DESIGN REPORT

Sedimentation Structure

N5-A

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N5-A will be an earthen embankment, designed and constructed 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 N5-A is shown on Plate 1, Site Plan.

This design report contains information specific to Structure N5-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

The proposed site of Structure N5-A was inspected by a senior geotechnical engineer from Dames & Moore in October, 1985 to ensure that the site is suitable and no adverse conditions exist to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed.

SITE DESCRIPTION

LAND USE

Structure N5-A has a 5.28-acre tributary drainage area and is located near Coal Mine Wash at the Black Mesa Mine. The watershed is classified as 100% reclaimed.

EMBANKMENT

A homogeneous earthen embankment was assumed for the hydraulic analysis and to develop the volume-elevation curve shown on Plate 2. Upstream and downstream slopes of 2:1 and 3:1 (horizontal to vertical), respectively, were used. The assumed slopes were not evaluated for geotechnical considerations such as slope stability since the foundation or embankment material types have not been determined.

DESIGN ANALYSES

GENERAL

Structure N5-A was designed by an interdisciplinary team of engineers from Dames & Moore. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Coal

Company files includes topographic maps developed from aerial photography flown in 1983 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

The slopes of Structure N5-A will be chosen based on the stability analyses performed for existing structures in the General Report. The embankment fill materials and the type of foundation will be identified in the field and the stable slopes chosen based on the category classification of the structure.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure N5-A is located downstream from Structures N5-A1 and N5-G. The three structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for N5-A was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure N5-A was analyzed using the 10-year, 24-hour storm.

Structure N5-A1 will be replaced by Structure N5-A2 when mining approaches N5-A1 and requires its removal.

The following parameters were used in the hydrologic analysis:

		10-year, 24-hour Storm	100-year, 6-hour Storm	
1.	Water Course length, L	0.098	1.545	mi
2.	Elevation Difference, H	60	305	ft
3.	Time of Concentration, T_c	0.037	0.474	h
4.	Lag time, $0.6T_c$	0.022	0.285	h
5.	SCS Curve Number	81	81	
6.	Rainfall Depth	2.1	2.4	in.
7.	Drainage Area	5.28	547.3	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the planned sedimentation structure, outflow from the structure and the resulting water surface elevations. The 10-year, 24-hour storm was routed through Structures N5-G and N5-A1 located upstream and into Structure N5-A. The 100-year, 6-hour storm was analyzed without the upstream structures. The initial conditions and results of the analysis are summarized in the following table.

N5-A 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	38	667	
Volume	acre-ft	0.54*	37.85	
Storage				
Peak Stage	ft	6458.02	--	
Spillway Elevation	ft	6461.00	--	
Peak Storage	acre-ft	10.15	--	
Storage Capacity	acre-ft	13.60	--	
Outflow				
Peak Flow	cfs	0	643	
Embankment Crest Elevation	ft	--	6466.00	
Peak Stage	ft	--	6464.92	
Freeboard	ft	--	1.08	
Spillway Channel				
Flow Depth	ft	--	3.92	
Critical Velocity	fps	--	7.8	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	5	36
Normal Velocity	fps	--	10.8	20.4
Normal Depth	ft	--	1.71	0.96
Manning's "n"		--	0.040	0.040

*Inflow volume for tributary drainage area between Structures N5-A and N5-G.

Spillway Channel

The spillway for N5-A will be a trapezoidal channel with the following dimensions:

Channel depth	5.0	ft
Channel width	30	ft
Channel length	40	ft
Side slopes (horizontal to vertical)	3:1	
Average exit slope	0	percent

Outflow Channel

The outflow channel for Structure N5-A will be a trapezoidal channel with the following dimensions:

Channel width	30	ft
Channel length	145	ft
Side slopes (horizontal to vertical)	3:1	
Average exit slope	5-36	percent

The alignment of the spillway, outflow channel and stilling basin is shown on Plate 1. The channel profile is shown on Plate 3 and the required dimensions are shown on Plates 4 and 5. The spillway, outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown on Plate 4.

STORAGE CAPACITY

The impoundment volume-elevation curve shown on Plate 2, Volume-Elevation Curve, N5-A is based on site specific topographic data developed for Peabody Coal Company in 1985, and 1985 site specific surveys, where available.

The calculations for the sediment load entering Structure N5-A were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.42
3. Slope Factor, LS 2.20
4. Cover Factor, C 0.15
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. Although Structure N5-A has sufficient storage by itself, the structures upstream from N5-A do not have sufficient storage and contribute excess runoff to N5-A. Therefore, the combined sediment storage capacity was determined for the three structures in series. The results of the analysis are presented in the following table.

COMBINED STORAGE FOR STRUCTURES N5-A1, N5-G, AND N5-A

	N5-A1	N5-G	N5-A	N5-G & N5-A Combined	
Total Storage Capacity	12.48	9.17	13.20	22.37	acre-ft
10-year, 24-hour Storm Inflow . .	7.32	18.78	0.54	19.32	acre-ft
Available Sediment Storage Capacity	5.16	—	--	3.05	acre-ft
Sediment Inflow Rate	0.53	1.07	0.025	1.09	acre-ft/yr
Sediment Storage Life	10	—	--	3	yrs

* * *

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

Plate 1 - Site Plan N5-A

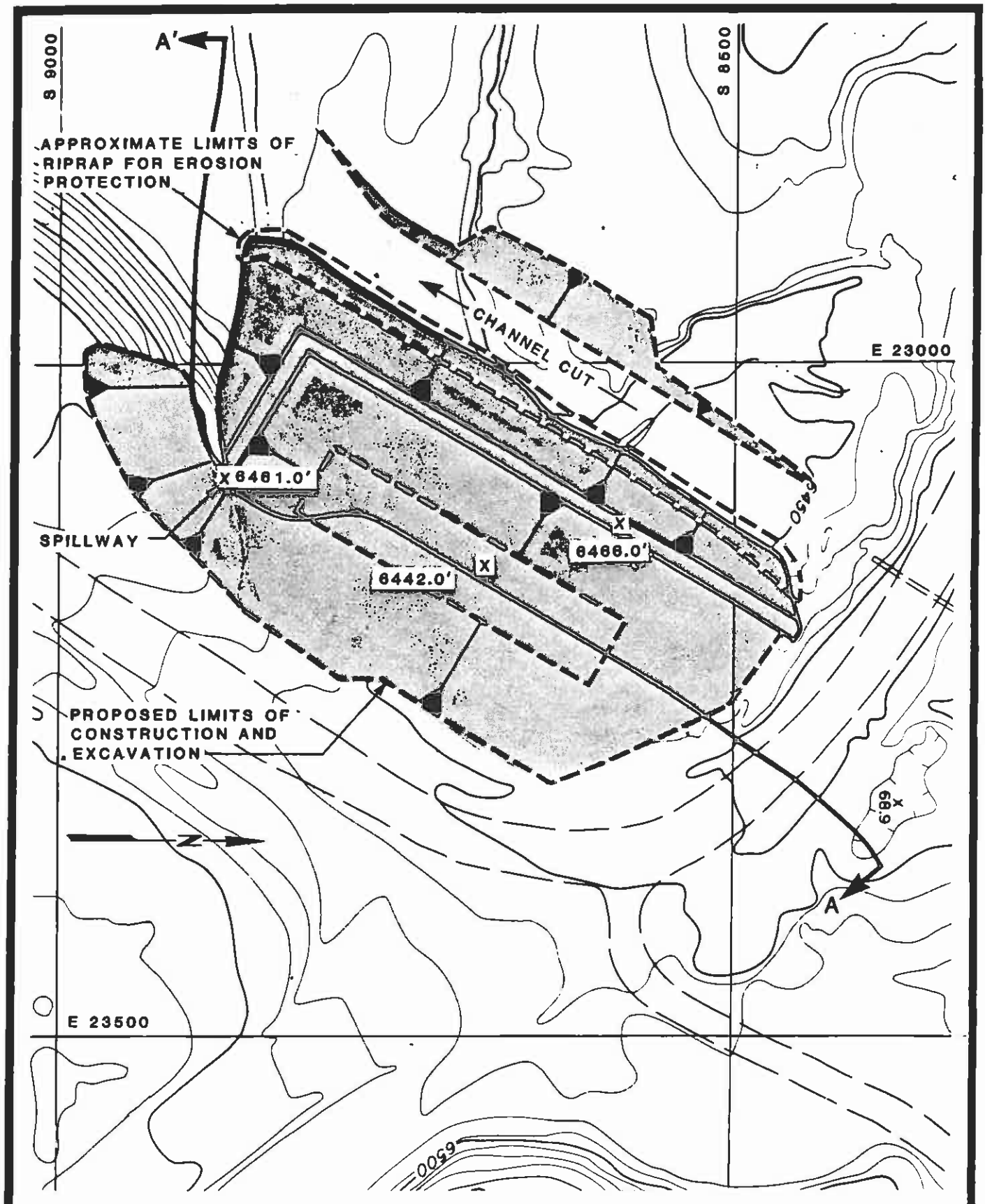
Plate 2 - Volume-Elevation Curve N5-A

Plate 3 - Channel Profile N5-A, A-A'

Plate 4 - Spillway and Outflow Channel Cross Section N5-A

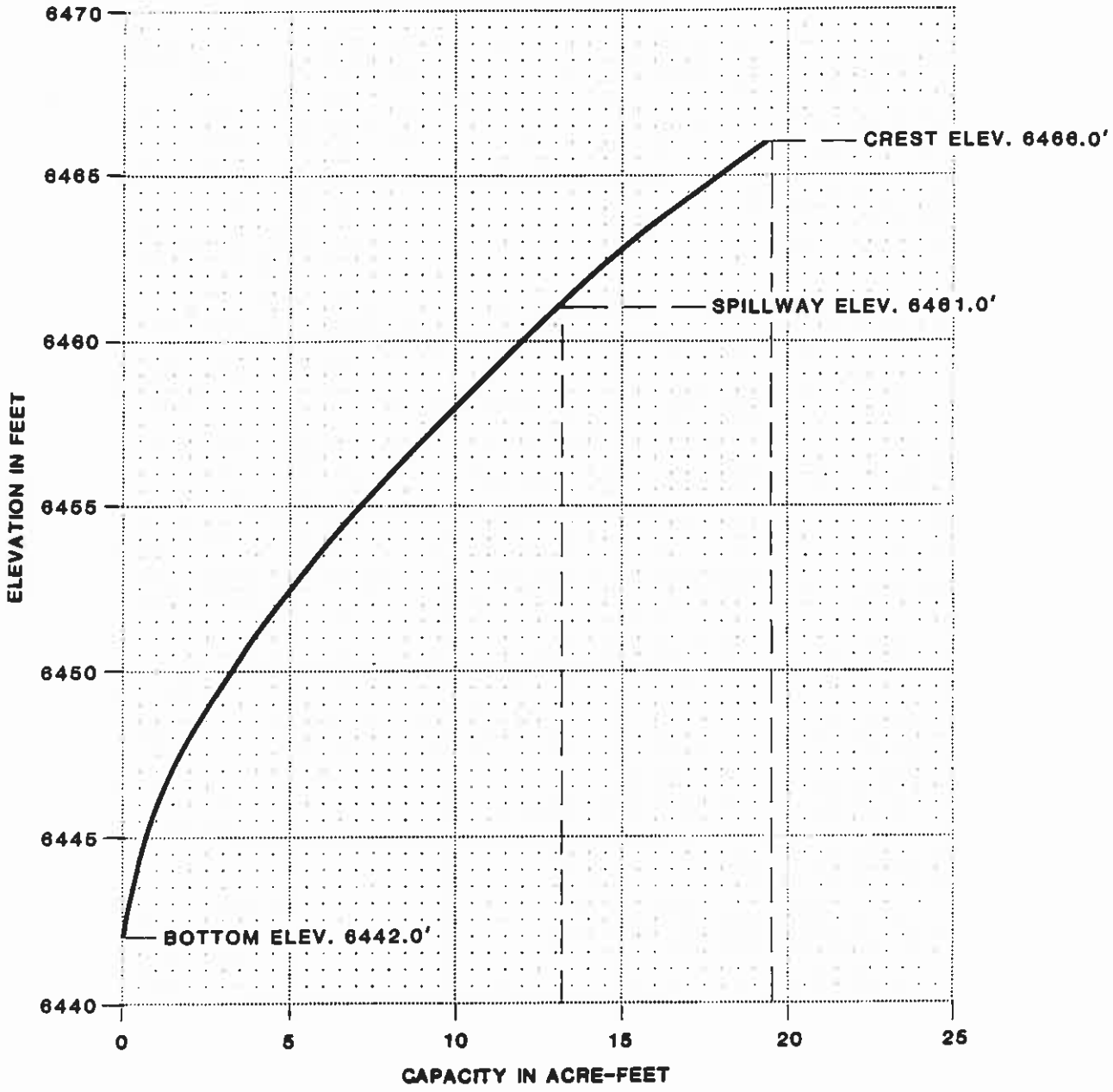
Plate 5 - Spillway Stilling Basin Plan N5-A

Appendix A - Hydrology and Hydraulic Calculations



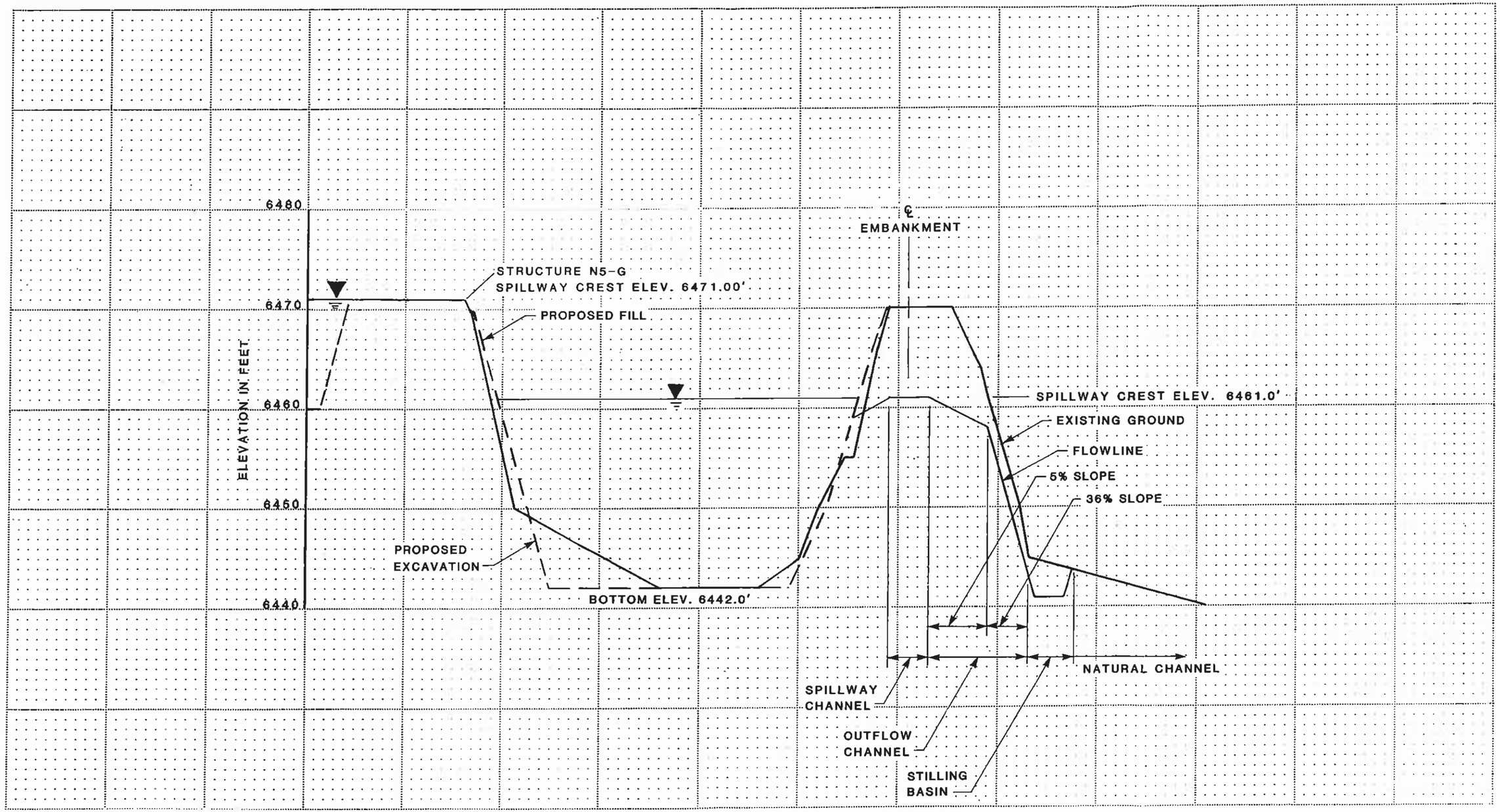
SITE PLAN
N5-A

BY **Dames & Moore** Plate 1



VOLUME-ELEVATION CURVE N5-A

BY **Dames & Moore** Plate 2

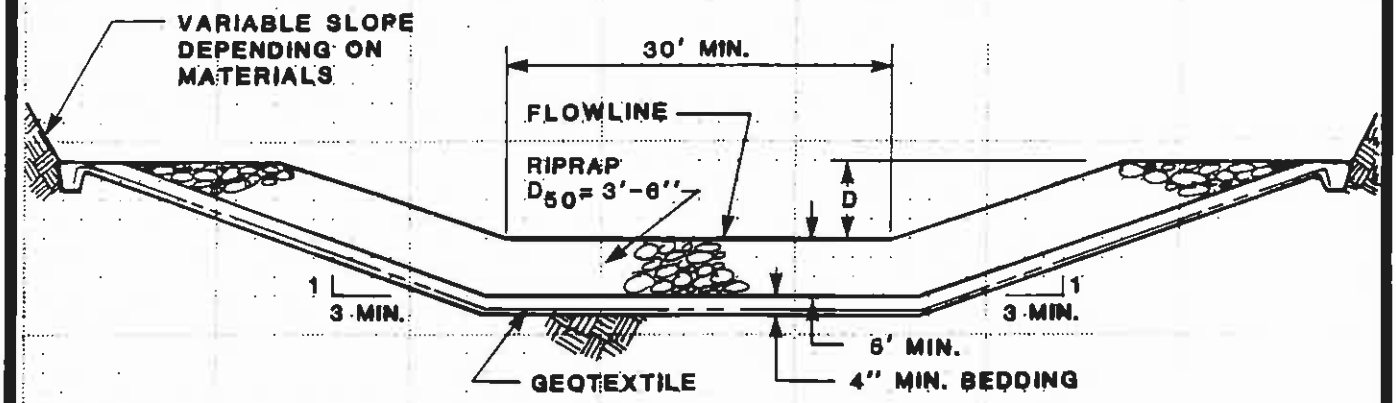


SCALE
0 100 200
FEET

CHANNEL PROFILE A-A'
N5-A

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 5.0'

LENGTH = 40'

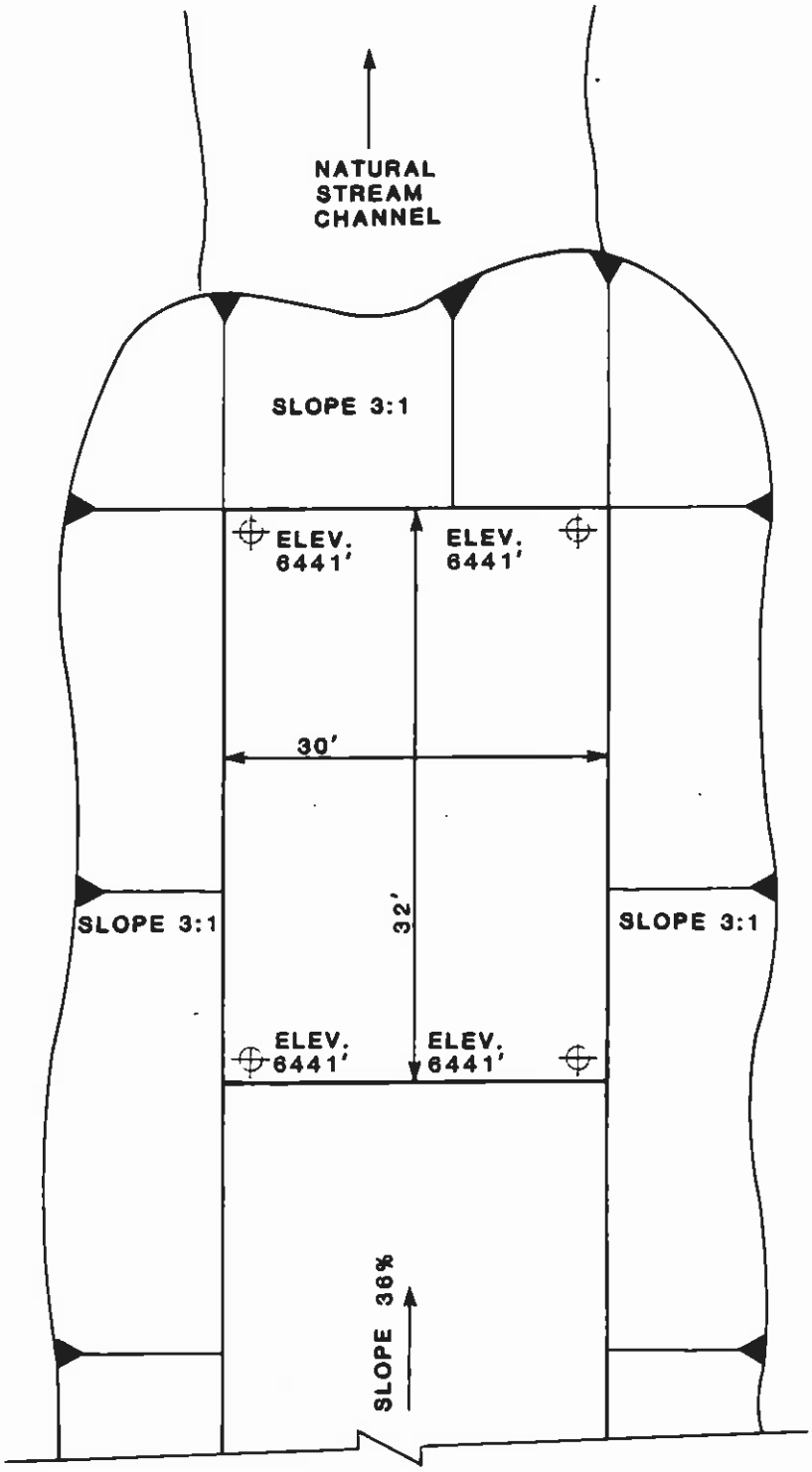
FLOWLINE ELEV.= 6461.00'

OUTFLOW CHANNEL

D = 2.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N5-A

BY **Dames & Moore** Plate 4



MINIMUM HEIGHT OF RIPRAP ALONG SIDEWALLS ABOVE THE BASIN FLOOR = 9.4'

MINIMUM DEPTH OF BASIN FLOOR BELOW NATURAL STREAMBED = 4.4'

SPILLWAY STILLING BASIN PLAN N5-A

BY **Dames & Moore** Plate 5

APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
N5-A
FINAL REVISION
SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6510 − 6450 = 60 ft. ✓

WATER COURSE LENGTH = 1.3 (400) = 520 ft. = 0.098 mi. ✓

$T_c = \left(\frac{11.9\ (0.098)^3}{60}\right)^{0.385}$ = .037 hr. ✓

LAG TIME = $0.6 T_c$ = .022 hr. ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
5.3	RRL.	fair		use 81

DRAINAGE BASIN AREA

5.3 ACRE 0.008 SQ MILE ✓

BY S. DOLAN DATE 11-8-85
CHECKED BY BHM 11/12/85
COPY TO EO ___

Dames & Moore

FILE PEABODY COAL CO 1039-011-22
SUBJECT SEDIMENT INFLOW
N5-A SHEET ___ OF ___
FINAL REVISION

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #35

K = .42

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
100	20	20	4.08 (100%) ✓

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
100±	RECLAIMED			0.15

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.42)(408)(.15)(1.0) = 10.28$ ton/acre/year ✓

$A = 10.28\left(\frac{1}{1047}\right)(5.3)(.95) = 0.025$ acre-feet/year ✓

BY S. DOLAN DATE 11-11-85
CHECKED BY BHM 11/12/85
COPY TO EO ___

Dames & Moore