaw County (Fig. 1). The power plant will produce electricity for the surrounding area through the Tennessee Valley Authority (TVA). The lignite mine will be operated by Mississippi Lignite Mining Company (MLMC) and the power plant will be operated by Choctaw Generation Limited Partnership (CGLP). While MLMC permits dealt mainly with mining laws and regulations, CGLP had several separate concerns. One of the most significant of these was finding an adequate water supply for cooling. The power plant is projected to require approximately 6 to 10 million gallons a day (MGD) to be used as make-up water in their closed-loop cooling system.

In meetings with CGLP, the Office of Land and Water Resources (OLWR) staff evaluated the principal aquifers currently used in the area. In Choctaw County, all sources of public water supply are developed in sands of the Meridian-upper Wilcox, middle Wilcox and lower Wilcox aquifers (Fig. 2). Approximately 10 miles to the east in Oktibbeha County, the Gordo aquifer has long been utilized for public and industrial water supplies (Fig. 3). None of the Wilcox aquifers used in Choctaw County were deemed to have the capability of producing the volume of water necessary for the power plant. More than 1.0 MGD of water is currently produced from these aquifers in the county and most of the wells only produce between 100 and 350 gallons per minute (GPM). Additionally, because of the shallow depths at which these aquifers occur, available drawdown space could be limited for large withdrawals of ground water.

Surface water was also evaluated as a potential source. The Big Black River was the nearest surface water source of any significant size. This reach of the Big Black is near the headwaters of the stream, with a very limited drainage area, and lacks sufficient flow during low water stages to reliably supply the required volume of water for the power plant. Therefore, some other source of water had to be considered.

Several published reports by United States Geological Survey (USGS) personnel and subsurface studies conducted by the staff of OLWR showed that there was an excellent chance of developing large-capacity water supply wells in the Tuscaloosa and possibly the Lower Cretaceous aquifers in the area. At the site of the proposed power plant, the water from all of these aquifers were expected to be unsuitable for human consumption without treatment, primarily due to excessive concentrations of total dissolved solids (TDS) and chlorides (Cl). Because water quality was not a major concern for CGLP, a decision was made to drill a test well to determine the feasibility of developing the water supply for the power plant from these deeper aquifers.

EVALUATION AND DEVELOPMENT OF A WATER SUPPLY

Based upon analysis of available geophysical logs of oil tests in Choctaw County and other information, a test hole was drilled beginning on April 7, 1997, near the proposed power plant site. Samples of drill cuttings were collected as drilling progressed. A reported total depth of 3,506 feet was reached and a suite of geophysical logs was run in the borehole on April 23, 1997. The information gained from these borehole surveys was utilized to select sand intervals from which water samples could be collected. During May, 1997, samples were obtained from three intervals. The following results were obtained from USGS laboratory analysis of these water samples. These results may be compared with those obtained from analysis of the samples by another lab shown in Figure 6.

	Total Dissolved Solids	Total Chlorides
Gordo Aquifer	922 mg/L	390 mg/L
Coker Aquifer	1,000 mg/L	450 mg/L
Massive Sand Aquifer	948 mg/L	420 mg/L

The deepest interval tested was screened from a depth of 3,140 to 3,180 feet. This interval was correlated with the Massive Sand of the Tuscaloosa Group. The next interval, correlated with the Coker formation of the Tuscaloosa Group, was screened from a depth of 2,910 to 2,950 feet. The final sample was collected from an interval that correlated with the Gordo formation of the Tuscaloosa Group that was screened from a depth of 2,652 to 2,692 feet. The recommended limit of chloride concentration by the U.S. Public Health Service is 250 mg/L for human consumption. Obviously the water was not suitable at this site for drinking without treatment. These results matched very closely the estimate of TDS made by Boswell (1963).

Analysis of the information obtained from this test resulted in a decision to develop a water supply for cooling for the power plant from the Coker-Massive Sand intervals. The OLWR decided to restrict pumpage to these aquifers so that the Gordo, containing better quality water, would be available for future development in Choctaw County. In the eastern part of the county, the Gordo, Coker and Massive Sand probably can supply water of good quality suitable for human consumption.

Beginning on January 14, 1998 a second test hole was drilled near the location of the first one and a large capacity test production well was later constructed in this borehole. This hole was drilled to a reported total depth of 4,117 feet into rocks of Paleozoic age. Samples of drill cuttings were collected as drilling progressed and a suite of geophysical logs was run in the borehole on February 2, 1998. This depth is nearly 1,000 feet below the bottom of the screened interval of the test production well that was constructed in this hole. The hole was drilled to this depth as a part of an agreement between the OLWR and Choctaw Generation, Inc. This was done for the purpose of determining that there were no significant structural disturbances affecting the sediments above the Paleozoic rocks, to estimate water quality in sands below the Massive Sand and to determine the degree of vertical separation and isolation between relatively fresh water and poorer quality water in deeper zones.

Based upon an analysis of the geophysical logs of this test hole, the surface of the Paleozoic rocks and the tops of all formations above it were found to occur at depths that were consistent with normal rates of dip, indicating no apparent structural anomalies above the Paleozoic surface (Fig. 5). The top of the Paleozoic surface was reached at a depth of approximately 4,019 feet at this site. Calculation of quality of water in sand intervals in the Lower Cretaceous section revealed a gradual increase in dissolved solids with increasing depth below the base of the Massive Sand and a separation of hundreds of feet between the screened interval and sands containing water in excess of 10,000 mg/L TDS (Fig. 6).

The test production well was constructed with a screen set from a depth of 2,830 feet to 3,170 feet in the Coker-Massive Sand aquifer. This well was pumped at rates up to 2,513 gallons per minute in pumping tests. The static water level measured in this well was 413 feet below land surface. Therefore, available drawdown is in excess of 2,700 feet. A transmissivity of approximately 128,000 gallons per day per foot and a specific capacity of 33 gallons per minute per foot of drawdown were determined from these tests. Current plans call for two more large capacity water supply wells to be constructed to meet the demands of the power plant for cooling water.

IMPLICATIONS FOR FURTHER DEVELOPMENT

The development of a water supply of several million gallons a day from an aquifer that had never been previously used in Choctaw County followed a fairly standard established procedure. First, a survey of published information was conducted to determine the extent of knowledge regarding ground-water resources in the area of interest and state and federal agencies were contacted to request information. Second, available subsurface information such as geophysical logs of boreholes and data from water wells in the area was examined. Third, based upon the results of this analysis, a drilling and testing program was designed to collect site-specific information concerning thickness and character of water-bearing sands and quality of water available from zones of interest. Finally, a test well was constructed to firmly establish the capability of the selected aquifer to meet the demand for water over the desired time period.

In recent years, test drilling programs have led to the development of new water supplies for communities throughout the state and have resulted in water of substantially improved quality and/or quantity being available to the public. Among several examples are the City of Natchez, where wells capable of pumping 1,000 GPM were drilled to depths of more than 900 feet northeast of the town. At West Point, wells capable of pumping 1,400 GPM were drilled to depths of more than 800 feet in the Gordo aquifer and more fresh water is available from deeper aquifers. At Booneville, wells capable of pumping 1,000 GPM were drilled in the Gordo aquifer at depths of more than 500 feet. More fresh water supplies could potentially be developed at Booneville from Paleozoic rocks. The City of Columbus, long dependent upon surface water, has developed wells capable of pumping more than 1,400 GPM from the Massive Sand at depths of more than 800 feet. The Town of Belmont in Tishomingo County recently drilled a successful test well in the Paleozoic rocks that shows promise of making much larger capacity wells than was previously possible. Finally, at Raymond, where highly colored water in the Cockfield aquifer has been a problem for years, testing of the deeper Sparta aquifer has resulted in the development of a large water supply of much better quality than the town has ever had.

There are untapped ground-water resources in many areas of Mississippi that could be developed in this same manner. In northeastern Mississippi, information exists to indicate that additional reserves of fresh water could be developed from sources in the Paleozoic rocks, the Gordo, Coker, Massive Sand, and Lower Cretaceous sediments. The Miocene aquifers are largely undeveloped in many areas of southern Mississippi and the Wilcox aquifers could support significant additional development in some areas of the state.

There are vast resources of brackish or colored ground water available in the state that are currently undeveloped because the quality is not suitable for drinking. Technology is becoming available that would allow these water resources to be developed. The City of Pascagoula is now treating water from some of its wells utilizing reverse osmosis and ozonation to remove chlorides in excess of 250 mg/L and color of more than 40 units. This type of water treatment might allow the Sparta and Cockfield aquifers to be utilized in parts of Hinds, Madison, and Rankin counties where excessive color in water from these aquifers has thus far prevented their development. The Meridian Sand and the lower Wilcox aquifers could potentially be utilized to supply additional ground water in some of the Jackson metropolitan area utilizing technology such as reverse osmosis and ozonation to reduce color, excess chlorides, and dissolved solids.

A direct implication of the development of a water supply of six million gallons a day from the previously untapped Tuscaloosa aquifers in Choctaw County is that Mississippi is not running out of ground water. In fact, in many areas of the state, it could be said that the available ground-water resources have hardly begun to be developed to their true potential.

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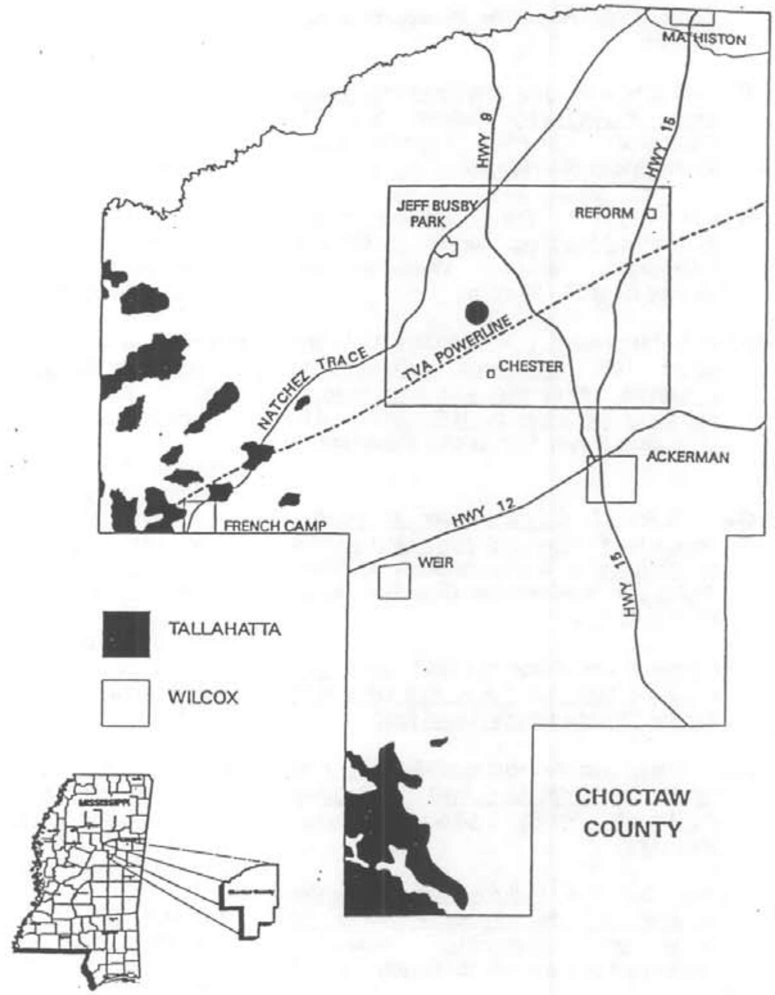

Figure 1. LOCATION OF PROPOSED POWER PLANT AND GENERALIZED SURFACE GEOLOGY OF CHOCTAW COUNTY, MISSISSIPPI.

Figure 2. WATER WELLS IN CHOCTAW COUNTY (ALL SUPPLIES FROM WILCOX AQUIFERS)

USE OF WATER	DEPTHS OF WELLS (FEET)
DOMESTIC (HOME)	32 - 630 AVG 100 - 300
RURAL WATER SYSTEMS	386 - 762
ACKERMAN	101 - 114
WEIR	104 - 540

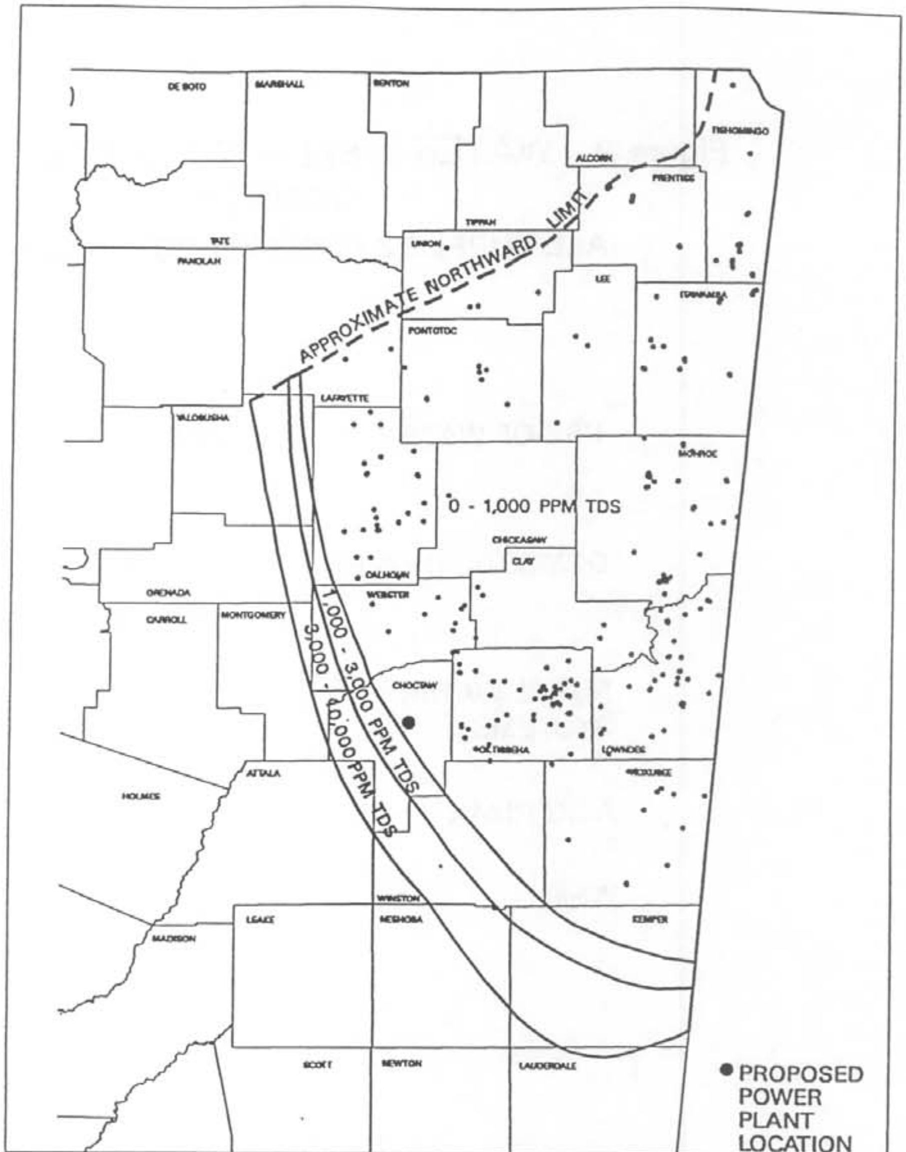

Figure 3. LOCATION OF PERMITTED GORDO WELLS (288 TOTAL)

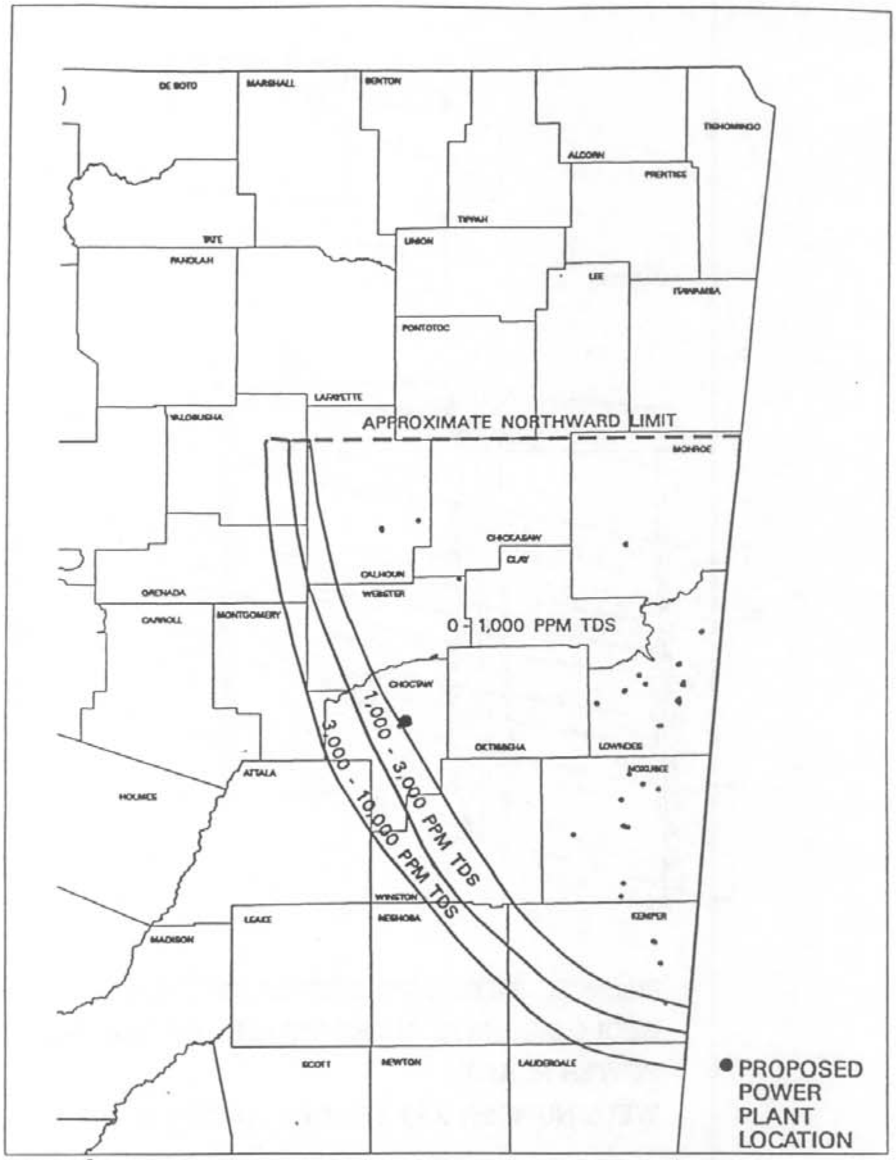

Figure 4. LOCATION OF PERMITTED COKER/MASSIVE SAND WELLS (55 TOTAL)

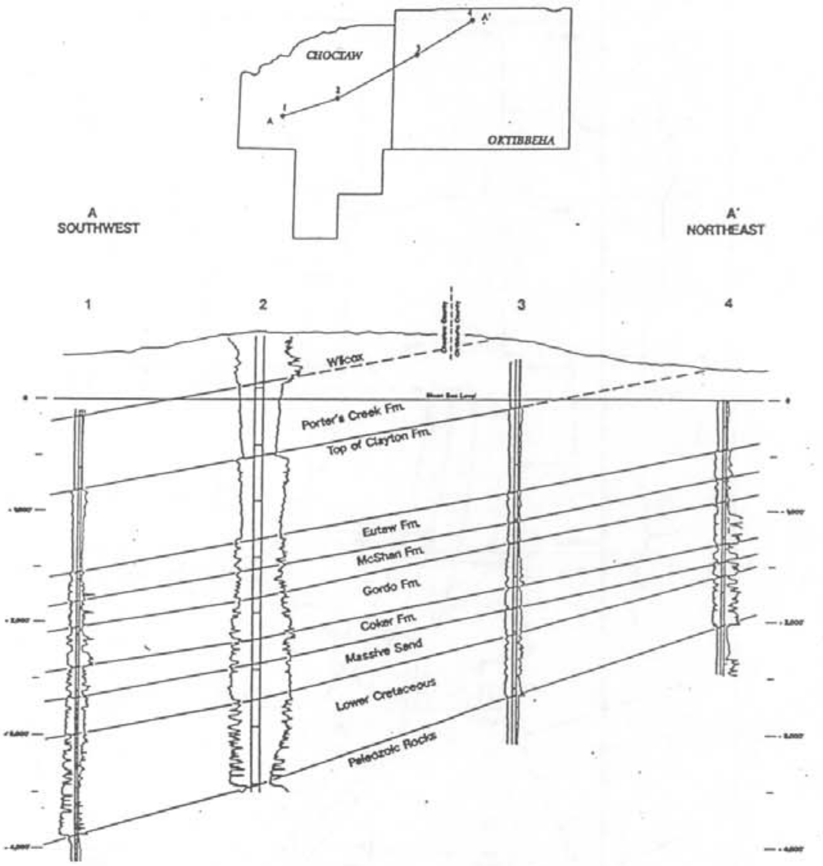

Figure 5. GEOLOGIC SECTION SHOWING RELATION OF GEOLOGIC UNITS IN THE VICINITY OF THE PROPOSED POWER PLANT.
WELL NUMBER 2 IS TEST PRODUCTION WELL.

Figure 6. GEOHYDROLOGIC DATA FOR SITE OF TEST WELL NO. 2