

INSPECTION REPORT
Sedimentation Structure
TPF-C
Kayenta Mine
Navajo County, Arizona
for
PEABODY COAL COMPANY



Dames & Moore
10139-011-22

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	6
REMEDIAL COMPLIANCE PLAN	7
GEOTECHNICS	7
HYDRAULICS	8
APPENDIX A - INSPECTION CHECK LIST	
APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure TPF-C is an earthen embankment, designed and constructed in 1982 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 TPF-C is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure TPF-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 TPF-C was inspected on September 5, 1985 by an interdisciplinary 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 TPF-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 TPF-C has a 7.26-acre tributary drainage area and is located near Yellow Water Valley at the Kayenta Mine. The watershed is classified as 61% Pinion/Juniper and 39% disturbed.

EMBANKMENT

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

Structure TPF-C

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	16.3 ft
Crest Width	14 ft
Upstream Slope	2.25 H : 1 V
Downstream Slope	2.75 H : 1 V

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

ANALYSES

STABILITY

Structure TPF-C is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 20 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 TPF-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 TPF-C is not in series with any other structure and therefore, the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure TPF-C was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1. Water Course length, L 0.159 mi
2. Elevation Difference, H 111 ft
3. Time of Concentration, T_c 0.051 h
4. Lag time, $0.6T_c$ 0.030 h
5. SCS Curve Number 87
6. Rainfall Depth, 10-year, 24-hour storm . 2.1 in.
25-year, 6-hour storm. . 1.9 in.
7. Drainage Area 7.26 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.

TPF-C HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume			
Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	15	20
Volume	acre-ft	0.63	0.53
Storage			
Peak Stage	ft	6517.96	6529.18
Spillway Elevation . .	ft	6528.80	--
Peak Storage	acre-ft	0.63	--
Storage Capacity . . .	acre-ft	5.01	--
Outflow			
Peak Flow	cfs	0	3
Embankment Crest			
Elevation	ft	--	6531.10
Peak Stage	ft	--	6529.18
Freeboard	ft	--	1.92
Spillway Channel			
Flow Depth	ft	--	0.38
Critical Velocity . . .	fps	--	1.5
Manning's "n"		--	0.035
Outflow Channel			
			<u>Section I</u> <u>Section II</u>
Slope	%	--	6 13
Normal Velocity	fps	--	1.6 2.1
Normal Depth	ft	--	0.06 0.05
Manning's "n"		--	0.035 0.035

Spillway Channel

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

Channel depth	5 ft
Channel width	26 ft
Channel length	60 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	2 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, TPF-C.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.14
3. Slope Factor, LS 5.27
4. Cover Factor, C 0.478
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 TPF-C and the results of the sediment inflow analysis are summarized in the following table.

TPF-C STORAGE

Total Storage Capacity	5.01	acre-ft
10-year, 24-hour Storm Inflow	0.63	acre-ft
Available Sediment Storage Capacity	4.38	acre-ft
Sediment Inflow Rate	0.048	acre-ft/yr
Sediment Storage Life	91	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure TPF-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.

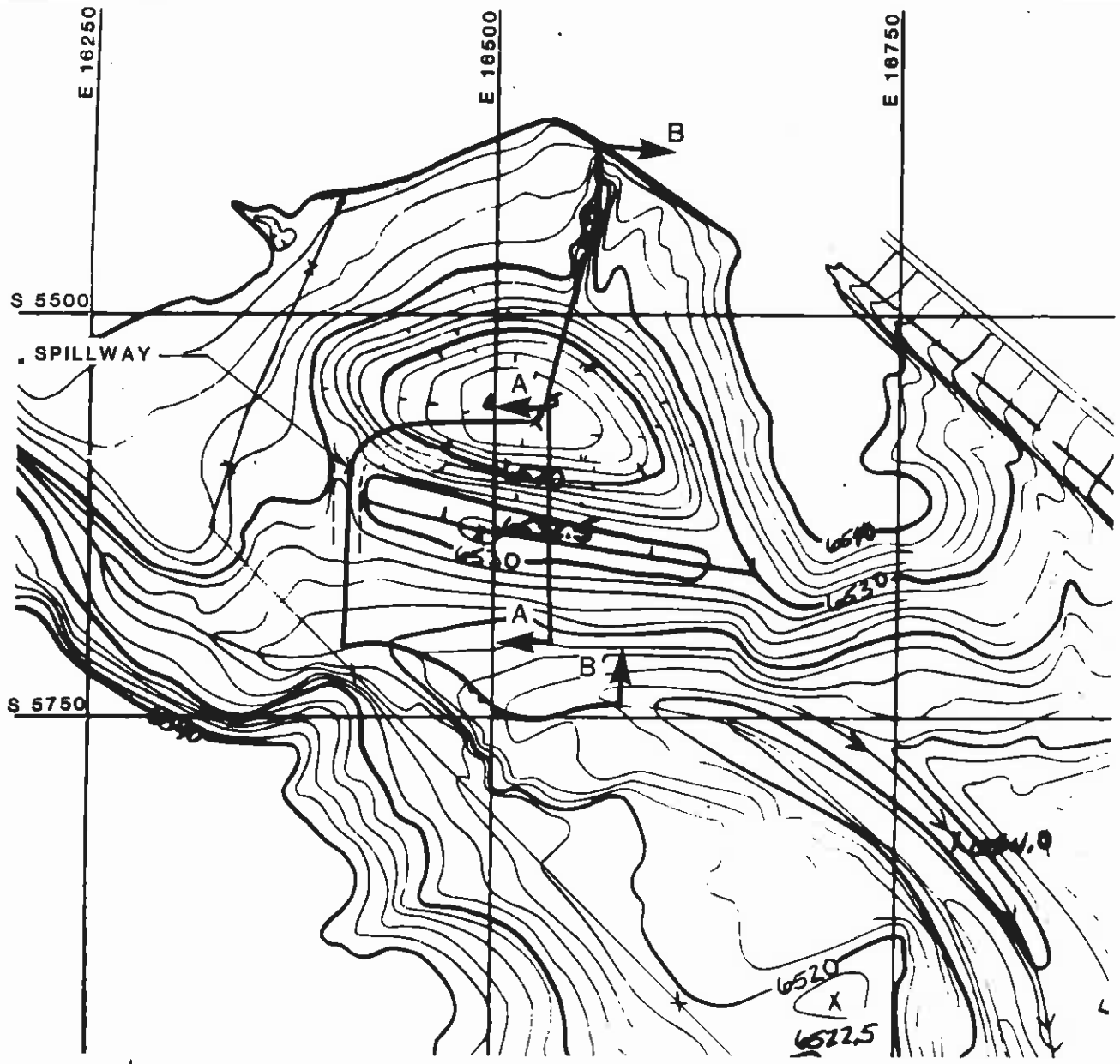
HYDRAULICS

The storage capacity and spillway capacity of Structure TPF-C are adequate; however, the spillway does not have an 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 gravel as shown in Plate 5.

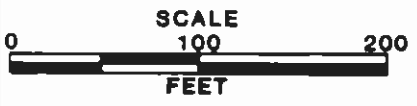
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The following plates and appendix are attached and complete this inspection report.

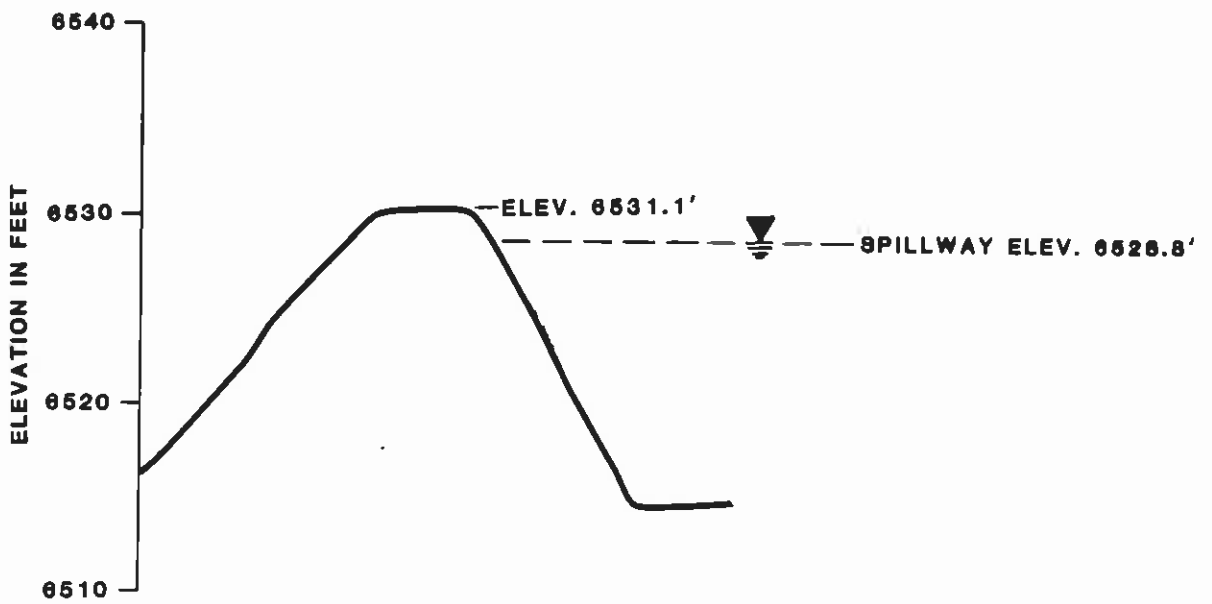
- Plate 1 - Site Plan TPF-C
- Plate 2 - Existing Maximum Cross Section TPF-C, A-A'
- Plate 3 - Volume-Elevation Curve TPF-C
- Plate 4 - Channel Profile TPF-C, B-B'
- Plate 5 - Spillway and Outflow Channel Cross Section TPF-C
- Appendix A - Inspection Check List
- Appendix B - Hydrology and Hydraulic Calculations



SPILLWAY



SITE PLAN
TPF-C

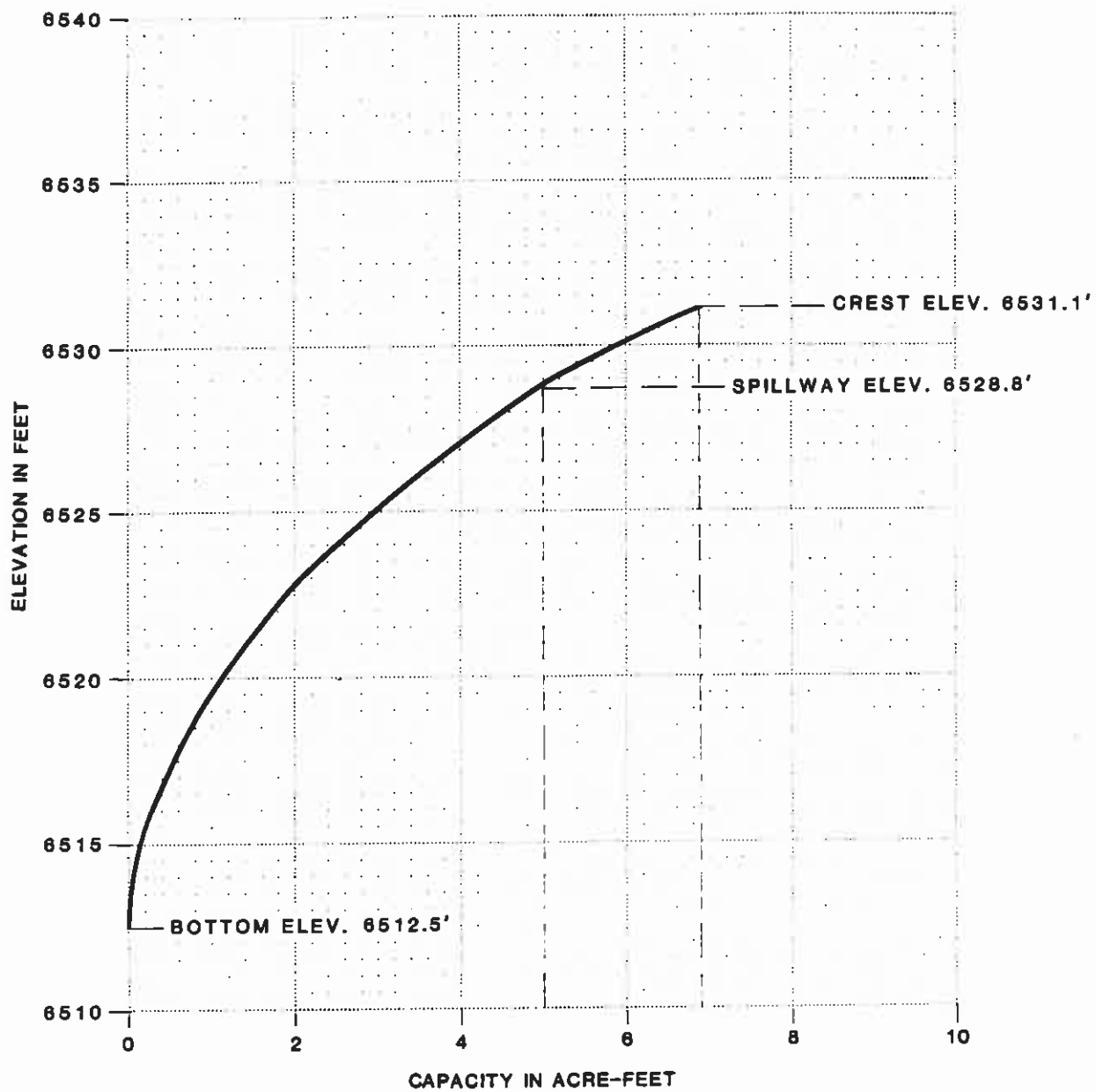


EXISTING
MAXIMUM CROSS-SECTION
A-A'
TPF-C

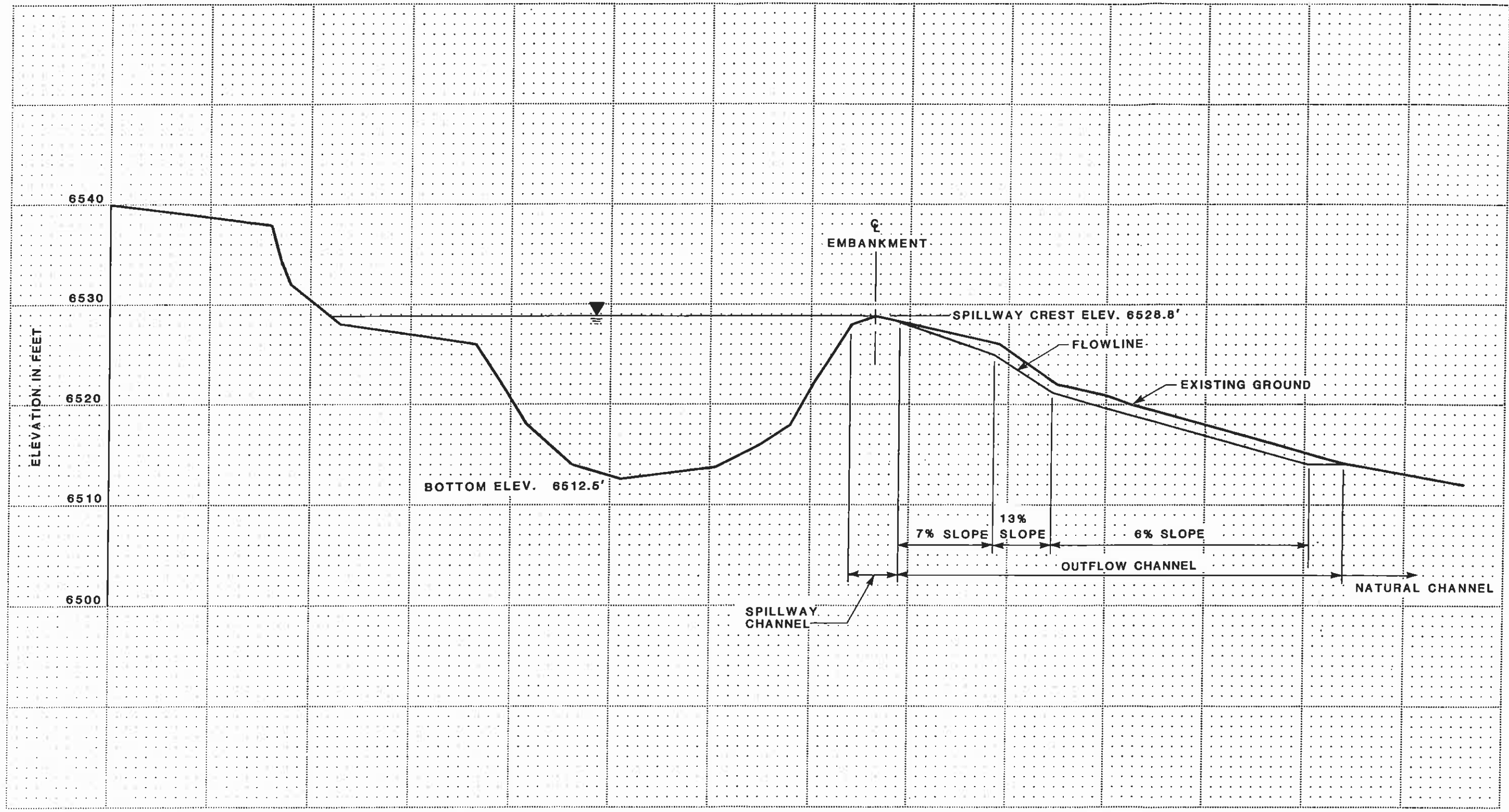
FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

Plate 2



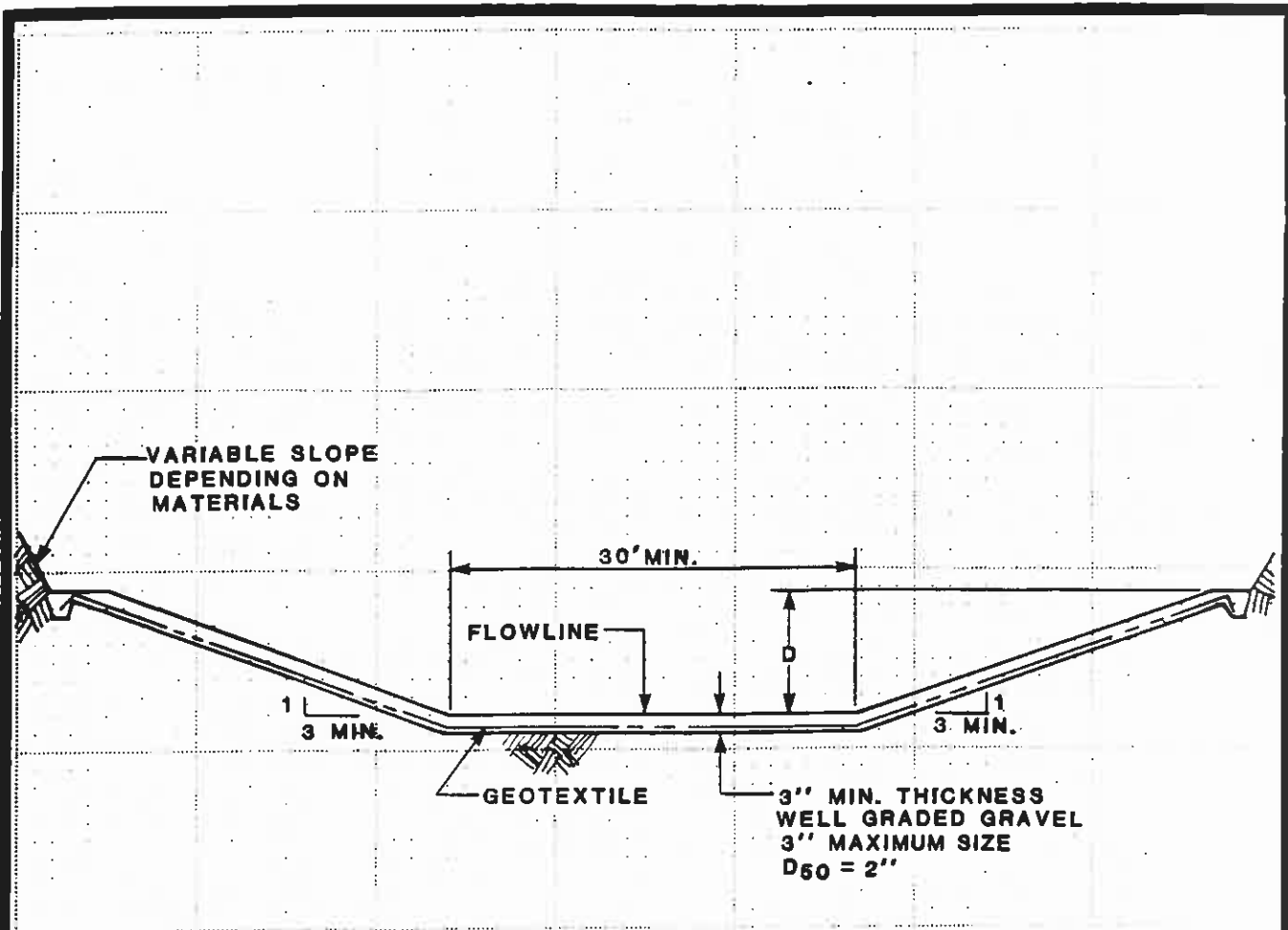
VOLUME-ELEVATION
CURVE
TPF-C



CHANNEL PROFILE B-B'
TPF-C



FOR LOCATION SEE PLATE 1



SPILLWAY CHANNEL

D = 1.4'

LENGTH = 50'

FLOWLINE ELEV. = 6528.80'

OUTFLOW CHANNEL

D = 1'

**SPILLWAY AND
OUTFLOW CHANNEL
CROSS SECTION
TPF-C**

APPENDIX A
INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			14' w.
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			24° 75% somewhat ragged slope
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. Adequate riprap protection?		X	Grass
g. Any stone deterioration?		X	NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			20°
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?		X	NA
i. Are the relief wells flowing?		X	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?			lt brown SM w rock
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?			lt brown sm / Rock

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		Near R.A
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			NA
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		
Are side slopes eroding?	X		Rills 5' below crest
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:		X	NA
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?			

26' W
60' L

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			

Canopy cover 40 %
 Ground Cover 80 %

APPENDIX B
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6640 - 6529 = 111 ft.

WATER COURSE LENGTH = 2.1(400) = 840 ft. = 0.159 mi.

$T_c = \left(\frac{11.9 (0.159)^3}{111} \right)^{0.385} = 0.051 \text{ hr.}$

Lag Time = 0.6 T_c = 0.030 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
2.9 (39%)	CONCRETE	—	D	0.39(91) = 35.5
4.5 (61%)	P-T	ave	D	0.61(83) = 50.6
			EH#30	86.1

Use 87

DRAINAGE BASIN AREA

7.26 ACRES 0.011 SQ. MILES

REVISIONS
 BY _____ DATE _____ TO EO _____
 BY _____ DATE _____ TO EO _____
 1. S. POLAN DATE 9-10-85
 CHECKED BY _____
 COPY TO EO _____

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

$R = 40$

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EM #30 .14.

$K = 0.14$

SLOPE FACTOR

<u>LENGTH (ft.)</u>	<u>Δ ELEV (ft.)</u>	<u>SLOPE (%)</u>	<u>LS</u>
400'	80	20%	8.16 (50%)
300	30	10%	2.37 (50%)

use 5.27

COVER FACTOR

<u>AREA (ac.)</u>	<u>COVER TYPE</u>	<u>% COVER</u>	<u>CANOPY (q)</u>	<u>WEIGHTED C</u>
39%	disturbed	—	—	.39 (1.0)
61%	P-J	40	25	.61 (.14)
				<u><u>C = .478</u></u>

EROSION CONTROL FACTOR

$P = 1.0$

SEDIMENT INFLOW

$A = 40 (.14) (5.27) (.478) (1.0) = 14.11$ ton/acre/year

$A = 14.11 \left(\frac{1}{2047} \right) (7.26) (.95) = 0.048$ acre-feet/year

REVISIONS
 BY _____ DATE _____ TO EO _____
 BY _____ DATE _____ TO EO _____

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