

DESIGN REPORT

Sedimentation Structure

N8-B1

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY



Dames & Moore  
10139-011-22

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## INTRODUCTION

Sedimentation Structure N8-B1 will be an incised structure with 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 Kayenta Mine. The location of Structure N8-B1 is shown on Plate 1, Site Plan.

This design report contains information specific to Structure N8-B1. 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 N8-B1 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 N8-B1 has a 354.8-acre tributary drainage area and is located near Yellow Water Canyon at the Kayenta Mine. The watershed is classified as 70% Pinion/Juniper and 30% 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. The incised portion of the structure will be excavated at 3:1 (horizontal to vertical) slopes.

### DESIGN ANALYSES

### GENERAL

Structure N8-B1 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 1985 for Peabody Coal Company and was used in the analyses of the structure.

#### STABILITY

The slopes of Structure N8-B1 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 N8-B1 is located upstream from Structure N8-B. The two structures have a combined storage capacity that is greater than 20 acre-feet. However, the spillway for N8-B1 was analyzed using the 25-year, 6-hour storm because it is the upstream structure. The storage capacity of Structure N8-B1 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

- |    |   |       |       |
|----|---|-------|-------|
| 1. | Water Course length, L . . . . .                | 1.76  | mi    |
| 2. | Elevation Difference, H . . . . .               | 670   | ft    |
| 3. | Time of Concentration, T <sub>c</sub> . . . . . | 0.407 | h     |
| 4. | Lag time, 0.6T . . . . .                        | 0.244 | h     |
| 5. | SCS Curve Number <sup>c</sup> . . . . .         | 83    |       |
| 6. | Rainfall Depth, 10-year, 24-hour storm .        | 2.1   | in.   |
|    | 25-year, 6-hour storm .                         | 1.9   | in.   |
| 7. | Drainage Area . . . . .                         | 354.8 | 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 initial conditions and results of the analysis are summarized in the following table.

N8-B1 HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
<b>Initial Reservoir Volume</b>			
Condition		Empty	Full to the spillway elevation
<b>Inflow</b>			
Peak Flow . . . . .	cfs	285	321
Volume . . . . .	acre-ft	22.18	17.44
<b>Storage</b>			
Peak Stage . . . . .	ft	6687.09	--
Spillway Elevation . .	ft	6686.50	--
Peak Storage . . . . .	acre-ft	—	—
Incised Storage			
Capacity . . . . .	acre-ft	14.71	—
Active Storage			
Capacity . . . . .	acre-ft	5.86	—
Total Storage			
Capacity . . . . .	acre-ft	20.57	—
<b>Outflow</b>			
Peak Flow . . . . .	cfs	2	220
Embankment Crest			
Elevation . . . . .	ft	—	6691.00
Peak Stage . . . . .	ft	—	6689.61
Freeboard . . . . .	ft	—	1.39
<b>Spillway Channel</b>			
Flow Depth . . . . .	ft	—	3.11
Critical Velocity . . .	fps	—	6.6
Manning's "n" . . . . .		—	0.040
<b>Outflow Channel</b>			
Slope . . . . .	%	—	<u>Section I</u> <u>Section II</u>
Normal Velocity . . . .	fps	—	12            2
Normal Depth . . . . .	ft	—	11.7        6.4
Manning's "n" . . . . .		—	1.03        1.71
			0.040        0.040

### Spillway Channel

The spillway for N8-B1 will be a trapezoidal channel with the following dimensions:

Channel depth . . . . .	4.2 ft
Channel width . . . . .	15 ft
Channel length . . . . .	40 ft
Side slopes (horizontal to vertical). .	3:1
Average exit slope . . . . .	0 percent

### Outflow Channel

The outflow channel for Structure N8-B1 will be a trapezoidal channel with the following dimensions:

Channel width . . . . .	15 ft
Channel length . . . . .	210 ft
Side slopes (horizontal to vertical). .	3:1
Average exit slope . . . . .	2-12 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, N8-B1 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 N8-B1 were made utilizing the Universal Soil Loss Equation with the following parameters:

- |   |       |
|---|-------|
| 1. Rainfall Factor, R . . . . .         | 40    |
| 2. Soil Erodibility Factor, K . . . . . | 0.224 |
| 3. Slope Factor, LS . . . . .           | 14.6  |
| 4. Cover Factor, C . . . . .            | 0.136 |
| 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. During the 10-year storm, Structure N8-B1 contributes flow to Structure N8-B located downstream. Therefore, the two structures were combined to determine the storage capacity and sediment storage life. The results of the sediment inflow analyses are summarized in the following table.

## COMBINED STORAGE N8-B AND N8-B1

	<u>N8-B1</u>	<u>N8-B</u>	<u>Total</u>	
Total Storage Capacity . . . . .	20.57	18.59	39.16	acre-ft
10-year, 24-hour Storm Inflow . . . . .	22.18	0.61	22.79	acre-ft
Available Sediment Storage Capacity . . .	--	--	16.37	acre-ft
Sediment Inflow Rate . . . . .	2.78	0.053	2.83	acre-ft/yr
Sediment Storage Life . . . . .	--	--	6	yrs

\* \* \*

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

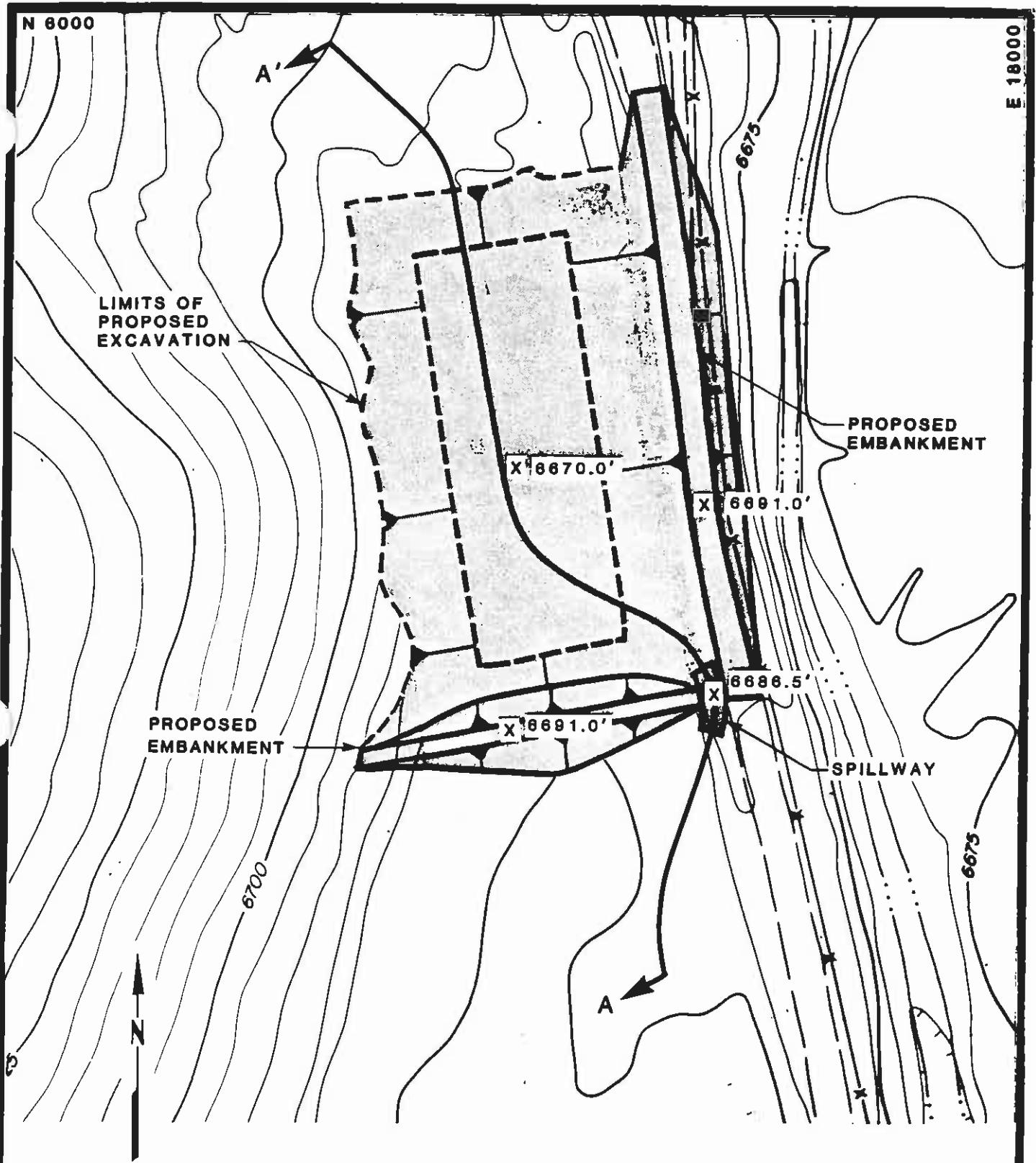
Plate 1 - Site Plan N8-B1

Plate 2 - Volume-Elevation Curve N8-B1

Plate 3 - Channel Profile N8-B1, A-A'

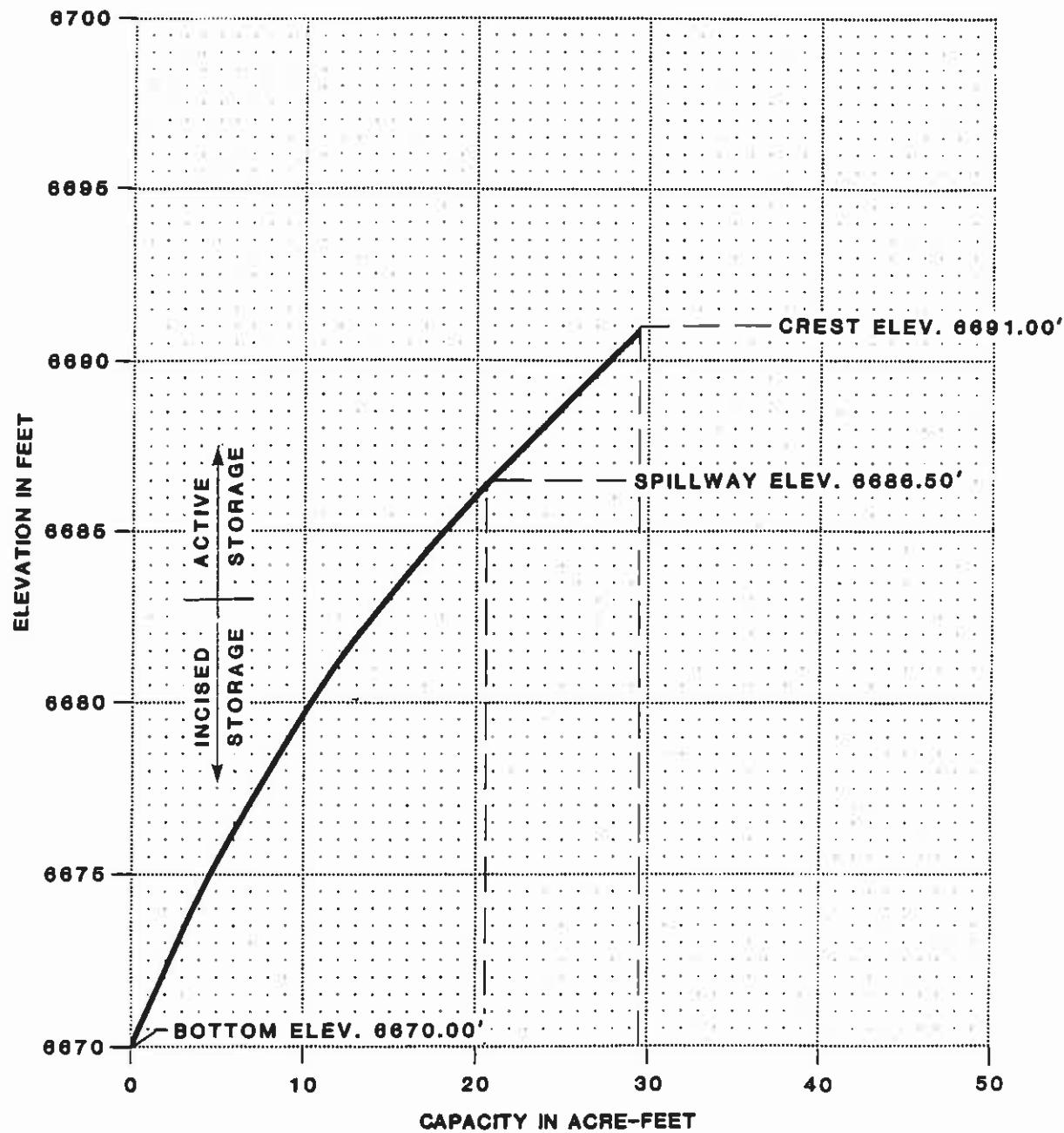
Plate 4 - Spillway and Outflow Channel Cross Section N8-B1

Appendix A - Hydrology and Hydraulic Calculations

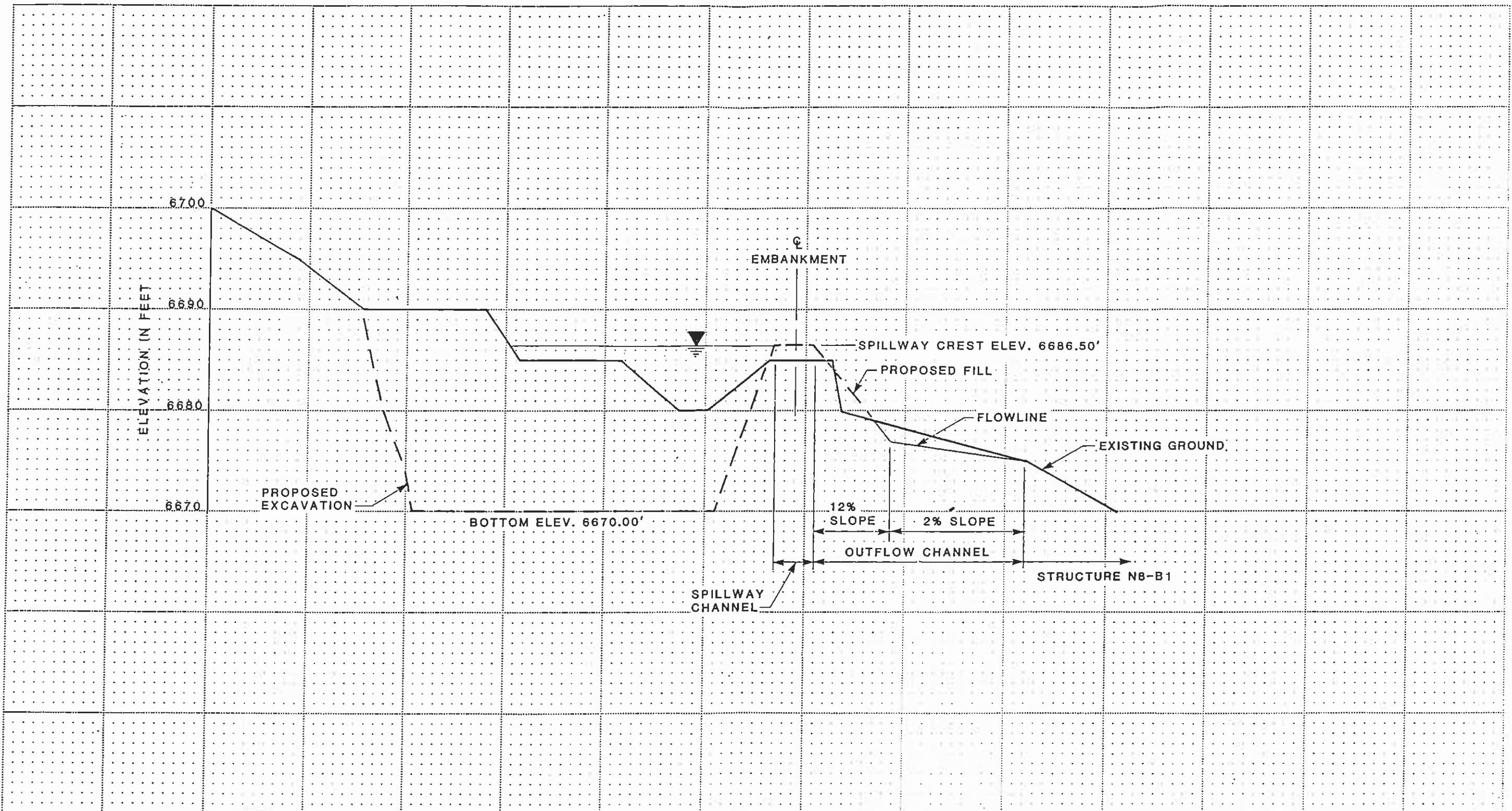


SITE PLAN  
N8-B1

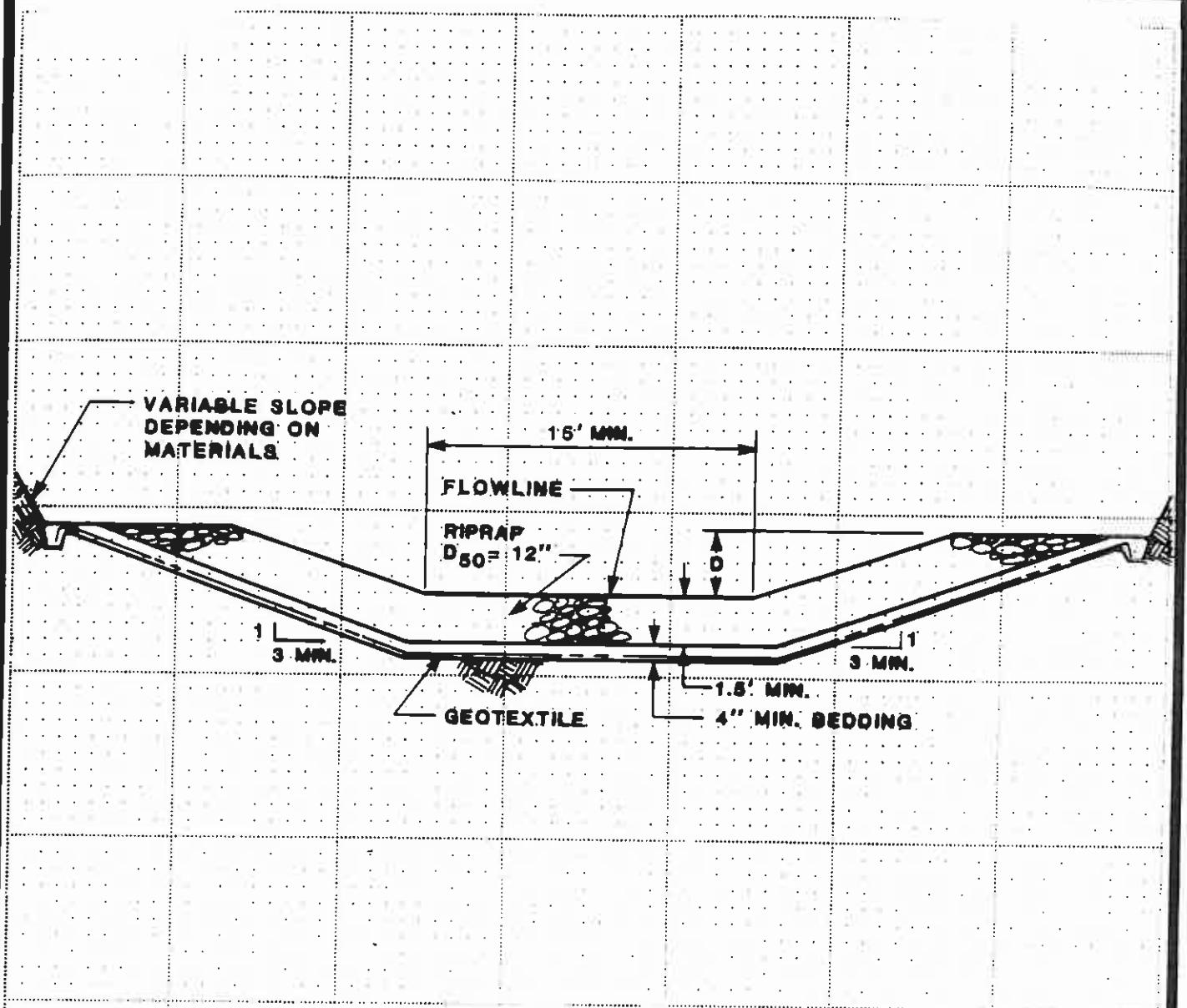
SCALE  
0 100 200  
FEET



VOLUME-ELEVATION  
CURVE  
N8-B1



CHANNEL PROFILE A-A'  
N8-B1



SPILLWAY CHANNEL

D = 4.2'

LENGTH = 40'

FLOWLINE ELEV. = 8886.50'

OUTFLOW CHANNEL

D = 3'

SPILLWAY AND  
OUTFLOW CHANNEL  
CROSS SECTION  
N8-B1

**APPENDIX A**

**HYDROLOGY AND HYDRAULIC CALCULATIONS**

TIME OF CONCENTRATION

$$\text{ELEVATION DIFFERENCE} = 7345 - 6675 = 670'$$

$$\text{WATER COURSE LENGTH} = 9271' = 1.76 \text{ mi} \checkmark$$

$$T_c = \frac{407}{406} \text{ hr}$$

$$\text{Lag Time} = 0.6 T_c = .244 \text{ hr} \checkmark$$

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
247.1	P-J	ave	D	83 (.70)
107.7	reclaimed (post law)	—	D	81 (.30)
		:		.82.4
				use <u>83</u>

DRAINAGE BASIN AREA

354.8 ACRES 0.554 SQ MILE  $\checkmark$

## UNIVERSAL SOIL LOSS EQUATION

### RAINFALL FACTOR

$$R = 40$$

### SOIL ERODIBILITY FACTOR

$$\begin{array}{l} \text{Soil Type} = \frac{70\% \text{ EM #30}}{30\% \text{ EM #35}} \\ \qquad \qquad \qquad \frac{(.7) .14}{(.3) .42} \\ \qquad \qquad \qquad \hline \qquad \qquad \qquad ,224 \checkmark \end{array}$$

$$K = \underline{0.224}$$

### SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
1200	125	10.4	5.08 (.3) ✓
800	360	37.5	36.4 (.20)
1200	150	12.5	6.7 (.3) ✓
800	216	26.25	19.1 (.2) ✓
			14.6

### COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
70%	P-J	40	25	.13 (.7)
30%	reclaimed	—	—	.15 (.3)
				.136

### EROSION CONTROL FACTOR

$$P = 1.0$$

### SEDIMENT INFLOW

$$A = 40 (.224)(14.6)(.136)(1.0) = 17.80 \text{ ton/acre/year}$$

$$A = 17.8 \left( \frac{1}{2047} \right) (354.8)(.9) = 2.78 \text{ acre-feet/year}$$