Results of recent geotechnical investigations supporting disposal facility design and the hydrogeological evaluation are reported in MACTEC Engineering and Consulting, Inc. (2004). Investigations included 12 geotechnical borings (B-1 through B-12) drilled to refusal at locations in and around the proposed site to characterize overburden stratigraphy and to acquire samples for laboratory testing (Figure 1-1). Sample collection and standard penetration resistance testing were performed at 5-ft intervals. Appendix A contains lithologic logs for these borings and a description of soil sampling methods. Laboratory hydraulic conductivity tests were performed on two remolded ash samples collected from the existing Ash Dredge Cell Area. Three additional auger borings were completed at existing ash deposits for in-situ hydraulic conductivity testing (designated B-1A, B-1B, and B-2A). Three piezometers were installed adjacent to borings B-1 through B-3 for periodic water level monitoring. These piezometers are located on the northwest-facing slope of Ash Dredge Cell 3. Cone penetrometer soundings were performed at 11 locations within the proposed disposal site to supplement boring data. Complete descriptions of sampling and testing procedures used in these investigations are presented in MACTEC (2004).

1.3 Previous Investigations

The hydrogeologic data used in the present evaluation are partially based on three previous investigations at the KIF site. The first was an EPA-sponsored study by Milligan and Ruane (1980) to examine the effects of coal ash leachate on groundwater quality. This study was initiated in 1976 with core sampling and monitoring well construction at eight sites, J1 through J8 (Figure 1-1). (Note that the "J" well prefix was dropped in later investigations and does not appear on figure well labels in the present report.) Soil samples were collected using a 2-inch diameter split-spoon sampler through a 12-inch outer diameter hollow-stem auger. Fourteen, four-inch diameter PVC wells, screened over the lower 1.5 ft, were installed through the auger following core sampling. Wells were installed either singly or in staged multiple-well clusters. Lithologic logs for these wells are presented in Appendix A. In addition, laboratory permeameter measurements of the horizontal and vertical components of hydraulic conductivity were performed on selected core samples. Soil column studies were also performed to examine the potential for geochemical attenuation of ash-related contaminants, particularly trace metals.

Velasco and Bohac (1991) performed a site-wide assessment of groundwater conditions at the KIF reservation. Single-well or multiple-well clusters were installed at eight additional sites (sites 9 through 16) in 1988 as part of the investigation. Wells were constructed with 2-inch PVC casing and were screened over the lower 10 ft. Lithologic logs for these wells are included in Appendix A along with a description of sampling methods. Well construction diagrams are presented in Appendix B. These wells, and those installed in 1976, were sampled six times between 1988 and

1990 to examine spatial and temporal trends in groundwater quality at the plant site. Constant-rate injection tests were performed at eight wells to determine bulk hydraulic conductivities of the overburden and shallow bedrock materials. These data were used in development of a groundwater flow model of the site. In addition, their investigations included an evaluation of the potential of geochemical attenuation of ash-related contaminants. Mineralogical analyses were conducted on 20 soil samples collected adjacent to monitoring wells 1 through 6 (Figure 1-1). X-ray diffraction analysis indicated clay minerals predominantly consisted of kaolinite and illite with trace amounts of other minerals, all of which tend to adsorb cations present in groundwater. Iron oxides were detected at contents of 0.33 to 0.60%, and are also known to adsorb several metals, e.g. arsenic, chromium, and zinc. Soil cation exchange capacities ranging from 6.6 to 34 meq/100 g were reported. Application of the MINTEQ geochemical speciation model using site soils data and representative chemical data for ash leachate indicated significant adsorption of arsenic, lead, and zinc. Attenuation of barium, chromium, and iron were predicted to occur by precipitation reactions (Velasco and Bohac, 1991).

Singleton Laboratories (1994) performed drilling and sampling investigations in the Ash Dredge Cell area at 10 locations (SS-1 through SS-10). Two-inch split-spoon and three-inch Shelby tube samples were collected for laboratory geotechnical testing. Top-of-rock and groundwater level elevations were established at each site. Boring logs are included in Appendix A.

A hydrogeologic evaluation was prepared by Boggs et al. (1995) for closure of the existing Ash Disposal Area on which the proposed CCB facility would be developed. The evaluation focused on the long-term impacts of the Ash Disposal Area on local groundwater and surface water resources following facility closure. The study was initiated with an examination of local hydrogeologic conditions, groundwater quality, and groundwater use in the site vicinity. Hydrogeologic and water quality data were derived from previous groundwater investigations at the plant site. Local groundwater use was established by a survey of residents within a two-mile radius of the disposal site. A water budget simulation of the closed facility was performed to quantify ash leachate production rates during a 30-year post-closure period. The ultimate impact of the closed facility was evaluated using the predicted leachate discharge in conjunction with leachate chemical characteristics and groundwater flow patterns in the site vicinity.

2. HYDROGEOLOGIC CONDITIONS

2.1 Geology and Soils

Kingston Fossil Plant resides within the Valley and Ridge physiographic province, a region characterized by narrow, subparallel ridges and valleys trending northeast-southwest. The controlling structural feature of the region is a series of northeast-striking thrust faults which have forced older rocks from the southeast over younger units. Bedrock units of the Rome Formation (lower Cambrian age), the Conasauga Group (middle to upper Cambrian), and the Knox Group (upper Cambrian to Ordovician) subcrop beneath the site in northeast-trending bands (Figure 2-1). These units generally dip to the southeast at angles averaging 45 to 50 degrees (Benziger and Kellberg, 1951). The band of Rome on the northwest side of the site, along with the overlying Conasauga and Knox formations, represent a thrust fault block which has been forced over the Knox outcrop to the northwest. The two major faults associated with this thrust block, shown on Figure 2-1, constitute the two closest faults to the proposed disposal site. Both faults are located in excess of 1000 ft from the proposed disposal area, placing them outside of the 200-ft exclusion zone required by Rule 1200-1-7-.04(1)(u). Foundation exploration in the plant powerhouse area indicated bedrock jointing but no evidence of faulting (Benziger and Kellberg, 1951). Drilling of the overlying Quaternary age alluvium there and elsewhere on the reservation has showed no evidence of faulting in these sediments.

The site lies within the Eastern Tennessee seismic zone (ETSZ), a 300-km long, northeast-trending seismic feature running through the lower mid-Atlantic and southeastern United States (Powell et al., 1994). With the exception of the New Madrid seismic zone, the rate of earthquake activity in the ETSZ has been the highest of any area east of the Rocky Mountains. However, the mean focal depth of recorded earthquakes within the ETSZ is 15 km, placing earthquakes in crystalline basement rocks and not in the overlying sedimentary rocks. Thrust faulting in the region was associated with the Applachian Orogeny which ended in late Permian time, i.e., at least 250 million years ago. Further movement along these faults is improbable. The areas specifically proposed for future CCB disposal are underlain by the Lower Conasauga Group, with the exception of a narrow band along the northwestern side of the proposed site which is underlain by the Rome formation (Figure 2-1). The Nolichucky, Maryville, Rogersville, Rutledge, and Pumpkin Valley formations make up the Lower Conasauga Group, whereas the Maynardville formation is associated with the Upper Conasauga. Total aggregate thickness of these units is unknown but estimated to be approximately 1500 ft (Harris and Foxx, 1982). These units