INSPECTION REPORT

Sedimentation Structure

J3-A

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Approach Channel	6
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	7
REMEDIAL COMPLIANCE PLAN	8
GEOTECHNICS	8
HYDRAULICS	8
APPENDIX A - INSPECTION CHECK LIST	
APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure J3-A is an earthen embankment, designed and constructed in 1979 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-A is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J3-A. 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-A was inspected on September 4, 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-A 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-A has a 62.9-acre tributary drainage area and is located near Coal Mine Wash at the Black Mesa Mine. The watershed is classified as 84% reclaimed and 16% Sagebrush/grass.

EMBANKMENT

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

Structure J3-A

Embankment	Residual Sandstone Soils
Foundation	Sandstone
Right Abutment	Sandstone
Left Abutment	Sandstone
Height	11.7 ft
Crest Width	13 ft
Upstream Slope	3.3 H : 1 V
Downstream Slope	3.7 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J3-A, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure J3-A is a category A-5 embankment. A standard category A-5 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 15 ft
2. Maximum upstream slope = 1.75 H : 1 V
3. Maximum downstream slope = 3.25 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J3-A embankment is lower in height and has flatter slopes than the category standard; therefore, the embankment has factors of safety greater 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-A is not in series with any other structure and therefore the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure J3-A was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.386	mi
2.	Elevation Difference, H	71	ft
3.	Time of Concentration, T_c	0.168	h
4.	Lag time, $0.6T_c$	0.101	h
5.	SCS Curve Number	85	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	62.9	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.

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	86	103
Volume	acre-ft	4.59	3.93
Storage			
Peak Stage	ft	6529.74	6532.68
Spillway Elevation . .	ft	6531.42	6531.42
Peak Storage	acre-ft	4.59	--
Storage Capacity . . .	acre-ft	6.30	--
Outflow			
Peak Flow	cfs	0	35
Embankment Crest Elevation	ft	--	6533.84
Peak Stage	ft	--	6532.98
Freeboard	ft	--	0.86

Approach Channel

The existing approach channel for J3-A has a U-shaped channel with following dimensions:

Channel width	13 ft
Channel length	50 ft
Slope	8 percent

Spillway Channel

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

Channel depth	2 ft
Channel width	13 ft
Channel length	40 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	1 percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J3-A has a U-shaped channel with the following dimensions:

Channel width	13 ft
Channel length	210 ft
Side slopes (horizontal to vertical)	2:1
Exit slope	15 percent

There is presently no 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-A.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.39
3. Slope Factor, LS 0.83
4. Cover Factor, C 0.147
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-A and the results of the sediment inflow analysis are summarized in the following table.

J3-A STORAGE

Total Storage Capacity	6.30	acre-ft
10-year, 24-hour Storm Inflow	4.59	acre-ft
Available Sediment Storage Capacity . .	1.71	acre-ft
Sediment Inflow Rate	0.0555	acre-ft/yr
Sediment Storage Life	31	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J3-A indicated that the geotechnical problems consist of rill and gully erosion on the upstream and downstream slopes, the side slopes of the spillway channel and the bottom of the outlet channel; and a steep downstream slope. Correction of erosion is considered a periodic maintenance task and does not require remedial action. There is evidence of seepage through the foundation bedrock below the downstream toe of the embankment. Remedial action for this condition is not required at the present time, however, future inspections should check the condition for changes.

HYDRAULICS

The storage capacity of Structure J-3A is adequate but the spillway capacity is inadequate. The structure does not have an adequate outflow channel. The bottom elevation of the existing spillway channel should be lowered to elevation 6531.27 while maintaining the bottom width of 15 feet as shown on Plate 5. A trapezoidal outflow channel with the same bottom width as the spillway 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 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.

Lowering the spillway elevation to 6531.27 feet decreases the storage capacity and increases the freeboard. The analysis of these conditions is summarized in the following table.

J-3A HYDRAULICS FOR REDESIGNED SPILLWAY

	Units	10-year 24-hour Storm	25-year 6-hour Storm	
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation	
Inflow				
Peak Flow	cfs	86	103	
Volume	acre-ft	4.59	3.93	
Storage				
Peak Stage	ft	6529.74	6532.68	
Spillway Elevation	ft	6531.27	6531.27	
Peak Storage	acre-ft	4.59	--	
Storage Capacity	acre-ft	6.14	--	
Available Sediment Storage Capacity	acre-ft	1.55	--	
Sediment Inflow Rate	acre-ft/yr	0.0555	--	
Sediment Storage Life.	yrs	28	--	
Outflow				
Peak Flow	cfs	--	44	
Embankment Crest Elevation	ft	--	6533.84	
Peak Stage	ft	--	6532.68	
Freeboard	ft	--	1.16	
Spillway Channel				
Flow Depth	ft	--	1.41	
Critical Velocity.	fps	--	4.2	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	6	16
Normal Velocity.	fps	--	5.4	7.3
Normal Depth	ft	--	0.50	0.37
Manning's "n"		--	0.040	0.040

* * *

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

Plate 1 - Site Plan J3-A

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

Plate 3 - Volume-Elevation Curve J3-A

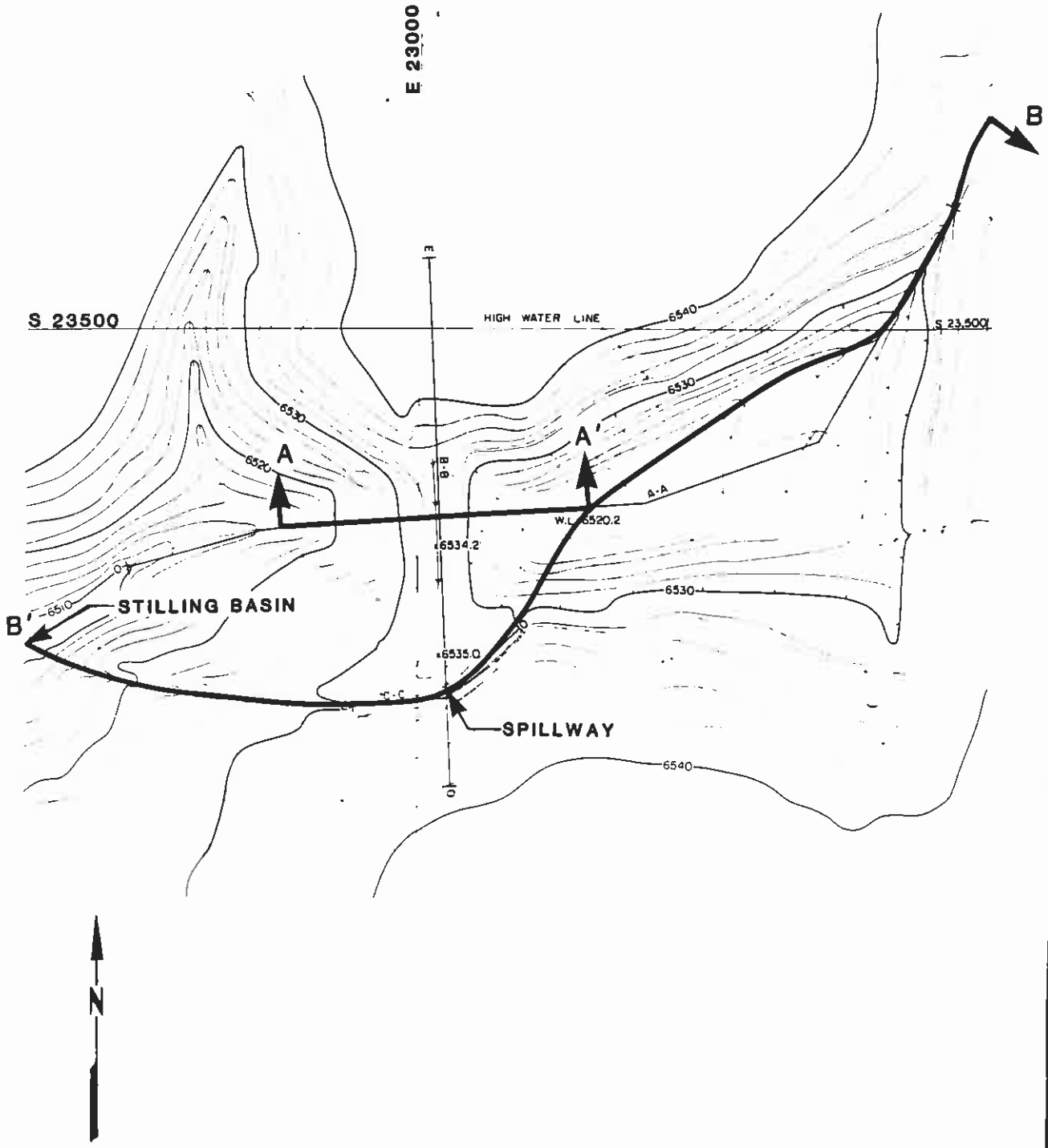
Plate 4 - Channel Profile J3-A, B-B'

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

Plate 6 - Spillway Stilling Basin Plan J3-A

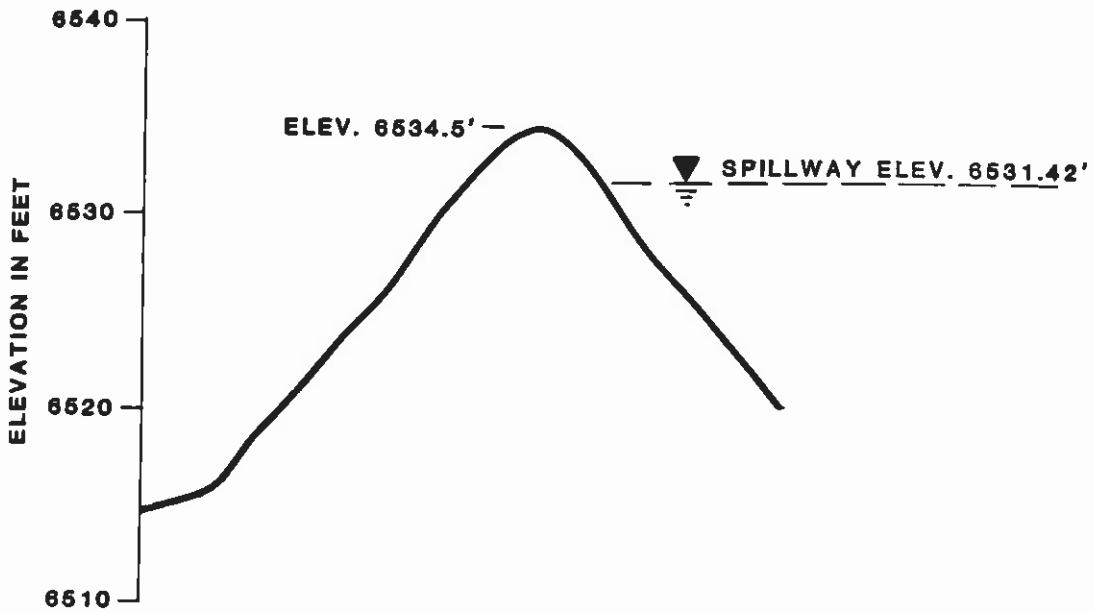
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J3-A

BY **Dames & Moore** Plate 1



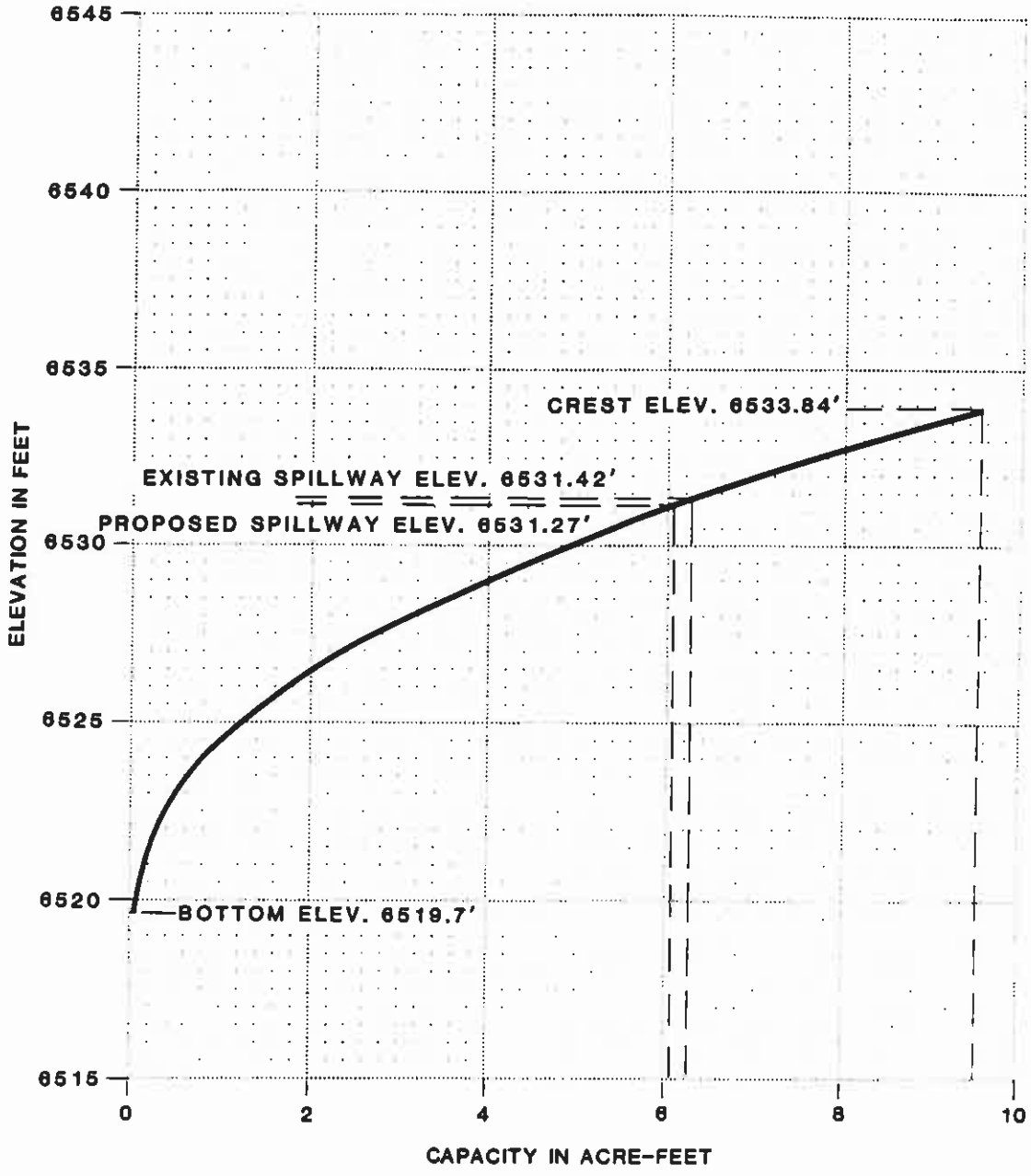
SCALE
0 50 100
FEET

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

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

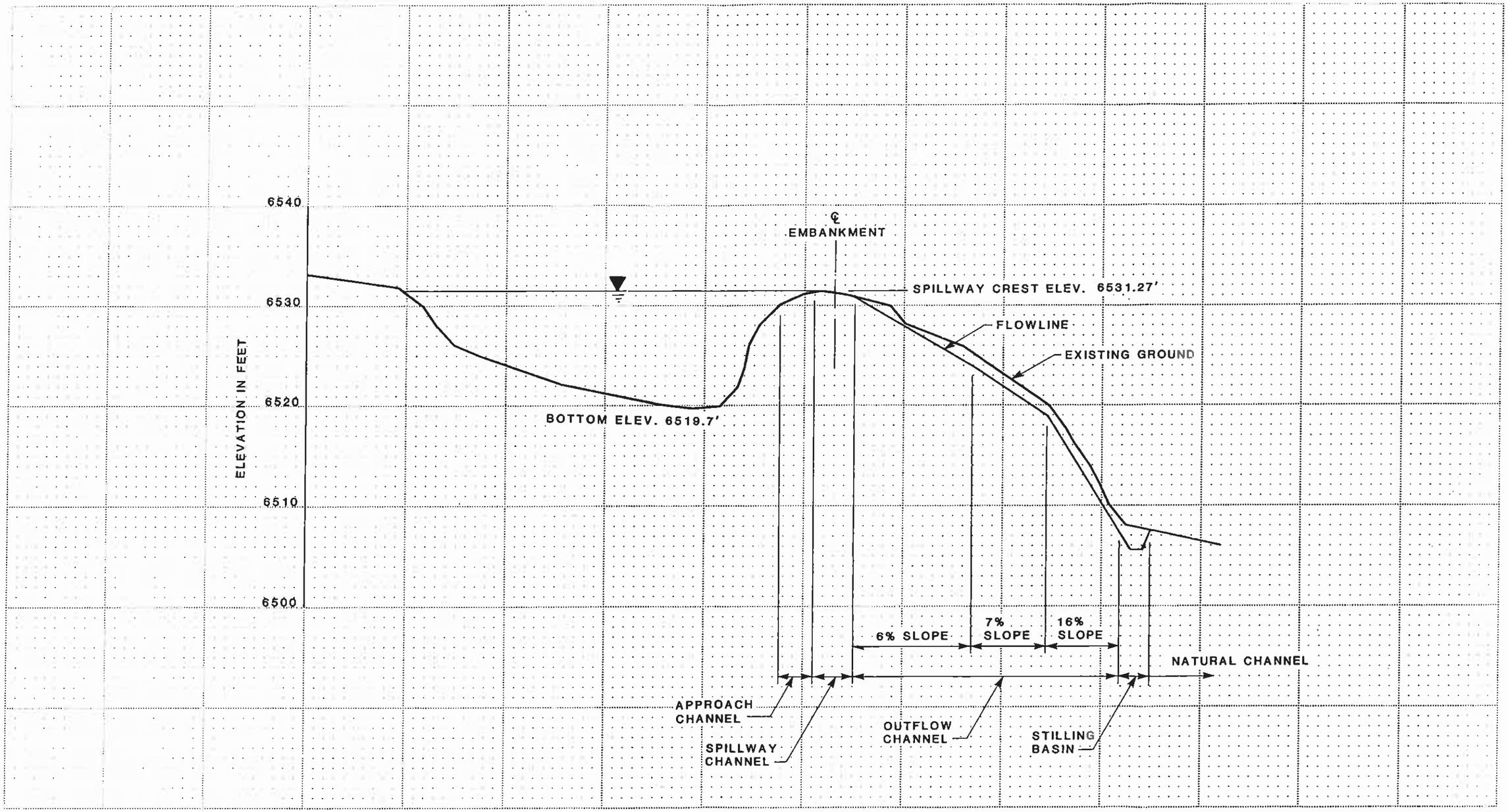
Plate 2



VOLUME-ELEVATION CURVE

J3-A

BY **Dames & Moore** Plate 3

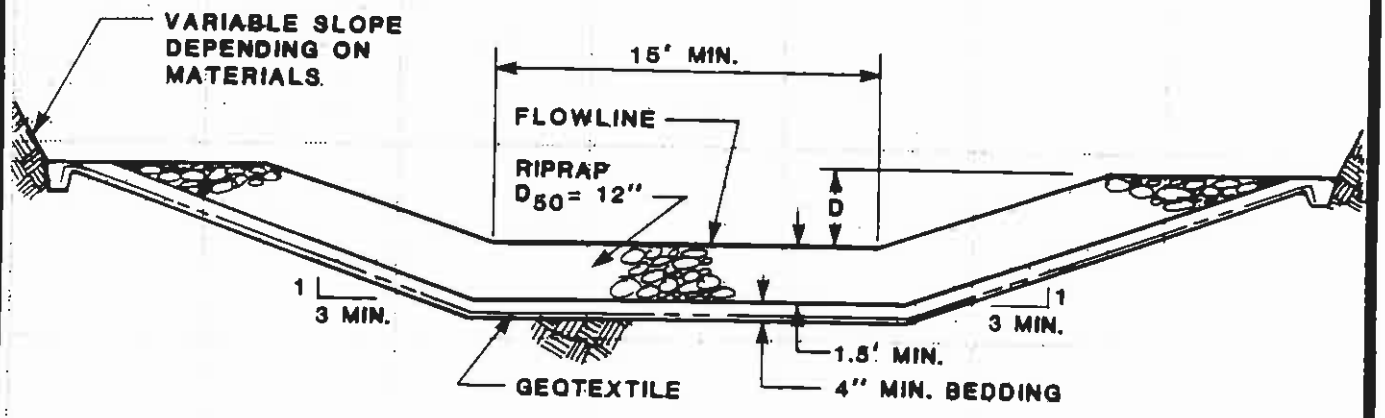


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
J3-A

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SPILLWAY CHANNEL

D = 2.5'

LENGTH = 40'

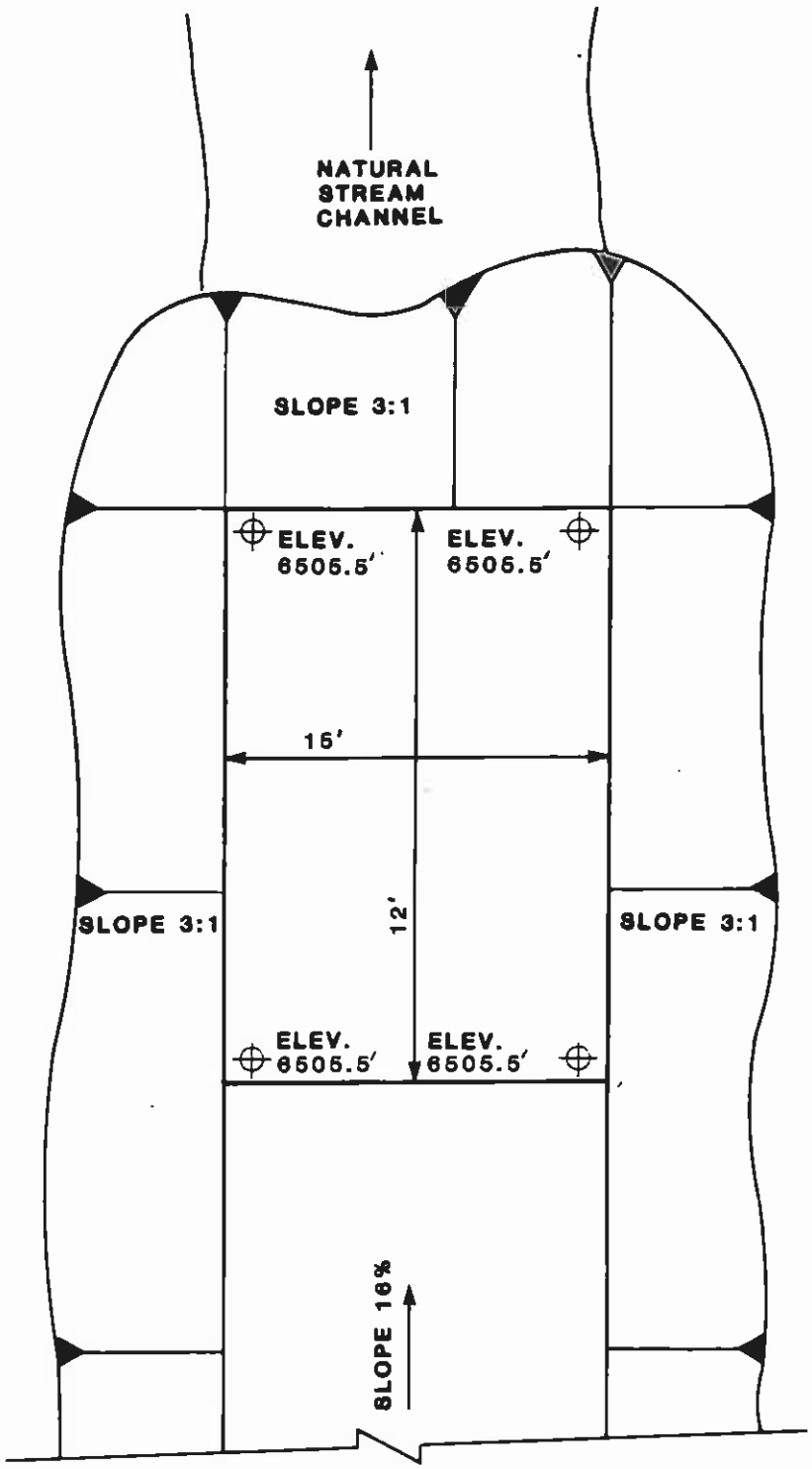
FLOWLINE ELEV. =6531.27'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J3-A

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 3.4'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAM BED = 1.8'

SPILLWAY STILLING BASIN PLAN
J3-A

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J3-A
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST VALLEY EMB.			13'
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			17°
a. Adequate grass cover?	X		50%
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			15°
a. Adequate grass cover?	X		90 %
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?		X	
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	Evidence of past seepage thru rock
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Rock
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Rock

Sediment Impoundment Name: J3-A
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankments?			50'L 13'W
b. Approach Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel: (2' below Crest)	X		13'W 40'L
Are side slopes eroding?	X		Gulleys on LA.
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		210'L 15'W
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		Gulley towards bottom
Obstructed?		X	
Erosion protection?		X	
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?			

ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?		X	(Elev.) feet
b. Water present?	X		(Elev.) feet
c. Siltation?	X		V. Minor
d. Watershed matches soil map?		X	Reclaim

9. GENERAL COMMENTS

OK

CANOPY COVER 5

GROUND COVER 100

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10134 011-22
SUBJECT SEDIMENT POND HYDROLOGY
J3-A SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6602 − 6531 = 71 ft.

WATER COURSE LENGTH = 5.1 (400) = 2040 ft. = 0.386 mi.

$$T_c = \left(\frac{11.9\,(0.386)^3}{71}\right)^{0.385} = 0.168 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.101 hr

SCS CURVE NUMBER

DRAINAGE AREA (ac)		COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
53.1	(84%)	RECLAIMED (Pre law)		C	0.84 (87) = 73.1
9.8	(16%)	S-G	ave	C	0.16 (73) = 11.7
				Ht #32	84.8

USE 85

DRAINAGE BASIN AREA

62.9 ACRE 0.098 SQ MILE

S. DOLAN DATE 9-9-85
CHECKED BY ___
COPY TO EO ___

FILE FEASBY .AL CO 10274-011-22
SUBJECT SEDIMENT INFLOW
J3A SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

K = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =			
84%	reclaimed	.84(.42)	
16%	EH #32	.16(.21)	
		.386	

K = .39

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
1800	65	3.6	.83

use .83

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
84%	reclaimed	—	—	.84(.15)
16%	S-G	40	25	.16(.13)
				C = .147

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.39)(.83)(.147)(1.0) = 1.9\phi$ ton/acre/year

$A = 1.9\left(\frac{1}{2047}\right)(62.9)(.95) = .0555$ acre-feet/year

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

Dames & Moore