APPENDIX E

Hydrogeologic Evaluation of Ash Pond Area

TENNESSEE VALLEY AUTHORITY
River System Operations & Environment
Research & Technology Applications
Environmental Engineering Services - East

KINGSTON FOSSIL PLANT

HYDROGEOLOGIC EVALUATION OF COAL-COMBUSTION BYPRODUCT DISPOSAL FACILITY EXPANSION

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TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

LIST OF APPENDICES

SUMMARY

The expansion of Class II coal-combustion byproduct (CCB) disposal facilities proposed within the existing Ash Disposal Area of Kingston Fossil Plant (KIF) was evaluated for two possible disposal options. The first (Option A) would involve future codisposal of coal ash and gypsum derived from flue-gas desulfurization. Under Option B the facility would receive only coal ash. Hydrogeological evaluations of the proposed facilities associated with both options were performed to examine their suitability relative to the appropriate standards of the Tennessee Department of Environment and Conservation (TDEC) Rule 1200-1-7. Evaluations addressed effects of proposed disposal facilities on local groundwater and surface water resources during both the operational and post-closure periods. Comparisons of water quality impacts for facility designs with and without a constructed three-foot geologic buffer were also provided as the basis for an alternative to an artificial geologic buffer.

Recent site investigations supporting these evaluations included 12 soil borings, installation and monitoring of three piezometers, and field hydraulic conductivity (K) testing at two sites and laboratory K testing of two ash samples. A survey of private water wells and public water supplies within two miles of the site was also conducted to determine current water use. Additional hydrogeologic data was obtained from previous studies in the existing Ash Disposal Area, and included 25 soil borings, water level data for 16 monitoring wells, 7 field aquifer tests in soil and bedrock wells, and lab K measurements for 10 soil and ash samples.

The Lower Conasauga Group and the Rome formation comprise bedrock beneath the proposed disposal area, and consist primarily of shale with thin, interbedded limestone, siltstone, and conglomerate. Drilling within the Conasauga and Rome in and around the disposal site revealed no evidence of karstification. A mantle of predominantly alluvial soils consisting of clay, silt, and sand with occasional gravel lies above bedrock. Thickness of the alluvium is highly variable, ranging from about 5 to 65 ft. Ash and ash-soil fill materials ranging up to 83 ft in thickness are present above the alluvium. Ash deposits are composed almost entirely of fly ash, with bottom ash comprising less than 10% of the ash fill. The first occurrence of groundwater below the area is generally within the existing ash fill. Groundwater movement at the site generally follows topography with groundwater flowing eastward from Pine Ridge toward Swan Pond Creek embayment, the Emory River, and the plant intake channel. An exception occurs in the Ash Dredge Cell area where mounding of the water table produces localized groundwater movement toward an on-site drainage feature that flows northeastward along the base of Pine Ridge. All groundwater originating on, or flowing beneath, the proposed disposal site ultimately discharges to the reservoir without traversing private property.

The proposed CCB disposal facilities would be developed entirely on existing ash deposits. Laboratory testing indicates the ash would not meet the hydraulic conductivity requirements of TDEC Rule 1200-1-7-.04 or Policy Memorandum SW-93. The environmental benefit of constructing an artificial 3-ft clay buffer at the base of the Phase 2 and 3 disposal areas was examined by numerically simulating leachate seepage from these disposal facilities with and without a clay buffer. The evaluation focused on the effects of ash and gypsum leachate on stream water quality, since leachate from proposed disposal facilities would ultimately discharge to the Emory River. Estimates of maximum in-stream concentrations were performed for selected CCB-related constituents under low stream flow conditions.

Hydrogeologic conditions at the proposed disposal site appear to satisfy geologic and hydrologic standards for Class II disposal facilities. Key findings and recommendations are summarized as follows:

- A survey of water use in May 2004 identified 13 residential wells and one public water supply spring located within approximately one mile of the proposed disposal facility boundary. Neither the public spring nor any of the residential wells is located downgradient of the proposed facility. Furthermore, there is no potential for future development of groundwater supplies downgradient of the facility since all property between the disposal site and surface water boundaries lies within the plant reservation.

- Modeling results indicate that construction of an artificial 3-ft clay buffer, having a hydraulic conductivity of 10^{-6} cm/s or less, beneath the Phase 2 and 3 disposal areas would not provide a substantial environmental benefit. During the operational phase, predicted leachate seepage rates for the no-buffer and buffer designs for Option A differed by 38% or less. Similar comparisons for Option B showed differences of 28% or less. Following facility closure, differences in seepage rates would be less than 1% due to the infiltration-limiting effect of the 10^{-6} cm/s clay cap. On this basis, construction of an artificial clay buffer is not recommended.

- Evaluation of CCB leachate seepage effects on local stream water quality further supports the suitability of the site for the proposed disposal options without an artificial geologic buffer. Under Option A, maximum cumulative COC stream loadings predicted for the Emory River during low flow conditions would not produce in-stream concentrations exceeding the drinking water standards maximum contaminant limit (MCL) or aquatic life criteria for either the buffer or no-buffer cases. Predicted COC concentrations for the Emory River under disposal Option B were below drinking water and aquatic life standards for all COC except ammonia. Worst-case NH_3-N concentrations of 0.58 and 0.47 mg/L estimated for the no-buffer and buffer designs pose no threat to human health, but could exceed the criteria continuous concentration (CCC) under

coincident conditions of extreme pH, temperature, and low flow in the Emory River. Historical data suggest the joint probability of such an occurrence would be less than 0.3%. The potential risk associated with ammonia under Option B can be addressed by future monitoring. Periodic sampling of ash ammonia content and groundwater downgradient of the facility would be performed to assure ammonia levels remain within the limits assumed in this evaluation.

- There is no evidence of Holocene-age faulting within the required 200-ft facility exclusion zone. In addition, there are no indications of karstification or other geologic features which might adversely affect facility containment.

- No streams, springs or lakes are located within 200 ft of the site, and facility would lie entirely above the projected 100-year flood stage of the Emory and Clinch Rivers.

1. INTRODUCTION

1.1 Background

The proposed coal-combustion byproduct (CCB) facility at TVA's Kingston Fossil Plant (KIF) is located on the west bank of the Emory River (mile 2 to 2.5) in Roane County, Tennessee (Figure 1-1). The disposal site encompasses approximately 244 acres and is located within the existing Ash Disposal Area. Land surface across the disposal site ranges from elevation 760 to 805 ft (above mean seal level), and is entirely above the 100-year flood stage of elevation 748 ft.

The facility Part II Permit Application, submitted to TDEC on June 10, 2004, considers two options for future CCB disposal at KIF. The first option (referred to in this report as Option A) proposes codisposal of coal ash and flue gas desulfurization (FGD) derived gypsum. If approved, a total of 12.4 million cubic yards (CY) of fly ash and bottom ash and 7.20 million CY of gypsum would be deposited in the area between 2004 and 2029. Under Option B the facility would receive only coal ash. A total of 21.4 million CY of fly ash and bottom ash would be deposited in the facility between 2004 and 2048.

1.2 Purpose and Scope

The objective of this report is to evaluate the suitability of the proposed CCB disposal facility in terms of the hydrogeologic features of the site and compliance with the design standards of TDEC Rule 1200-1-7. The potential effects of the facility on local groundwater and surface water resources are addressed for both the operational and post-closure periods. The focus is on stream water quality effects since shallow groundwater originating on, or flowing beneath, the site ultimately discharges to streams without traversing off-site property. Numerical models were used to estimate leachate generation rates from each disposal area. Leachate seepage estimates were used along with CCB leachate chemical compositions in predicting worst-case in-stream concentrations of selected constituents under low stream flow conditions. Separate evaluations were performed for Options A and B. Additionally, comparisons of water quality impacts for facility designs with and without a constructed 3-ft geologic buffer are provided for each disposal option. Hydrogeologic data used to support the analysis were derived from recent geotechnical investigations at the site conducted by MACTEC Engineering and Consulting, Inc. (2004) and from several previous site investigations (described in Section 1.3). A survey of private water wells and public water supplies within two miles of the site was conducted to establish local water use.

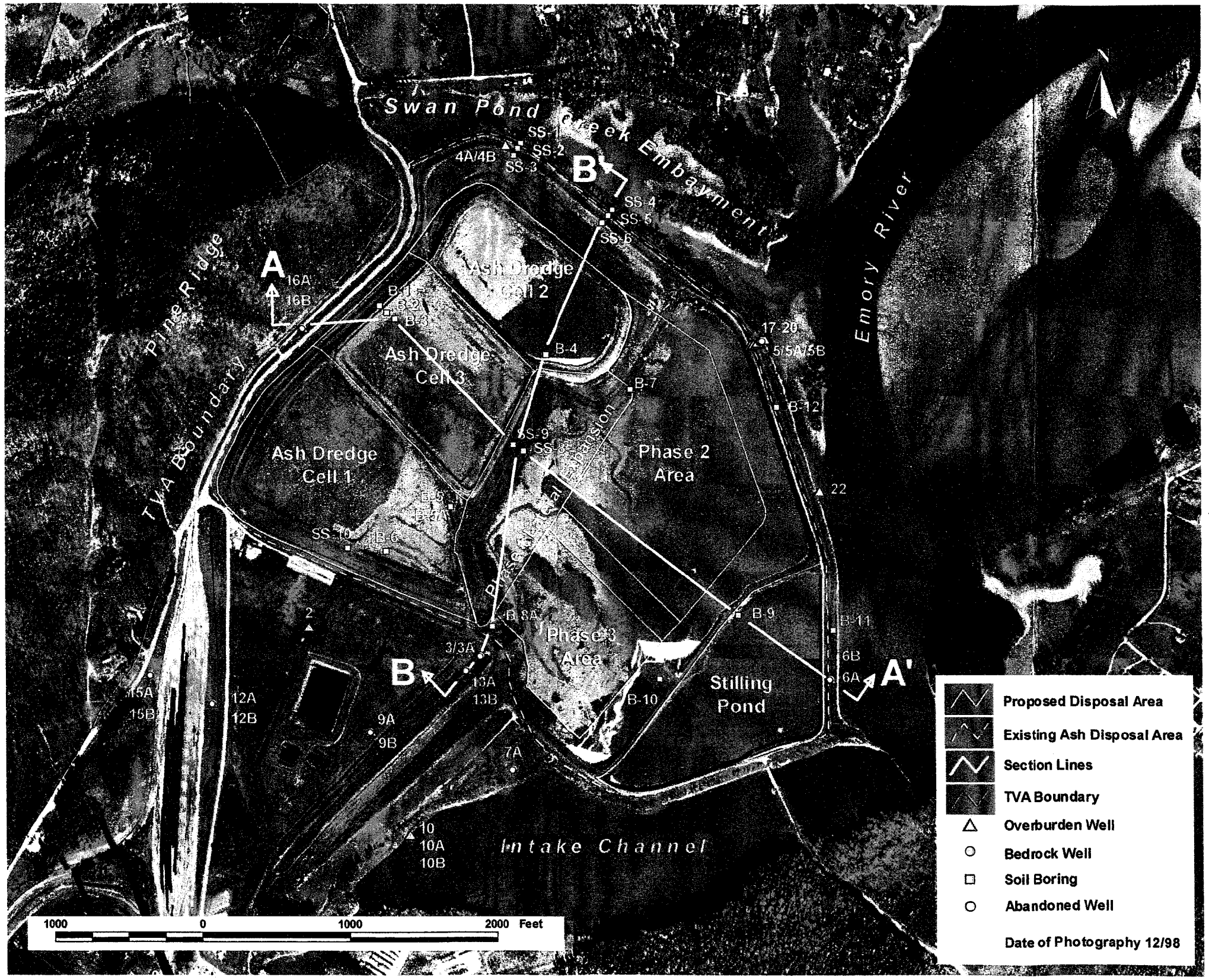

Figure 1-1. Site Location Map Showing Soil Borings and Monitoring Wells