INSPECTION REPORT

Sedimentation Structure

N14-P

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N14-P is an earthen embankment, designed and constructed in 1982 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Kayenta Mine. The location of Structure N14-P is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N14-P. 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 N14-P was inspected on September 9, 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 N14-P 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 N14-P has a 10.41-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 67% disturbed and 33% Pinion/Juniper.

EMBANKMENT

Structure N14-P is a homogeneous earthen embankment classified as a cross-valley embankment. Physical characteristics of the embankment are listed in the following table:

Structure N14-P

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	11.0 ft
Crest Width	17 ft
Upstream Slope	2.1 H : 1 V
Downstream Slope	2.5 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section N14-P, A-A'.

ANALYSES

STABILITY

Structure N14-P is a category B-1 embankment. A standard category B-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 = 15 ft
2. Maximum upstream slope = 1.75 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The N14-P 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 N14-P 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 N14-P was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.144	mi
2.	Elevation Difference, H	59	ft
3.	Time of Concentration, T_c	0.058	h
4.	Lag time, $0.6T_c$	0.035	h
5.	SCS Curve Number	91	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	10.41	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.

N14-P 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	27	35	
Volume	acre-ft	1.09	0.93	
Storage				
Peak Stage	ft	6837.92	6842.75	
Spillway Elevation	ft	6841.72	--	
Peak Storage	acre-ft	1.09	--	
Storage Capacity	acre-ft	2.63	--	
Outflow				
Peak Flow	cfs	0	4	
Embankment Crest Elevation	ft	--	6844.17	
Peak Stage	ft	--	6842.75	
Freeboard	ft	--	1.42	
Spillway Channel				
Flow Depth	ft	--	1.03	
Critical Velocity	fps	--	2.0	
Manning's "n"		--	0.035	
Outflow Channel			Section I	Section II
Slope	%	--	4	12
Normal Velocity	fps	--	2.1	2.9
Normal Depth	ft	--	0.13	0.09
Manning's "n"		--	0.035	0.035

Spillway Channel

The existing spillway for N14-P has a trapezoidal channel with the following dimensions:

Channel depth	2.7	ft
Channel width	13	ft
Channel length	45	ft
Side slopes (horizontal to vertical)	2:1	
Average exit slope	2	percent

There is presently no erosion protection within the channel.

Outflow Channel

The structure presently has no outflow 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, N14-P.

The calculations for the sediment load entering Structure N14-P 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 3.60
4. Cover Factor, C 0.716
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 N14-P and the results of the sediment inflow analysis are summarized in the following table.

N14-P STORAGE

Total Storage Capacity	2.63	acre-ft
10-year, 24-hour Storm Inflow	1.09	acre-ft
Available Sediment Storage Capacity . .	1.54	acre-ft
Sediment Inflow Rate	0.110	acre-ft/yr
Sediment Storage Life	15	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N14-P indicated that the only geotechnical problems are rill and gully erosion on the upstream and downstream slopes and the right and left abutments. Correction of erosion is considered a periodic maintenance task and does not require remedial action.

HYDRAULICS

The storage capacity and spillway capacity of Structure N14-P are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. A trapezoidal outflow channel should be constructed along the alignment B-B' shown in Plate 1. The channel profile is shown in Plate 4 and the required dimensions are shown in Plate 5. Both the spillway and outflow channel should be protected against erosion using geotextile and gravel as shown in Plate 5.

* * *

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

Plate 1 - Site Plan N14-P

Plate 2 - Existing Maximum Cross Section N14-P, A-A'

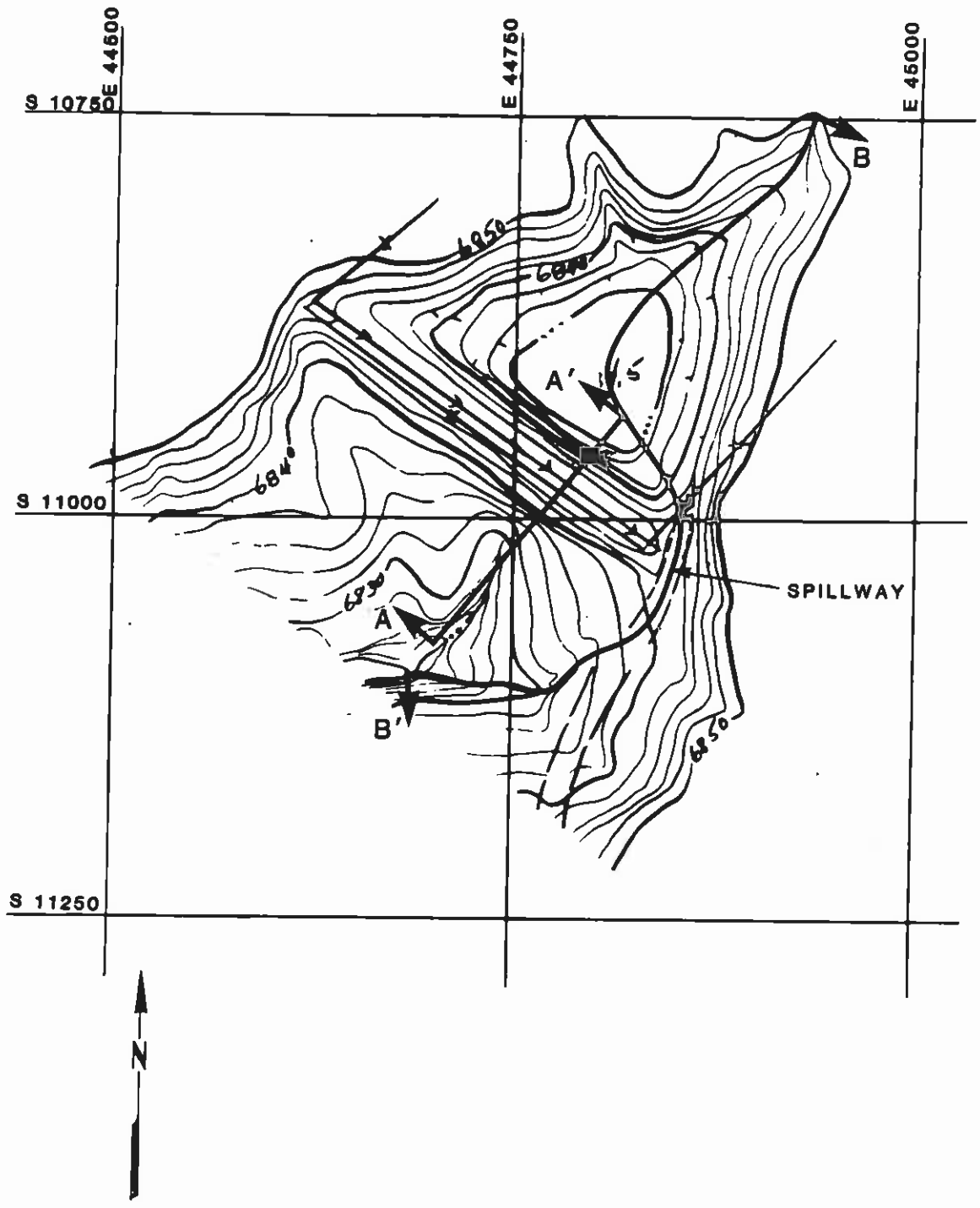
Plate 3 - Volume-Elevation Curve N14-P

Plate 4 - Channel Profile N14-P, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N14-P

Appendix A - Inspection Check List

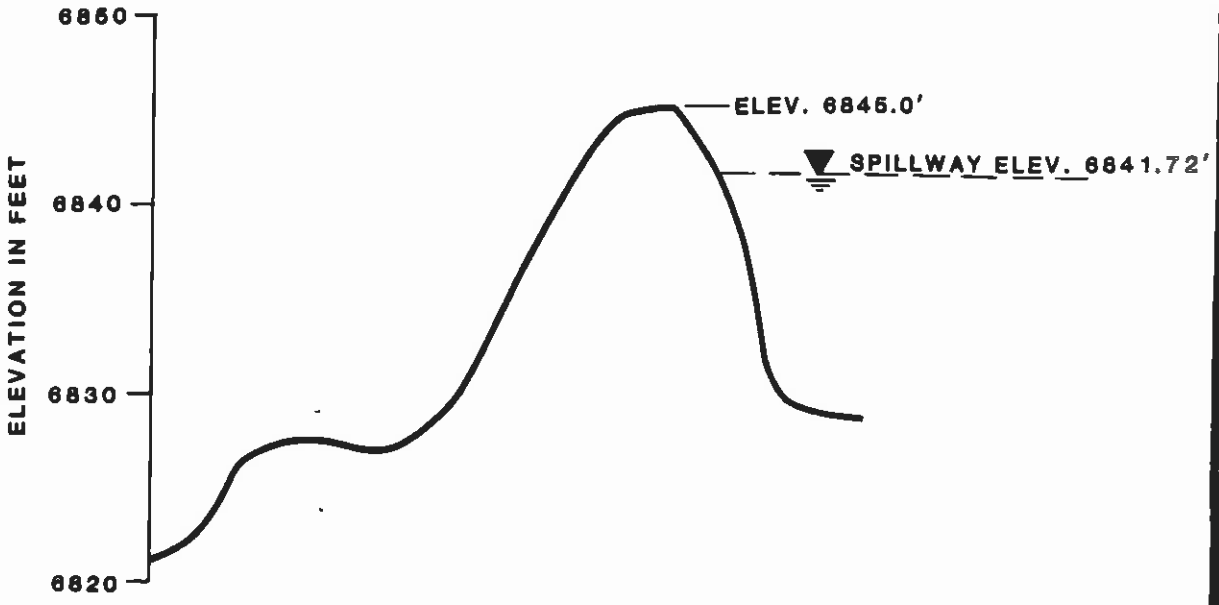
Appendix B - Hydrology and Hydraulic Calculations



SCALE
0 100 200
FEET

SITE PLAN
N14-P

BY **Dames & Moore** Plate 1



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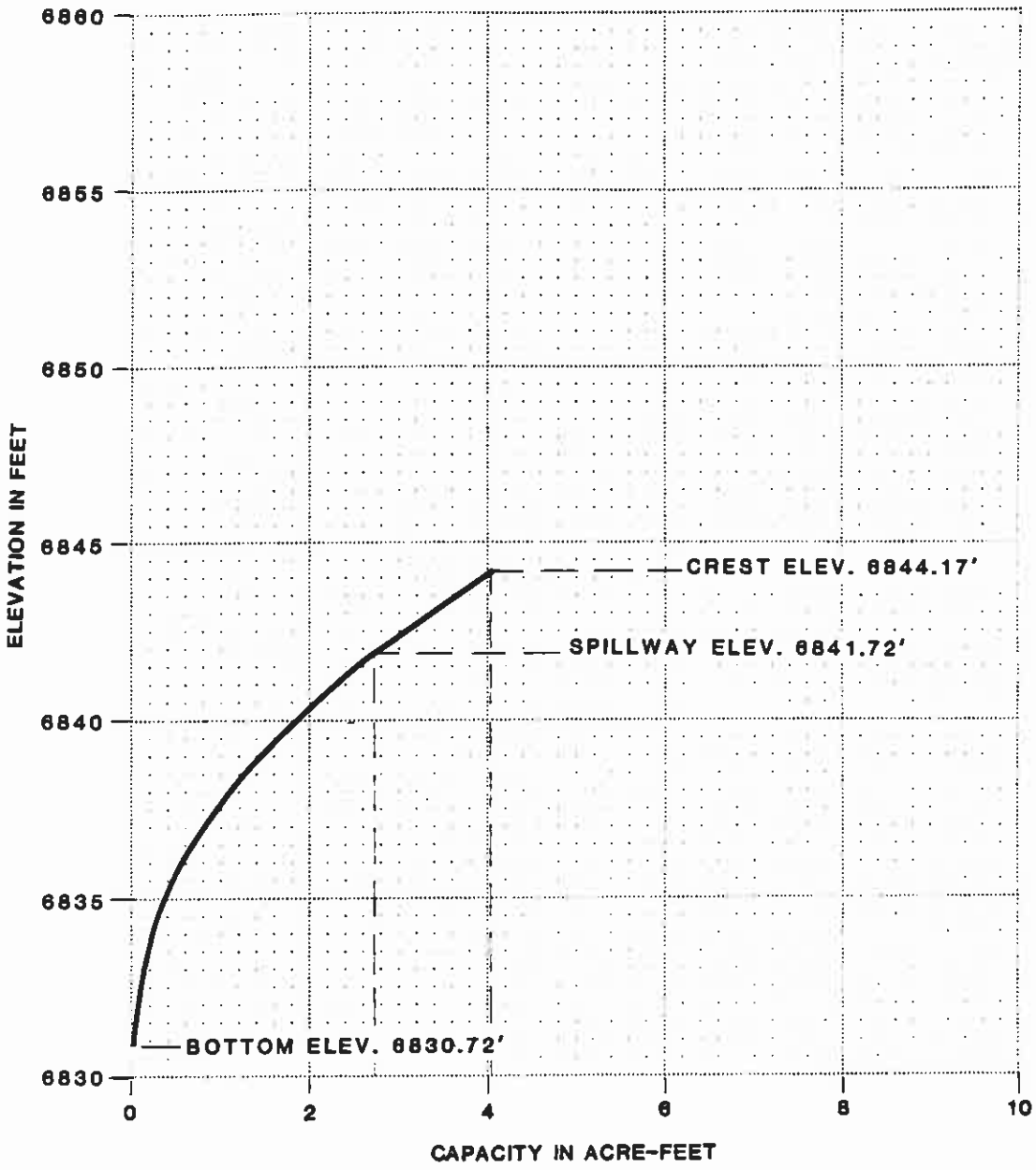
EXISTING MAXIMUM CROSS-SECTION A-A' N14-P

FOR LOCATION SEE PLATE 1

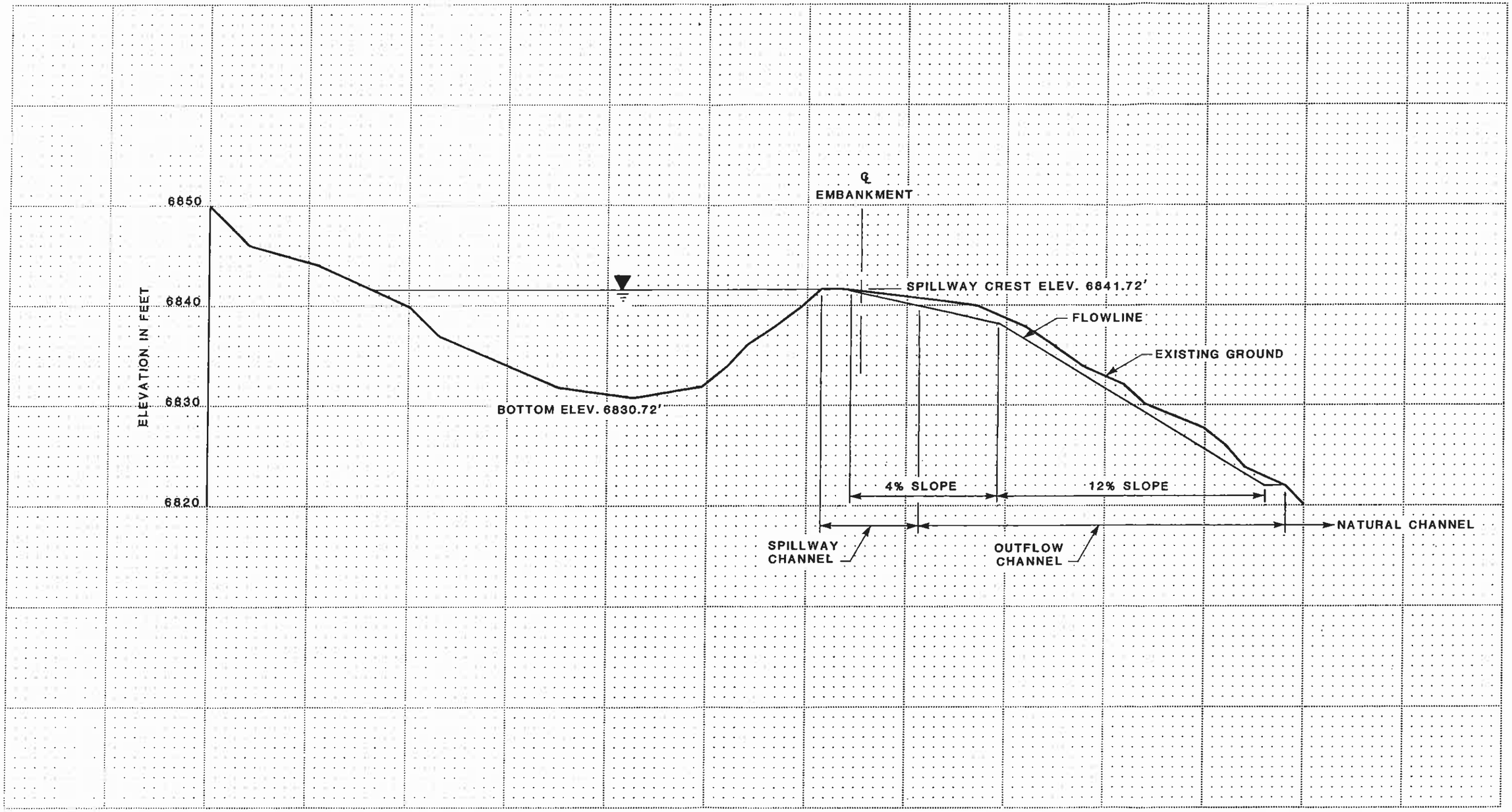
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

N14-P

BY **Dames & Moore** Plate 3

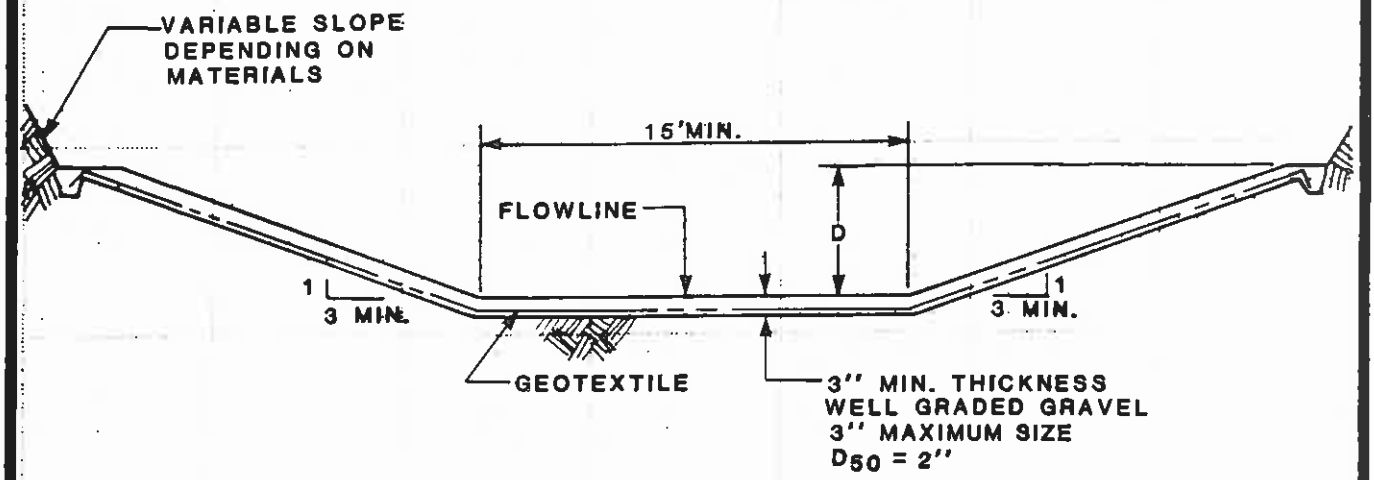


SCALE
0 50 100
FEET

CHANNEL PROFILE B-B'
N14-P

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SPILLWAY CHANNEL

D = 2.1'

LENGTH = 50'

FLOWLINE ELEV.= 6841.72'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N14-P

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			17' W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			25
a. Adequate grass cover?		X	
b. Any erosion?	X		Rills
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			22
a. Adequate grass cover?		X	
b. Any erosion?	X		Rills
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?			N.A
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		gulley contact D.S. slope & u.s.
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Into Spillway - Rills
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Gray SM

Sediment Impoundment Name: N14-P
Page: 5

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?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		13'W, 2.7' below crest
Are side slopes eroding?		X	45'L.
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:		X	
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
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		
d. Watershed matches soil map?		X	

9. GENERAL COMMENTS

Spillway could use grading.

Canopy cover 15

Ground cover 60

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-2
SUBJECT SEDIMENT POND HYDROLOGY
N14-P SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6901 − 6842 = 59 ft.

WATER COURSE LENGTH = 1.9(400) = 760 ft. = 0.144 mi.

$$T_c = \left(\frac{11.9\ (0.144)^3}{59}\right)^{0.385} = 0.575 \text{ hr.} \rightarrow 0.058 \text{ hr}$$

LAG TIME = $0.6 T_c$ = 0.035 hr. ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
3.4	P-J	average	>	83 (.33)
7.0	Disturbed		D	94 (.67)
				90.37

100% → 33

so 91

DRAINAGE BASIN AREA

10.41 ACRE 0.016 SQ MILE

BY S. DOLAN DATE 1-23-87
CHECKED BY ___
COPY TO EO ___

Dames & Moore

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

FILE [illegible]

SUBJECT SEDIMENT INFLOW

NHP SHEET ___ OF ___

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

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

K = 47

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #33 .22

K = .22

SLOPE FACTOR

LENGTH (ft)	ΔELEV (ft)	SLOPE (%)	LS
300	35	11.7	3.0 (.4)
400	60	15.0	5.12 (.4)
300	20	6.7	1.4 (.2)

use 3.6

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
67%	disturbed	—	—	.67 (1.0)
33%	P-J	40	25	.33 (.14)
				C = .716

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.22)(3.6)(.716)(1.0) = 22.68$ ton/acre/year

$A = (22.68)\left(\frac{1}{2047}\right)(10.41)(.95) = 0.110$ acre-feet/year

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