INSPECTION REPORT

Sedimentation Structure

J3-E

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J3-E is an earthen embankment, designed and constructed in 1981 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Black Mesa Mine. The location of Structure J3-E is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J3-E. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure J3-E was inspected on August 29, 1985 by an inter-disciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the J3-E project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

Peabody Coal Company. The survey data developed in August 1984 was used in the analyses of the structure. Results of the field inspection are included in this report as Appendix A.

SITE DESCRIPTION

LAND USE

Structure J3-E has a 239.2-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 41% Pinion/Juniper, 29% Sagebrush/grass, 16% reclaimed, and 14% disturbed.

EMBANKMENT

Structure J3-E is a homogeneous earthen embankment classified as a cross-valley embankment. Physical characteristics of the embankment are listed in the following table:

Structure J3-E

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	18.4 ft
Crest Width	15 ft
Upstream Slope	2.6 H : 1 V
Downstream Slope	3.3 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J3-E, A-A'.

ANALYSES

STABILITY

Structure J3-E is a category A-1 embankment. A standard category A-1 embankment has static and seismic factors of safety equal to or greater than 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 30 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 4.25 H : 1 V
4. Normal pool with steady seepage saturation conditions

The upstream slope is lower in height, and flatter than the design criteria. The downstream slope is steeper than the category standard; therefore, the embankment has factors of safety less than the design minimum.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J3-E is located downstream from Structure WW-5. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for J3-E was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure J3-E was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

		10-year, 24-hour Storm	100-year, 6-hour Storm	
1.	Water Course length, L	0.97	0.97	mi
2.	Elevation Difference, H	160	160	ft
3.	Time of Concentration, T_c . . .	0.355	0.355	h
4.	Lag time, $0.6T_c$	0.213	0.213	h
5.	SCS Curve Number	84	84	
6.	Rainfall Depth	2.1	2.4	in.
7.	Drainage Area	239.2	251.3	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the sedimentation structure, outflow from the structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table.

J3-E HYDRAULICS

	Units	10-year 24-hour Storm	100-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	217	382
Volume	acre-ft	15.9*	20.7
Storage			
Peak Stage	ft	6530.84	--
Spillway Elevation . .	ft	6530.30	--
Peak Storage	acre-ft	--	--
Storage Capacity . . .	acre-ft	13.0	--
Outflow			
Peak Flow	cfs	3	276
Embankment Crest Elevation	ft	--	6534.66
Peak Stage	ft	--	6533.27
Freeboard	ft	--	1.39

*Inflow volume for tributary drainage area between Structures J3-E and WW-5.

Spillway Channel

The existing spillway for J3-E has a trapezoidal channel with the following dimensions:

Channel depth	5.5 ft
Channel width	28 ft
Channel length	32 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	0 percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J3-E has a trapezoidal channel with the following dimensions:

Channel width	20 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	31 percent

Rock with a D50 of 10 inches provides some, but inadequate erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, J3-E.

The calculations for the sediment load entering Structure J3-E were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.249
3. Slope Factor, LS 2.735
4. Cover Factor, C 0.259
5. Erosion Control Factor, P 1.0

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. The existing storage capacity of J3-E and the results of the sediment inflow analysis are summarized in the following table.

J3-E STORAGE

Total Storage Capacity	13.0	acre-ft
10-year, 24-hour Storm Inflow	15.9	acre-ft
Available Sediment Storage Capacity . .	0	acre-ft
Sediment Inflow Rate	0.742	acre-ft/yr
Sediment Storage Life	0	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J3-E indicated that the geotechnical problems consist of rill erosion on the downstream slope and the right and left abutments; and a steep downstream slope. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The downstream slope should be flattened to 4.25 horizontal to 1 vertical to meet stability requirements.

HYDRAULICS

The spillway capacity of Structure J3-E is adequate but the storage capacity is inadequate. The structure does not have an adequate outflow channel. The storage capacity should be increased to 18.8 acre-feet by excavating the pond as shown on Plates 1 and 5. A trapezoidal outflow channel and a stilling basin should be constructed along the alignment shown in Plate 1. The channel and stilling basin profile is shown in Plate 4 and the required dimensions are shown in Plate 5 and Plate 6. The spillway, outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5.

Enlarging the storage capacity to 18.8 acre-feet gives additional sediment storage. The analysis of these conditions is summarized in the following table.

J3-E HYDRAULICS FOR EXCAVATED IMPOUNDMENT

	Units	10-year 24-hour Storm	100-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	217	382
Volume	acre-ft	15.9	20.7*
Storage			
Peak Stage	ft	6528.63	—
Spillway Elevation	ft	6530.3	--
Peak Storage	acre-ft	15.9	—
Storage Capacity	acre-ft	18.8	—
Available Sediment Storage Capacity	acre-ft	2.90	—
Sediment Inflow Rate	acre-ft/yr	0.742	--
Sediment Storage Life.	yrs	4	—
Outflow			
Peak Flow	cfs	0	276
Embankment Crest Elevation	ft	—	6534.66
Peak Stage	ft	--	6533.27
Freeboard	ft	—	1.39
Spillway Channel			
Flow Depth	ft	—	2.97
Critical Velocity.	fps	—	6.7
Manning's "n"		—	0.040
Outflow Channel			Section I / Section II
Slope	%	--	4 / 26
Normal Velocity.	fps	--	8.3 / 15.3
Normal Depth	ft	—	1.39 / 0.81
Manning's "n"		--	0.040 / 0.040

*Inflow volume for both tributary drainage areas of WW-5 and J3-E.

* * *

The following plates and appendix are attached and complete this inspection report.

Plate 1 - Site Plan J3-E

Plate 2 - Existing Maximum Cross Section J3-E, A-A'

Plate 3 - Volume-Elevation Curve J3-E

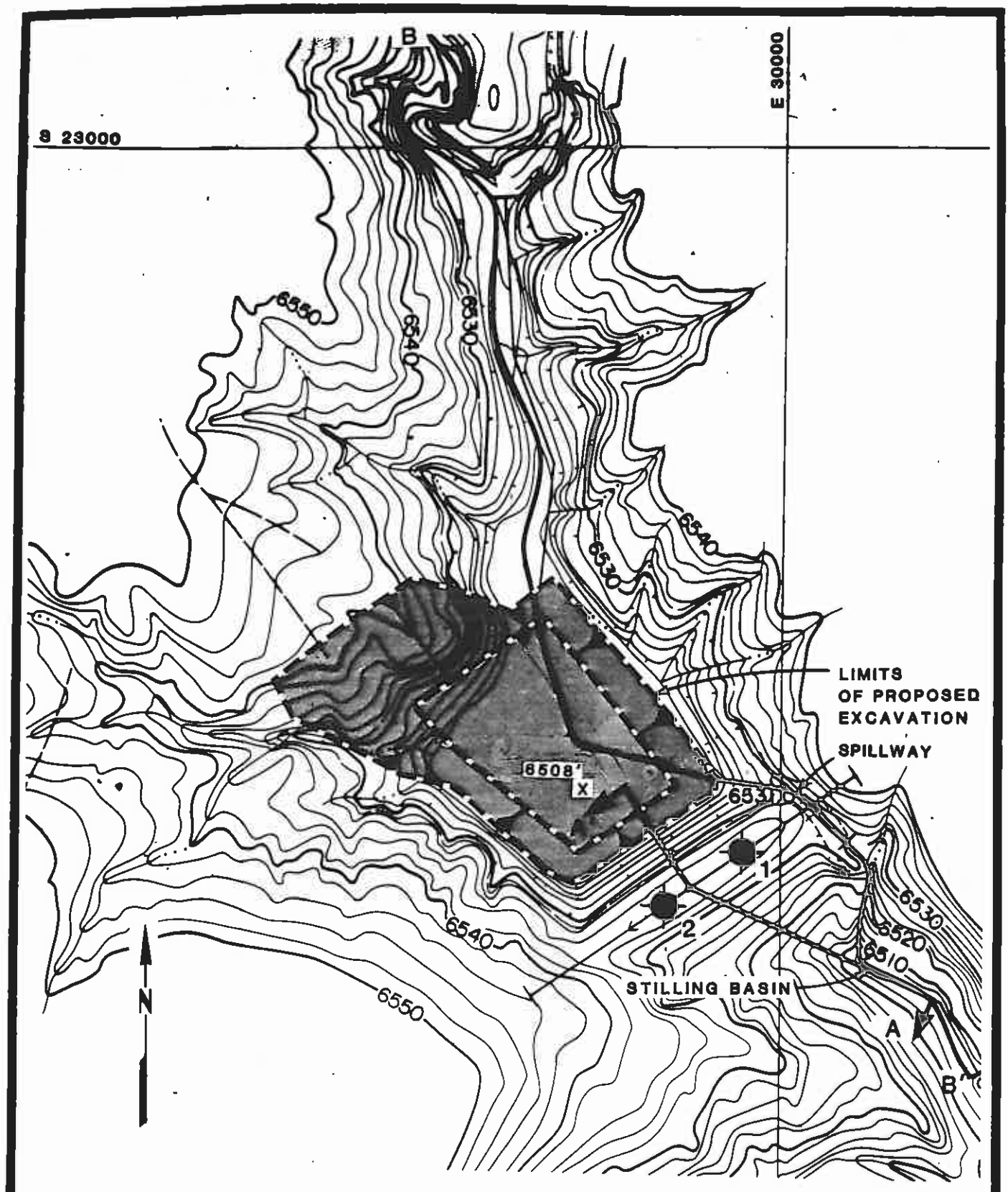
Plate 4 - Channel Profile J3-E, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J3-E

Plate 6 - Spillway Stilling Basin Plan J3-E

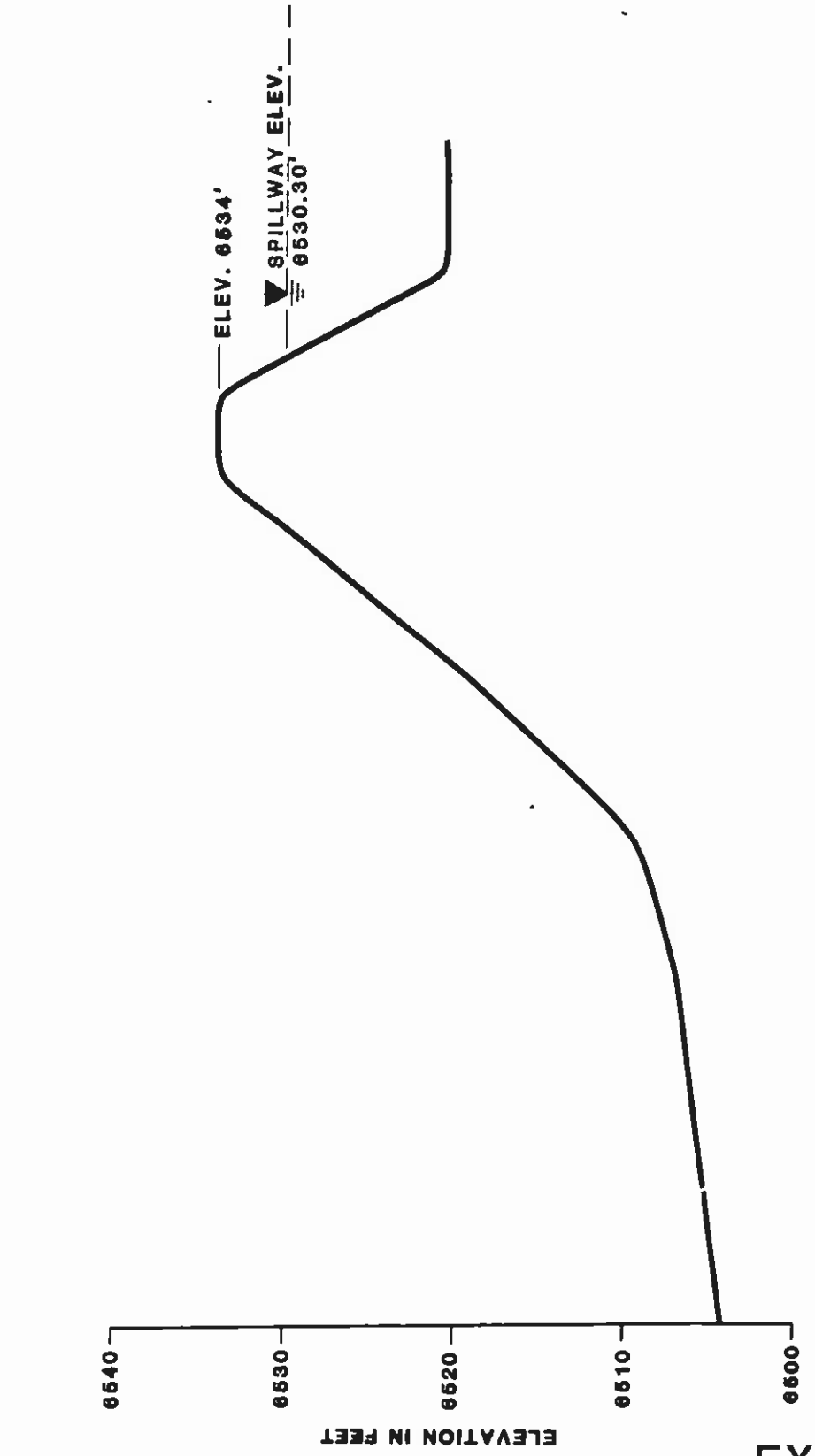
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J3-E

BY **Dames & Moore** Plate 1



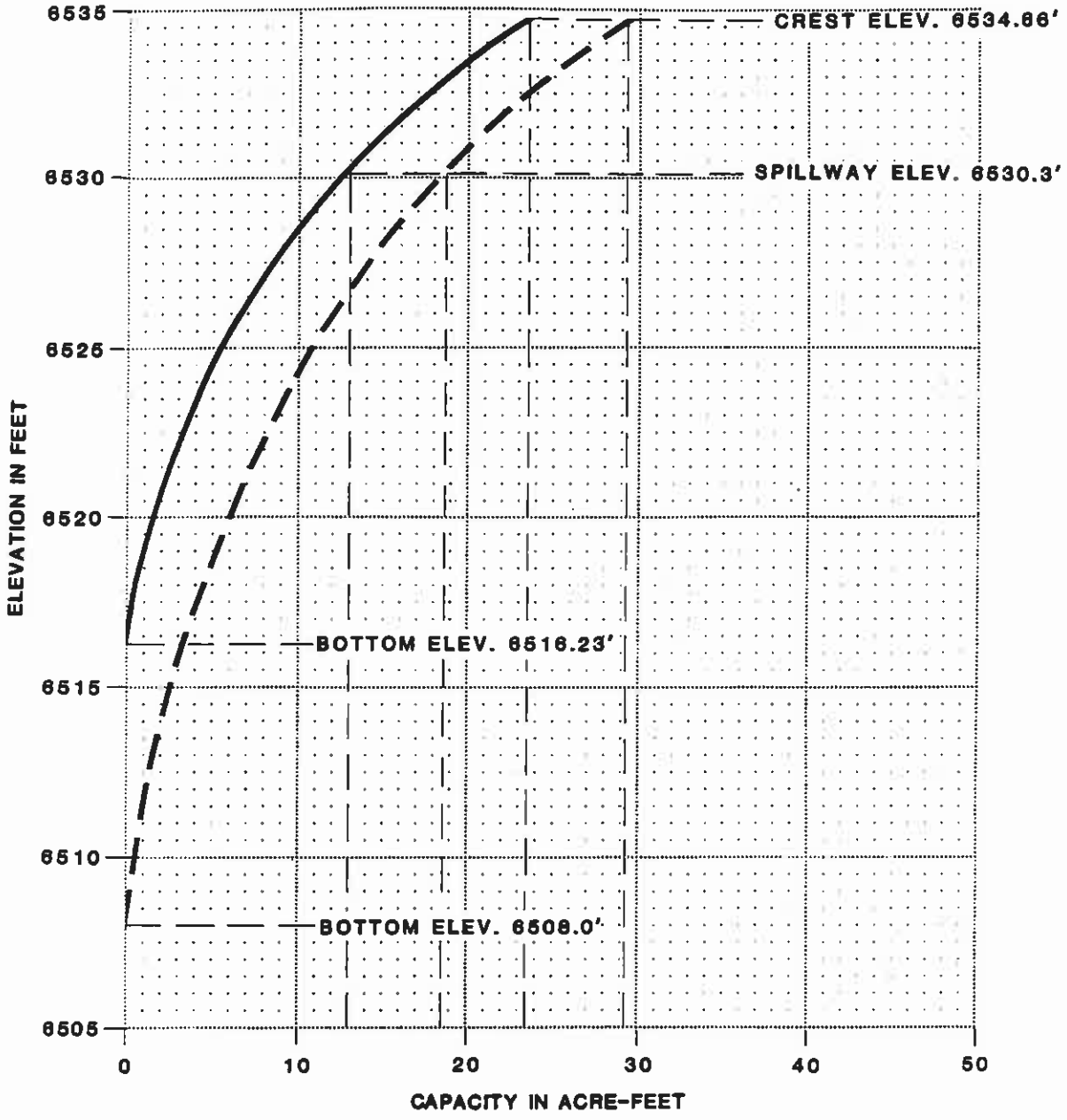
SCALE
0 50 100
FEET

EXISTING MAXIMUM CROSS-SECTION A-A' J3-E

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

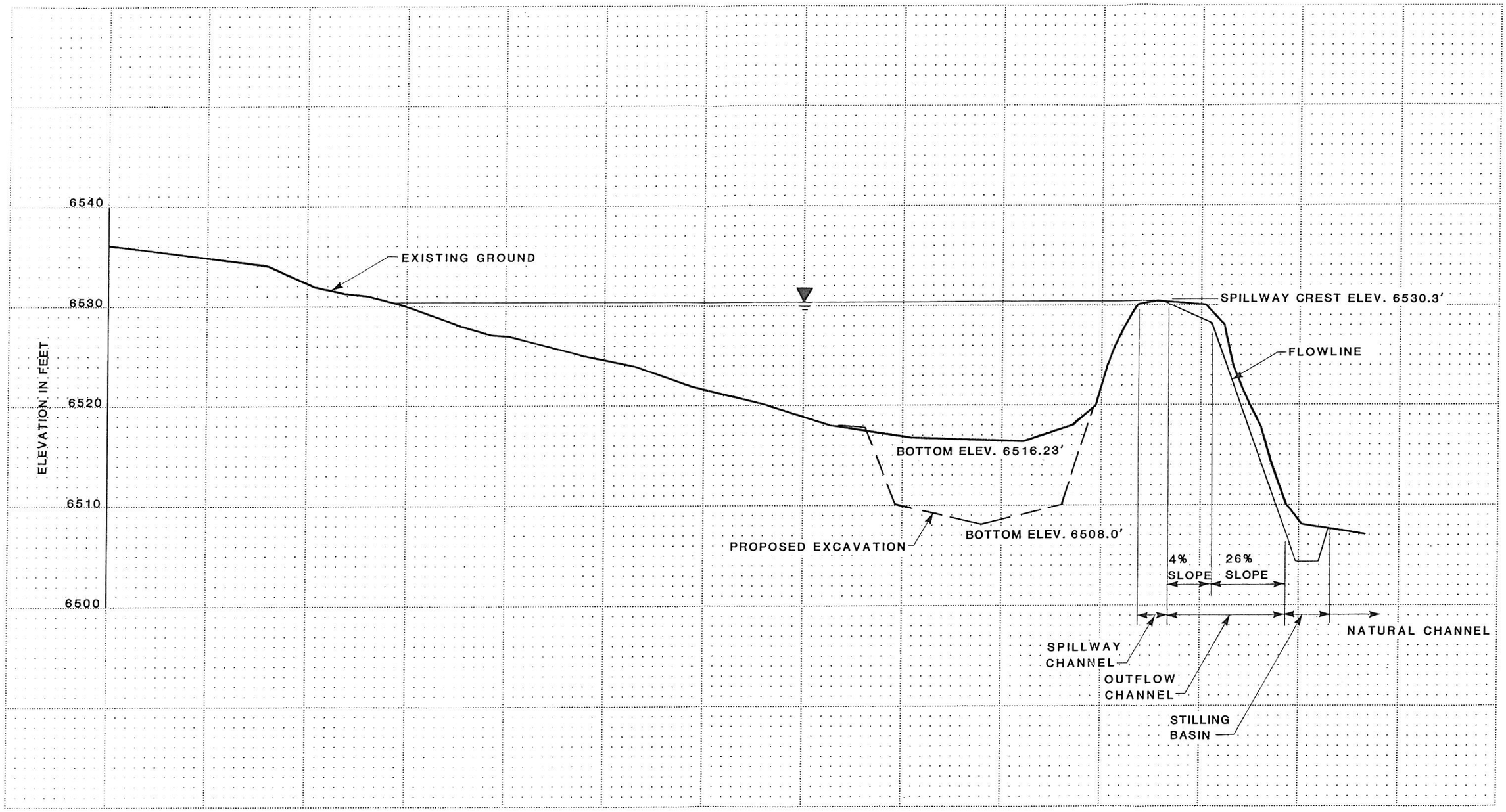
Plate 2



EXISTING VOLUME
PROPOSED VOLUME

VOLUME-ELEVATION CURVE J3-E

BY **Dames & Moore** Plate 3

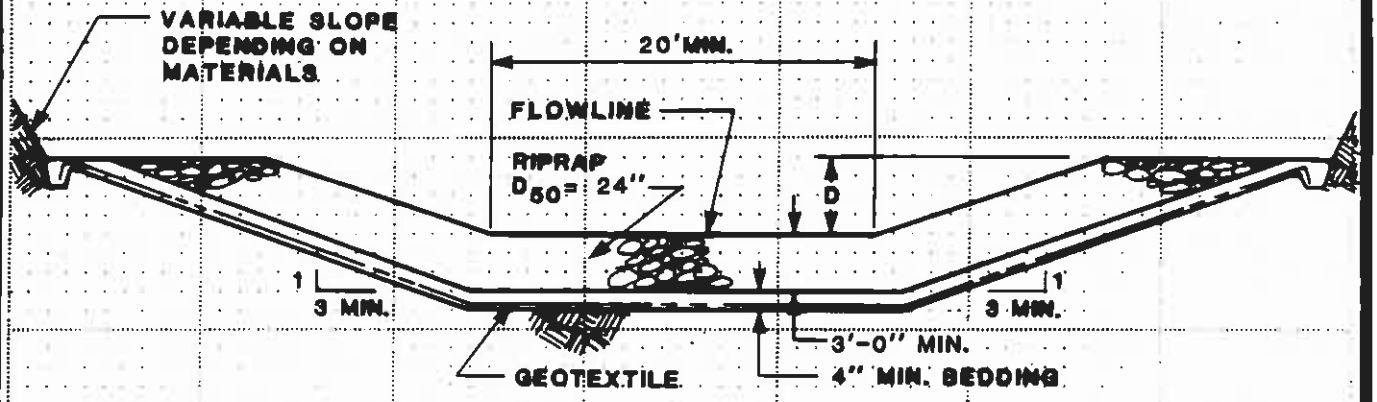


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
J3-E

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SPILLWAY CHANNEL

D = 4.0'

LENGTH = 30'

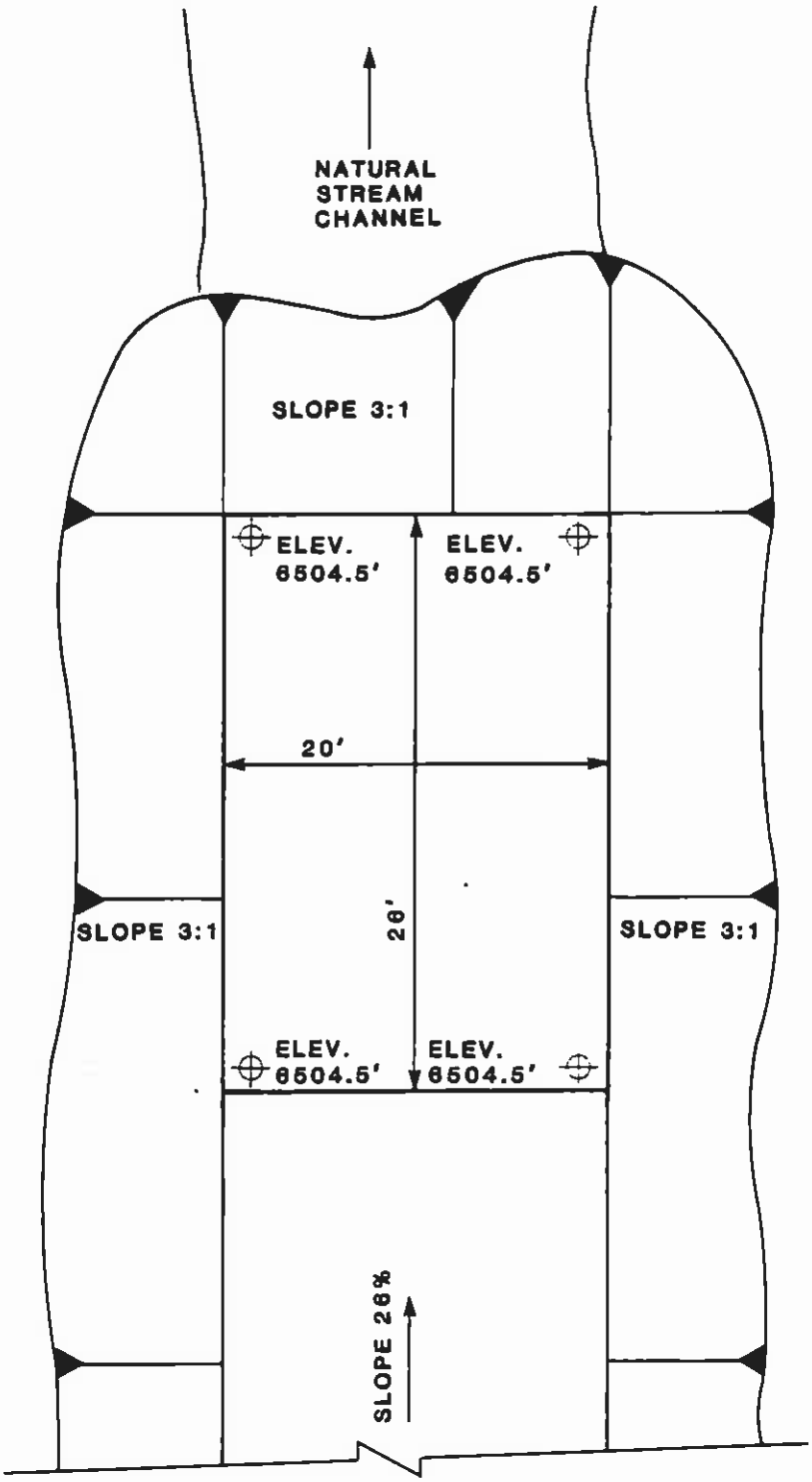
FLOWLINE ELEV. = 6530.30'

OUTFLOW CHANNEL

D = 2.6'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J3-E

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP ALONG SIDEWALLS ABOVE THE BASIN FLOOR = 7.3'

MINIMUM DEPTH OF BASIN FLOOR BELOW NATURAL STREAMBED = 3.5'

SPILLWAY STILLING BASIN PLAN J3-E

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			21° 2.6 to 1
a. Adequate grass cover?			NA
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?			NA
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			17° 3.25 to 1
a. Adequate grass cover?			NA
b. Any erosion?	X		Rills 40%
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?			IRREGULAR SLOPE SURFACE
g. Visual settlements?		X	
h. Is the toe drain dry?			NA
i. Are the relief wells flowing?			NA
j. Are boils present at the toe?		X	
k. Is seepage present?	X		
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?	X		Minor AT CONTACT
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			SM over shallow bedrock Reddish brown
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Rills Perpendicular (in line with crest
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			gray sm with rock

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankments?			
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:			
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		Rock 10"
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			NA
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

8. GENERAL COMMENTS

Impoundment

No Sinkholes

Water present 8.1' below spillway

Juniper/Pinion Bush 25% density

Watershed disturbance 25% dis.

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J3-E SHEET ___ OF ___

REVISIONS
BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6690 - 6530 = 160'

WATER COURSE LENGTH = 5100' = 0.97 mi

$T_c = \left(\frac{11.9\,(0.97)^3}{160}\right)^{0.385} = 0.355$ hr.

LAG TIME = $0.6\,T_c$ = 0.213 hr

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
(16%)	RECLAIM (pre law)		D	87 (.16)
(14%)	DIST. GRAV.		C	89 (.14)
(41%)	P-J	average	D	83 (.41)
(29%)	S-G	average	D	79 (.29)
				83.32

(Note: disturbed area is EH #37)

35% EH #32 - C
35% EH #33 - D
20% EH #35 - D
10% EH #34 - D

use 84

DRAINAGE BASIN AREA

239.2 AC. 0.374 SQ. MI.

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE TOMBOY COAL CO 10159-01-EE
SUBJECT SEDIMENT INFLOW
J3-E SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

K = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =			
	16%	reclaimed	.16 (.42)
	35%	EH 32	.35 (.21)
	35%	EH 33	.35 (.22)
	14%	EH 34	.14 (.22)
			.249

K = .249

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
900	70	7.8	2.9 (.20)
500	80	16.0	6.4 (.10)
1300	90	6.9	3.0 (.20)
500	60	12.0	4.0 (.10)
900	30	3.3	.62 (.10)
500	30	6.0	1.51 (.3)

use 2.735

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
16%	reclaimed	—	—	.16 (.15)
14%	disturbed	—	—	.14 (1.0)
41%	P-J	40	25	.41 (.14)
29%	S-G	40	25	.29 (.13)
				C = .259

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.249)(2.735)(.259)(1.0) = 7.055$ ton/acre/year

$A = 7.055\left(\frac{1}{2047}\right)(239.2)(.9) = .742$ acre-feet/year

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

Dan.es & Moore