DESIGN REPORT

Sedimentation Structure

N10-A2

Kayenta 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
DESIGN ANALYSES	2
GENERAL	2
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	7

APPENDIX A - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure N10-A2 will be a totally incised structure with a small 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 Kayenta Mine. The location of Structure N10-A2 is shown on Plate 1, Site Plan.

This design report contains information specific to Structure N10-A2. 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 N10-A2 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 N10-A2 has a 52.7-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 52% Pinion/Juniper, 23% Sagebrush/grass, 18% reclaimed, and 7% disturbed.

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. The incised portion of the structure will be excavated at 3:1 (horizontal to vertical) slopes.

DESIGN ANALYSES

GENERAL

Structure N10-A2 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 N10-A2 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 N10-A2 is located downstream from Structure N10-A and upstream from Structure N10-A1. Structures N10-A and N10-A2 have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for N10-A2 was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure N10-A2 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

		10-year, 24-hour Storm	100-year, 6-hour Storm	
1.	Water Course length, L	0.233	2.11	mi
2.	Elevation Difference, H	162	530	ft
3.	Time of Concentration, T_c . . .	0.068	0.548	h
4.	Lag time, $0.6T_c$	0.041	0.329	h
5.	SCS Curve Number	79	83	
6.	Rainfall Depth	2.1	2.4	in.
7.	Drainage Area	52.7	677.8	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 storm was routed through structure N10-A and into Structure N10-A2. The 100-year storm was analyzed without Structure N10-A located upstream. The initial conditions and results of the analysis are summarized in the following table.

N10-A2 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	217	864
Volume	acre-ft	2.5*	--
Storage			
Peak Stage	ft	6644.50	--
Spillway Elevation	ft	6644.00	--
Peak Storage	acre-ft	--	--
Incised Storage Capacity	acre-ft	4.64	--
Active Storage Capacity	acre-ft	19.95	--
Total Storage Capacity	acre-ft	24.59	--
Outflow			
Peak Flow	cfs	4	805
Embankment Crest Elevation	ft	--	6650.00
Peak Stage	ft	--	6648.40
Freeboard	ft	--	1.6
Spillway Channel			
Flow Depth	ft	--	4.4
Critical Velocity	fps	--	8.3
Manning's "n"		--	0.040
Outflow Channel			Section I / Section II
Slope	%	--	2 / 8
Normal Velocity	fps	--	8.5 / 13.5
Normal Depth	ft	--	2.51 / 1.69
Manning's "n"		--	0.040 / 0.040

*Inflow volume for the tributary drainage area between Structures N10-A and N10-A2.

Spillway Channel

The spillway for N10-A2 will be a trapezoidal channel with the following dimensions:

Channel depth	5.4	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 N10-A2 will be a trapezoidal channel with the following dimensions:

Channel width	30	ft
Channel length	280	ft
Side slopes (horizontal to vertical)	3:1	
Average exit slope	2-8	percent

The alignment of the spillway and outflow channel are shown on Plate 1. The channel profile is shown on Plate 3 and the required dimensions are shown on Plate 4. Both the spillway and outflow channel 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, N10-A2 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 N10-A2 were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.287
3. Slope Factor, LS 9.4
4. Cover Factor, C 0.20
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. Structure N10-A2 receives outflow from Structure N10-A located upstream and contributes excess inflow to Structure N10-A1 located downstream. Therefore, the sediment storage capacity of the three structures is combined. The results of the combined analysis are summarized in the following table.

COMBINED STORAGE FOR N10-A, N10-A2, AND N10-A1

	N10-A	N10-A2	N10-A1	Total	
Total Storage Capacity	14.00	24.59	12.20	50.79	acre-ft
10-year, 24-hour Storm Inflow	39.10	2.50	0.98	42.58	acre-ft
Available Sediment Storage Capacity .	--	--	--	8.21	acre-ft
Sediment Inflow Rate	3.31	0.528	0.238	4.08	acre-ft/yr
Sediment Storage Life	--	--	—	2.0	yrs

* * *

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

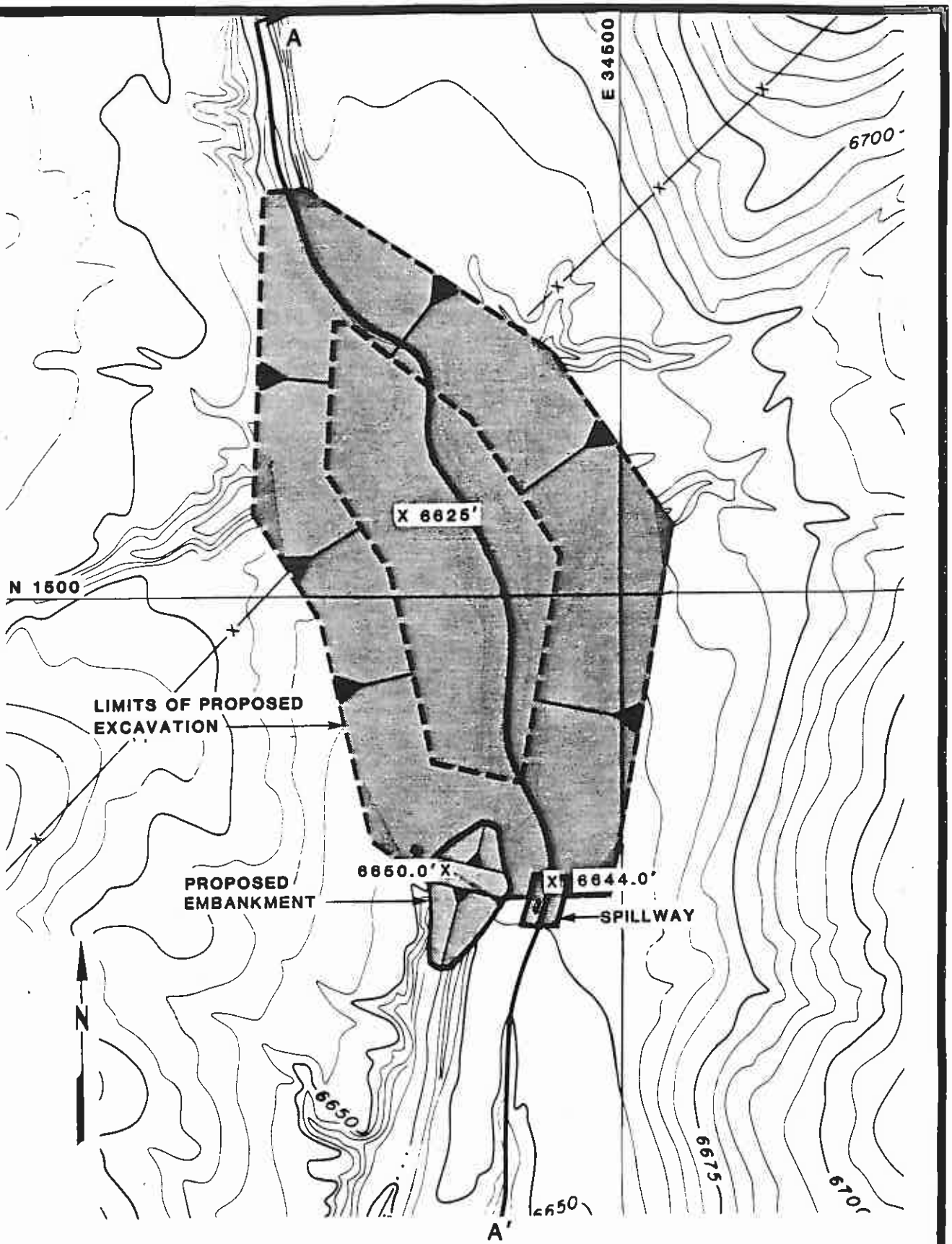
Plate 1 - Site Plan N10-A2

Plate 2 - Volume-Elevation Curve N10-A2

Plate 3 - Channel Profile N10-A2, A-A'

Plate 4 - Spillway and Outflow Channel Cross Section N10-A2

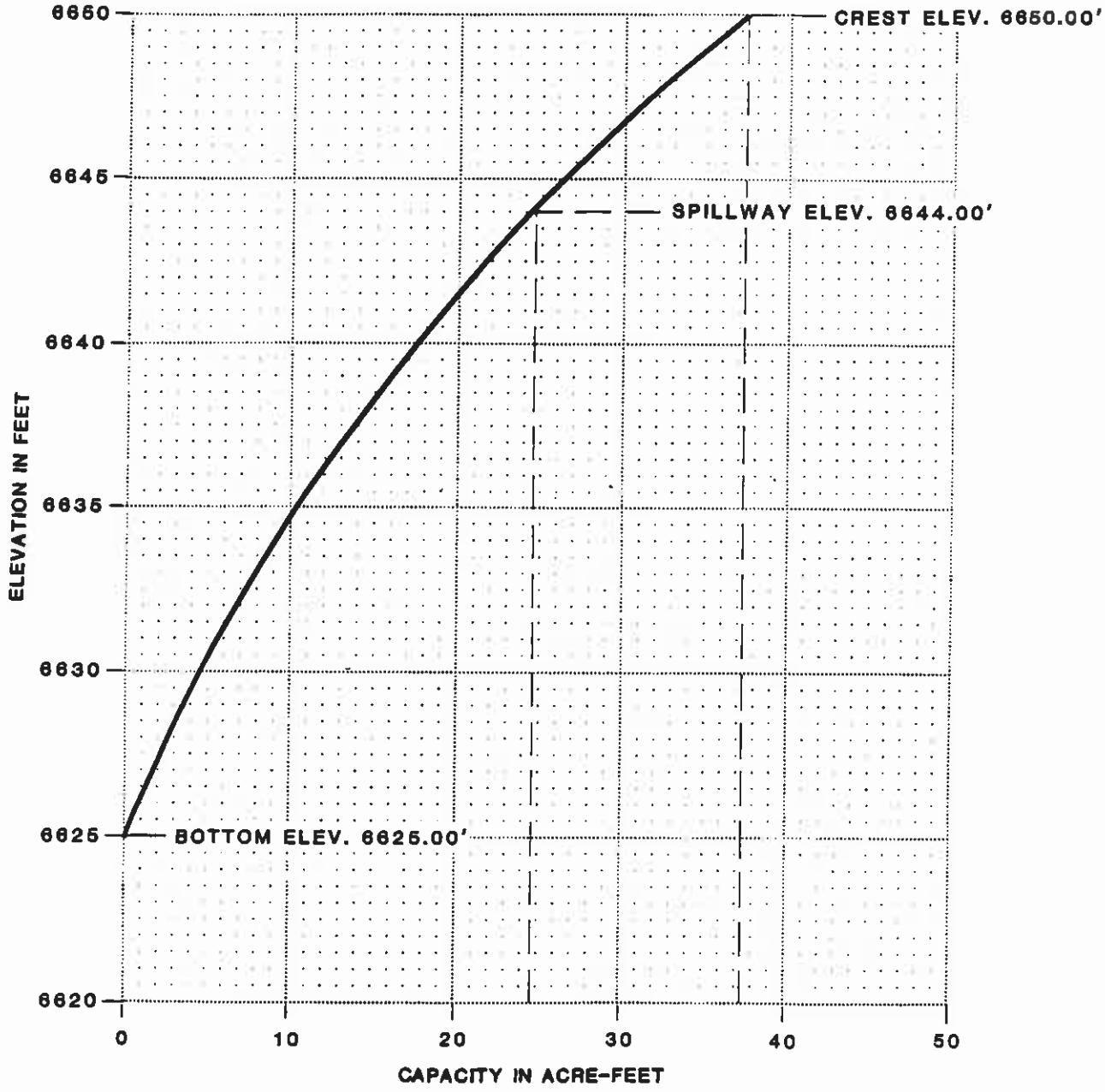
Appendix A - Hydrology and Hydraulic Calculations



SITE PLAN
N10-A2

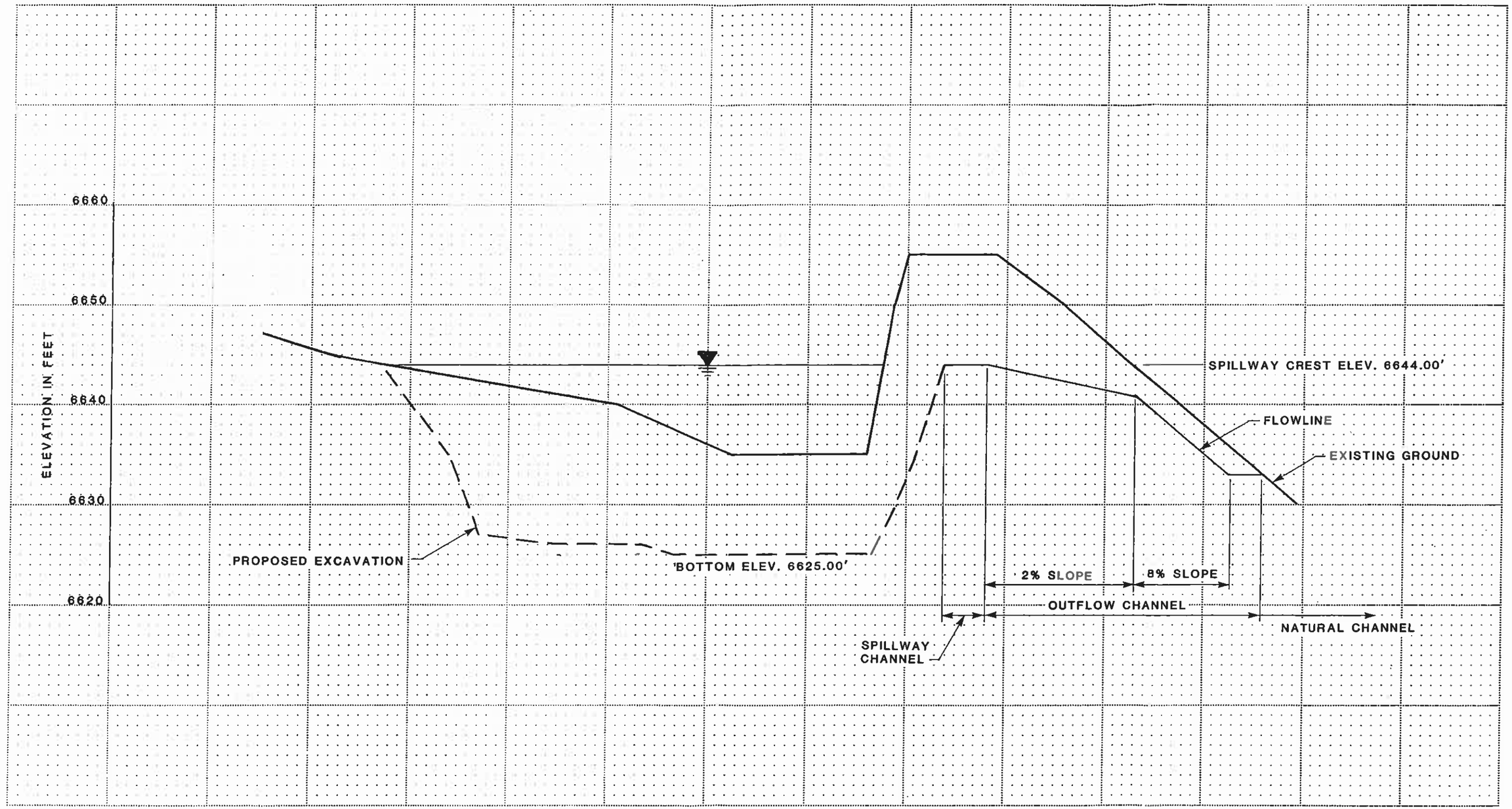
SCALE
0 100 200
FEET

BY **Dames & Moore** Plate 1



VOLUME-ELEVATION CURVE N10-A2

BY **Dames & Moore** Plate 2

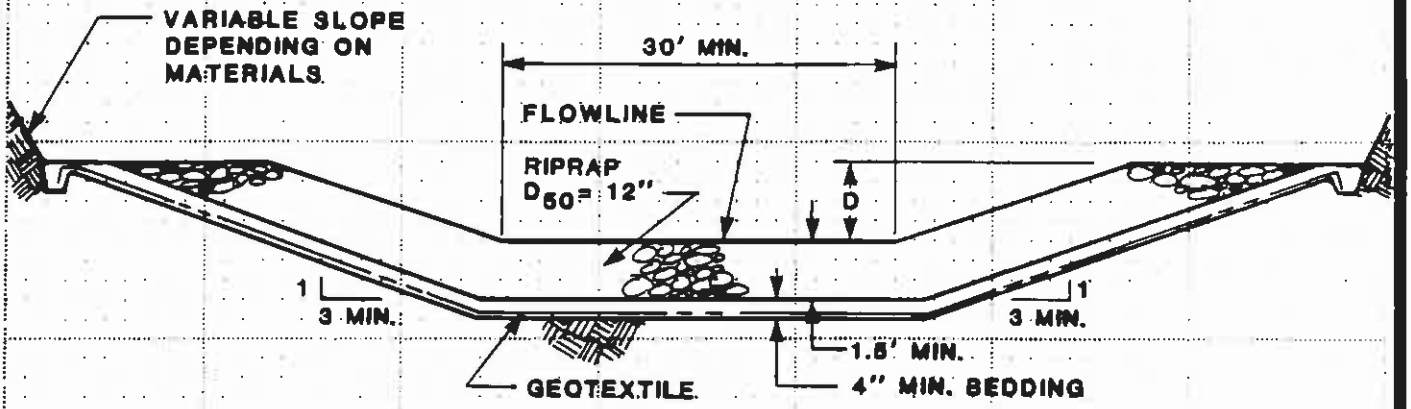


SCALE
0 100 200
FEET

CHANNEL PROFILE A-A'
N10-A2

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 5.4'

LENGTH = 40'

FLOWLINE ELEV. = 6644.00'

OUTFLOW CHANNEL

D = 3.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N10-A2

APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE [illegible]

SUBJECT SEDIMENT POND HYDROLOGY

N10-A2 SHEET ___ OF ___

BY ___ DATE ___ TO EO ___

BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6812 − 6650 = 162 ✓

WATER COURSE LENGTH = 1230' = .233 mi ✓

T_c = 0.068 hr ✓

LAG TIME = $0.6 T_c$ = 0.041 hr ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
9.6	reclaimed (pre law)	poor	—	87 (.18)
3.6	disturbed (road)		D	89 (.07)
27.3	P-5	ave	D	83 (.52)
12.2	S-6	ave	B	60 (.23)
				78.85

18% EH #35
23% EH #27
59% EH #25

use 79 ✓

DRAINAGE BASIN AREA

52.7 ACRE 0.082 SQ MILE ✓

CHECKED BY DHM 4/5/85

COPY TO EO ___

FILE _____

SUBJECT SEDIMENT INFLOW

N10-A2 SHEET ___ OF ___

BY ___ DATE ___ TO EO ___

BY ___ DATE ___ TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =	18% EA #35	.18(.42)
	60% EH #25	.6 (.22)
	22% EA #27	.22(.36)
		0,287 ✓

K = .287

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
900	160	17.8	10.4 (.6)
800	125	15.6	7.9 (.4)
			9.4

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
18%	reclaimed	—	—	.15 (.18)
7%	disturbed	—	—	1.0 (.07)
52%	P-J	40	25	.14 (.52)
23%	S-G	40	25	.13 (.23)
				0.20 ✓

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.287)(9.4)(.2)(1.0) = 21.58$ ton/acre/year

$A = 21.58\left(\frac{1}{2047}\right)(52.7)(.95) = 0.528$ acre-feet/year

CHECKED BY BHM 11/5/85

COPY TO EO ___

Dames & Moore

FILE [illegible]

SUBJECT Sediment Pond Hydrology

N10-A2 SHEET ___ OF ___

100yr - Excluding N10-A Upstream 6hr

BY ___ DATE ___ TO EO ___

BY ___ DATE ___ TO EO ___

Time of Concentration

Elevation Difference = 7165 − 6635 = 530 ft.

Water Course Length = 27.8(400) = 11120 ft. = 2.106 mi.

$$T_c = \left(\frac{11.9\ (2.106)^3}{530}\right)^{0.385} = 0.548 \text{ hr.}$$

Lag Time = $0.6 T_c$ = 0.329 hr.

SCS Curve Number

	Drainage Area (ac)	Cover Type	Hydrologic Condition	Soil Type	Weighted Curve Number
A2	52.7				79 (.08)
A	625.1				83 (.92)
					82.7
					use 83

Drainage Basin Area

677.8 acre 1.059 sq mile

CHECKED BY ___

COPY TO EO ___