# PHASE III

## DESIGN CONSIDERATIONS

The design of the various seals and barriers for diverting the mine water to the E-3 discharge was based on available mine maps and the surficial and subsurface investigations conducted at the Ernest site. However, it was recognized that actual field conditions observed during construction could vary and it would be necessary to make certain revisions to the design. Therefore, engineering field inspection by EDCE was maintained throughout the construction phase.

The following briefly describes the design parameters and assumptions adopted for each work area.. It is noted that the discussion below refers to the site conditions which existed prior to construction. The referenced drawings show "as-built conditions" and a full description of changes to the original designs is presented in Phase IV of this report. Cummings Shaft (Drawing 70-108-M10)

The existing Cummings Shaft walls were fractured with the front wall "broken out" to permit discharge at El. 1061 or approximately five feet below the top of the wall. Design flow from Cummings Shaft was 1000 gallons per minute (gpm). To discharge water from the E-1 entry without pumping, it would be necessary to raise the pool level in the shaft to El. 1066 or higher. This would be accomplished by completely encasing the existing shaft in a reinforced concrete box constructed to El. 1071 or five feet above the E-1 entry (El. 1066). A 12-inch-diameter valve installed in the front wall at El. 1061 would permit lowering of the water level in the shaft for emergencies. A fivefoot-high cyclone fence was specified atop the new wall for security purposes.

The available mine maps show masonry barriers that may require removal to permit flow from Cummings Shaft to E-l. An investigation of the barriers was planned as part of the construction.

The concrete encasement around the existing shaft was designed for the hydrostatic pressure of the anticipated pool within the shaft. The bottom of the wall was required to be sealed into the in-situ soil or rock materials surrounding the shaft.

E-1 and E-2 Entries (Drawings 70-108-M11 and M12, respectively)

Reinforced concrete barriers were designed to anchor the 18-inch diameter pipe transferring the flow from the mine north of McKee Run at E-1
to the mine south of McKee Run at E-2 and to provide access to the ends of the pipe for cleaning.

E-1 and E-2 Transfer Pipe (Drawing 70-108-M13)

The 18-inch diameter steel pipe specified to transfer the flow from E-1 to E-2 was to be coated for protection against corrosion and insulated against freezing of the exposed or partially covered sections. The 18-inch steel pipe was designed for a 0.6 percent slope which is more than adequate for the design flow of 1000 gpm.

E-3 Entries (Drawing 70-108-M14)

A concrete barrier was designed for construction at the E-3 entry similar to that specified at E-1 and E-2. A four-foot square opening would be left in the barrier wall to accommodate the transfer pipe from E-3 to the treatment plant. The design and construction of the pipe itself was outside the scope of this project.

An entry adjoining E-3 was partially collapsed and it was planned to excavate to rock and completely seal the opening with a reinforced concrete wall. Both entries are at approximate El. 1050.

DDH-44 Borehole and Crooked Creek Borehole

The exact location and diameter of these boreholes was not known. In the construction phase of the project it was planned to locate, caliper, and completely seal all the boreholes with a cement water grout. Flow was .not observed discharging from the boreholes prior to construction.

E-4 Boreholes (Drawing 70-108-M15)

Two 8-inch and one 16-inch diameter boreholes were discharging mine water at a combined flow of approximately 3100 gpm prior to work on the project. A fourth 8-inch diameter borehole was suspected to exist in the area. Investigation of the fourth borehole was planned as part of the construction.

To seal the boreholes and install the valves, it would be necessary to reduce the 16-inch-diameter borehole to 10 inches and the 8-inch-diameter boreholes to 5 inches. Clearances for seating the packers in the boreholes would necessitate a reduction in the valve diameter. The packers and stainless steel valves were designed for a hydraulic pressure head of 135 feet of water (100 feet prior to the project and an additional 35 feet to El. 1050).

Draw down Analysis: The results of a preliminary analysis conducted to determine the draw down characteristics of the E-4 boreholes after installation of the valves and subsequent to raising the mine pool to El. 1050 are shown on Fig. 1 as a "theoretical curve" of elevation of water in the mines plotted as a function of time. The calculations were based upon the following assumptions.

1. A constant inflow into the mine complex of 3100 gpm (7.0 cubic feet per second).

2. Storage volume equal to 70 percent of the 4-foot thick coal seam extending over a 10-square mile area.

3. The invert elevation of the discharge pipes is El. 1021 (design invert elevation of pipe elbows). Total differential head is 28 feet, or El. 1021 to El. 1049.

Also shown on the figure is a plot of the actual draw down of the mine water following opening of the E-4 valves. Events related to the measured mine water levels are described in a later section of this report entitled "Phase V, Piezometer Monitoring Program."

Fulton Shafts (Drawing 70-108-M16)

Two large rectangular vertical shafts located in the town of Fulton Run had ground surface elevations of approximate E1s. 1040 (Fulton Shaft A) and 1050 (Fulton Shaft B). Each shaft would be sealed with a one-foot-thick reinforced concrete mat, placed over the shaft walls and extending approximately two feet beyond the shaft walls into rock. The depth of the seals below ground surface would be approximately 20 feet and the seals backfilled to grade.

Piezometer Installation (Drawing 70-108-M16)

Piezometers were planned to monitor the water elevation in the mine at each work area. The well point of each piezometer would be inserted in an NX size core hole, seated above the mine roof and sealed with cement grout to the surface. The tops of the piezometer pipes would be housed for

protection against weather and vandalism. Those piezometers with ground surface elevation lower than 1050 would be valved and a pressure gage apparatus used to record the water elevation.

Design Drawings and Technical Specifications

The design drawings for the mine drainage abatement system are enclosed with the report. The drawings have been revised to reflect actual construction and a detailed description of the as-built construction conditions are presented later in the report.

The Technical Specifications, presented in Appendix C, refer to the proposed design prior to construction and any changes during construction are not reflected in the Specifications.