

INSPECTION REPORT
Sedimentation Structure
J28-C
Kayenta Mine
Navajo County, Arizona
for
PEABODY COAL COMPANY



Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J28-C is an earthen embankment, designed and constructed in 1983 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 J28-C is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J28-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 J28-C was inspected on September 12, 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 J28-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 J28-C has a 31.6-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 71% disturbed and 29% Pinion/Juniper.

EMBANKMENT

Structure J28-C is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J28-C

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	9.9 ft
Crest Width	15 ft
Upstream Slope	2.2 H : 1 V
Downstream Slope	3.3 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J28-C, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure J28-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 = 15 ft
2. Maximum upstream slope = 1.75 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J28-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 J28-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 J28-C was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.242	mi
2.	Elevation Difference, H	68	ft
3.	Time of Concentration, T_c	0.099	h
4.	Lag time, $0.6T_c$	0.060	h
5.	SCS Curve Number	88	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	31.6	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.

J28-C HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
<hr/>			
Initial Reservoir Volume			
Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	62	80
Volume	acre-ft	2.90	2.40
Storage			
Peak Stage	ft	6805.83	--
Spillway Elevation . .	ft	6812.41	--
Peak Storage	acre-ft	2.89	--
Storage Capacity . . .	acre-ft	13.4	--
Outflow			
Peak Flow	cfs	0	4
Embankment Crest			
Elevation	ft	--	6815.64
Peak Stage	ft	--	6813.17
Freeboard	ft	--	2.47
Spillway Channel			
Flow Depth	ft	--	0.76
Critical Velocity . . .	fps	--	1.8
Manning's "n"		--	0.035
Outflow Channel			
			<u>Section I</u> <u>Section II</u>
Slope	%	--	2 16
Normal Velocity	fps	--	1.4 2.7
Normal Depth	ft	--	0.14 0.08
Manning's "n"		--	0.035 0.035

Approach Channel

The existing approach channel for J28-C has a U-shaped channel with the following dimensions:

Channel width	21 ft
Channel length	30 ft
Average exit slope	0 percent

Spillway Channel

The existing spillway for J28-C has a trapezoidal channel with the following dimensions:

Channel depth	3.9 ft
Channel width	21 ft
Channel length	45 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	0 percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J28-C has a U-shaped channel with the following dimensions:

Channel width	21 ft
Channel length	90 ft
Average exit slope	2 percent

There is presently no erosion protection within the 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, J28-C.

The calculations for the sediment load entering Structure J28-C were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.32
3. Slope Factor, LS 4.42
4. Cover Factor, C 0.751
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 J28-C is shown on Plate 3, Volume-Elevation Curve, J28-C, and the results of the analysis are summarized in the following table.

J28-C STORAGE

Total Storage Capacity	13.4	acre-ft
10-year, 24-hour Storm Inflow	2.89	acre-ft
Available Sediment Storage Capacity . .	10.51	acre-ft
Sediment Inflow Rate	0.623	acre-ft/yr
Sediment Storage Life	17	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J28-C indicated that the geotechnical problems consist of rill erosion on the upstream and downstream slopes, the side slopes of the approach, spillway, and outlet channel and the right abutment and cracks in the embankment. Correction of erosion is considered a periodic maintenance task and does not require remedial action. Longitudinal cracks were noted on the crest and at the top of the upstream slopes. The sections of embankment exhibiting the cracks should be repaired by excavating the material to the depths of the cracks and replacement with compacted fill.

HYDRAULICS

The storage capacity and spillway capacity of Structure J28-C are adequate; however, the spillway does not have an adequate 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.

* * *

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

Plate 1 - Site Plan J28-C

Plate 2 - Existing Maximum Cross Section J28-C, A-A'

Plate 3 - Volume-Elevation Curve J28-C

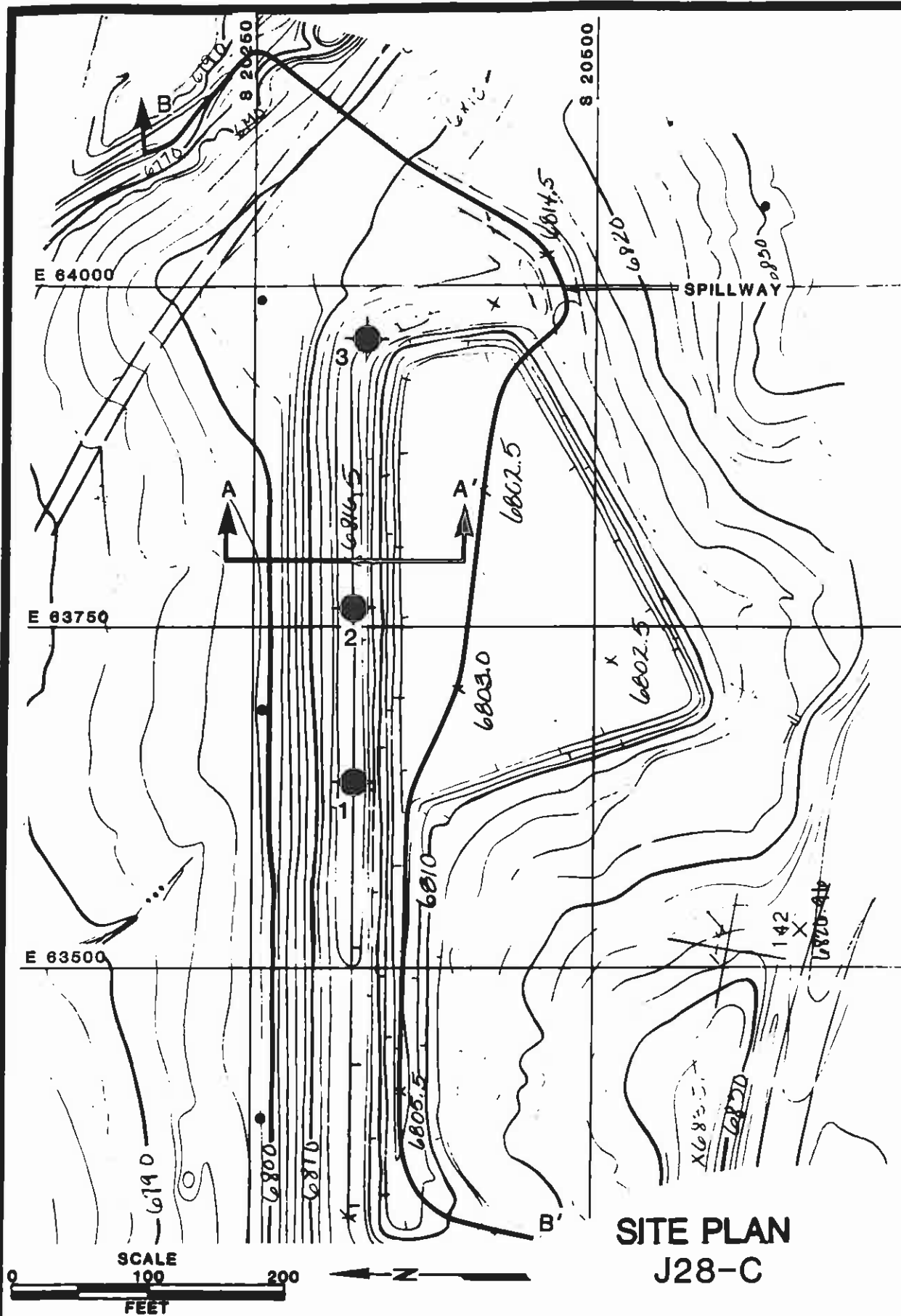
Plate 4 - Channel Profile J28-C, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J28-C

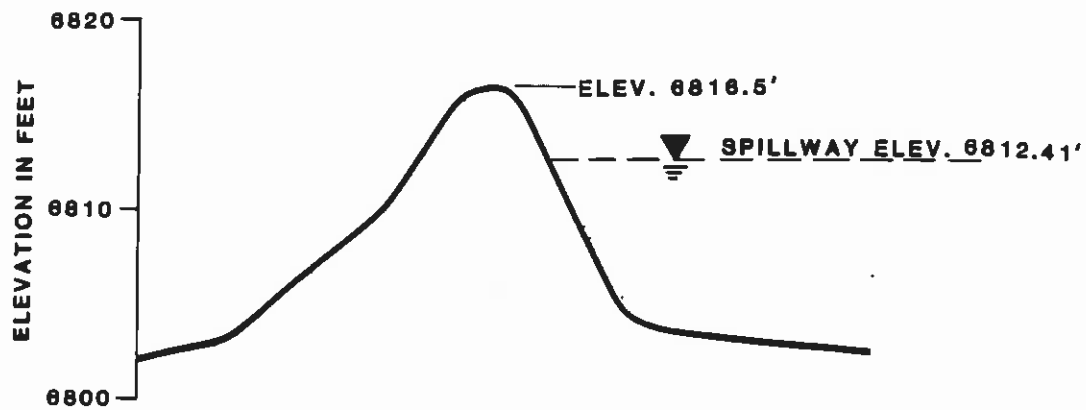
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations

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SITE PLAN
J28-C

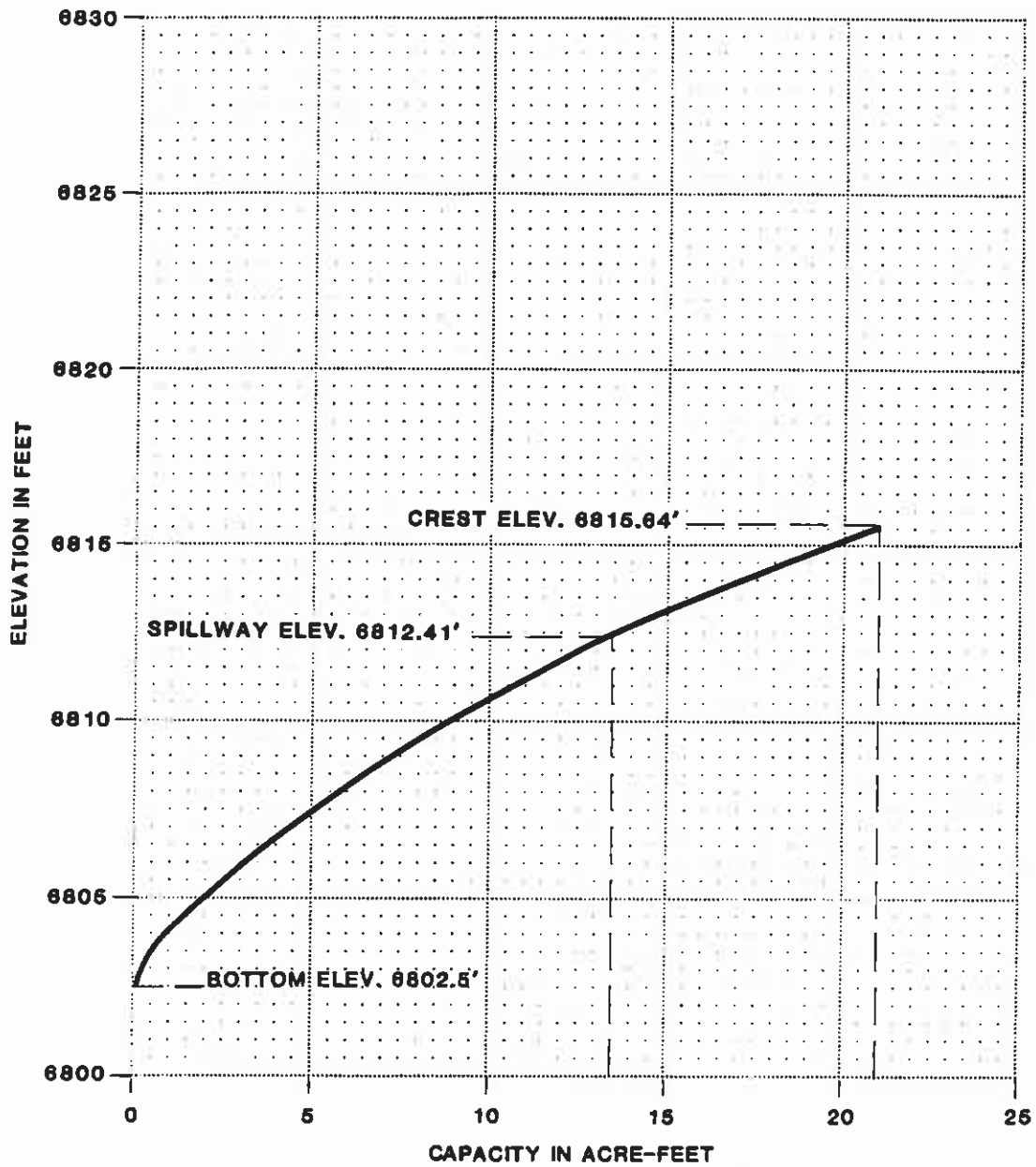


EXISTING
MAXIMUM CROSS-SECTION
A-A'
J28-C

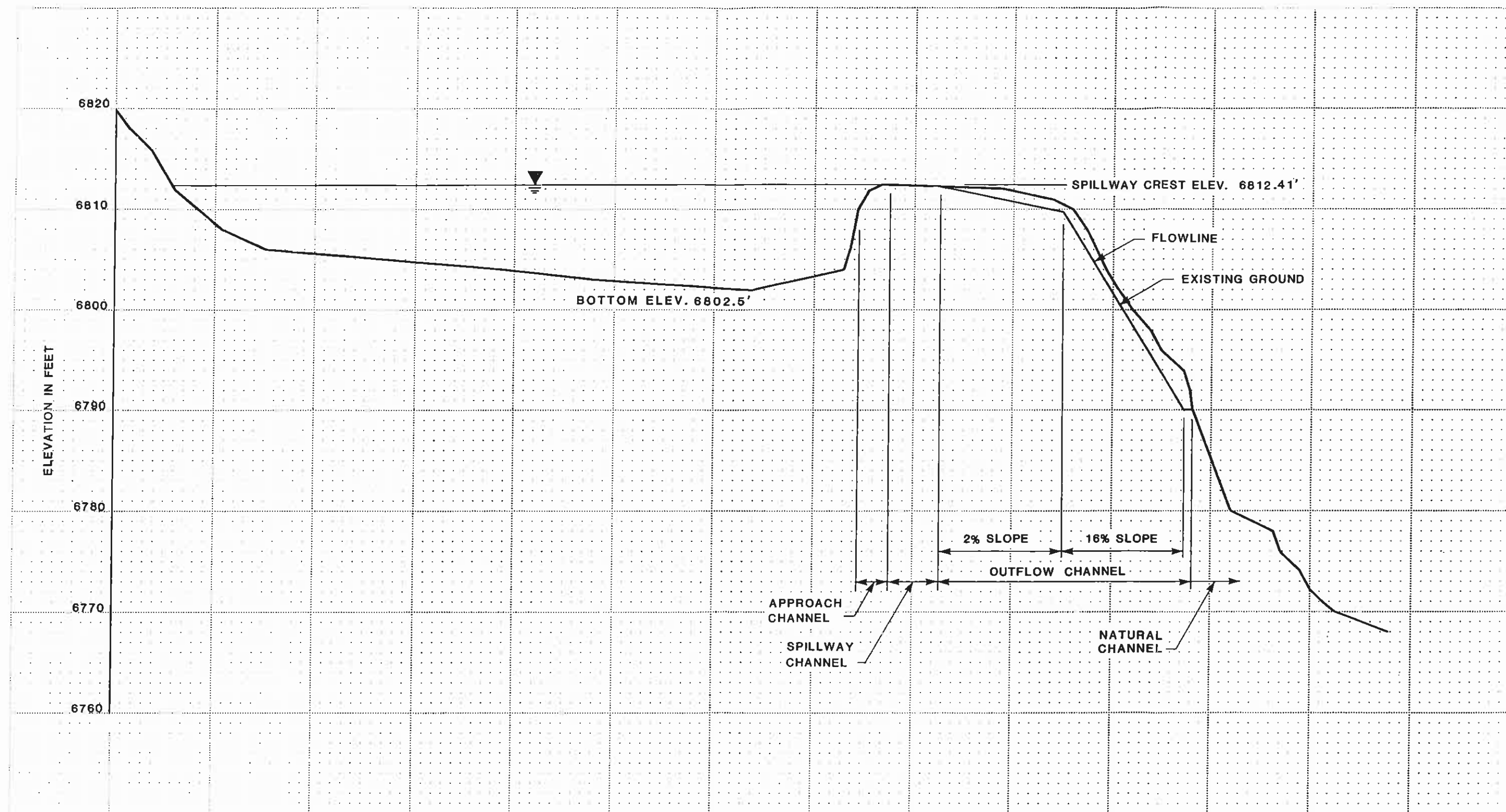
FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

Plate 2

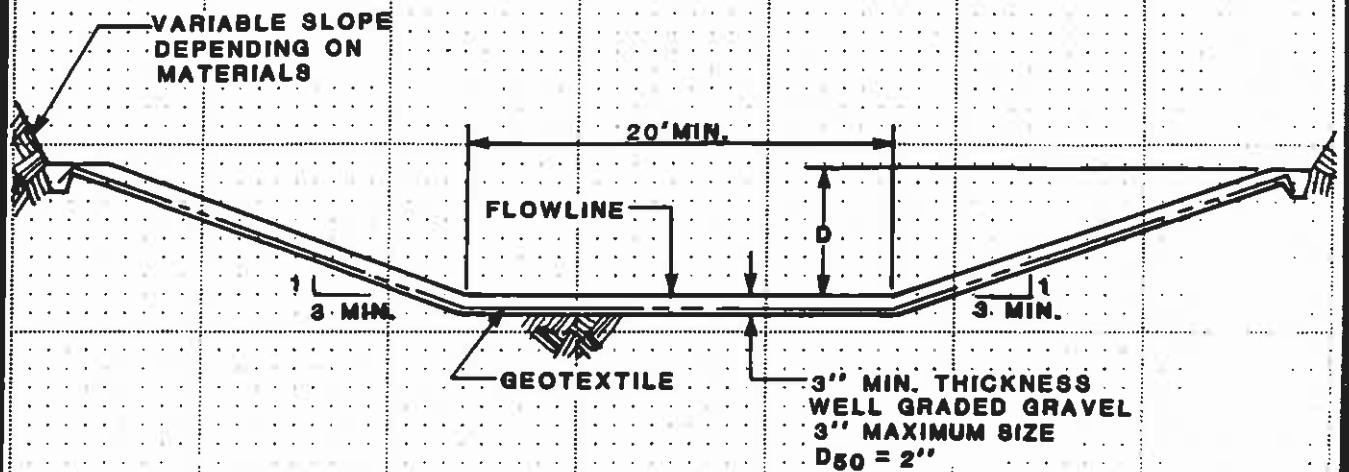


VOLUME-ELEVATION
CURVE
J28-C



CHANNEL PROFILE B-B'
J28-C





SPILLWAY CHANNEL

$D = 1.8'$

LENGTH = 50'

FLOWLINE ELEV. = 6812.41'

OUTFLOW CHANNEL

$D = 1'$

**SPILLWAY AND
OUTFLOW CHANNEL
CROSS SECTION**

J28-C

APPENDIX A
INSPECTION CHECK LIST

Sidehill

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			15' W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?	X		1 crack (longitudinal) near u.s. slope 25' at center of 30' L. dam
2. UPSTREAM SLOPE			another 2 cracks towards LA near u.s. slope
a. Adequate grass cover?	X		60%
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?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			Some unevenness near RA not trimmed 17'
a. Adequate grass cover?	X		65%
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		near turn due to poor trimming.
g. Visual settlements?		X	
h. Is the toe drain dry?			NA
i. Are the relief wells flowing?			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		Rills into spillway
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM
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?			brown SM

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			Fence in spillway and across outlet channel, could catch brush & reduce flow.
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:	X		
Are side slopes eroding?	X		Rills 21'W Gully at entrance
Are side slopes sloughing?		X	30' L into pond
Bottom of channel eroding?		X	39' below crest 6% slope
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		Rills 45' L 21'W 0% slope
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		21'W 90' L 2% slope
Are side slopes eroding?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
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?			

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			
Some gulleying where runoff enters pond from road			
culvert partially blocked.			
Cracks at n.s. edge of crest noted.			

Caughey 0
 Gravel 35%

APPENDIX B
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6330 - 6312 = 68 ft,

WATER COURSE LENGTH = $3.2(400) = 1280 = 0.242$ mi,

$T_c = \left(\frac{11.9 (0.242)^3}{68} \right)^{0.385} = 0.099$ hr,

LAK TIME = $0.5 T_c = 0.060$ hr.

SCS CULVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SCS TYPE	WEIGHTED CULVE NUMBER
9.3	P-J	average	C	78(.29)
22.3	disturbed	—	C	91(.71)
				<u>87.2</u>

100% ET # 26

use 88

DRAINAGE BASIN AREA

31.6 ACRES

0.049 SQ MILES

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UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

$$R = 40$$

SOIL ERODIBILITY FACTOR

$$\text{SOIL TYPE} = 100\% \text{ EH \#26} = .32$$

$$K = \underline{\underline{.32}}$$

SLOPE FACTOR

<u>LENGTH (ft.)</u>	<u>Δ ELEV (ft.)</u>	<u>SLOPE (%)</u>	<u>LS</u>
600	40	6.7	1.89 (.4)
400	110	27.5	13.79 (.2)
400	35	8.8	2.25 (.4)
			<u><u>= 4.42</u></u>

COVER FACTOR

<u>AREA (ac.)</u>	<u>COVER TYPE</u>	<u>% COVER</u>	<u>CANOPY (%)</u>	<u>WEIGHTED C</u>
29 %	P-J	40	25	.29 (.14)
71 %	disturbed	—	—	.71 (1.0)
				<u><u>C = .751</u></u>

EROSION CONTROL FACTOR

$$P = 1.0$$

SEDIMENT INFLOW

$$A = 40(.32)(4.42)(.751)(1.0) = 42.49 \text{ ton/acre/year}$$

$$A = (42.49) \left(\frac{1}{2047} \right) (31.6)(.95) = .623 \text{ acre-feet/year}$$

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