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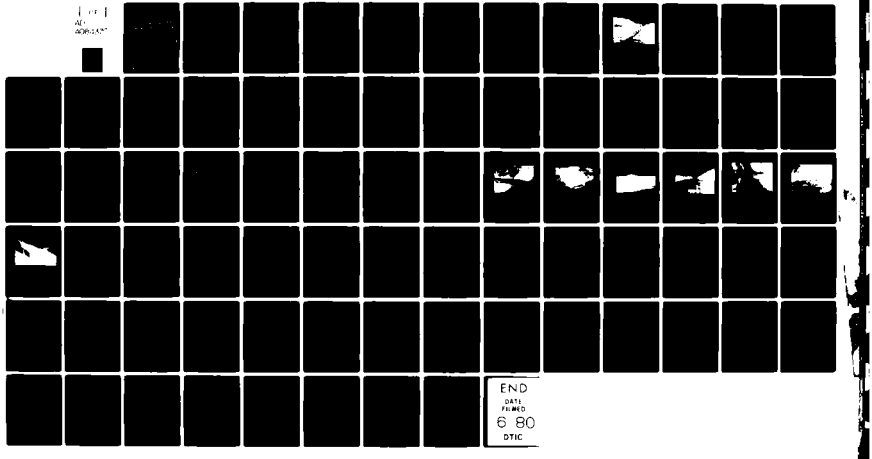

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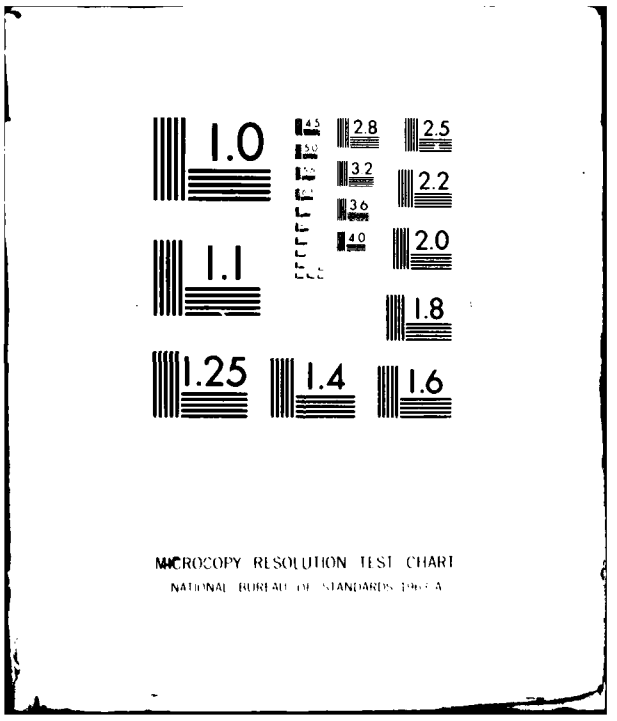
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TENNESSEE RIVER BASIN

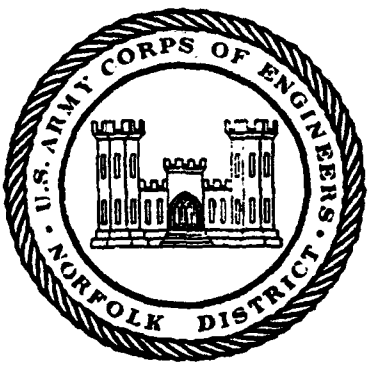
Name Of Dam: MIDDLE FORK SLURRY IMPOUNDMENT

Location: RUSSELL COUNTY, VIRGINIA

Inventory Number: VA. NO. 16708

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

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MARCH 1980

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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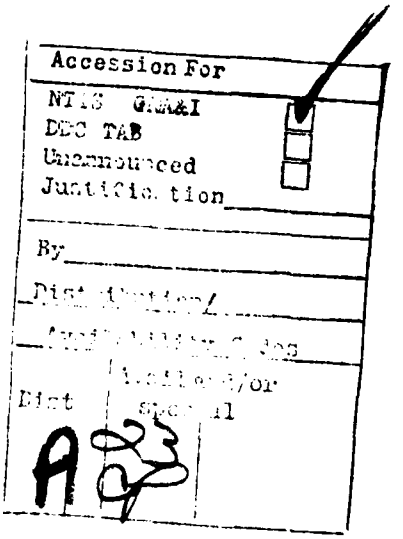

Name: Middle Fork Slurry Impoundment Va. No. 16708
State: Virginia
County: Russell
USGS Quad Sheet: Carbo
Coordinates: Lat 36° 57.7' Long 82° 12.1'
Stream: Middle Fork of Dumps Creek
Date of Inspection: December 11, 1979

BRIEF ASSESSMENT OF DAM

Middle Fork Slurry Impoundment Dam is a mine waste structure, constructed with fine to coarse coal refuse materials. It is approximately 1100 ft long and 300 ft high at its lowest point. This impoundment is a cross valley type structure which is located on the Middle Fork of Dumps Creek approximately 2 miles north of Carbo, Virginia. The dam is owned by Clinchfield Coal Company. The impoundment is used to contain coal refuse pumped from the Moss Mine No. 3 coal preparation plant. Water from the slurry is decanted into a 60 inch diameter diversion pipe at the upstream end of the impoundment. The 60 inch pipe also serves to divert runoff around the impoundment.

This dam is ultimately scheduled for abandonment by filling with refuse, and plans are being prepared for the abandonment procedure.

The dam is an "intermediate" size, "significant" hazard structure. The appropriate spillway design is the PMF. The dam will contain 100 percent of the PMF without overtopping. Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the dam is rated adequate.

The actual embankment structure is presently being graded to conform with current design drawings for future use and abandonment

of the dam. The stability analysis for the original dam prior to the modifications presently in progress indicates a factor of safety of 1.22 with respect to steady seepage. This is less than the 1.5 requirement included in Reference 1, Appendix VIII. The present modifications will improve the stability of the structure and additional studies are not recommended.

The visual inspection revealed no apparent problems with the embankment and there are no immediate needs for remedial or maintenance measures.

Prepared by:

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J. K. TIMMONS AND ASSOCIATES, INC.

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Commonwealth of Virginia

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District Engineer

Recommended By:

Original signed by
JACK G. STARR

Jack G. Starr, R.A., P.E.
Chief, Engineering Division

Date: MAR 8 1980

Overview Photo

(Upstream is to the left

(Hall 1979)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MIDDLE FORK SLURRY IMPOUNDMENT
VA. NO. 16708

SECTION 1 - PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (See Reference 1, Appendix VIII). The main responsibility is to expeditiously identify those dams which may be a potential threat to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: The Middle Fork Slurry Impoundment Dam is a cross valley mine waste structure constructed with coarse to fine coal refuse materials. It is approximately 1100 ft long and 300 ft high at its lowest point (measured from the toe of the downstream face). The dam is approximately 36 ft high measured from the upstream sediment elevation to the low point in the dam crest. The top of the dam varies in elevation from 1950± msl to 2000± msl, and the width of the dam crest varies from 100 ft to 400 ft.

Upstream slopes are at the angle of repose (less than one horizontal to one vertical, 1:1) and the downstream slopes vary from 1:1 to 3:1 (See Sheet 9, Appendix III).

Within the impoundment, two additional embankments exist (See Plate No. 2, Appendix I). The middle embankment was previously used for slurry containment upstream, but has been abandoned and replaced with embankment "D" located an additional 1500 ft upstream.

The spillway consists of a 60 inch diameter corrugated metal pipe (CMP) used as a diversion channel. The pipe inlet is located upstream of the impoundment at embankment "D", and extends under the impoundment to the toe of the main embankment (See Plate No. 3, Appendix I). The 60 inch pipe discharges into the natural valley stream below the toe of the dam.

1.2.2 Location: Middle Fork Slurry Impoundment is located on the Middle Fork of Dumps Creek approximately two miles north of Carbo, Virginia (See Plate 1, Appendix I).

1.2.3 Size Classification: The dam is classified as an "intermediate" size structure because of the impoundment potential at the dam crest of 3300 acre ft.

1.2.4 Hazard Classification: The dam is located in a rural area; however, based upon the downstream proximity of the Clinch River Power Plant and the Town of Carbo, the dam is assigned a "significant" hazard classification. The hazard classification used to categorize a dam is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned by the Clinchfield Coal Company, a member of the Pittston Coal Group.

1.2.6 Purpose: The impoundment is used to contain coal sediment from the slurry pumped out of Moss No. 3 Preparation Plant, and to decant the water after the solids have settled out.

1.2.7 Design and Construction History: There was no original design data available; however, the dam was reportedly constructed under the supervision of the Clinchfield Coal Company. Future use and abandonment plans are currently being prepared by the Owner's engineering consultant. An abandonment plan is the filling of the impoundment with refuse and diversion of runoff away from the impoundment. Preliminary engineering studies were performed by L. Robert Kimball and Associates, in 1978; however, Orbital Engineering Inc., Carnegie, Pennsylvania, has since been retained by the Owner to complete the plans. Reports and plans are submitted on an interim basis and the study was not complete at the time of the investigation. Appendix IV includes a brief description of the plan approved in 1978 for upgrading the impoundment. Plate No. 2 of Appendix I includes grading plans for the structure with the present pool level sketched in.

1.2.8 Normal Operational Procedures: The diversion pipe inlet, which acts as a spillway, is ungated; therefore, water rising above the invert of the outlet pipe automatically is discharged downstream in quantities based on the pipe capacity. Normal pool (elev 1916 msl) is maintained by the overflow weir located on

embankment "D" immediately upstream of the pipe inlet. The diversion pipe also intercepts upstream runoff and diverts the runoff away from the impoundment.

1.3 Pertinent Data:

1.3.1 Drainage Areas: The drainage area is 1.00 square miles.

1.3.2 Discharge at Dam Site: Maximum known flood at the dam site occurred in April 1977; however, the pool elevation was not observed. Water has reportedly never overtopped the dam.

Spillway Discharge:

Pool Elevation at Crest of Dam (elev 1950 msl) 215 CFS

1.3.3 Dam and Reservoir Data: See Table 1.1, below:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation Feet msl	Reservoir Area Acres	Reservoir Acre Feet**	Watershed Inches	Length Miles
Crest of Dam	1950*	53	3300	31.9	1.1
Spillway Invert	1875	27	750	1.2	0.5
Downstream Toe of Dam	1650±	-	-	-	-

* Low Point In Embankment
** Includes refuse storage accumulation

SECTION 2 - ENGINEERING DATA

2.1 Design: There are no design data for the original construction. All phases of mining operations are controlled and regulated by the U. S. Department of Labor, Mine Safety and Health Administration (MSHA); the Virginia Division of Mines and Quarries (VDMQ); and the Virginia Division of Mined Land Reclamation (DMLR). The impoundment has been used and maintained in compliance with standards required by the above governmental agencies. Although design and "As Built" data were not available, the Owner is presently completing an engineering study for future use and eventual abandonment (for explanation of abandonment, see Section 1) of the entire Moss No. 3 refuse area, which includes the Middle Fork Slurry Impoundment. A preliminary abandonment report was completed in 1978 by L. Robert Kimball and Associates, which included a hydrologic and stability study. The Owner has since retained Orbital Engineering for completion of the future use and abandonment plan. This dam is scheduled for abandonment as an impoundment, and all impoundment capabilities will be eliminated by filling the reservoir with refuse.

The dam site is located with the southeast edge of the Appalachian Plateau (locally Cumberland Plateau) Physiographic Province of Virginia. The Cumberland Plateau is a stream-dissected plateau which is underlain by sedimentary rocks up to upper Pennsylvania in age (See Reference 3, Appendix VIII). The structure crosses the contact between the Lee and Norton Formations. Both formations consist basically of alternating beds of sandstone and shale with interbeds of coal. Coal beds in the Norton, however, are generally thicker and of

greater commercial value. Local geologic structure is controlled by the Hunter Valley Fault which extends in a northeastward direction approximately ½ mile south of the site. Presence of the fault causes bedding dips to increase from horizontal to vertical over the one-half mile± distance.

At the Owner's request, two engineering studies were conducted between 1976 and 1978 by L. Robert Kimball and Associates in order to evaluate the stability of the dam embankment and prepare plans to modify the embankment to meet MSHA requirements. A summary of stability analyses and pertinent laboratory test data are included as Appendix VI. Analyses completed in 1978 resulted in the proposed addition of an embankment berm at the downstream toe of the originally proposed (1976) embankment design configuration. It was believed that the 1978 report was prepared without conclusive documentation of existing seepage conditions within the existing embankment. Consequently, the proposed design configuration with berm added did not resolve the issue of long-term embankment stability to the complete satisfaction of MSHA.

The Owner later engaged Orbital Engineering, Inc. to perform a geotechnical engineering study which would evaluate conditions within the existing embankment, determine the engineering properties of fill materials to be used in constructing the remainder of the embankment, and evaluate the stability of the minimum (no berm) embankment design section described in the 1978 Kimball report. Test borings were drilled and test pits excavated to obtain soil samples for laboratory testing and engineering evaluation of material properties. A

pneumatic piezometer was installed in each test boring upon completion. A plan of the embankment area showing locations of the piezometers, test pits, and embankment section used in the stability analysis is presented as Plate 1 of Appendix VII. Boring logs are included as Appendix V.

At the time of the inspection, water levels in the piezometers had not stabilized; however, readings are now taken weekly and recorded by the Owner. The following readings were taken by Orbital Engineering on December 17, 1979:

PIEZOMETER NO.	GROUND EL @ INSTALLATION	TIP EL (MSL)	WATER LEVEL (MSL)
P-1	1772.4	1683.4	1699.8
P-2	1779.2	1685.1	DRY
P-3	1977.4	1777.4	DRY

The preliminary engineering report and supplementary data developed by Orbital Engineering, Inc. includes laboratory test data describing the physical properties of the materials used to construct the embankment. Soil parameters developed in previous studies by L. Robert Kimball and Associates were also considered. Stability calculations were developed using the ICES (Bishop slip circle) slope and embankment stability program, SLOPE. Stability analysis data developed by Orbital Engineering, Inc. are presented in Appendix VII.

2.2 Construction: Construction records were not available. The dam has been constructed with equipment owned by Clinchfield Coal Company.

2.3 Operation: Present grading and filling procedures are intended to increase the stability of the structure. Piezometers were installed in 1979 to monitor the phreatic water level below the downstream slope. Plans are presently being developed to modify the embankment in compliance with MSHA requirements. More detailed information will be available from the Owner upon completion of current and future studies.

2.4 Evaluation: Original engineering calculations and drawings are not available, but the drawings for the proposed embankment modification are representative of the dam, and hydrologic and hydraulic calculations are adequate. There are no other records available, except the records of the recently installed piezometers.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: The impoundment was generally in good condition at the time of inspection. Field observations are outlined in Appendix III.

3.1.1 General: An inspection was made 11 December 1979, and the weather was fair with the temperature 35°F. The pool at the time of inspection was at elevation 1916 msl and no tailwater was observed. At the time of inspection, ground conditions were dry. No previous inspection reports were available.

3.1.2 Dam and Spillway: The embankment has been constructed with fine to coarse coal refuse and was essentially free of vegetation. The downstream slope included three benched surfaces at the time of the inspection. Except for the upper most slope, all benches and slopes appeared to be recently constructed and relatively free of erosion. The steep slope (1:1±) existing between the crest of the impoundment and the first bench (100 ft± difference in elevation) was severely eroded and included gullies 1.5 ft± deep and 10 ft± wide. The only seepage observed was located near the right abutment on the uppermost bench. The Owner was aware of these wet areas and stated that recent studies by their engineer concluded that the wet spots represent surface water seepage along a buried impervious haul road surface and not seepage through the dam.

Bedrock is exposed only in the right abutment and consists of thin to massively bedded sandstone with weathered shale interbeds. Bedding dips at 45 degrees± to the southeast. No faults were observed in the field during this investigation and geologic maps of the area do not show the presence of faults in the immediate vicinity.

The spillway consists of an ungated 60" CMP located at the upstream end of the impoundment. The pipe is in good condition and was recently extended to its current location.

3.1.3 Reservoir Area: The reservoir is in rock cuts, from construction operations, and natural terrain with slopes ranging from vertical to 2:1. These slopes range from bare to densely wooded. Sedimentation was observed throughout the majority of the reservoir area. Pool depth ranged from zero at the main embankment to ± 20 ft at embankment "D".

3.1.4 Downstream Area: The Middle Fork of Dumps Creek and Dumps Creek converge with the Clinch River approximately two miles downstream of the embankment. The Town of Carbo and the Clinch River Power Plant are located at the Dumps Creek intersection with the Clinch River. The Power Plant and several dwellings in Carbo are located in the flood plain of the Clinch River.

3.1.5 Instrumentation: Three air-activated piezometers were recently installed. Two occur along the downstream toe and one on the crest of the embankment.

3.2 Evaluation:

3.2.1 Dam and Spillway: Overall, the dam was in good condition at the time of inspection. The wet spots observed on the uppermost bench are believed to represent surface runoff/seepage following along the path of a covered haul road. The December 17, 1979 piezometer reading from P-1 indicates a piezometric level greater than 100 ft below these wet spots.

The erosion observed on the uppermost portion of the downstream slope is nor considered serious because of the massive width of the

embankment. As the future use and abandonment plan is initiated, future grading operations will reshape this slope and provide a more stable and erosion-resistant surface.

The 60" CMP (spillway) appears to be in good condition and appears to be functioning properly.

3.2.2 Downstream Area: The location of the Clinch River Power Plant and the Town of Carbo downstream of the dam (two miles), provides potential for damage and loss of life.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Coal refuse slurry is pumped into the impoundment through an eight inch pipe located at the upstream end of the impoundment. After the solids settle out, the water is decanted from the upstream end of the impoundment into the 60 inch diameter diversion pipe. Runoff from the upstream valley and the impoundment is diverted into the diversion structure. If the runoff exceeds the diversion structure capacity, excess runoff is stored in the impoundment until it can be removed through the diversion pipe.

4.2 Maintenance of Dam and Appurtenances: Maintenance of the dam and appurtenances is the responsibility of the Clinchfield Coal Company. The embankment is maintained to prevent erosion and the diversion pipe inlet is kept clean of debris. There are no other maintenance requirements.

4.3 Warning System: None exists.

4.4 Evaluation: The maintenance of the dam and appurtenances is adequate. An early warning system should be implemented and an emergency action plan should be prepared.

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: No data is available.

5.2 Hydrologic Records: There are no hydrologic records available for this drainage area.

5.3 Flood Experience: The maximum pool elevation observed was in April 1977; however, the pool elevation is not known.

5.4 Flood Potential: In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Precipitation amounts for the PMF and ½ PMF are taken from U. S. Weather Bureau Information (Reference 4, Appendix VIII). Appropriate adjustments for basin size and shape were accounted for and inflow volumes were determined by procedures as outlined in Reference 4, Appendix VIII. The maximum pool elevation was determined by the reservoir storage curve at the volume of inflow predicted.

5.5 Reservoir Regulation: The pool at the beginning of the inflow was assumed to be at elevation 1916 msl (normal pool). Reservoir stage-storage data was determined from the available plans, reports, field measurements, and USGS quadrangle sheets. The diversion pipe was assumed to be blocked and not functioning.

5.6 Overtopping Potential: The predicted rise of the reservoir pool and other pertinent data were determined by storing the volume of inflow in the reservoir as previously described. The results for

the flood conditions (PMF, ½ PMF) are shown in the following Table 5.1:

TABLE 5.1 RESERVOIR PERFORMANCE

	Normal Flow	Flood	
		½ PMF	PMF
Total Inflow, Ac-Ft	-	665	1330
Maximum Storage* (Ac-Ft)	1900	2565	3230
Maximum Pool Elev., ft., MSL	1916	1930	1944

* Includes refuse storage accumulation

5.7 Reservoir Emptying Potential: There is no method of lowering the reservoir below the spillway except by seepage and pumping.

5.8 Evaluation: Department of the Army, COE, guidelines indicate the appropriate spillway design flood (SDF) for an intermediate size significant hazard dam is the ½ PMF to PMF. Because of the risk involved, the PMF has been selected as the SDF. The reservoir will store 100 percent of the PMF with six feet of freeboard.

Hydrologic data used in the evaluation pertains to present day conditions with no consideration given to future development.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam is believed to be founded on alluvial and/or residual soils, all of which are underlain by the Lee and Norton Formations. Three test borings drilled at the site (See Appendix V) encountered from 89 to 215 ft of coarse coal refuse. Boring P-3, drilled to a depth of 215 ft did not fully penetrate the fill. The test boring logs only describe the coarse coal refuse and bedrock; therefore, it is not known where alluvial and/or residual soils exist and what their physical character and thicknesses are. Top of bedrock was encountered between elevation 1690 and 1680 in the two borings in which bedrock was cored. The bedrock included brown to gray weathered to slightly weathered sandstone, gray clay and weathered shale. Core recoveries (Bx-size or 1-5/8 inch diameter) ranged from 50 to 100% for the sandstone while blow counts recorded during Standard Penetration Tests ranged from 41 per ft to 50/0.3 ft in the clay and weathered shale. Bedrock exposed in the right abutment consisted of similar rock; however, their surface exposure has resulted in a more weathered and fractured physical appearance.

6.2 Embankment: The upstream slope is very steep, ranging from 2 horizontal to 1 vertical to near vertical. The downstream slope includes three benched areas with intervening slopes ranging from approximately 1 horizontal to 1 vertical, to 3 horizontal to 1 vertical (See Sheet 9, Appendix III). The crest of the embankment ranges from elevation 1950± to 2000± msl while the downstream toe is at elevation 1650±.

Normal pool for the impoundment is elevation 1916±. Recently developed laboratory test data concludes that the embankment fill or coal refuse is non-plastic and granular; ranging from fine sand to coarse gravel in size. Placement of this material is by bulldozer and compaction is accomplished by the weight of the machinery during grading operations.

Three piezometers have been recently installed at the locations shown on Plate 2, Appendix I in order to monitor the phreatic level within or beneath the embankment. Readings taken in December 1979 indicate water at elevation 1700± in P-1, which corresponds to the basal portion of the fill. No water was encountered in the other piezometers. Seepage or wet spots described in Section 3 on the downstream slope occur well above elevation 1700± and apparently are caused by surface water seepage along impervious buried surfaces.

Steep to moderately steep slopes form the right abutment; however, the left abutment was covered with coarse coal refuse and was not visible. Weathered and fractured sandstone and shale are exposed in the right abutment and slopes in this area were considered safe and stable at the time of inspection.

6.3 Evaluation:

6.3.1 Foundation and Abutments: Dam foundations must be evaluated on the basis of potential settlement, sliding and seepage. Excessive settlement of the dam is not believed to be a problem since test boring data indicates the structure rests upon fairly competent bedrock and hard residual clay. The contact between the embankment fill and overburden soils was not defined in the test boring logs.

Based upon the size of the embankment and the type of soils encountered, it is assumed that settlement related to compression of native overburden soils has been essentially completed under the existing loading condition.

Subsurface mining has been performed within the Jawbone coal bed of Norton Formation. This bed is approximately 4 ft thick and is present just below elevation 1700. The Jawbone seam has been mined beneath the back of the impoundment. A mining plan developed by the Owner considered the possibility of subsidence and its effects on the impoundment. The plan provided an adequate factor of safety against subsidence, and consequently the plan was approved by MSHA in April, 1979. No mining has reportedly taken place beneath the embankment.

A review of the geologic and test boring data indicates that some of the thin clay seams present near the top of the underlying formations could possibly act as potential sliding surfaces. However, the relatively stiff condition of these soils and high ratio of base width to height of this dam reduces the possibility of sliding of the dam along the interface between the embankment and the foundation soils or rock. Consequently, sliding within the foundation bedrock is not believed to be a problem.

Examination of bedrock exposed in the right abutment and the test boring data indicate that much of the underlying near-surface shale and sandstone could be jointed or fractured enough to allow

some seepage beneath the dam. Based upon the physical character of the bedrock, this seepage would probably not be detrimental to the satisfactory performance of the structure.

6.3.2 Embankment: No undue settlement, cracking or seepage was noted at the time of inspection; thus it appears that the embankment is adequate for normal pool level with water at elevation 1916± msl. The stability analysis performed for the original embankment (Appendix VI) indicated a factor of safety of 1.22 for the steady seepage case which is less than the factor of safety of 1.5 required by the guidelines included in Reference 1, Appendix VIII. The rapid drawdown case was not considered since it is not possible for this type of loading condition to occur. Since the dam is presently being modified and stability analyses have been performed for this modification, no additional studies are recommended.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The Middle Fork Slurry Impoundment at the time of inspection appeared sound and in good condition. The reservoir will store 100 percent of the PMF without overtopping. The SDF is the PMF, and the dam will have six feet of freeboard during the SDF.

The actual embankment structure is presently being graded to conform to the most recent abandonment drawings (See Plate No. 2, Appendix I). The stability analysis performed for the steady seepage case for the existing embankment indicates a factor of safety of 1.22 which is less than the 1.5 requirement of Reference 1, Appendix VIII. Modifications presently in progress will increase the factor of safety of the embankment and no further studies are recommended.

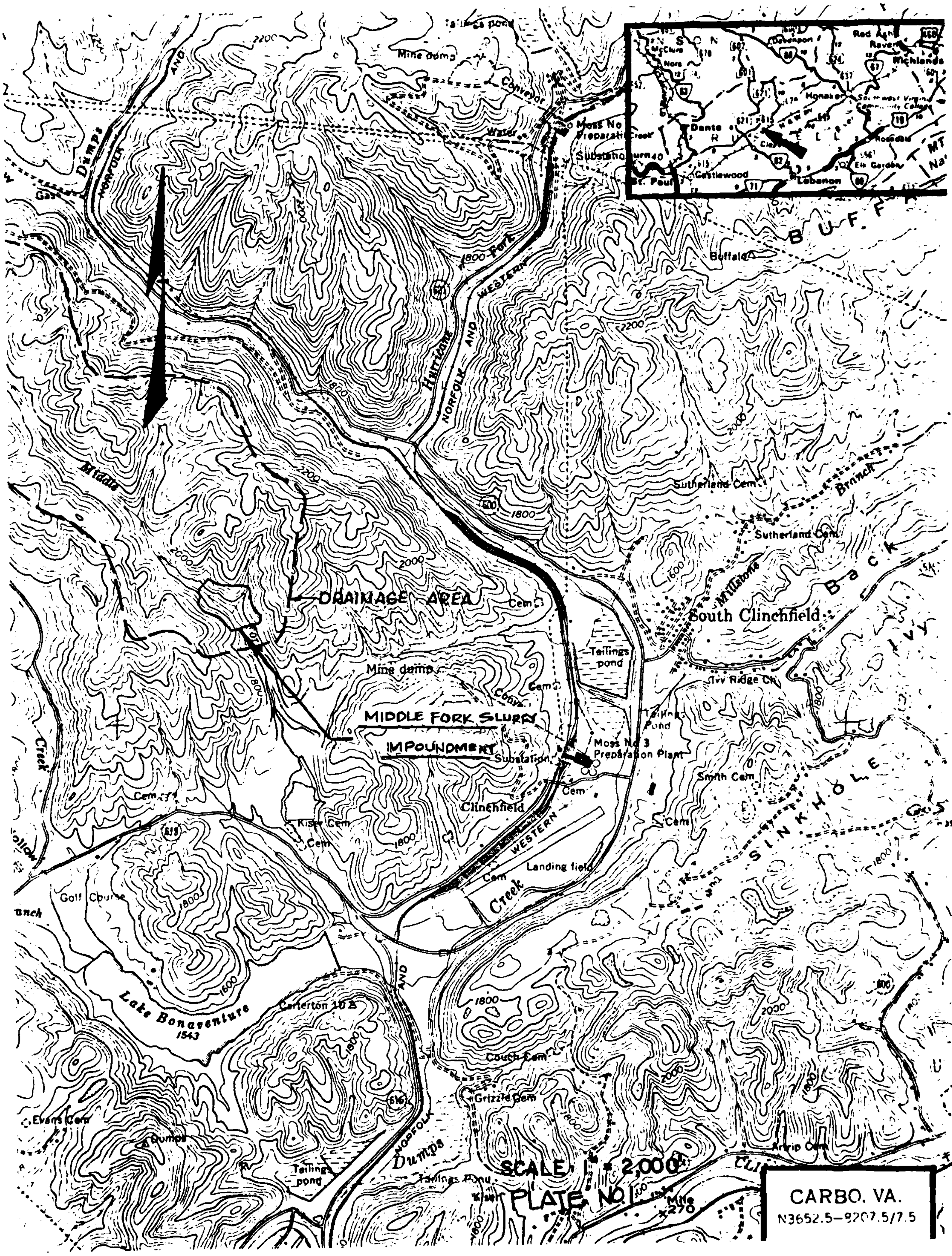
The dam is considered adequate.

7.2 Remedial Measures: Based on the visual inspection and review of existing records, there is no serious problem that would require immediate action for the normal pool conditions.

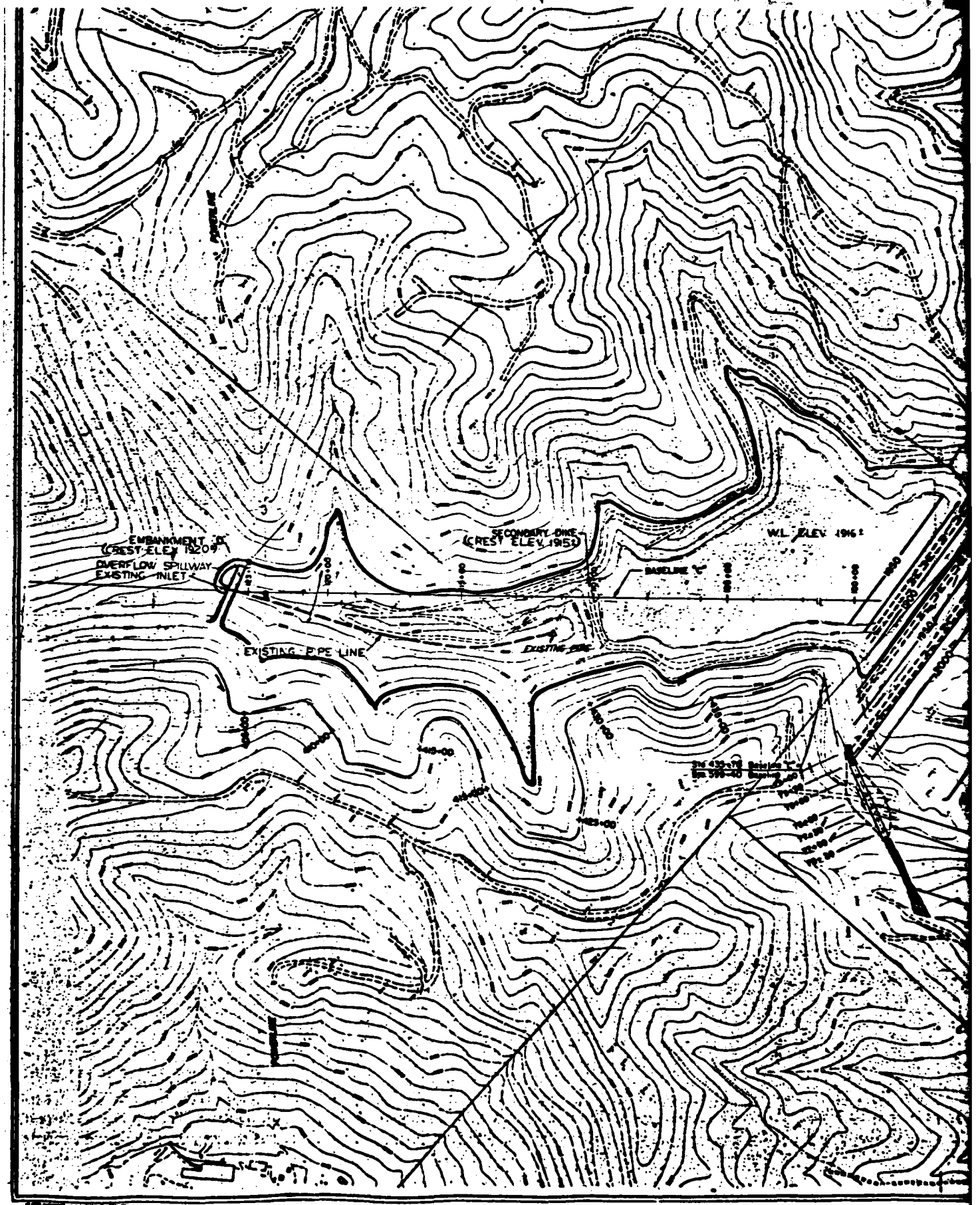
7.3 Maintenance Measures: Based on the visual inspection, there is no problem that would require immediate action for the normal pool conditions.

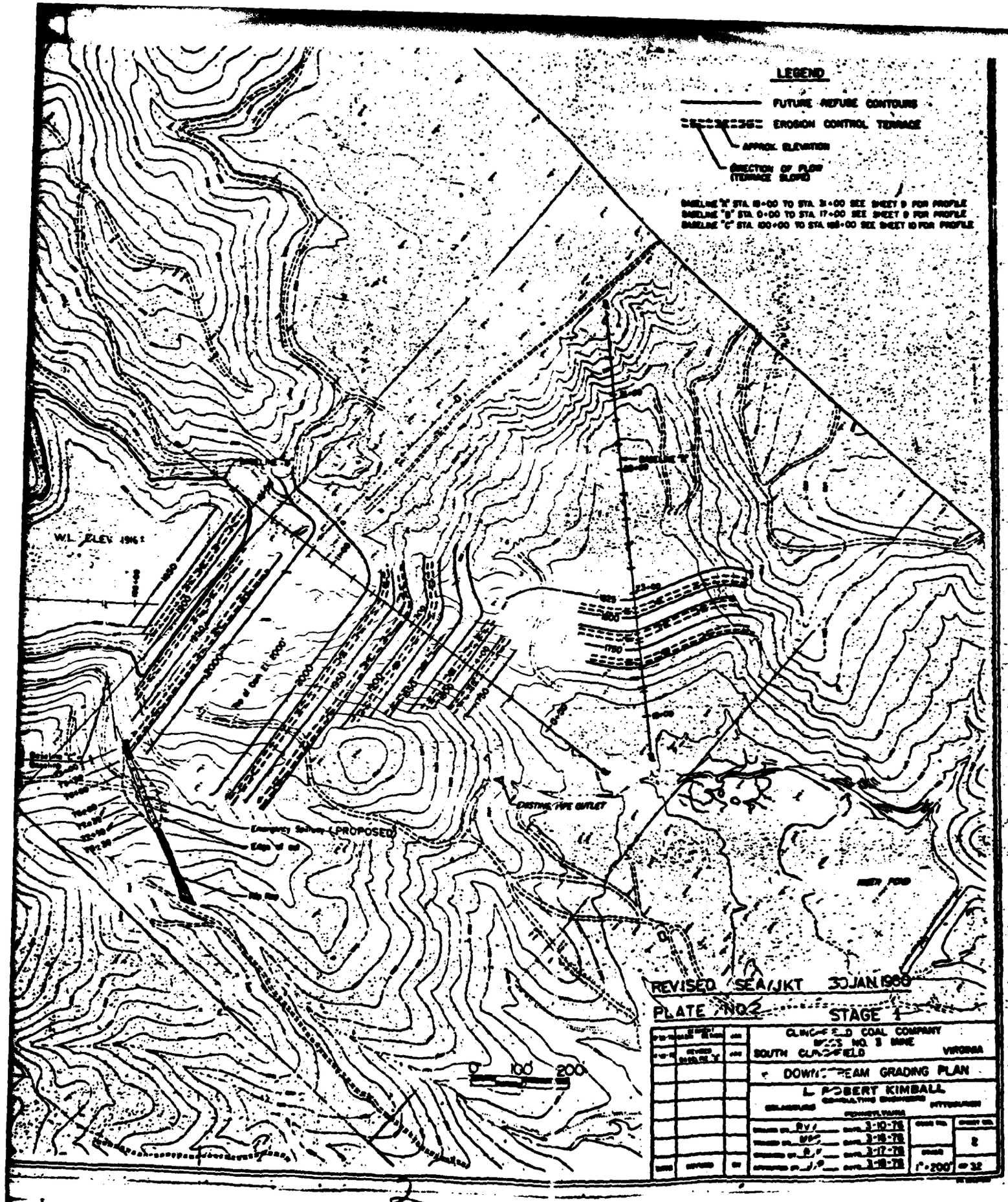
APPENDIX I

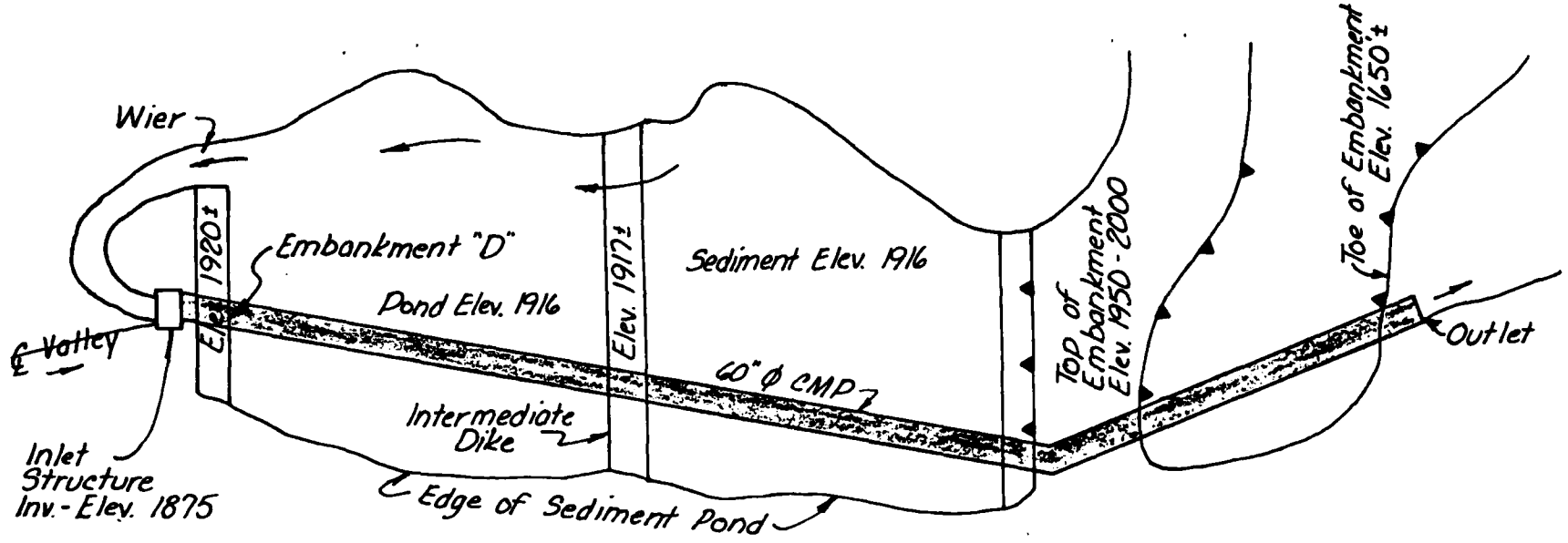
MAPS AND DRAWINGS



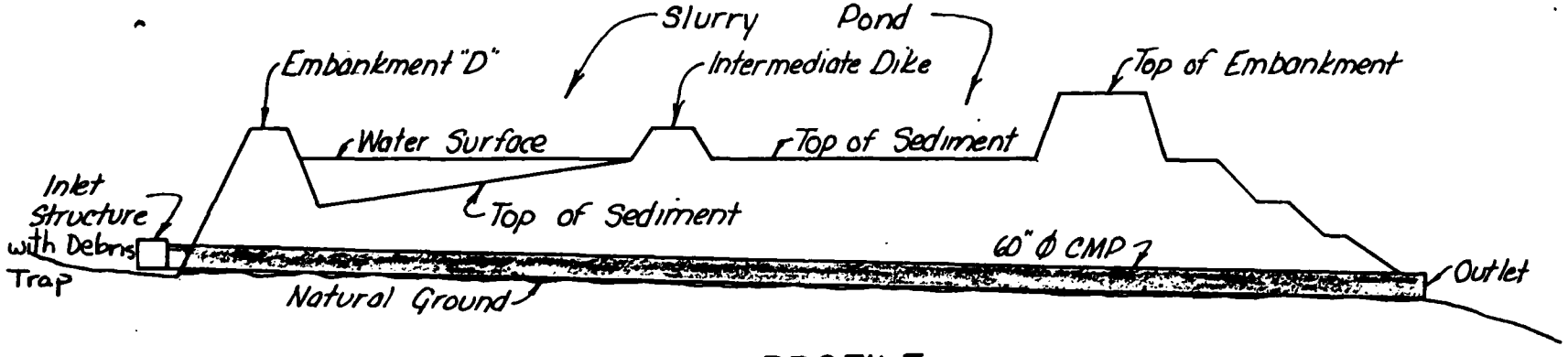
DRAINAGE AREA
MIDDLE FORK SLURRY
IMPOUNDMENT
Moss No 3
Preparation Plant
Substation
Clinchfield
South Clinchfield
Tailings pond
Mine dump
Conveyor
Landing field
Golf Course
Lake Bonaventure
1543
Kiser Cem
Sutherland Cem
Smith Cem
Ivy Ridge Ch
Couch Cem
Grizzle Cem
Evans Cem
Carterton
Buffalo
NORFOLK AND WESTERN
Middle
Creek
Hurricane Fork
Millstone
Branch
SINKHOLE
Back
Ivy
BUFF
Dumps
Dante
Honaker
Lebanon
Castlewood
St. Paul
Richlands
Red Ash
Raven
SCALE 1 = 2,000
PLATE NO. 1
CARBO. VA.
N3652.5–8207.5/7.5


EMBANKMENT
CREST ELEV 1920
OVERFLOW SPILLWAY
EXISTING INLET
SECONDARY DIKE
CREST ELEV 1952
W.L. ELEV 1916
BASELINE
EXISTING PIPE LINE
EXISTING DIKE
PIPELINE


LEGEND
FUTURE REFUSE CONTOURS
EROSION CONTROL TERRACE
APPROX. ELEVATION
DIRECTION OF FLOW (TERRACE SLOPED)
BASELINE "A" STA. 18+00 TO STA. 31+00 SEE SHEET 9 FOR PROFILE
BASELINE "B" STA. 0+00 TO STA. 17+00 SEE SHEET 9 FOR PROFILE
BASELINE "C" STA. 100+00 TO STA. 108+00 SEE SHEET 10 FOR PROFILE
W.L. ELEV. 1965
EXISTING PIPE OUTLET
Emergency Spillway (PROPOSED)
0 100 200
REVISED SEA/JKT 30JAN1980
PLATE NO 2
STAGE 1
CLINCHFIELD COAL COMPANY
BUCKS NO. 3 MINE
SOUTH CLINCHFIELD VIRGINIA
DOWNSTREAM GRADING PLAN
ROBERT KIMBALL
CONSULTING ENGINEERS
COLUMBUS PITTSBURGH
3-10-78
3-16-78
3-17-78
3-18-78
1"=200'
8



PLAN



PROFILE

MIDDLE FORK SLURRY IMPOUNDMENT

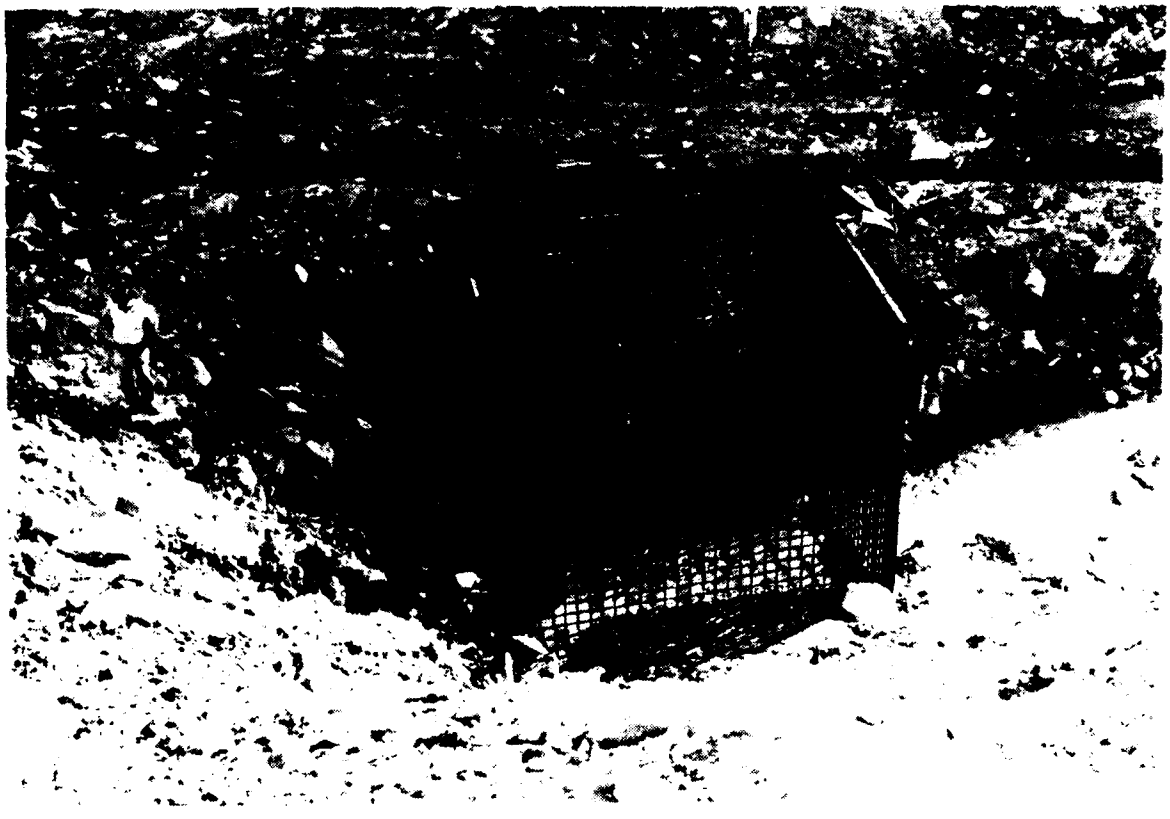
OVERALL SCHEMATIC

PLATE N°3

APPENDIX II

PHOTOGRAPHS

PIPELINE [illegible] TRAP AND 60"



VIEW OF DEBRIS TRAP AT THE PRINCIPAL SPILLWAY OUTLET PIPE (SUMMER 1979) (PRINCIPAL SPILLWAY OUTLET PIPE IS 60" IN DIAMETER)

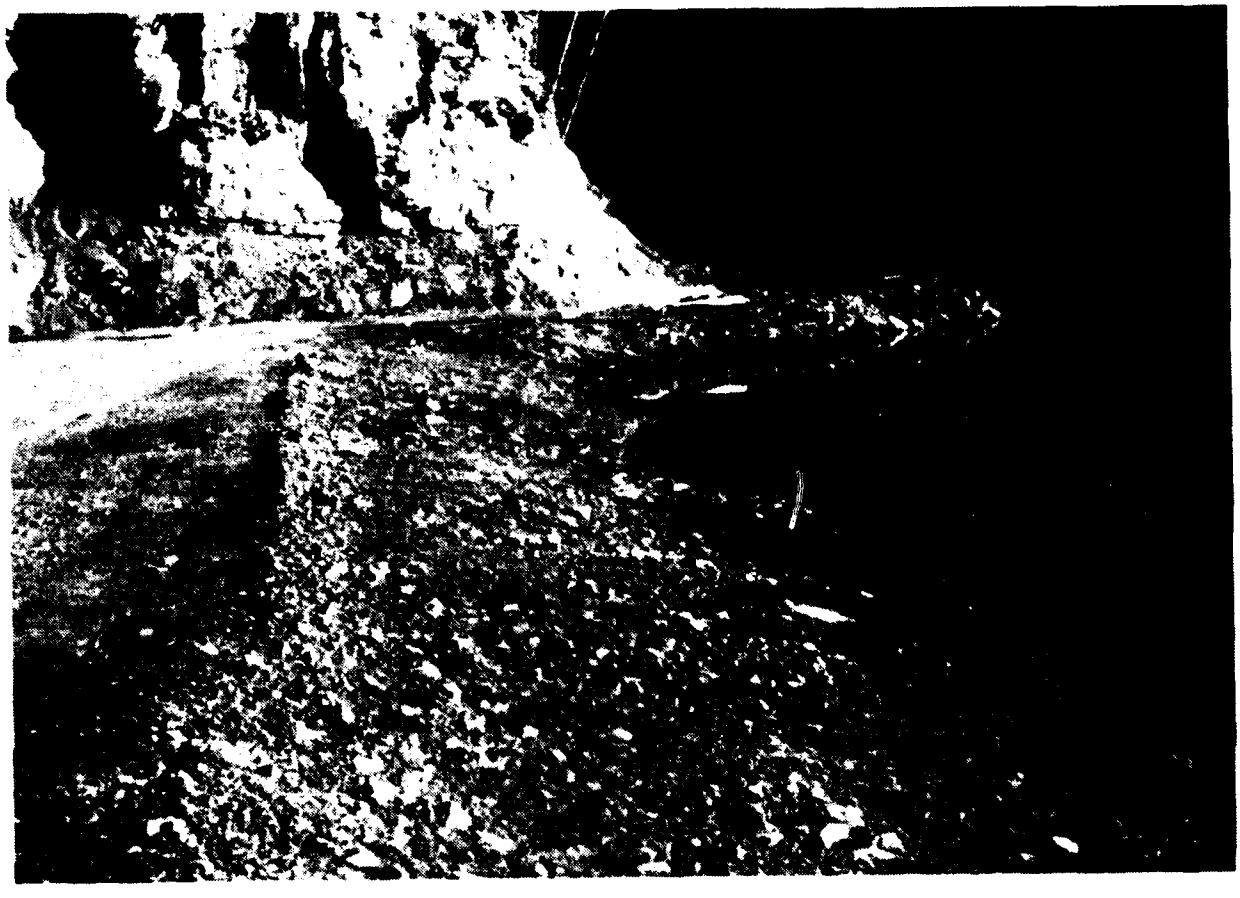
PHOTOGRAPH NO. 2

VIEW OF EMBANKMENT LOOKING UPSTREAM. (ARROW DENOTES APPROXIMATE LOCATION OF EMBANKMENT) (SUMMER 1979)

PHOTOGRAPH NO. 3

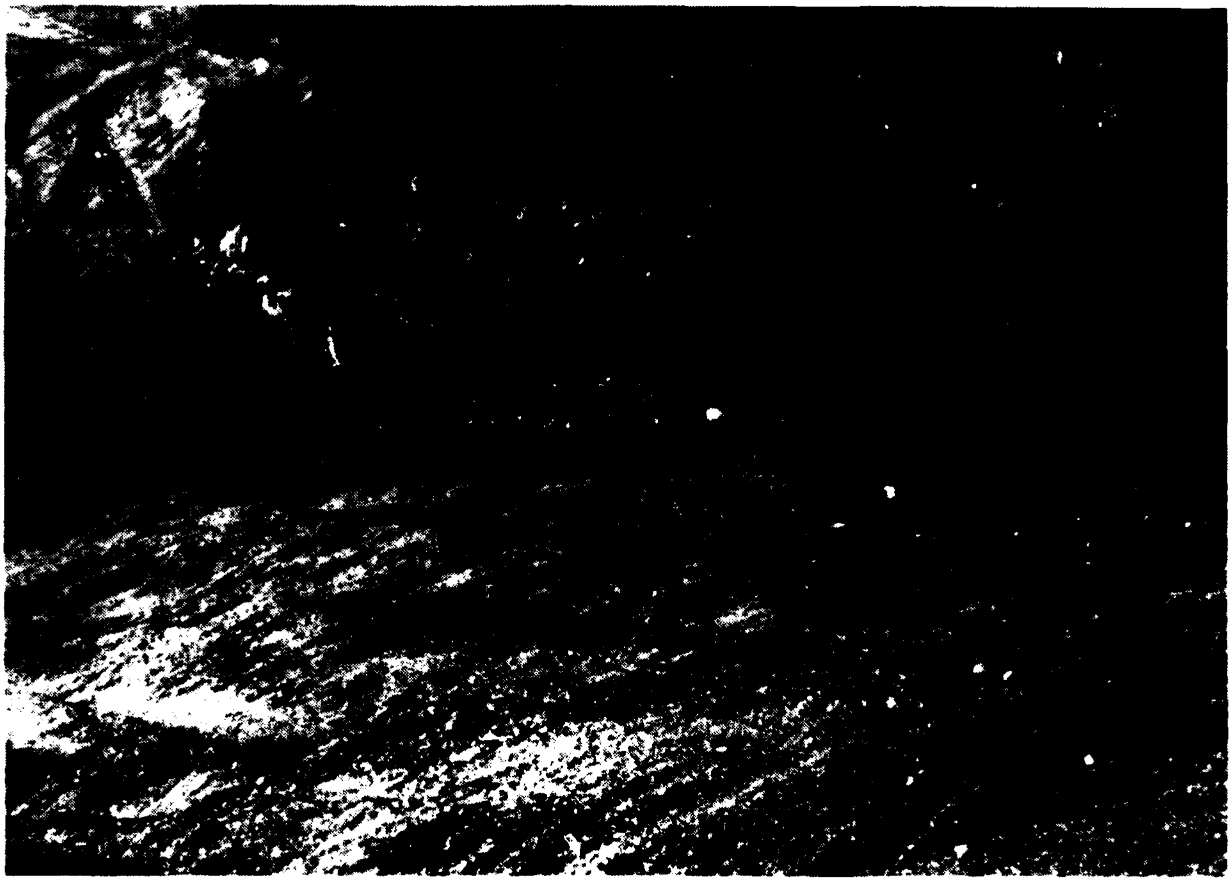
VIEW OF IMPOUNDED SLURRY POND LOOKING UPSTREAM. (NOTE, HOLLOW ARROWS DENOTE ORGIINAL BERM) (NOTE, SOLID ARROW SHOWS APPROXIMATE LOCATION OF PRINCIPAL SPILLWAY AND DEBRIS RACK AND SECOND RETAINING BERM). (SUMMER 1979)

PHOTOGRAPH NO. 4



View of Upstream Retaining Embankment "D"
(Left Bank)

PHOTOGRAPH NO. 3



View of Downstream Face of [illegible] Embankment
(Looking from Top of [illegible])
(Fall [illegible])

PHOTOGRAPH NO. 6

View of Upstream Face of Main Embankment
Fall 19[illegible]

PHOTOGRAPH NO. [illegible]

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam Middle Fork Slurry Impoundment County Russell State Virginia Coordinators Lat. 36° 57.7' Long. 82° 12.1'

Date(s) Inspection 12/11/79 Weather Fair Temperature 35°F

Pool Elevation at Time of Inspection 1916 msl Tailwater at Time of Inspection 1875 msl

Inspection Personnel:

Schnabel Engineering Associates
Ray E. Martin, P.E.
Stephen G. Werner (Recorder)

J. K. Timmons & Associates
Robert G. Roop, P.E.
Donald Balzer (Recorder)

Clinchfield Coal Company
Michael Holbrook

Orbital Engineering, Inc.
Jim Shellhammer

Virginia State Water Control Board
Ed Constantine
Leon Musselwhite

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed. The embankment is being constructed with coarse coal refuse and was free of vegetation.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movements or cracking were noted on the dam or downstream beyond the embankment toe.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Scattered surface erosion is present along the upper half of the downstream slope. This area has not yet been benched and slopes steeply at about 1H:1V. The surface erosion includes gullies up to 15 ft± deep and 10 ft± wide. Except of the upper most slope, all other benches and slopes appeared to be recently constructed and relatively free of erosion. A diversion ditch has been excavated near the crest - right abutment area which can divert runoff into the adjacent hollow.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	The massive size of this embankment makes it difficult to accurately assess the vertical and horizontal alignment. The embankment crest is roughly 1100 ft long and 400 ft± wide.	
RIPRAP FAILURES	No riprap was observed. It is not required due to the lack of water in the impoundment.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Conditions at the junction of the embankment and the abutments appear to be good. The right abutment includes thin to massively bedded sandstone outcrops with weathered shale interbeds. The bedrock dips to the southeast at about 45°. The left abutment consists of a very massive pile of coarse coal refuse. Two small areas of original ground are exposed within this waste pile; however, present grading operations will eventually bury these areas. No emergency spillway exists. No faults were observed in the field and geologic maps of the area do not show the presence of faults in the immediate vicinity.	
ANY NOTICEABLE SEEPAGE	Scattered wet spots or seepage at less than 1 gpm were encountered about halfway down the slope at the junction with the first bench about 50 ft east of the right abutment (see field sketch). The Owner was aware of these wet areas and stated that recent studies by their engineer concluded that the wet spots represent surface water seepage along a buried impervious haul road surface and not seepage through the dam.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	A stone drain which is now covered with coarse coal refuse extends along the left abutment (see field sketch). An estimated 20 gpm of water was flowing from the drain at its surfacing point, following a drainage ditch toward the lower pond. The drain appeared to be functioning properly and water was clear.	

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None	Not applicable
APPROACH CHANNEL	None	Not applicable
DISCHARGE CHANNEL	None	Not applicable
BRIDGE AND PIERS	None	Not applicable

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	Corrugated metal pipe
INTAKE STRUCTURE	60" C.M.P. with debris cage. The pipe extends beneath the embankment and exits below the downstream toe.	Constructed less than one year ago. Good condition
OUTLET STRUCTURE	60" C.M.P.	Good condition
DIVERSION CHANNEL	25' wide with rock base. No erosion	Good condition
EMERGENCY GATE	None	Not applicable

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Very steep (vertical to 2:1) cut and natural slopes with southeastwardly dipping bedrock and thin soil cover bound the revervoir. The slopes range from bare to densely wooded. The cut slopes were created during construction of the impoundment.	
SEDIMENTATION	Reservoir is continuously filled with coal refuse slurry. Water depths ranged from 0 ft in the front area to 20 ft in rear (Dam "D").	

DOWNSTREAM CHANNEL

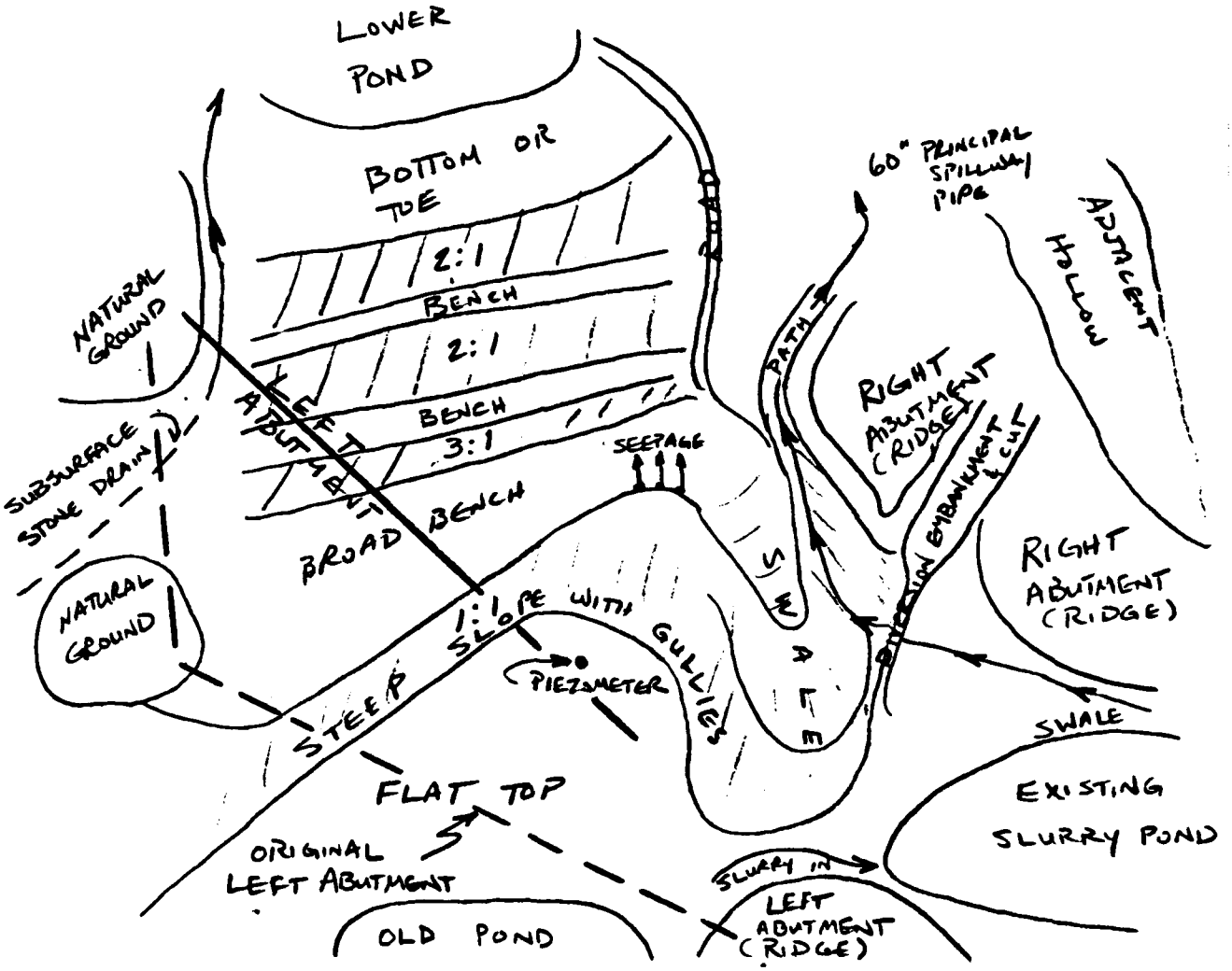
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Good condition, no erosion.	
SLOPES	Range from shallow to very steep. Generally densely vegetated.	
APPROXIMATE NO. OF HOMES AND POPULATION	The Clinch River Power Plant (Appalachian Power) and Town of Carbo are located in Flood Plain of Clinch River at the convergence with Dumps Creek, approximately two miles downstream. Dam breach during peak flooding could cause significant rise in Clinch River.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	Not applicable
OBSERVATION WELLS	None	Not applicable
WEIRS	None	Not applicable
PIEZOMETERS	Three air activated piezometers have been recently installed, one on the crest and two along the downstream toe. Water levels have not reportedly stabilized; therefore, no readings were taken. Water level readings will be available in the future from the owner.	
OTHER	None	Not applicable

BY REM DATE 12/11/79 SUBJECT FIELD SKETCH SHEET NO. 9 OF 9

CHKD. BY ____ DATE ____ MOSS MINE NO. 3 JOB NO. ____



NO SCALE

APPENDIX IV

CURRENT PLAN FOR UPGRADING IMPOUNDMENT

CURRENT PLAN

The plan for upgrading the Middle Fork Impoundment which was approved by the District Manager of the Coal Mine Safety and Health District 5 on June 13, 1978 consists of:

1. Trench drains and abutments drains will be constructed with selected coarse refuse to carry any seepage which may possibly come from the wet spots on the slope past the toe of the proposed embankment. Filter cloth will be placed directly over the areas of suspected seepage.
2. The embankment will be constructed as shown on Sheet 8 of the "Construction Drawings" up to elevation 1850. The specifications for the construction of this embankment can be found in Appendix G.
3. When construction reaches about elevation 1850, the embankment will be drilled and piezometers will be installed to determine the internal water level.
4. The information obtained from the drilling program will be used to determine the need for drains, buttress, or other remedial work which may be necessary to acquire the required factor of safety.

The work as outlined above has already been initiated. From an economic and engineering standpoint, we feel that the proposed plan is the most logical way to approach the problem. This plan allows for a constant increase in the stability of the embankment while allowing for the acquisition of necessary information to adequately assess the stability of the embankment.

R. Michael Holbrook
Civil Engineer

APPENDIX V

PRELIMINARY TEST BORING LOGS

STARTED: 9/12/79
COMPLETED: 9/28/79
CONTRACTOR: Law Engineering
EQUIPMENT: CME-55
WEATHER:

S 50855.7 E 53663.2
OFFSET: N/A
GROUND SURFACE EL.: 1772.4

PROJECT NO.: E-782L
CLIENT: Clinchfield Coal Co.
LOCATION: Dante, Virginia
FIELD ENGINEER: M. Lucas

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.
1770.0		S/11		COARSE COAL REFUSE -	
		S/12			
	5.0	S/22			
		S/8			
		S/7			
		S/9			
	10.0	S/11			
1760.0		S/11			
		S/10			
	15.0	S/11			
		S/10			
		S/9			
	20.0	S/6			
1750.0		S/11			
	25.0	S/10			
	30.0	S/11			
1740.0					
	35.0	S/22			
	40.0	S/27			
1730.0					
	45.0	S/17			

PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50

WATER CONTENT (PERCENT) 20 40

—101 WEST MALL PLAZA—
—CARNEGIE, PENNSYLVANIA 15106—
—(412) 276-4500—

ORBITAL ENGINEERING

TEST BORING LOG | TEST BORING NO. T-1 | 2 OF 3

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.
				COARSE COAL REFUSE	
	50.0	S/19			
1720.0					
	55.0	S/56			
	60.0	S/54			
1710.0					
	65.0	S/60			
	70.0	S/50			
1700.0					
	75.0	S/73			
	80.0	S/76			
1690.0					
	85.0	S/15			
	90.0	S/100		COAL REFUSE AND BROWN SILTY CLAY	
1680.0					
	95.0	BX 60%		LIGHT BROWN BROKEN AND WEATHERED SANDSTONE WITH ZONES OF GREY WEATHERED SHALE	

PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50

WATER CONTENT (PERCENT) 20 40

—101 WEST MALL PLAZA—
— CARNEGIE, PENNSYLVANIA 15106 —
—(412) 276-4500 —

ORBITAL ENGINEERING

TEST BORING LOG | TEST BORING NO. T-1 | 3 OF 3

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
		BX 60%		LIGHT BROWN BROKEN AND WEATHERED SANDSTONE WITH ZONES OF GREY WEATHERED SHALE			
	100.0	BX 50%					
1670.0				LIGHT GREY SANDSTONE, FINE TO MEDIUM GRAINED, FRAGMENTED, MEDIUM HARD			
	105.0						
	110.0	BX 83%					
1661.3	111.1			BOTTOM OF HOLE			

—101 WEST MALL PLAZA—
— CARNEGIE, PENNSYLVANIA 15106 —
—(412) 276-4500—

ORBITAL ENGINEERING

STARTED: 10/3/79
COMPLETED: 10/9/79
CONTRACTOR: Law Engineering
EQUIPMENT: CME-55
WEATHER:

COORDINATES
S 51045.7 E 53691.9
OFFSET: N/A
GROUND SURFACE EL.: 1779.2

PROJECT NO.: E-782E
CLIENT: Clinchfield Coal Co.
LOCATION: Dante, Virginia
FIELD ENGINEER: A. Baldrige

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.
		S/9		COARSE COAL REFUSE	
		S/8			
	5.0	S/6			
		S/7			
		S/20			
1770.0		S/15			
	10.0	S/10			
		S/14			
		S/12			
	15.0	S/14			
		S/10			
		S/12			
1760.0		S/23			
	20.0	S/37			
	25.0	S/29			
1750.0					
	30.0	S/25			
	35.0	S/16			
1740.0					
	40.0	S/34			
	45.0	S/28			

PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50

WATER CONTENT (PERCENT) 20 40

—101 WEST MALL PLAZA—
—CARNEGIE, PENNSYLVANIA 15106—
—(412) 276-4500—

ORBITAL ENGINEERING

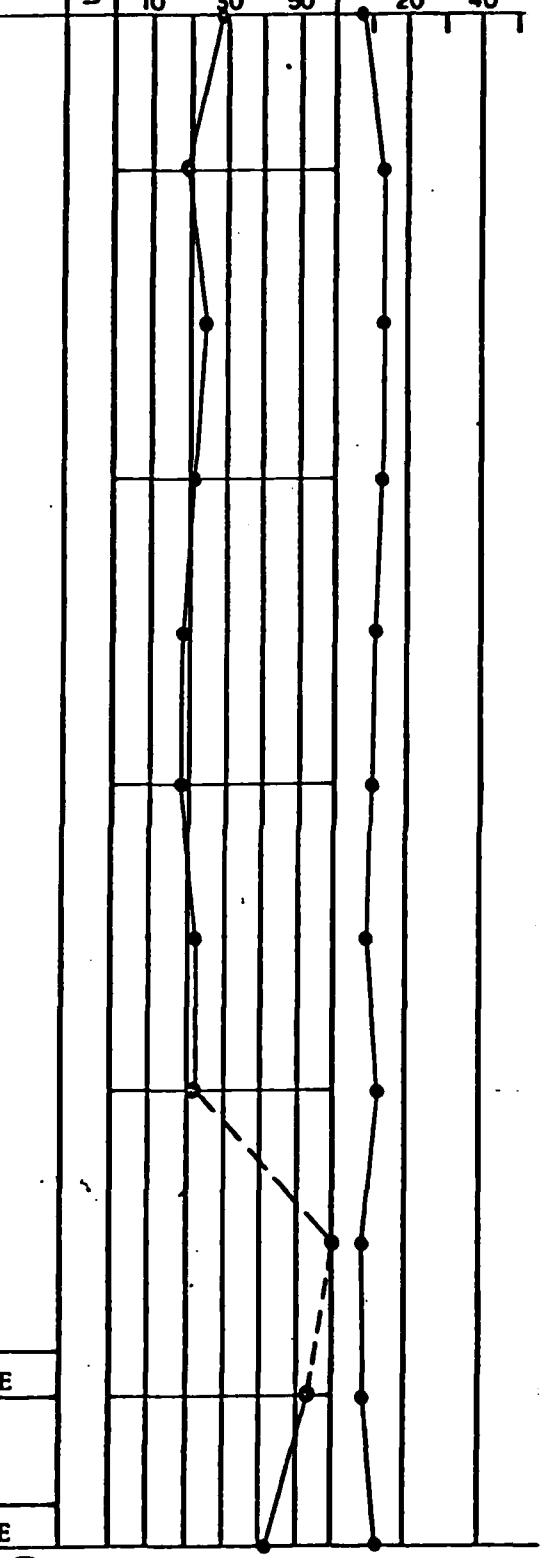
TEST BORING LOG

TEST BORING NO. P-2 | SHEET 2 OF

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.
				COARSE COAL REFUSE	
1730.0	50.0	S/19			
	55.0	S/24			
1720.0	60.0	S/21			
	65.0	S/19			
1710.0	70.0	S/18			
	75.0	S/22			
1700.0	80.0	S/22			
	85.0	S/75			
1690.0	90.0	S/53		GREY CLAY AND WEATHERED SHALE	
	95.0	S/41		GREY CLAY AND WEATHERED SHALE	

PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50

WATER CONTEN (PERCENT) 20 40



—101 WEST MALL PLAZA—
—CARNEGIE, PENNSYLVANIA 15106—
—(412) 276-4500—

ORBITAL ENGINEERING

TEST BORING LOG | TEST BORING NO. B-2 | 3 OF 3

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
	98.5	S/50/0.3"		GREY CLAY AND WEATHERED SHALE			
1680.0	98.8						
	100.0	BX 100%		LIGHT GREY SANDSTONE, HARD, FINE TO MEDIUM GRAINED, SLIGHTLY WEATHERED			
	105.0						
1670.4	108.8			BOTTOM OF HOLE			

— 101 WEST MALL PLAZA —
— CARNEGIE, PENNSYLVANIA 15106 —
— (412) 276-4500 —

ORBITAL ENGINEERING

STARTED: 11/13/79
COMPLETED: 11/20/79
CONTRACTOR: Law Engineering
EQUIPMENT: CME-55
WEATHER:

COORDINATES
S 50449.5 E 53625.1
OFFSET: N/A
GROUND SURFACE EL.: 1977.4

PROJECT NO.: E-782E
CLIENT: Clinchfield Coal Co
LOCATION: Dante, Virginia
FIELD ENGINEER: A. Baldrige

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.
1975.0	0	S/36		COARSE COAL REFUSE	
		S/35			
	5.0	S/42			
1970.0		S/53			
		S/21			
	10.0	S/15			
		S/19			
1965.0		S/17			
	15.0	S/11			
		S/13			
1960.0		S/13			
		S/17			
	20.0	S/32			
1955.0		S/19			
		S/27			
	25.0				
1950.0					
	30.0	S/14			
1945.0					
	35.0	S/15			
1940.0					
	40.0	S/19			
1935.0					
	45.0				

PENETRATION RESISTANCE (BLOWS PER FOOT)
10 30 50

WATER CONTENT (PERCENT)
20 40

—101 WEST MALL PLAZA—
—CARNEGIE, PENNSYLVANIA 15106—
—(412) 276-4500—

ORBITAL ENGINEERING

TEST BORING LOG

TEST BORING NO. _____ SHEET _____ OF _____

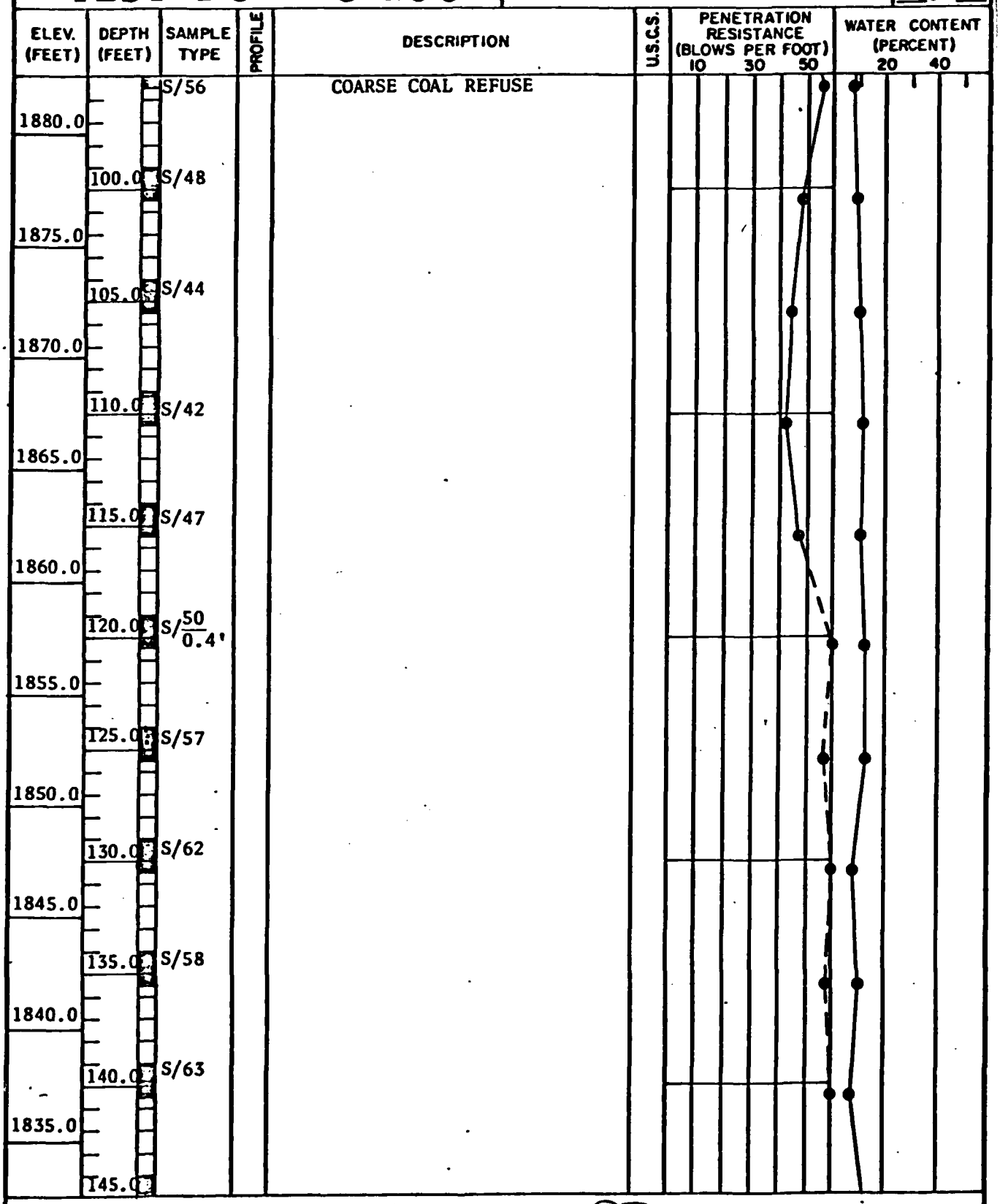
ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
1930.0		S/17		COARSE COAL REFUSE			
	50.0	S/14					
1925.0							
	55.0	S/22					
1920.0							
	60.0	S/18					
1915.0							
	65.0	S/23					
1910.0							
	70.0	S/28					
1905.0							
	75.0	S/29					
1900.0							
	80.0	S/24					
1895.0							
	85.0	S/33					
1890.0							
	90.0	S/45					
1885.0							
	95.0						

—101 WEST MALL PLAZA—
—CARNEGIE, PENNSYLVANIA 15106—
—(412) 276-4500—

ORBITAL ENGINEERING

TEST BORING LOG

TEST BORING NO. P-3 | SHEET 3 OF 5



—101 WEST MALL PLAZA—
—CARNEGIE, PENNSYLVANIA 15106—
—(412) 276-4500—

ORBITAL ENGINEERING

TEST BORING LOG | TEST BORING NO. [illegible] | 4 OF 5

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
1830.0		S/79		COARSE COAL REFUSE			
	150.0	S/75					
1825.0							
	155.0	S/58					
1820.0							
	160.0	S/92					
1815.0							
	165.0	S/44					
1810.0							
	170.0	S/50					
1805.0							
	175.0	S/$\frac{50}{0.4'}$					
1800.0							
	180.0	S/59					
1795.0							
	185.0	S/$\frac{50}{0.3'}$					
1790.0							
	190.0	S/85					
1785.0							
	195.0						

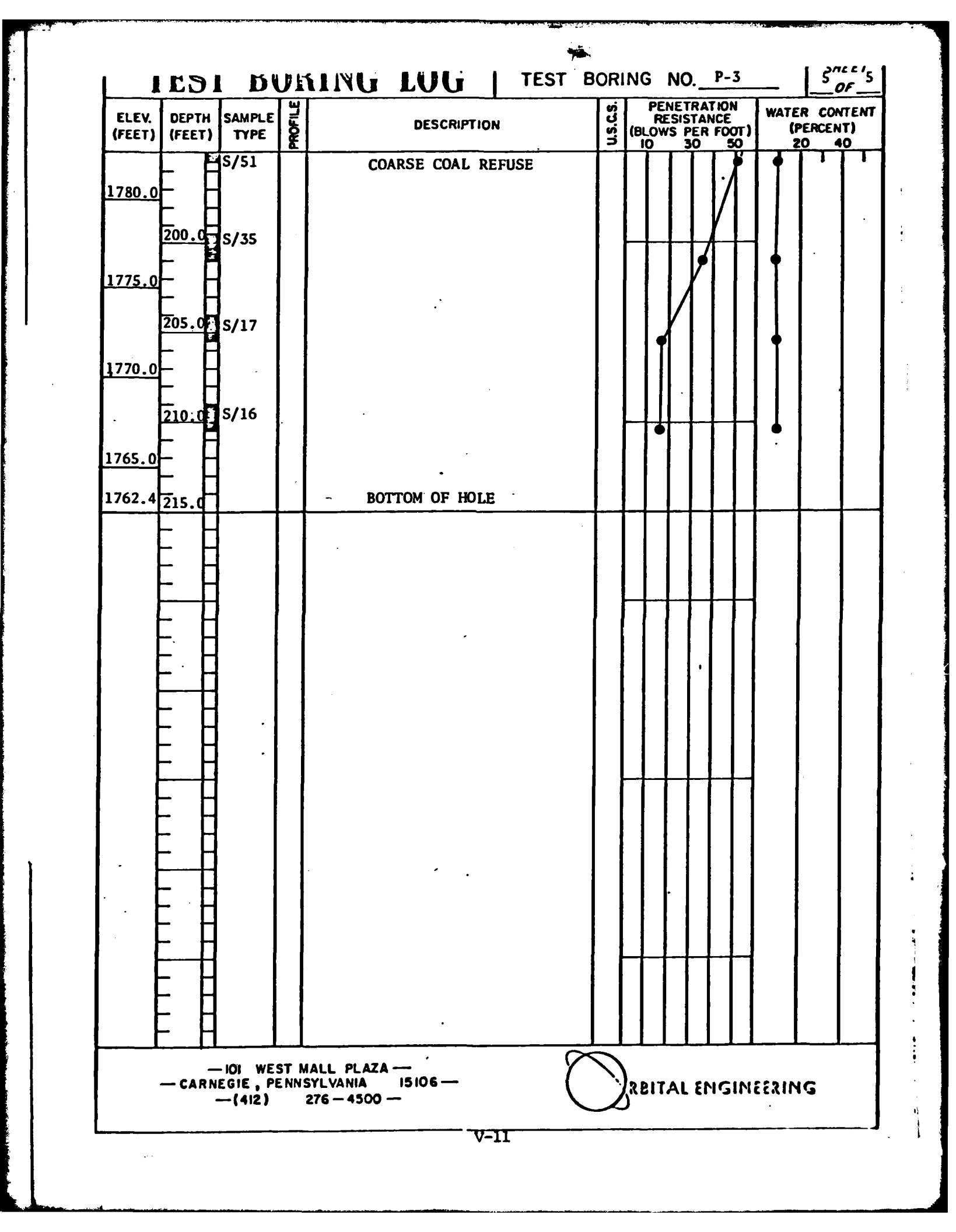
—101 WEST MALL PLAZA—
—CARNEGIE, PENNSYLVANIA 15106—
—(412) 276-4500—

ORBITAL ENGINEERING

TEST BORING LOG

TEST BORING NO. P-3 | SHEET 5 OF 5

ELEV. (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	U.S.C.S.	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
		S/51		COARSE COAL REFUSE			
1780.0							
	200.0	S/35					
1775.0							
	205.0	S/17					
1770.0							
	210.0	S/16					
1765.0							
1762.4	215.0			BOTTOM OF HOLE			



— 101 WEST MALL PLAZA —
— CARNEGIE, PENNSYLVANIA 15106 —
— (412) 276 — 4500 —

ORBITAL ENGINEERING

APPENDIX VI

STABILITY ANALYSIS SUMMARY

by

L. ROBERT KIMBALL & ASSOCIATES

The following stability analyses data were developed by L. Robert Kimball & Associates and presented in Reference 6 of Appendix VII:

STABILITY ANALYSIS - 1976 STUDY

The effective stress parameters were used in the stability analysis, because under long term conditions excess pore pressures should not build up in a material as permeable as coarse refuse. The Simplified Bishop Method was used to evaluate the embankment section. The seepage line was estimated for maximum pool conditions. Results of the embankment stability analysis indicated a lowest factor of safety of 1.57, under static loading conditions for the proposed slope configuration. A profile of the proposed slope which was analyzed can be found on Sheet 8 of the "Construction Drawings". The results of this stability analysis and the failure circle corresponding to the lowest factor of safety can be found on Sheet 9 of the "Construction Drawings". The stability analysis backup data can be found in Appendix B.

SUMMARY OF TRIAXIAL (R) TEST RESULTS (1976)

MATERIAL	SAMPLE NO.	ϕ DEGREES	c PSI	$\bar{\phi}$ DEGREES	$\bar{c}$ PSI
SLURRY		6.3	7.1	13.5	5.5
NEW REFUSE	A-1	14.3	6.1	23.9	5.0
OLD REFUSE	A-2	10.4	5.8	38.3	0.5
SOIL	A-3	12.0	1.0	29.5	0.5

STABILITY ANALYSES - 1977 - 1978 STUDY

Several stability analyses were performed utilizing various parameters and assumptions. The results of these analyses are summarized below. The computer back-up data for these analyses can be found in Appendix F.

1. A stability analysis was performed on the existing conditions, assuming a high phreatic surface and lower soil parameters than those used in the 1976 stability analysis. The lowest factor of safety was calculated to be 1.22. The results of this stability analysis can be found on Sheet 10 of the "Construction Drawings".

2. A stability analysis was performed on the slope configuration proposed in 1976, assuming a high phreatic surface and soil parameters lower than the two previous stability analyses. The lowest factor of safety was calculated to be 1.36. The results of this stability analysis can be found on Sheet 11 of the "Construction Drawings".

3. A stability analysis was performed on a proposed slope configuration utilizing a downstream berm and drainage blanket, assuming a high phreatic surface and the same soil parameters as in analysis 2 above. The lowest factor of safety was calculated to be 1.65. The results of this stability analysis can be found on Sheet 12 of the "Construction Drawings".

4. A dynamic stability analysis was performed utilizing the same slope configuration and parameters as in analysis 3 above. This analysis was performed using the Fellenius Method. The lowest factor of safety was calculated to be 1.27. The results of this stability analysis can be found on Sheet 13 of the "Construction Drawings".

SUMMARY OF TRIAXIAL (S) TEST RESULTS (1977 - 1978)

MATERIAL	SAMPLE	$\bar{\phi}$ DEGREES	$\bar{c}$ PSI
COARSE REFUSE	REMOLDED γ=90	31.8	3.2
COARSE REFUSE	REMOLDED γ=95	34.0	1.6
COARSE REFUSE	REMOLDED γ=100	33.3	3.3
COARSE REFUSE	REMOLDED γ=110	34.5	7.4

APPENDIX VII

STABILITY ANALYSIS SUMMARY

by

ORBITAL ENGINEERING, INC.

STABILITY ANALYSIS

Computerized stability calculations were performed on the minimum (no berm) embankment configuration to evaluation the downstream stability of the proposed design profile. This profile is as described in L. Robert Kimball's 1976 and 1978 reports. The location of this particular embankment section is shown on Drawing E-782E-SK1. The geometry of the embankment section analyzed by OEI and the soil properties used to described the various material layers are presented on Drawings E-782E-SK3 and E-782E-SK4. The stability during a maximum probable seismic event was evaluated using an equivalent static horizontal load factor of 0.1g, an appropriate value for Seismic Risk Zone 2.

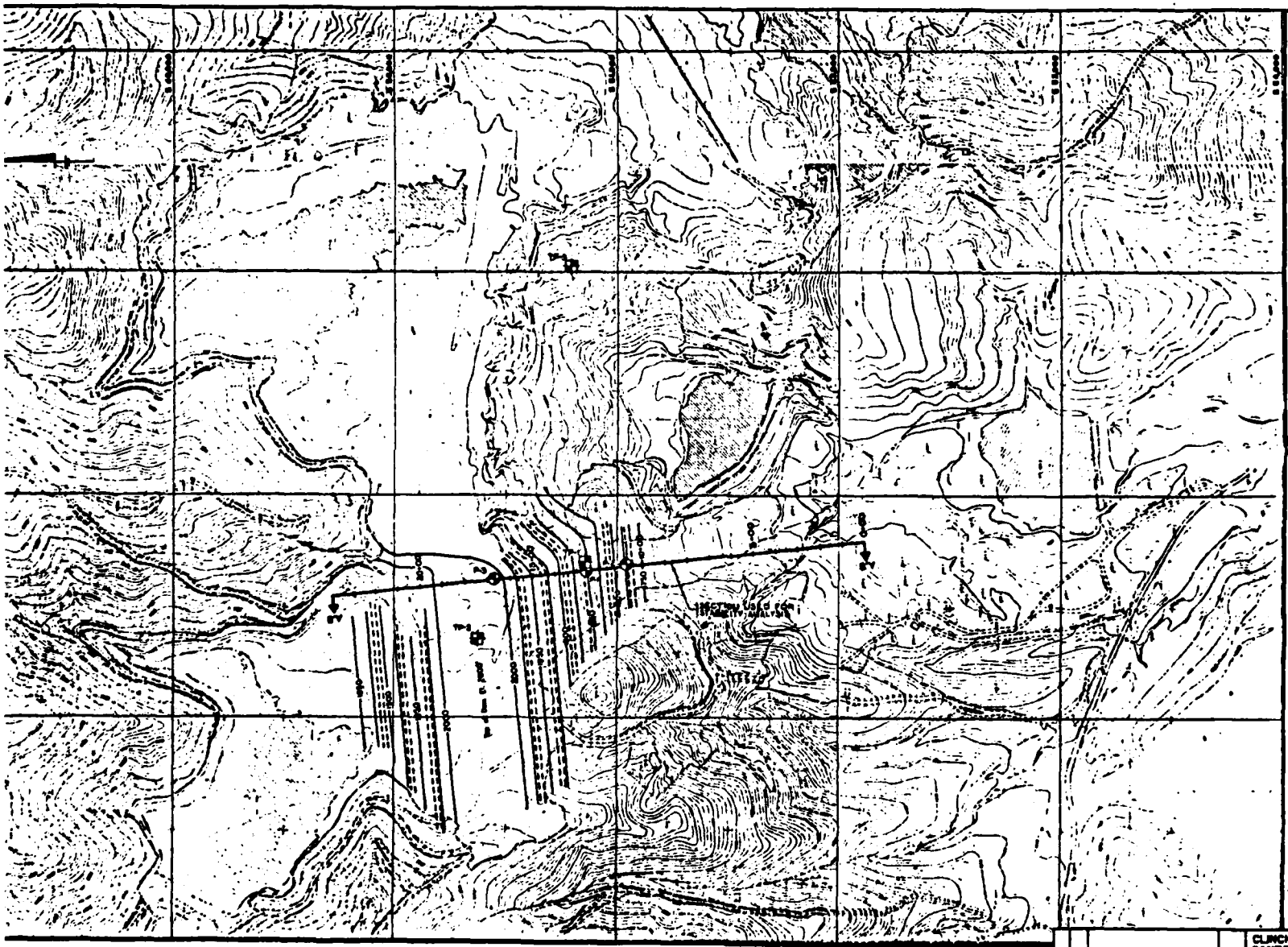
The ground water level used in this analysis was based on our engineering evaluation of the existing ground water conditions obtained from the most recent piezometer readings available (see Table 4). A plot of the water versus date based on the piezometer readings is presented in Figure 5. From this data, and from our engineering evaluation of expected steady state seepage conditions, of the configuration of the phreatic surface used in this analysis was conservatively estimated to be as presented on Drawings E-782E-SK3 and E-782E-SK4.

The stability calculations were carried out using McDonnell Douglas Automation Company (MCAUTO) computer facilities and the ICES slope and embankment stability program, SLOPE. Appendix C contains a description of this program.

An abbreviated summary of the results of these calculations is presented in Table 5 and on Drawings E-782E-SK3 and E-782E-SK4. As these results suggest, the analysis indicates that the minimum factor of safety for static conditions is about 1.58, and corresponds to a localized, surficial, circular arc type failure along the downstream slope. For the more critical type of failure condition involving a relatively deep-seated, circular arc type failure mode encompassing all, or a substantial portion, of the embankment downstream slope, the minimum factor of safety for static conditions is 1.69.

For seismic conditions, the minimum factor of safety is about 1.22; for a localized, surficial failure mode, and about 1.29 for the more critical deep-seated failure mode.

Consideration was given to analyzing the proposed embankment profile for a wedge type failure mode, but such an analysis was discounted because the rock profile is not conducive to this type of failure.



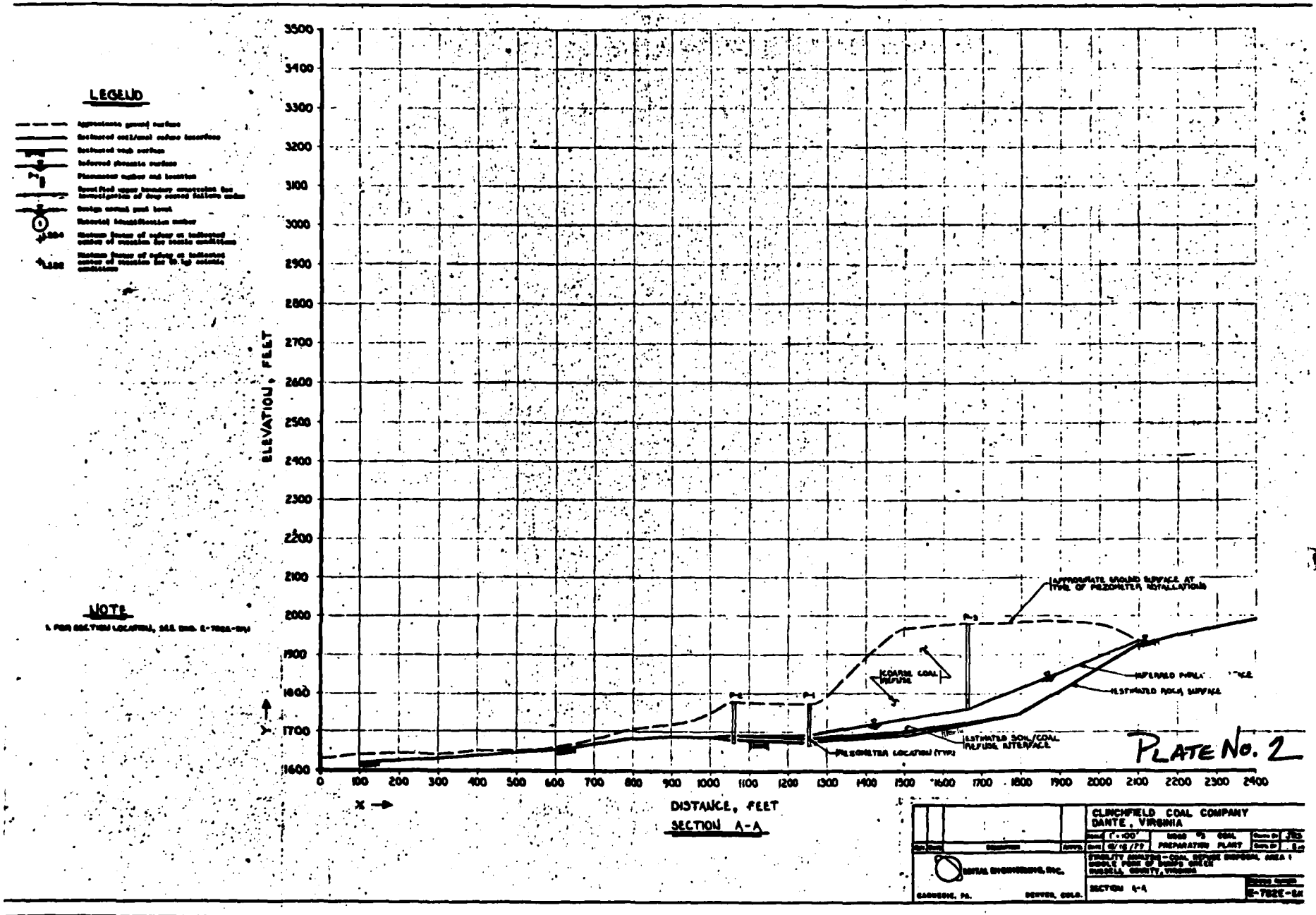
LEGEND

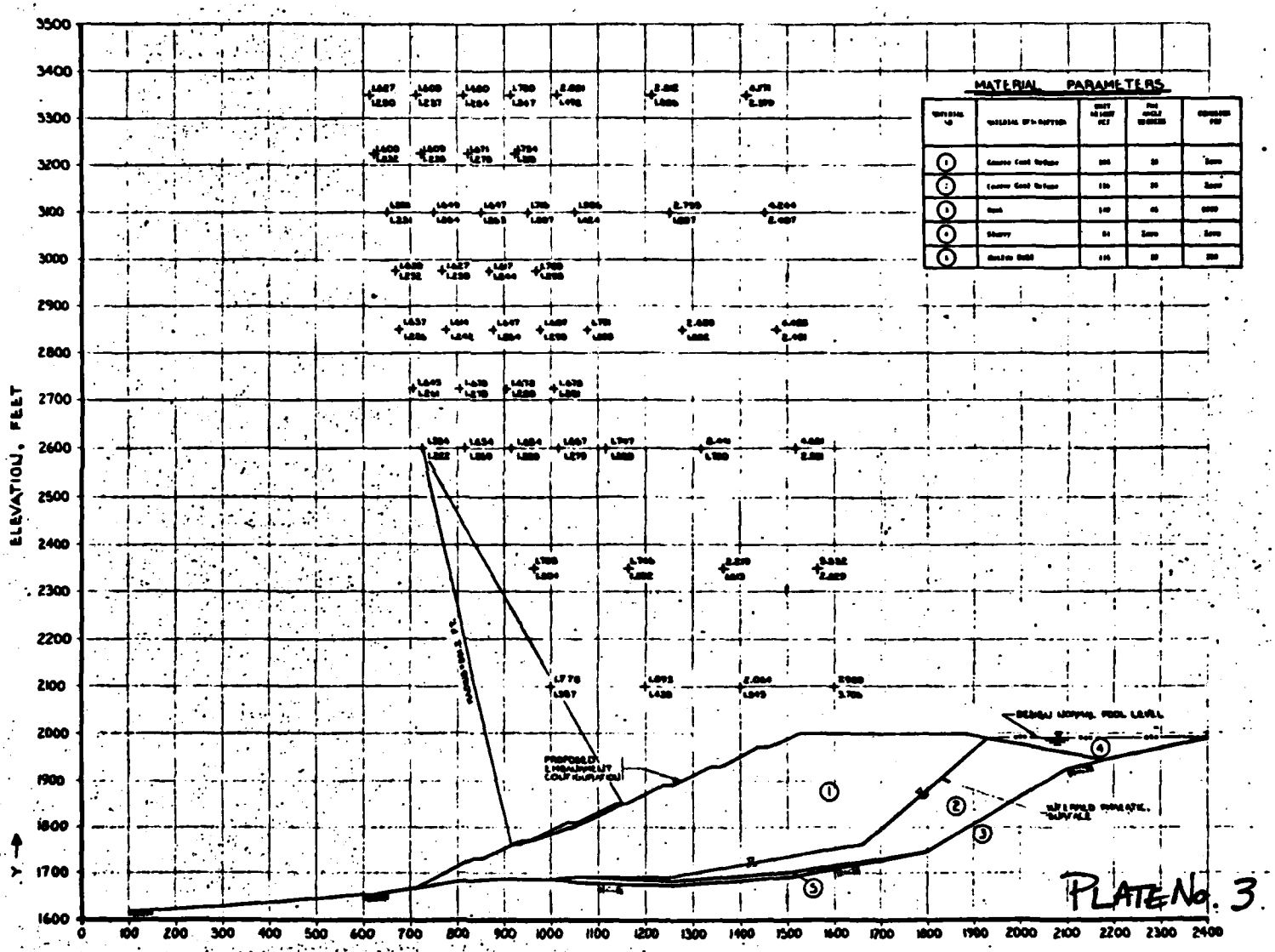
NOTES

SITE PLAN

PLATE No. 1

CLINCHFIELD COAL COMPANY
DANTE, VIRGINIA

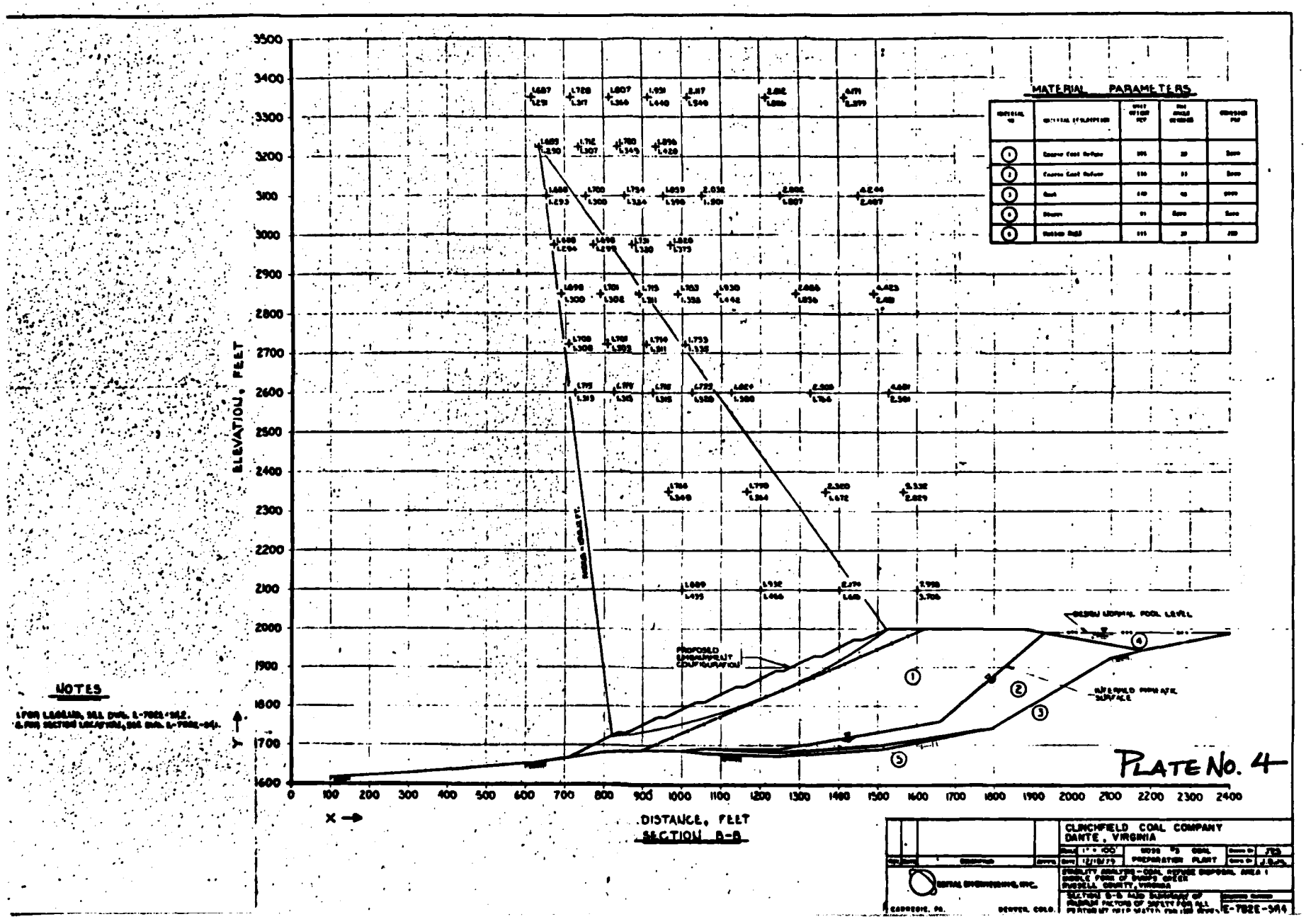

LEGEND
NOTE
ELEVATION, FEET
DISTANCE, FEET
SECTION A-A
COARSE COAL REFUSE
ESTIMATED SOIL/COAL REFUSE INTERFACE
ESTIMATED ROCK SURFACE
PIEZOMETER LOCATION (TYP.)
P-1
P-2
P-3
CLINCHFIELD COAL COMPANY
DANTE, VIRGINIA
PREPARATION PLANT
SECTION A-A
PLATE No. 2



NOTES

PLATE No. 3

CLINCHFIELD COAL COMPANY
DANTE, VIRGINIA


MATERIAL PARAMETERS
ELEVATION, FEET
DISTANCE, FEET
X →
Y ↑
PROPOSED EMBANKMENT CONFIGURATION
NOTES
SECTION B-B
PLATE No. 4
CLINCHFIELD COAL COMPANY
DANTE, VIRGINIA
E-782E-5M4

APPENDIX VIII-REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.
2. Design of Small Dams, U. S. Department of Interior, Bureau of Reclamation, 1974, 816 pp.
3. The Geology and Coal Resources of Russell County, Virginia, Bulletin No. 22, C. K. Wentworth, Virginia Division of Mineral Resources, 1922, 179 pp.
4. Hydrometerologic Report No. 33, U. S. Department of Commerce, Weather Bureau, U. S. Department of Army, Corps of Engineers, Washington, D.C., April 1956.
5. Engineering Report for Remedial Modification to the Existing Slurry Pond for Moss #3 Coal Refuse Disposal Area on Middle Fork of Dumps Creek; Clinchfield, Russell County, Virginia, Clinchfield Coal Company, Dante, Virginia; November, 1978
6. *Slope Stability Evaluation at Area 1, Moss #3 Coal Preparation Plant for Clinchfield Coal Company, Dante, Virginia, Orbital Engineering, Inc., Carnegie, Pennsylvania, December, 1979.
7. Calculation Brief, Proposed Upstream Slurry Retention Dam, Middle Fork of Dumps Creek, Russell County, Virginia, Orbital Engineering, Inc., Carnegie, Pennsylvania, November, 1978.

* Preliminary