

DESIGN REPORT
Sedimentation Structure
N8-B
Kayenta Mine
Navajo County, Arizona
for
PEABODY COAL COMPANY



Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N8-B will be a partially 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 N8-B is shown on Plate 1, Site Plan.

This design report contains information specific to Structure N8-B. 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-B 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-B has a 11.1-acre tributary drainage area and is located near Yellow Water Canyon at the Kayenta 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. The incised portion of the structure will be excavated with 3:1 (horizontal to vertical) slopes.

DESIGN ANALYSES

GENERAL

Structure N8-B 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-B 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-B is located downstream from Structure N8-B1. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for N8-B was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure N8-B was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

	10-year, <u>24-hour Storm</u>	100-year, <u>6-hour Storm</u>	
1. Water Course length, L	0.109	1.81	mi
2. Elevation Difference, H	48	670	ft
3. Time of Concentration, T	0.045	0.421	h
4. Lag time, $0.6T_c$	0.027	0.253	h
5. SCS Curve Number	81	83	
6. Rainfall Depth	2.1	2.4	in.
7. Drainage Area	11.1	365.4	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 N8-B1 located upstream and into N8-B. The 100-year storm was analyzed without Structure N8-B1. The initial conditions and results of the analysis are summarized in the following table.

N8-B HYDRAULICS

	Units	10-year 24-hour Storm	100-year 6-hour Storm
<hr/>			
Initial Reservoir Volume			
Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	15	546
Volume	acre-ft	0.61	28.66
Storage			
Peak Stage	ft	6668.49	--
Spillway Elevation . .	ft	6675.00	--
Peak Storage	acre-ft	2.22	--
Storage Capacity . . .	acre-ft	18.59	--
Outflow			
Peak Flow	cfs	0	403
Embankment Crest			
Elevation	ft	--	6678.50
Peak Stage	ft	--	6677.27
Freeboard	ft	--	1.23
Spillway Channel			
Flow Depth	ft	--	2.27
Critical Velocity . . .	fps	--	5.7
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	8
Normal Velocity	fps	--	10.7
Normal Depth	ft	--	0.87
Manning's "n"		--	0.040

Spillway Channel

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

Channel depth	3.3 ft
Channel width	30 ft
Channel length	30 ft
Side slopes (horizontal to vertical). .	3:1
Average exit slope	0 percent

Outflow Channel

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

Channel width	30 ft
Channel length	30 ft
Side slopes (horizontal to vertical). .	3:1
Average exit slope	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, N8-B 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-B 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 4.08
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. During the 10-year storm, Structure N8-B receives inflow from Structure N8-B1 located upstream. Therefore, the two structures were combined to determine the storage capacity and sediment storage life. The results of the sediment inflow analysis 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.

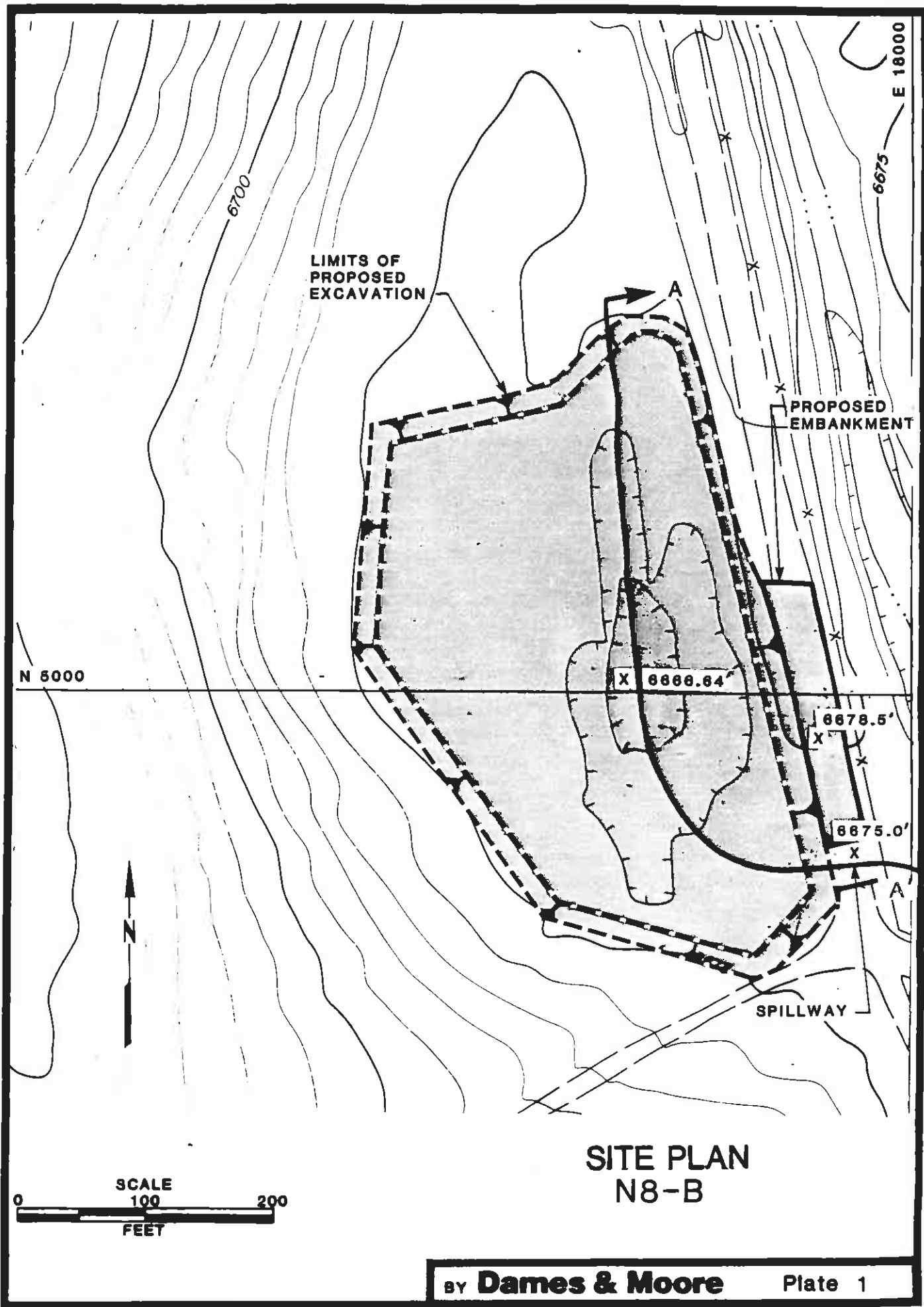
Plate 1 - Site Plan N8-B

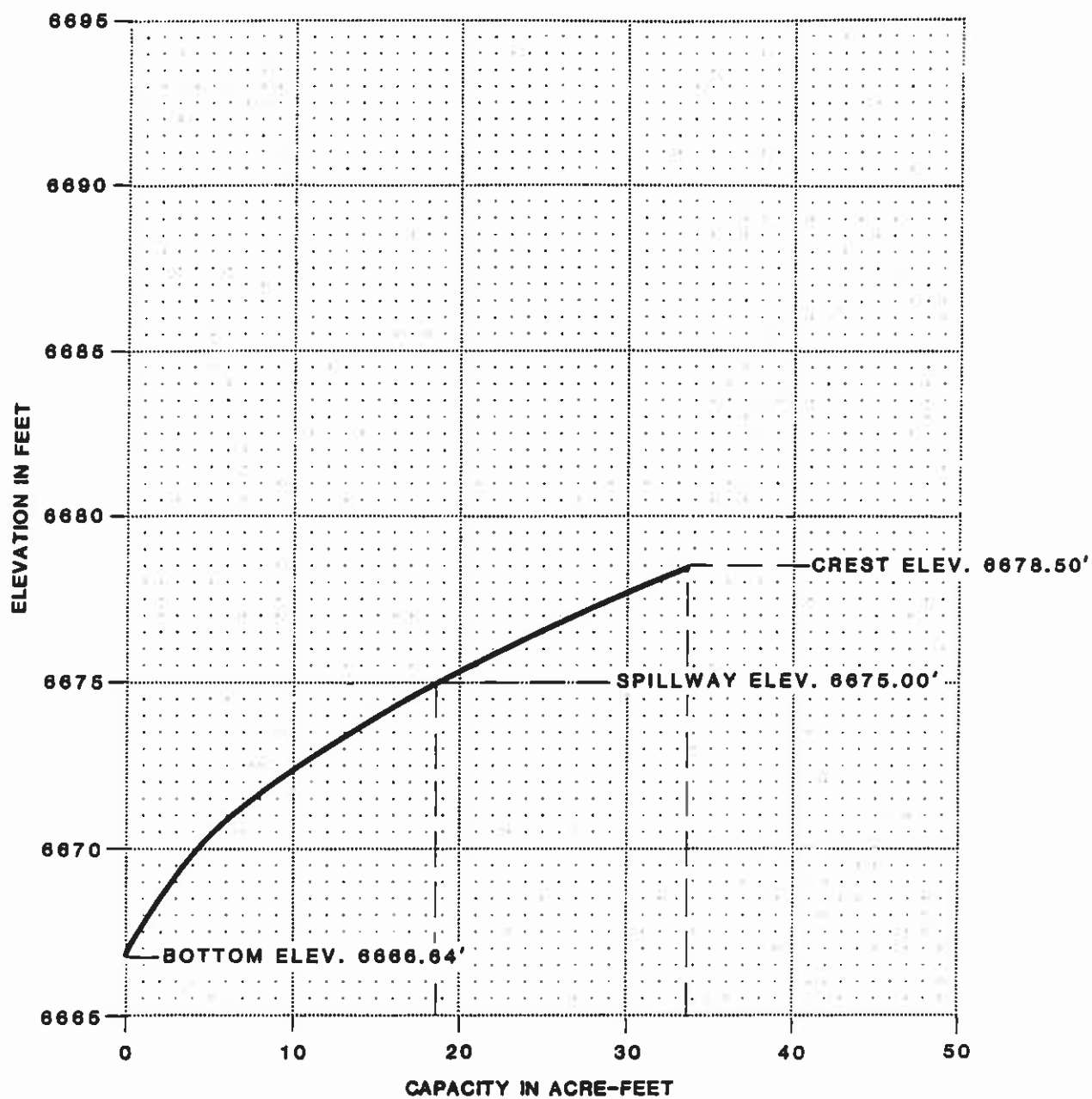
Plate 2 - Volume-Elevation Curve N8-B

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

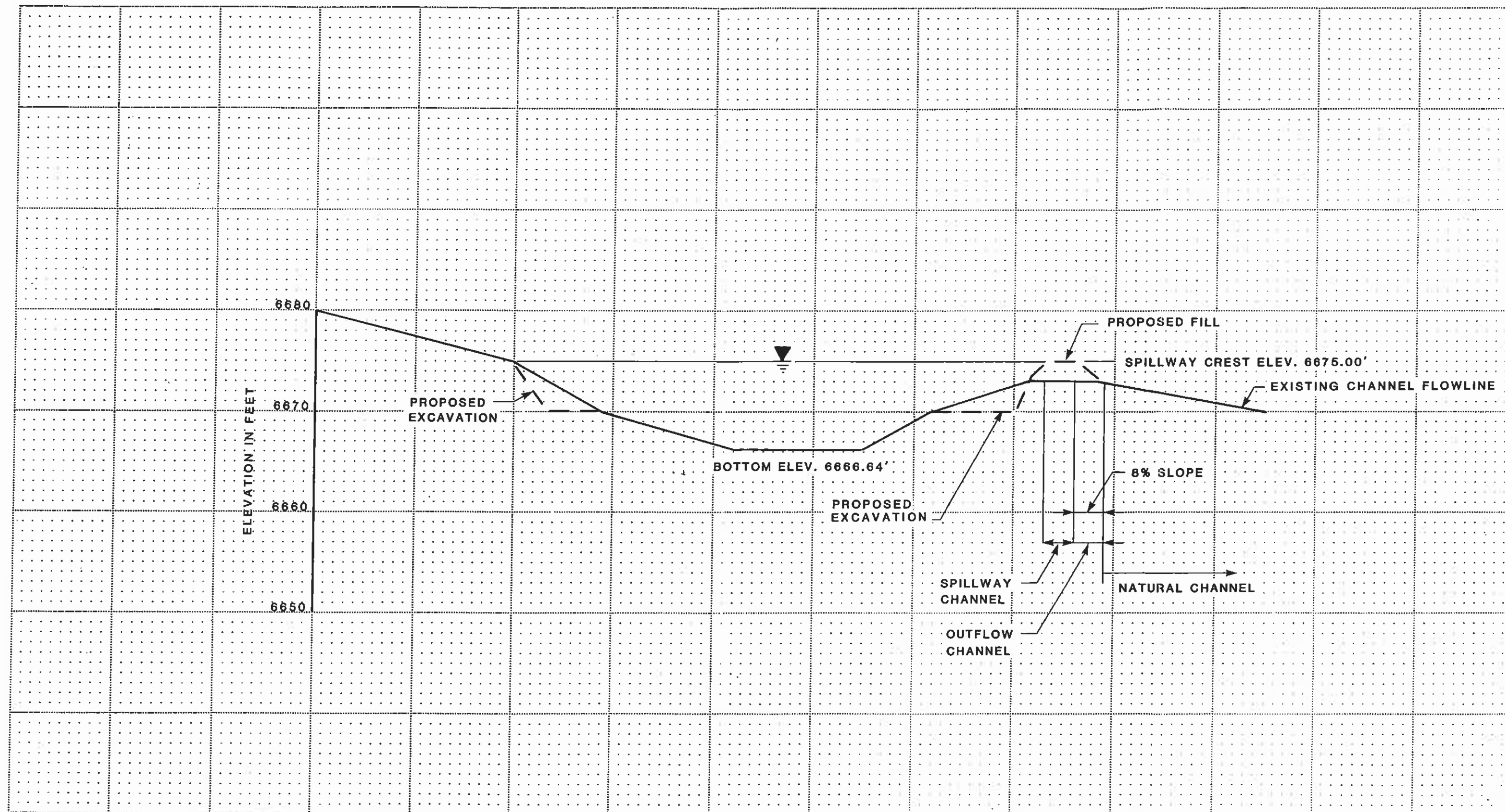
Plate 4 - Spillway and Outflow Channel Cross Section N8-B

Appendix A - Hydrology and Hydraulic Calculations





VOLUME-ELEVATION
CURVE
N8-B

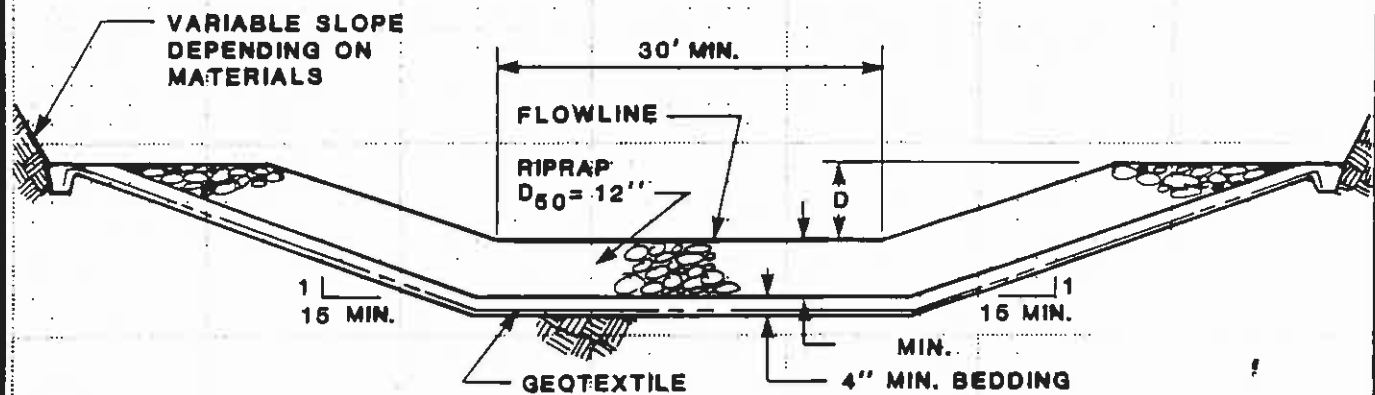


CHANNEL PROFILE A-A'
N8-B

SCALE
0 100 200
FEET

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

$D = 3.3'$

LENGTH = 30'

FLOWLINE ELEV. = 6675.00'

OUTFLOW CHANNEL

$D = 2.0'$

**SPILLWAY AND
OUTFLOW CHANNEL
CROSS SECTION
N8-B**

APPENDIX A
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 48'

WATER COURSE LENGTH = 570' = ^{.108}.109 mi ✓

$T_c = .045$ hr. ✓

Lag Time = $0.6 T_c = .027$ hr ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
.11.1	reclaimed (post law)	fair	—	<u>81</u>

DRAINAGE BASIN AREA

.11.1 ACRES 0.0174 SQ MILE

REVISIONS

BY DATE TO EO
 BY DATE TO EO

BY DATE
 CHECKED BY BHM 11/5/85
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TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 670'

WATER COURSE LENGTH = 9571' = 1.81 mi

$$T_c = \left(\frac{11.9(1.81)^3}{670} \right)^{0.385} = .421 \text{ hr}$$

Lag Time = $0.6 T_c = .253 \text{ hr}$

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
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use weighted average from NBB1 and
 NBB2 watersheds

$$(82.4) \frac{354.8}{(354.8 + 11.1)} + 81 \frac{(11.1)}{(354.8 + 11.1)} = 82.3$$

use 83

DRAINAGE BASIN AREA

365.9 ACRES 0.572 SQ MILES

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

$R = 40$

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EX # 35

$K = \underline{\underline{0.42}}$

SLOPE FACTOR

<u>LENGTH (ft.)</u>	<u>Δ ELEV (ft.)</u>	<u>SLOPE (%)</u>	<u>LS</u>
500	60	12%	<u><u>4.08</u></u> ✓

COVER FACTOR

<u>AREA (ac)</u>	<u>COVER TYPE</u>	<u>% COVER</u>	<u>CANOPY (%)</u>	<u>WEIGHTED C</u>
100%	reclaimed	—	—	<u><u>0.15</u></u>

EROSION CONTROL FACTOR

$P = 1.0$

SEDIMENT INFLOW

$A = 40(.42)(4.08)(.15)(1.0) = 10.28$ ton/acre/year ✓

$A = 10.28 \left(\frac{1}{2047} \right) (11.1)(.95) = 0.053$ acre-feet/year ✓

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