INSPECTION REPORT

Sedimentation Structure

WW-3

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

INTRODUCTION

Sedimentation Structure WW-3 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 WW-3 is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure WW-3. 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 WW-3 was inspected on September 3, 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 WW-3 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 WW-3 has a 19.7-acre tributary drainage area and is located near Red Peak Valley at the Black Mesa Mine. The watershed is classified as 100% Pinion/Juniper.

EMBANKMENT

Structure WW-3 is a partially incised structure with a homogeneous earthen embankment. Physical characteristics of the embankment are listed in the following table:

Structure WW-3

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	8 ft
Crest Width	15 ft
Upstream Slope	2.5 H : 1 V
Downstream Slope	4.0 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section WW-3, A-A'. Grass provides erosion protection on the upstream slope of the embankment.

ANALYSES

STABILITY

Structure WW-3 is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 10 ft
2. Maximum upstream slope = 1.5 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The WW-3 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 WW-3 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 WW-3 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.333	mi
2.	Elevation Difference, H	250	ft
3.	Time of Concentration, T_c	0.087	h
4.	Lag time, $0.6T_c$	0.052	h
5.	SCS Curve Number	80	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	19.7	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.

WW-3 HYDRAULICS

	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	25	30
Volume	acre-ft	1.16	0.090
Storage			
Peak Stage	ft	6434.09	6450.95
Spillway Elevation . .	ft	6450.40	--
Peak Storage	acre-ft	1.16	--
Storage Capacity . . .	acre-ft	12.5	--
Outflow			
Peak Flow	cfs	0	2
Embankment Crest Elevation	ft	--	6452.00
Peak Stage	ft	--	6450.95
Freeboard	ft	--	1.05
Spillway Channel			
Flow Depth	ft	--	0.55
Critical Velocity. . .	fps	--	1.6
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	8
Normal Velocity. . . .	fps	--	1.8
Normal Depth	ft	--	0.07
Manning's "n"		--	0.040

Spillway Channel

The existing spillway for WW-3 has a trapezoidal channel with the following dimensions:

Channel depth	2 ft
Channel width	15 ft
Channel length	60 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	3 percent

Rock provides erosion protection within the channel.

Outflow Channel

The existing outflow channel for WW-3 has a trapezoidal channel with the following dimensions:

Channel width	15 ft
Channel length	50 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	8 percent

Rock provides 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, WW-3.

The calculations for the sediment load entering Structure WW-3 were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.22
3. Slope Factor, LS 10.90
4. Cover Factor, C 0.085
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 WW-3 and the results of the sediment inflow analysis are summarized in the following table.

WW-3 STORAGE

Total Storage Capacity	12.5	acre-ft
10-year, 24-hour Storm Inflow	1.16	acre-ft
Available Sediment Storage Capacity . .	11.34	acre-ft
Sediment Inflow Rate	0.075	acre-ft/yr
Sediment Storage Life	151	yrs

Excess storage capacity in Structure WW-3 can be used for storing water produced during maintenance of the nearby water well.

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure WW-3 indicated that the geotechnical problems consist of rill and gully erosion on the upstream slope and the right abutment and major undercutting of the upstream slope near the right

abutment. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The undercut section of the embankment, due to past discharges from the well pump, should be repaired by placement of compacted fill.

HYDRAULICS

The storage capacity and spillway capacity of Structure WW-3 are adequate. The spillway channel and outflow channel are protected with riprap. Therefore, no construction is required to bring the structure into compliance with the regulations. Plate 4 shows the existing spillway and outflow channel profile and Plate 5 shows the channel dimensions.

* * *

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

Plate 1 - Site Plan WW-3

Plate 2 - Existing Maximum Cross Section WW-3, A-A'

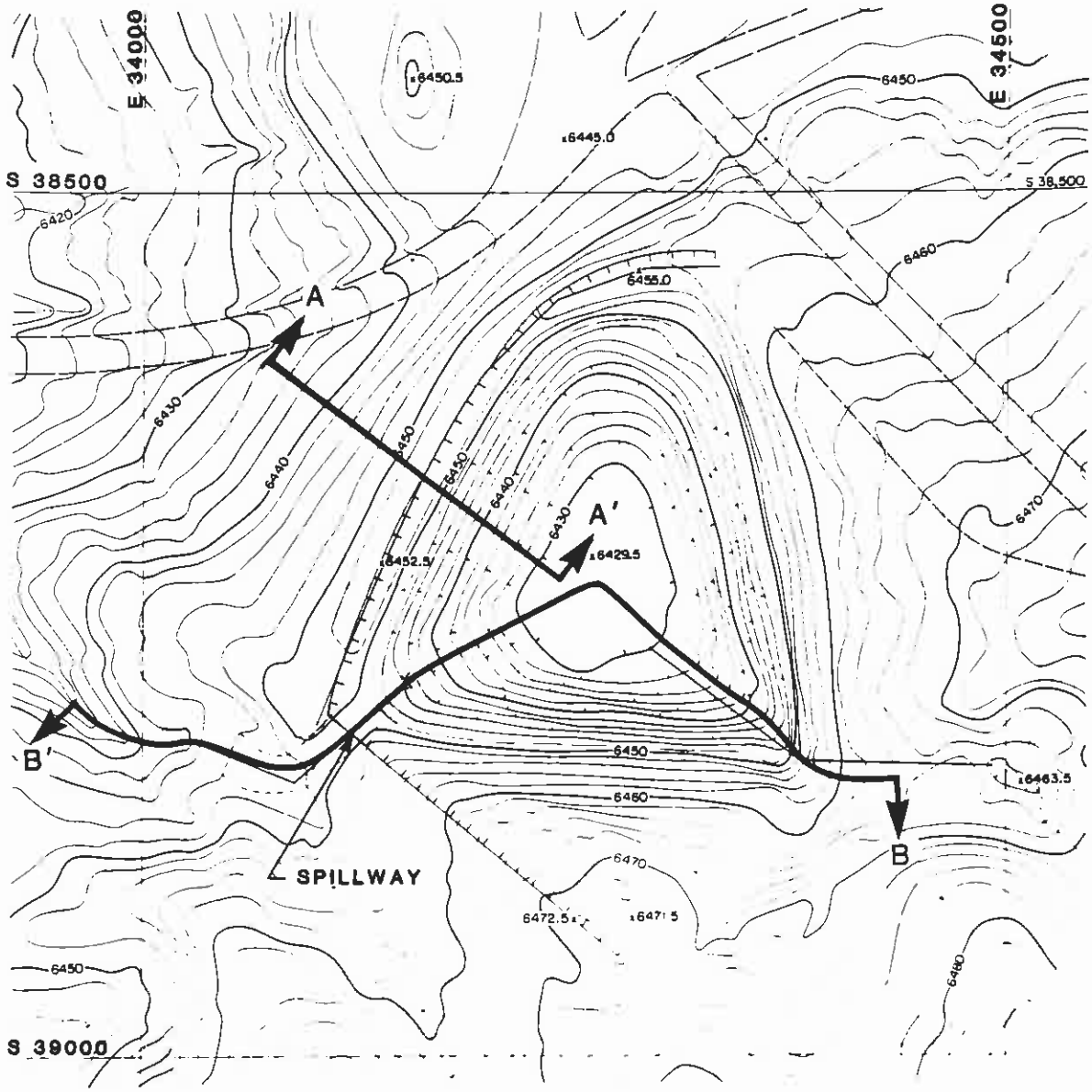
Plate 3 - Volume-Elevation Curve WW-3

Plate 4 - Channel Profile WW-3, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section WW-3

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SCALE
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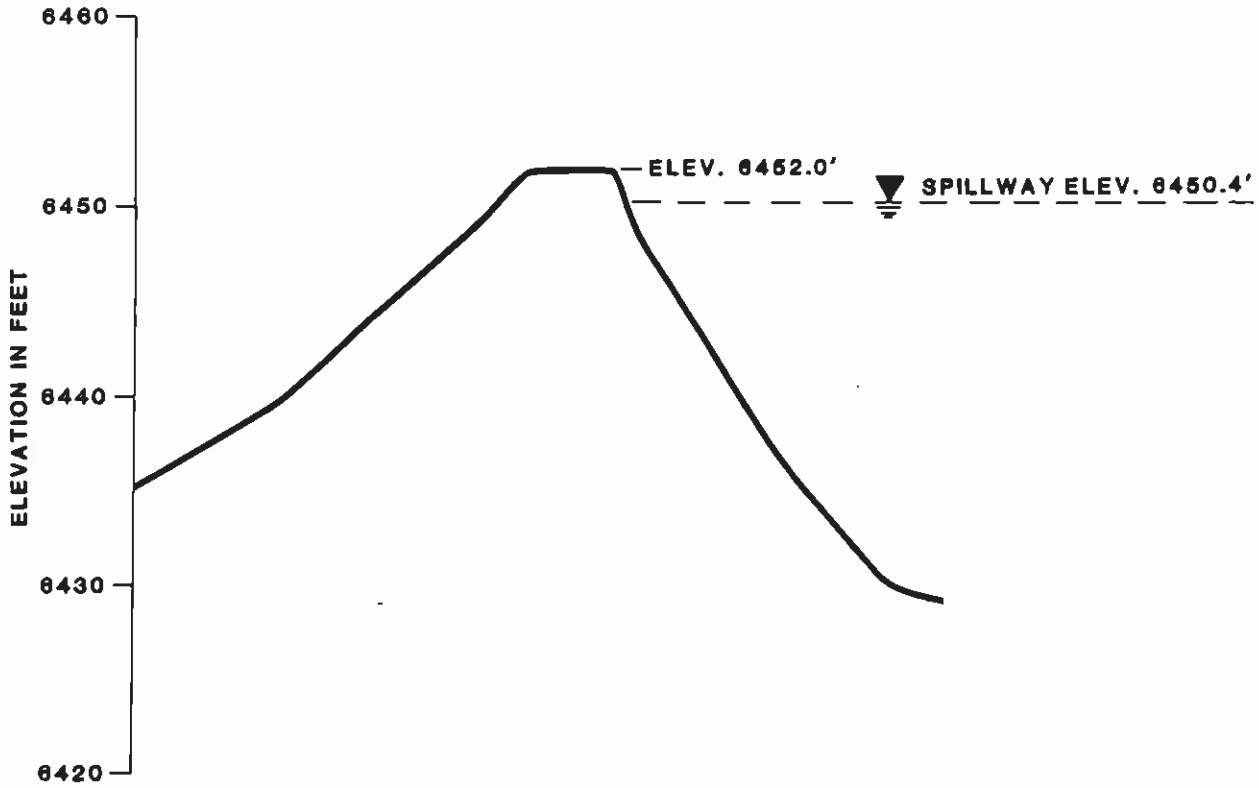
FEET

SITE PLAN
WW-3

BY **Dames & Moore** Plate 1



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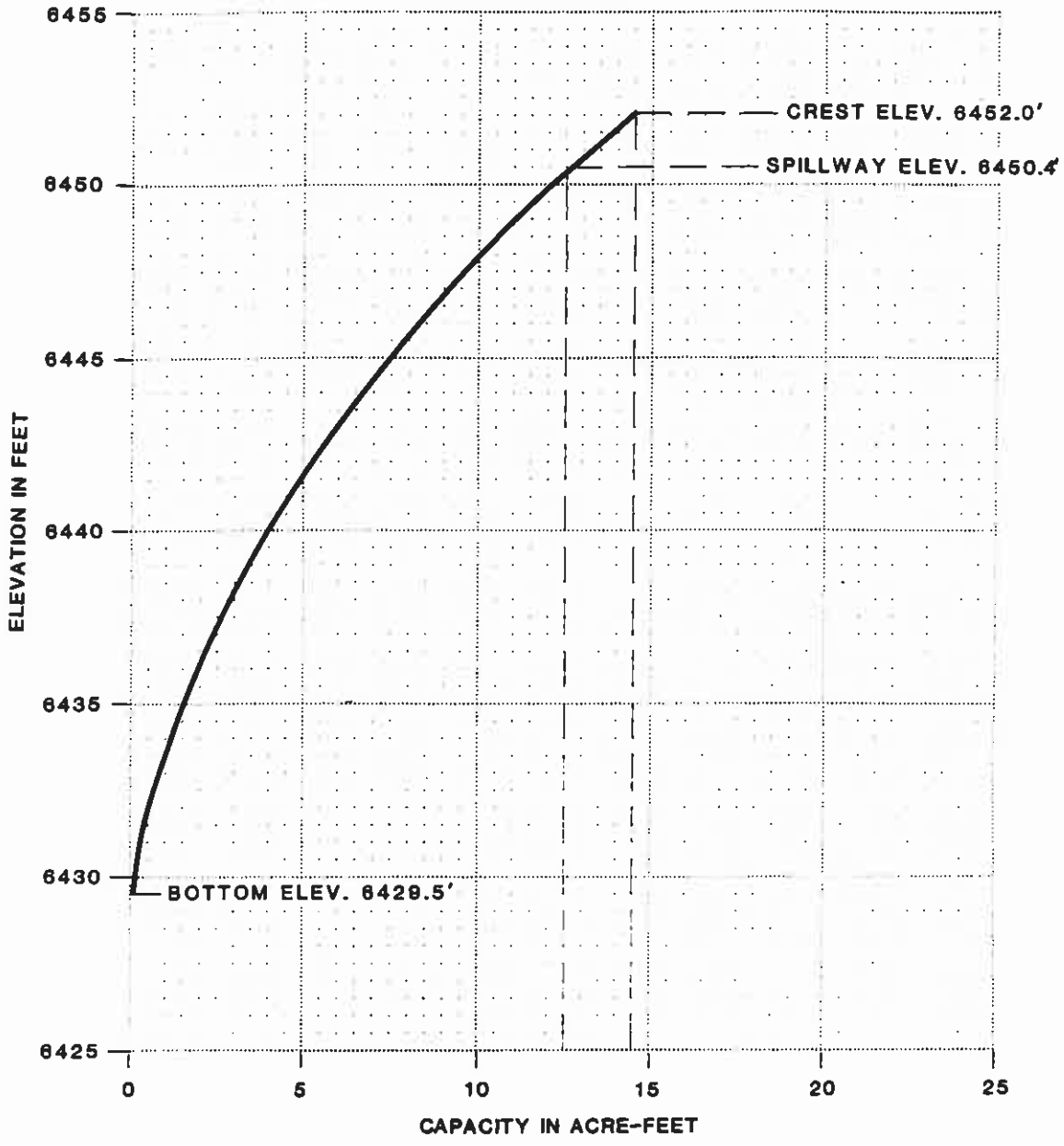
EXISTING MAXIMUM CROSS-SECTION A-A' WW-3

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

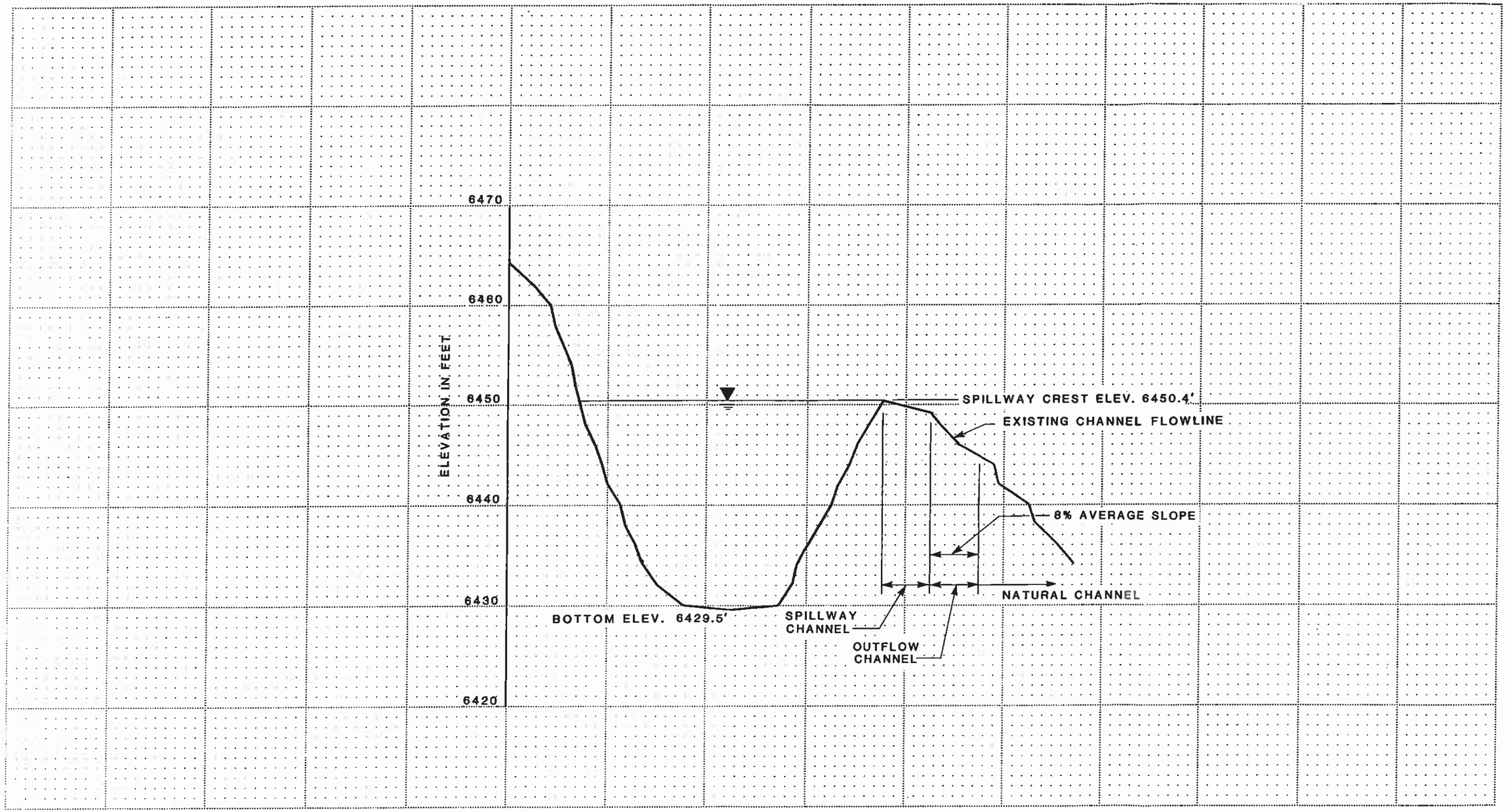
Plate 2



VOLUME-ELEVATION CURVE

WW-3

BY **Dames & Moore** Plate 3



SCALE
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FEET

CHANNEL PROFILE B-B'
WW-3

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: WW3
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			
a. Adequate grass cover?	X		50%
b. Any erosion?	X		Rills, some gullys (sw)
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			
a. Adequate grass cover?		X	
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	
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?	X		Major
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			SM brown
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?			SM brown

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankments?			
b. Approach Channel:		X	NA
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		D50 - 18"
d. Outflow Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		D50 - 18"
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		some
d. Watershed matches soil map?	X		

9. GENERAL COMMENTS
Needs work. Fill in eroded section
Future riprap discharge section for pump inlet

Canopy cover 50 %
Ground cover 75 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE Peabody Coal Co 10.39-011-22
SUBJECT Sediment Pond Hydrology
WW-3 SHEET ___ OF ___

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

Time of Concentration

Elevation Difference = 6700 − 6450 = 250 ft.

Water Course Length = 4.4(400) = 1760 ft. = 0.333 mi.

$$T_c = \left(\frac{11.9\,(0.333)^3}{250}\right)^{.6385} = 0.087 \text{ hr.}$$

Lag Time = $0.6\,T_c$ = 0.052 hr.

SCS Curve Number

Drainage Area (ac)	Cover Type	Hydrologic Condition	Soil Type	Weighted Curve Number
100%	P-J	good	D	80
			EH#22	

Use 80

Drainage Basin Area

19.7 acres 0.031 sq mile

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

Dames & Moore

945 1 (3-72) PRINTED IN U.S.A.

FILE FEARDY GULCH 10139-011-22
SUBJECT SEDIMENT INFLOW
WW-3 SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #22 = .22

K = .22

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
400	150	37.5	22.8 (.3)
650	90	13.8	5.75 (.7)
			use 10.9

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
100%	P-J	60	25	1.0 (.085)

C = .085

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

EROSION CONTROL FACTOR

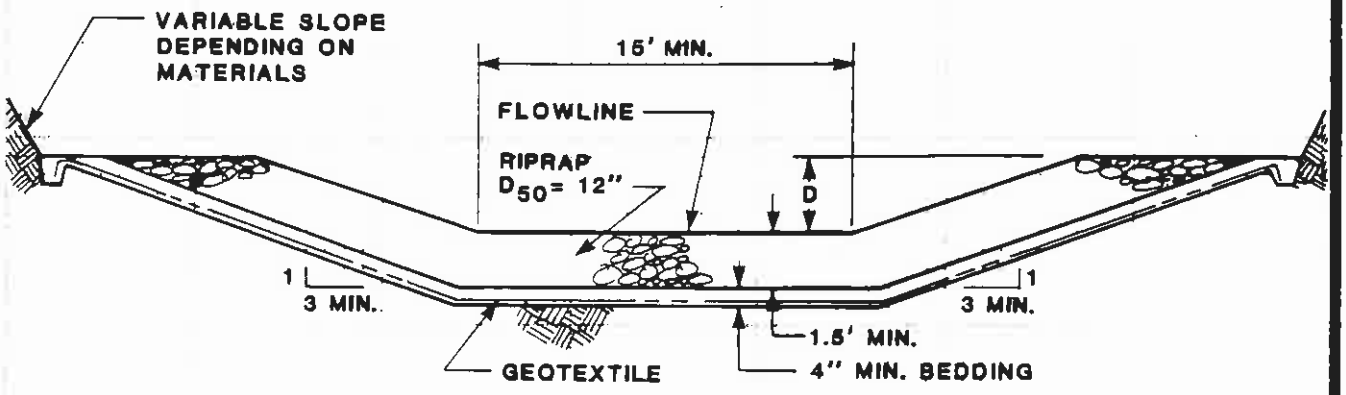
P = 1.0

SEDIMENT INFLOW

$A = 40(.22)(10.9)(.085)(1.0) = 8.15$ ton/acre/year

$A = 8.15\left(\frac{1}{2047}\right)(19.7)(.95) = .075$ acre-feet/year

Dames & Moore



SPILLWAY CHANNEL

D = 1.6'

LENGTH = 50'

FLOWLINE ELEV. = 6450.40'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION WW-3

BY **Dames & Moore** Plate 5