INSPECTION REPORT

Sedimentation Structure

N14-C

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

INTRODUCTION

Sedimentation Structure N14-C 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 Kayenta Mine. The location of Structure N14-C is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N14-C. 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-C 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-C 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-C has a 99.3-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 61% Pinion/Juniper, 27% disturbed, and 12% reclaimed.

EMBANKMENT

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

Structure N14-C

Embankment	Residual Shale Soils/Alluvium
Foundation	Alluvium
Right Abutment	Alluvium
Left Abutment	Residual Shale Soils
Height	18.0 ft
Crest Width	18 ft
Upstream Slope	2.5 H : 1 V
Downstream Slope	3.5 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section N14-C, A-A'. Grass provides erosion protection on the upstream slope of the embankment.

ANALYSES

STABILITY

Structure N14-C is a category B-3 embankment. A standard category B-3 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 = 25 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The N14-C 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-C is located downstream from Structure N14-D, an MSHA structure. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for N14-C was analyzed using the 100-year, 6-hour storm. The 100-year storm was routed through N14-D with the N14-D reservoir at the maximum water surface level at the start of the storm. The 100-year storm filled N14-D and produced a peak outflow of 320 cfs. This was combined with the local inflow between N14-D and N14-C to produce the inflow hydrograph for N14-C.

The storage capacity of Structure N14-C was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.606	mi
2.	Elevation Difference, H	254	ft
3.	Time of Concentration, T_c	0.173	h
4.	Lag time, $0.6T_c$	0.104	h
5.	SCS Curve Number	83	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	100-year, 6-hour storm	2.4	in.
7.	Drainage Area	99.3	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.

	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	120	328	
Volume	acre-ft	6.52*	8.44*	
Storage				
Peak Stage	ft	6570.35	--	
Spillway Elevation	ft	6580.52	--	
Peak Storage	acre-ft	6.52	—	
Incised Storage Capacity	acre-ft	12.6	—	
Active Storage Capacity	acre-ft	14.7		
Total Storage Capacity	acre-ft	27.3		
Outflow				
Peak Flow	cfs	0	278	
Embankment Crest Elevation	ft	--	6585.42	
Peak Stage	ft	--	6584.05	
Freeboard	ft	--	1.37	
Spillway Channel				
Flow Depth	ft	—	3.55	
Critical Velocity	fps	--	6.9	
Manning's "n"		—	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	2	14
Normal Velocity	fps	--	6.9	13.3
Normal Depth	ft	--	1.95	1.12
Manning's "n"		--	0.040	0.040

*Inflow volume for the tributary drainage area between Structures N14-D and N14-C.

Spillway Channel

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

Channel depth	5.3	ft
Channel width	16	ft
Channel length	65	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 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-C.

The calculations for the sediment load entering Structure N14-C were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.272
3. Slope Factor, LS 7.50
4. Cover Factor, C 0.374
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-C and the results of the sediment inflow analysis are summarized in the following table.

N14-C STORAGE

Total Storage Capacity	27.3	acre-ft
10-year, 24-hour Storm Inflow	6.52	acre-ft
Available Sediment Storage Capacity . .	20.78	acre-ft
Sediment Inflow Rate	1.41	acre-ft/yr
Sediment Storage Life	15	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N14-C indicated that the only geotechnical problem is rill erosion on the upstream and downstream slopes and the side slopes of the spillway channel. 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-C 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 riprap as shown in Plate 5.

* * *

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

Plate 1 - Site Plan N14-C

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

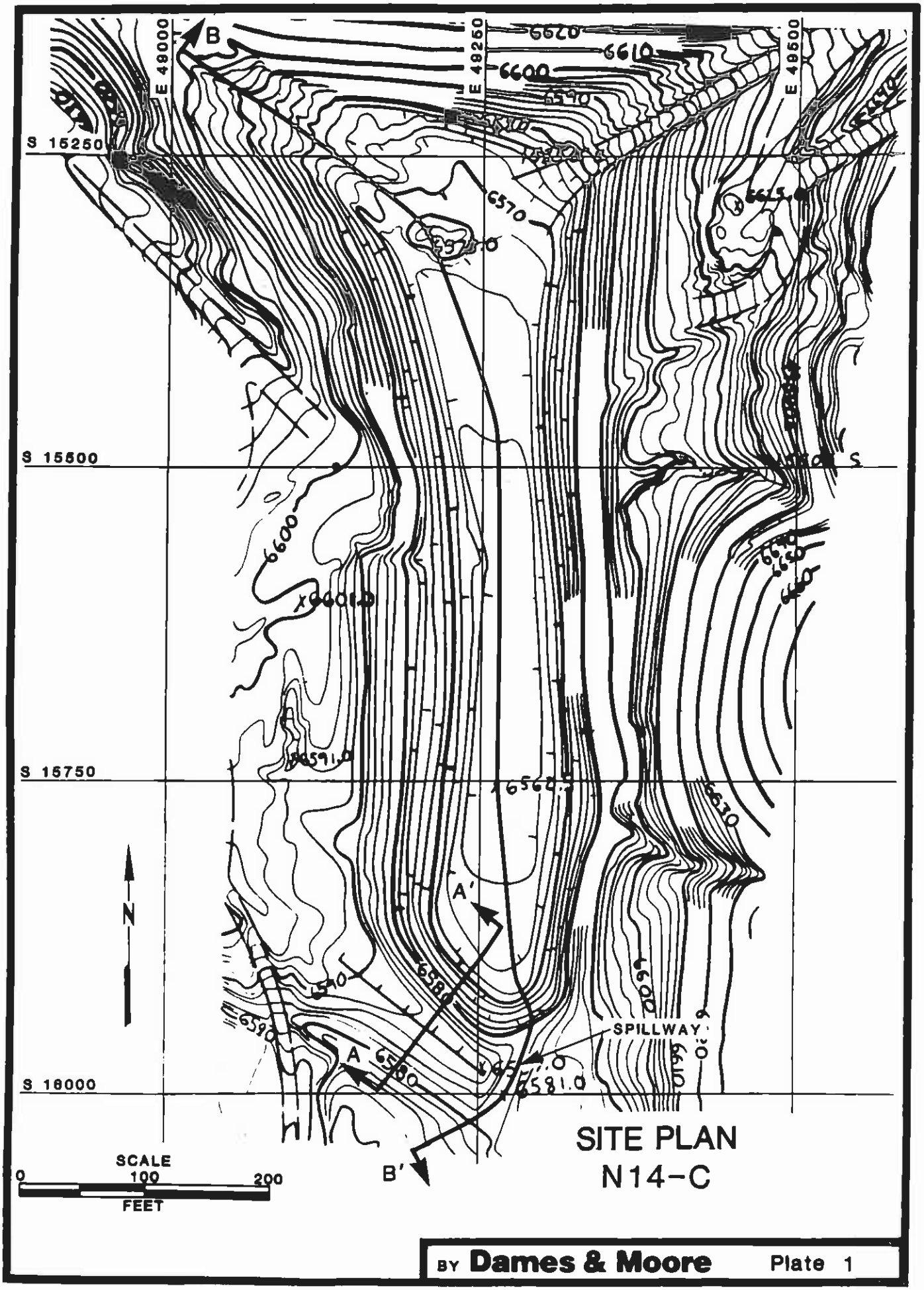
Plate 3 - Volume-Elevation Curve N14-C

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

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

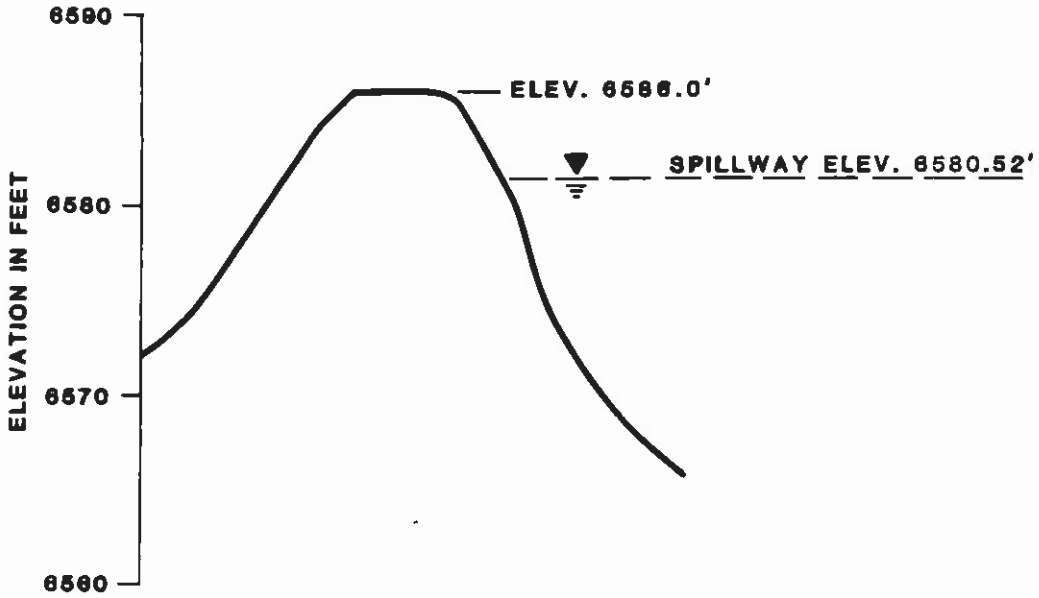
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
N14-C

BY **Dames & Moore** Plate 1



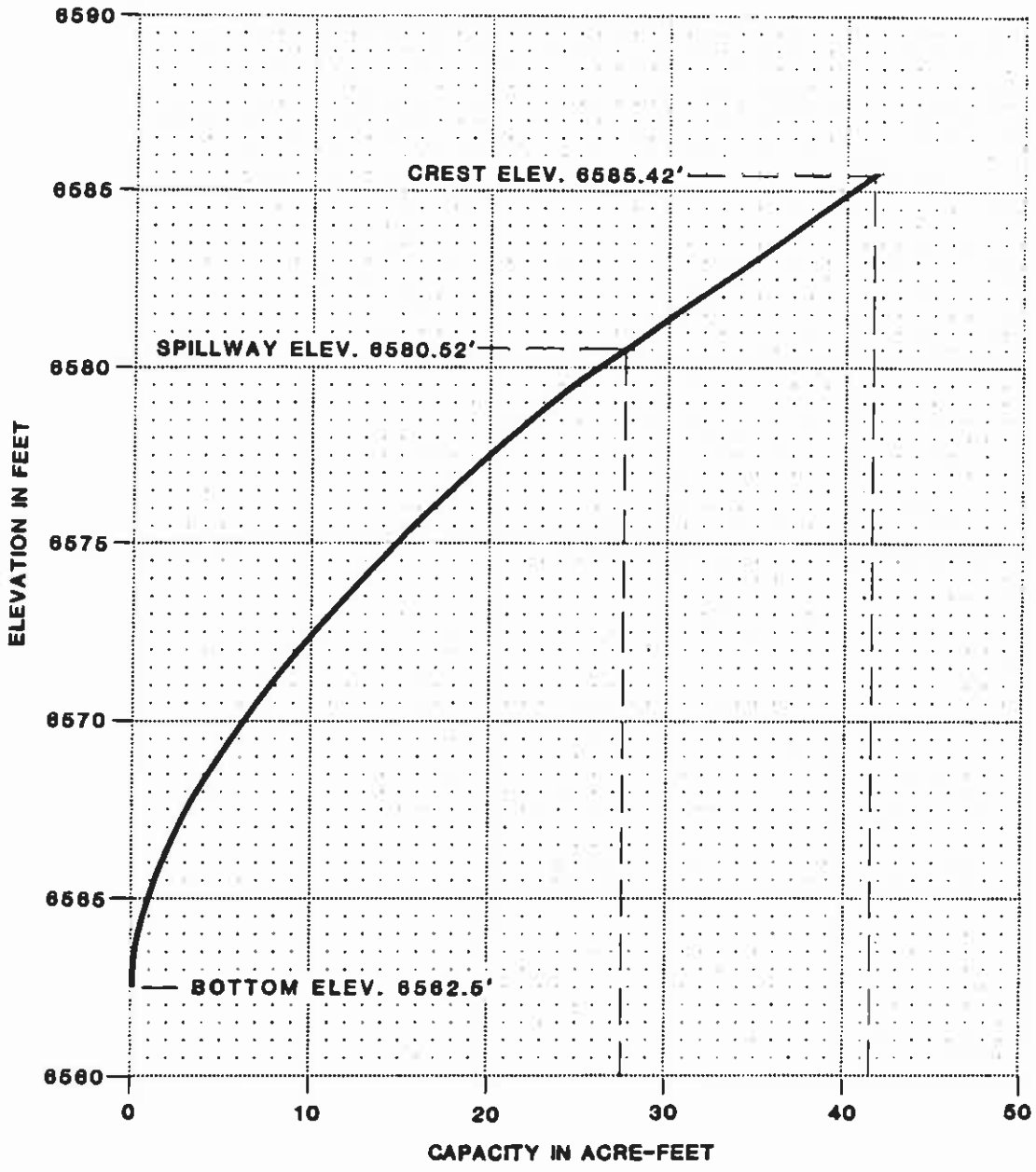
SCALE
0 50 100
FEET

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

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

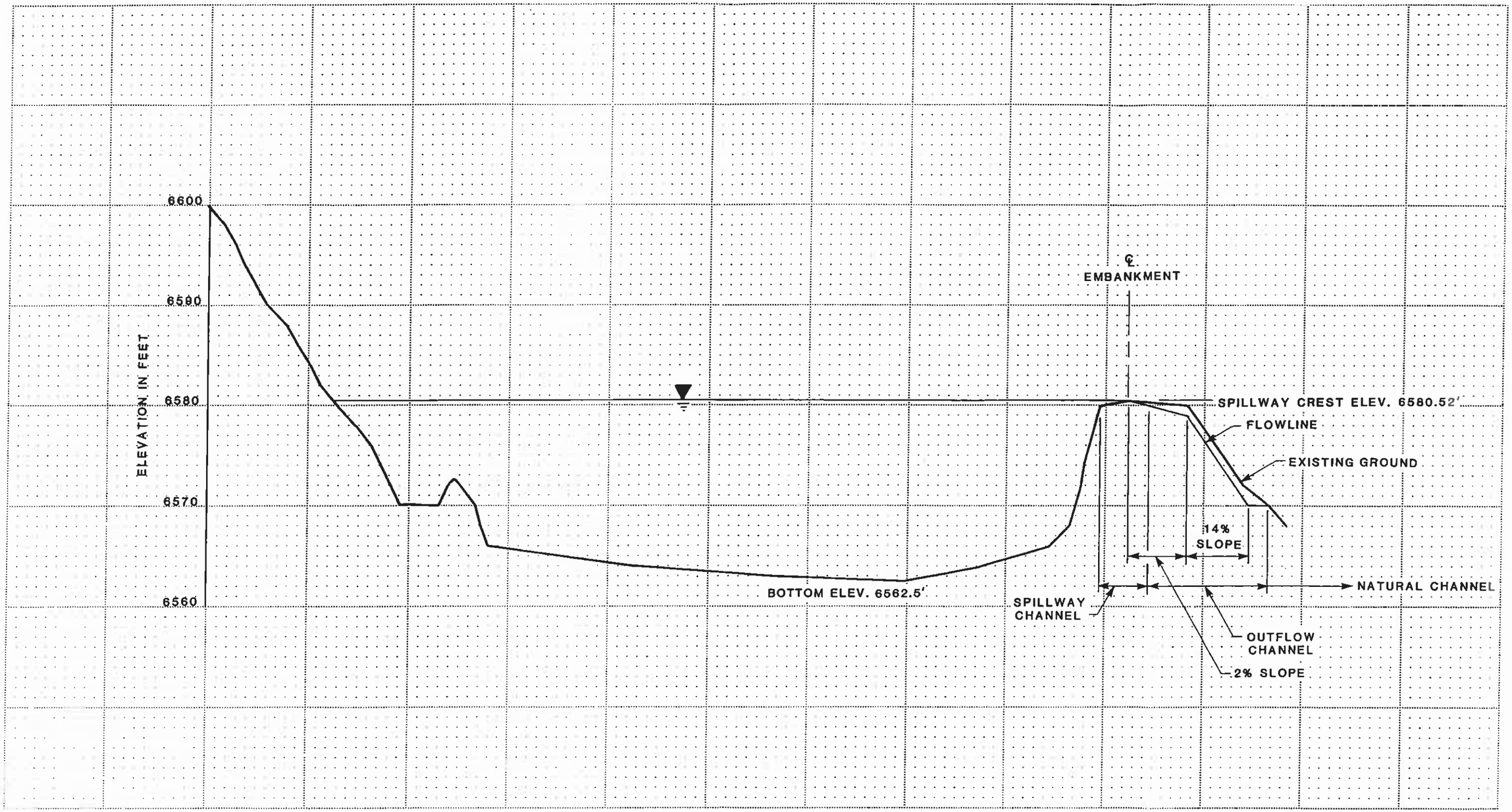
Plate 2



VOLUME-ELEVATION CURVE

N14-C

BY **Dames & Moore** Plate 3

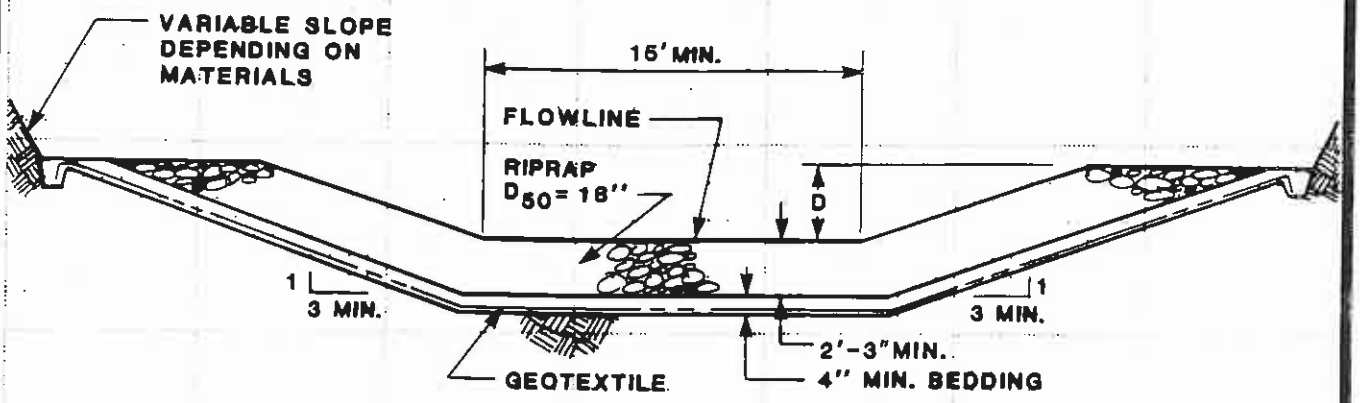


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
N14-C

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SPILLWAY CHANNEL

D = 4.6'

LENGTH = 50'

FLOWLINE ELEV. = 8580.52'

OUTFLOW CHANNEL

D = 3.0'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N14-C

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			18'W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			22°
a. Adequate grass cover?	X		75
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		Grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			16°
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?			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	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown silt
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?			brown Rock Fill

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		Near LA
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		5.3' below crest · 3.7 below LA
Are side slopes eroding?	X		Rills 16' W 65' L
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?	X		Cardboard wired to fence
Erosion protection?		X	
d. Outflow Channel:		X	
Are side slopes eroding?			
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

Spill way partially blocked by cardboard wired into fence

Canopy - 40 %
Cover - 60 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
N14-C SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6835 − 6591 = 254 ft.

WATER COURSE LENGTH = 8.0 (400) = 3200 ft. = 0.606 mi.

$$T_c = \left(\frac{11.9\,(0.606)^3}{254}\right)^{0.385} = 0.173 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.104 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
60.4	P-J	average	D	83 (.61)
26.5	Disturbed	----	B	82 (.27)
12.4	post law reclaimed	fair	D	81 (.12)
				82.5

20% EH # 27
68% EH # 25
12% EH # 35

use 83

DRAINAGE BASIN AREA

99.3 ACRE 0.155 SQ MILE

BY S. Dietz DATE 10-2-85
CHECKED BY ___
COPY TO EO ___

FILE PEABODY COAL CO 10134-011-22
SUBJECT SEDIMENT INFLOW
N14-C SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 20 % EH #27 (.2)(.36)
68 % EH #25 (.68)(.22)
12 % EH #35 (.12)(.42)

K = .272

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
1000	100	10.0	4.33 (.6)
600	130	21.7	11.40 (.35)
400	130	32.6	18.3 (.05)
			= 7.50

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
61%	P-J	40	25	.61 (.14)
27%	disturbed	—	—	.27 (1.0)
12%	reclaimed	—	—	.12 (.15)
				C = .374

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

$A = 40(.272)(7.5)(.374)(1.0) = 30.52$ ton/acre/year

$A = (30.52)\left(\frac{1}{2047}\right)(99.3)(.95) = 1.41$ acre-feet/year

Dames & Moore