

INSPECTION REPORT
Sedimentation Structure
J7-I
Black Mesa 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	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 J7-I 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 Black Mesa Mine. The location of Structure J7-I is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J7-I. 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 J7-I was inspected on September 2, 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 J7-I 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 J7-I has a 117.1-acre tributary drainage area and is located near Yucca Flats Wash at the Black Mesa Mine. The watershed is classified as 66% disturbed, 31% Sagebrush, and 3% reclaimed.

EMBANKMENT

Structure J7-I is a homogeneous earthen embankment classified as a roadway embankment. Physical characteristics of the embankment are listed in the following table:

Structure J7-I

Embankment	Residual Sandstone/Shale Soils
Foundation	Sandstone
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	13.7 ft
Crest Width	30 ft
Upstream Slope	3.75 H : 1 V
Downstream Slope	3.75 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J7-I, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure J7-I is a category A-5 embankment. A standard category A-5 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 30 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 4.25 H : 1 V
4. Normal pool with steady seepage saturation conditions

The upstream slope is lower in height and has a flatter slope than the category standard. The downstream slope is steeper than the category standard; therefore, the embankment has factors of safety less 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 J7-I is located downstream from Structure J7-H. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for J7-I was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure J7-I was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.473	mi
2.	Elevation Difference, H	135	ft
3.	Time of Concentration in hours, T_c	0.166	h
4.	Lag time, $0.6T_c$	0.099	h
5.	SCS Curve Number	85	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	100-year, 6-hour storm	2.4	in.
7.	Drainage Area, 10-year, 24-hour storm	117.1	acres
	100-year, 6-hour storm	150.1	acres

HYDRAULICS

The HEC-1 program was utilized to evaluate inflow, reservoir response and outflow from the sedimentation structure. The initial conditions and results of the analysis are summarized in the following table.

J7-I 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	162	362
Volume	acre-ft	8.59	10.54
Storage			
Peak Stage	ft	6335.76	6343.19
Spillway Elevation . .	ft	6340.00	--
Peak Storage	acre-ft	8.57	--
Storage Capacity . . .	acre-ft	16.8	--
Outflow			
Peak Flow	cfs	0	80
Embankment Crest			
Elevation	ft	--	6347.60
Peak Storage	ft	--	6343.19
Freeboard	ft	--	3.19
Spillway			
Pipe Exit Velocity . .	fps	--	10.3
Mannings "n"		--	0.024
Outflow Channel			
			<u>Section I</u> <u>Section II</u>
Slope	%	--	14 5
Normal Velocity	fps	--	8.7 6.2
Normal Depth	ft	--	0.74 0.55
Manning's "n"		--	0.040 0.040

Spillway

The existing spillway for J7-I consists of two corrugated metal pipes (CMP) with the following dimensions:

Pipe Diameter	36 in.
Pipe length	89 ft
Upstream invert elevation	6340.0 ft
Approximate slope	3.9 percent

Outflow Channel

The existing outflow channel for J7-I has a trapezoidal channel with the following dimensions:

Channel depth	2 ft
Channel width	15 ft
Channel length	100 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	10 percent

The first 50 feet of the channel is riprapped with rock.

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, J7-I.

The calculations for the sediment load entering Structure J7-I were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.192
3. Slope Factor, LS 1.0
4. Cover Factor, C 0.673
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 J7-I is shown on Plate 3, Volume-Elevation Curve, J7-I, and the results of the analysis are summarized in the following table.

J7-I STORAGE

Total Storage Capacity	16.8	acre-ft
10-year, 24-hour Storm Inflow	8.59	acre-ft
Available Sediment Storage Capacity	8.23	acre-ft
Sediment Inflow Rate	0.27	acre-ft/yr
Sediment Storage Life	30	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J7-I indicated that the geotechnical problems consist of rill erosion on the upstream slopes; a large gully on downstream slope; heavy erosion at the downstream toe of the embankment and gullies on the right abutment; and a steep downstream slope. Correction of erosion is considered a periodic maintenance task and does not require

remedial action. The downstream slope should be flattened to 4.25 horizontal to 1 vertical to meet stability requirements. Evidence of seepage was noted below the downstream toe of embankment through the sandstone bedrock. Remedial action for this condition is not required at the present time, however, future inspections should check for changes.

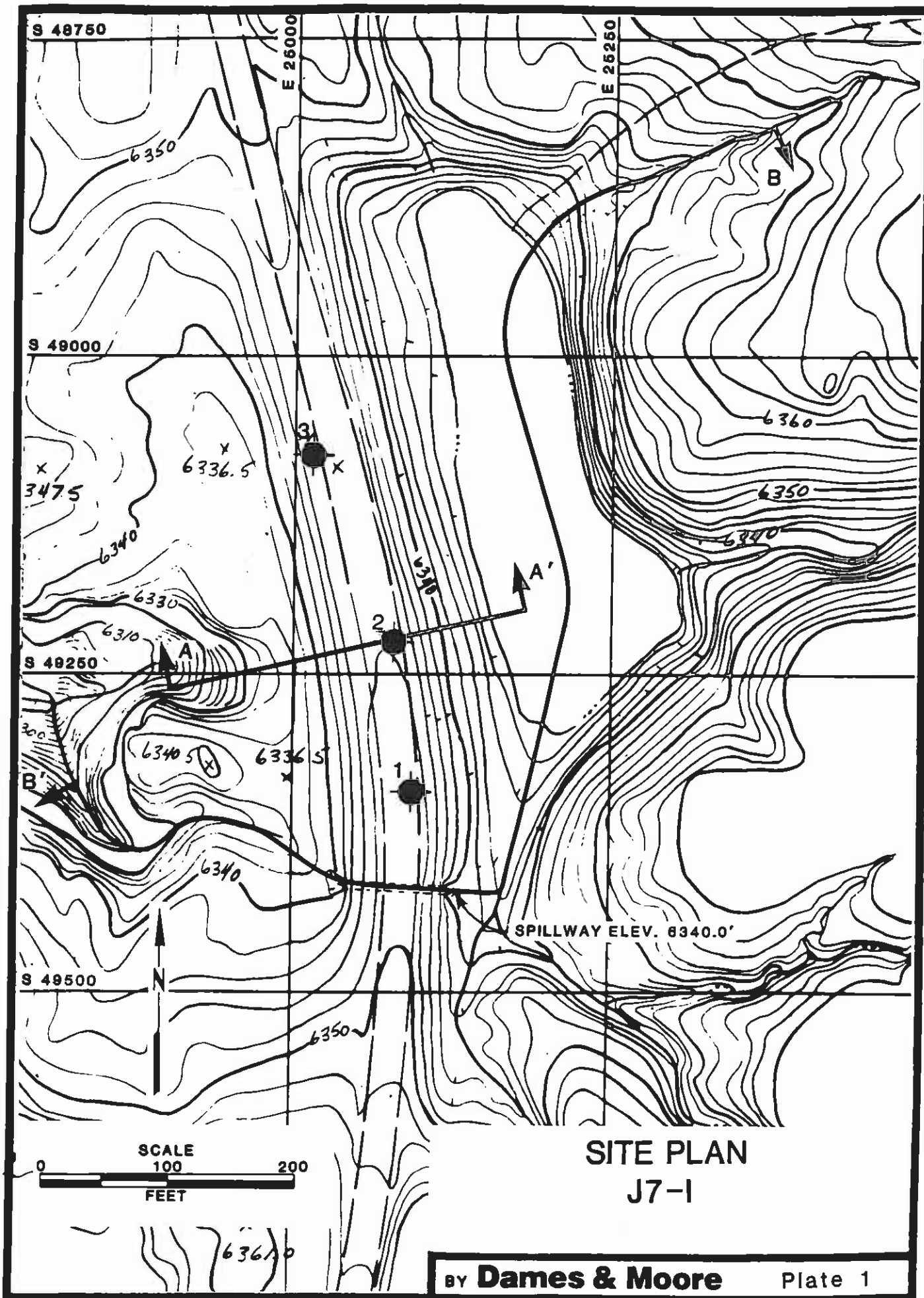
HYDRAULICS

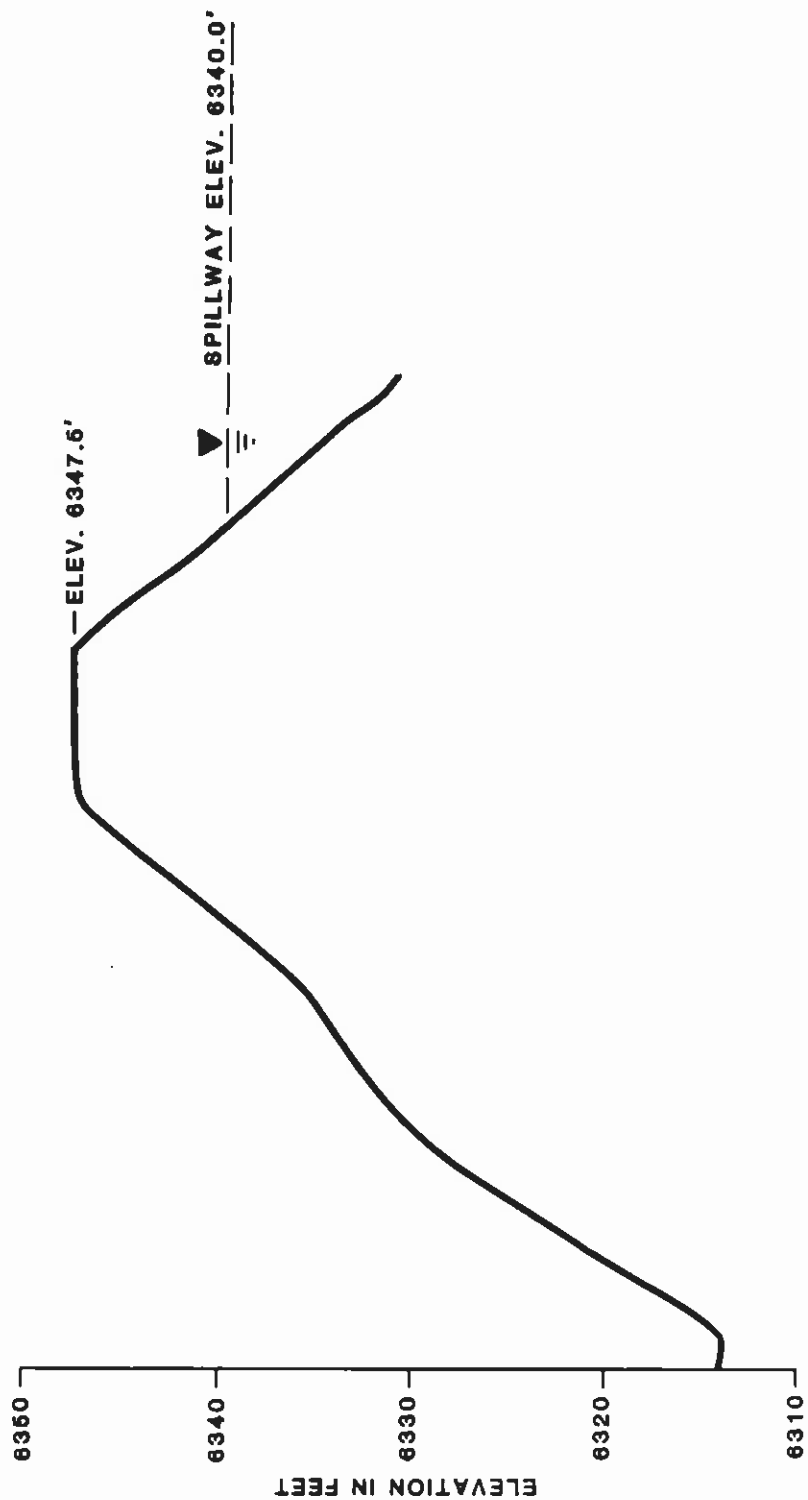
The storage capacity and spillway capacity of Structure J7-I are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. A trapezoidal outflow channel and a stilling basin should be constructed along the alignment B-B' shown in Plate 1. The channel and stilling basin profile is shown in Plate 4 and the required dimensions are shown in Plate 5 and Plate 6. The outflow channel, and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5. A trashrack should be installed on the inlet of the CMP to prevent clogging of the spillway.

* * *

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

- Plate 1 - Site Plan J7-I
- Plate 2 - Existing Maximum Cross Section J7-I, A-A'
- Plate 3 - Volume-Elevation Curve J7-I
- Plate 4 - Channel Profile J7-I, B-B'
- Plate 5 - Spillway and Outflow Channel Cross Section J7-I
- Plate 6 - Spillway Stilling Basin Plan J7-I
- Appendix A - Inspection Check List
- Appendix B - Hydrology and Hydraulic Calculations



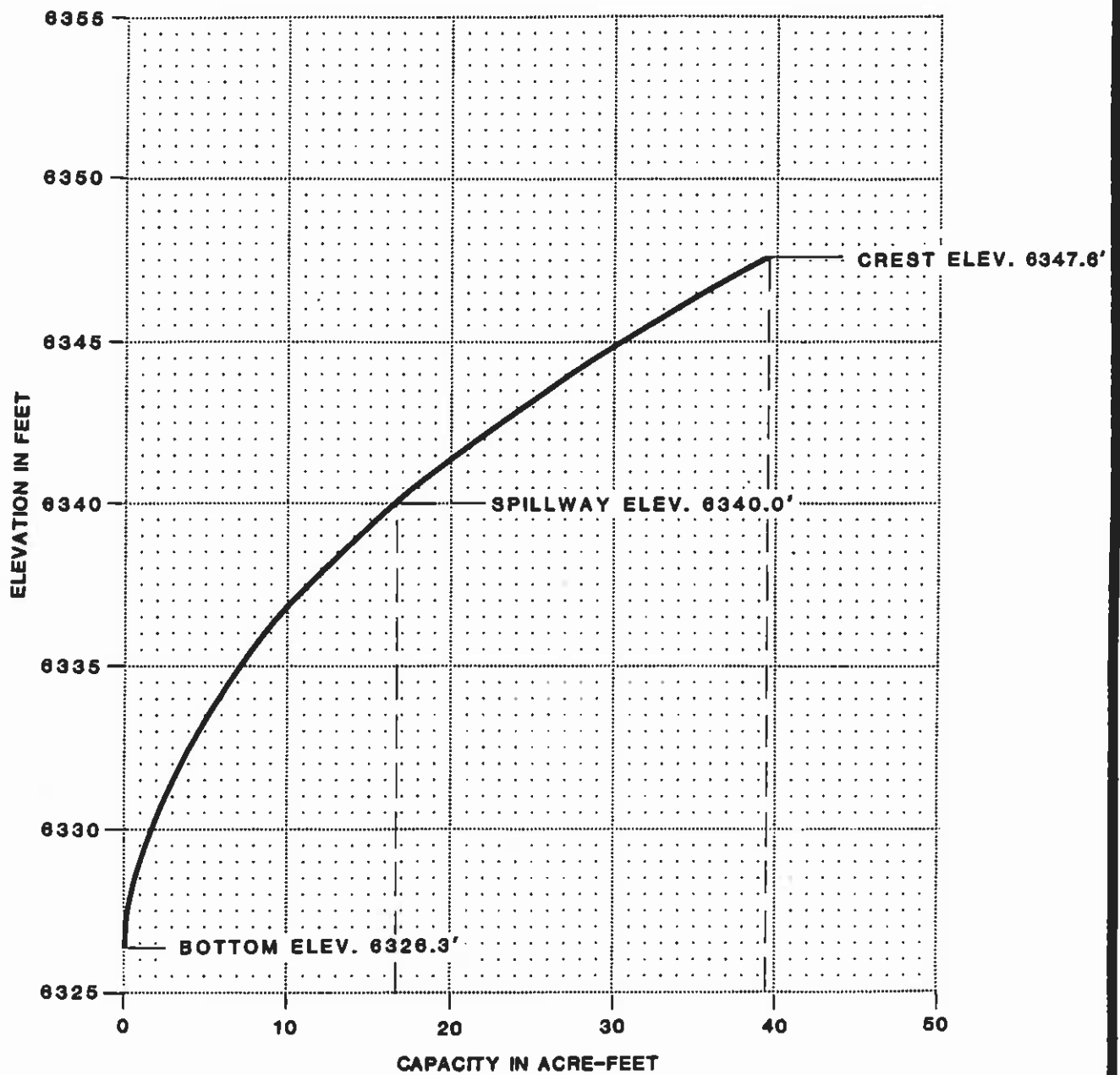


EXISTING
MAXIMUM CROSS-SECTION
A-A'
J7-1

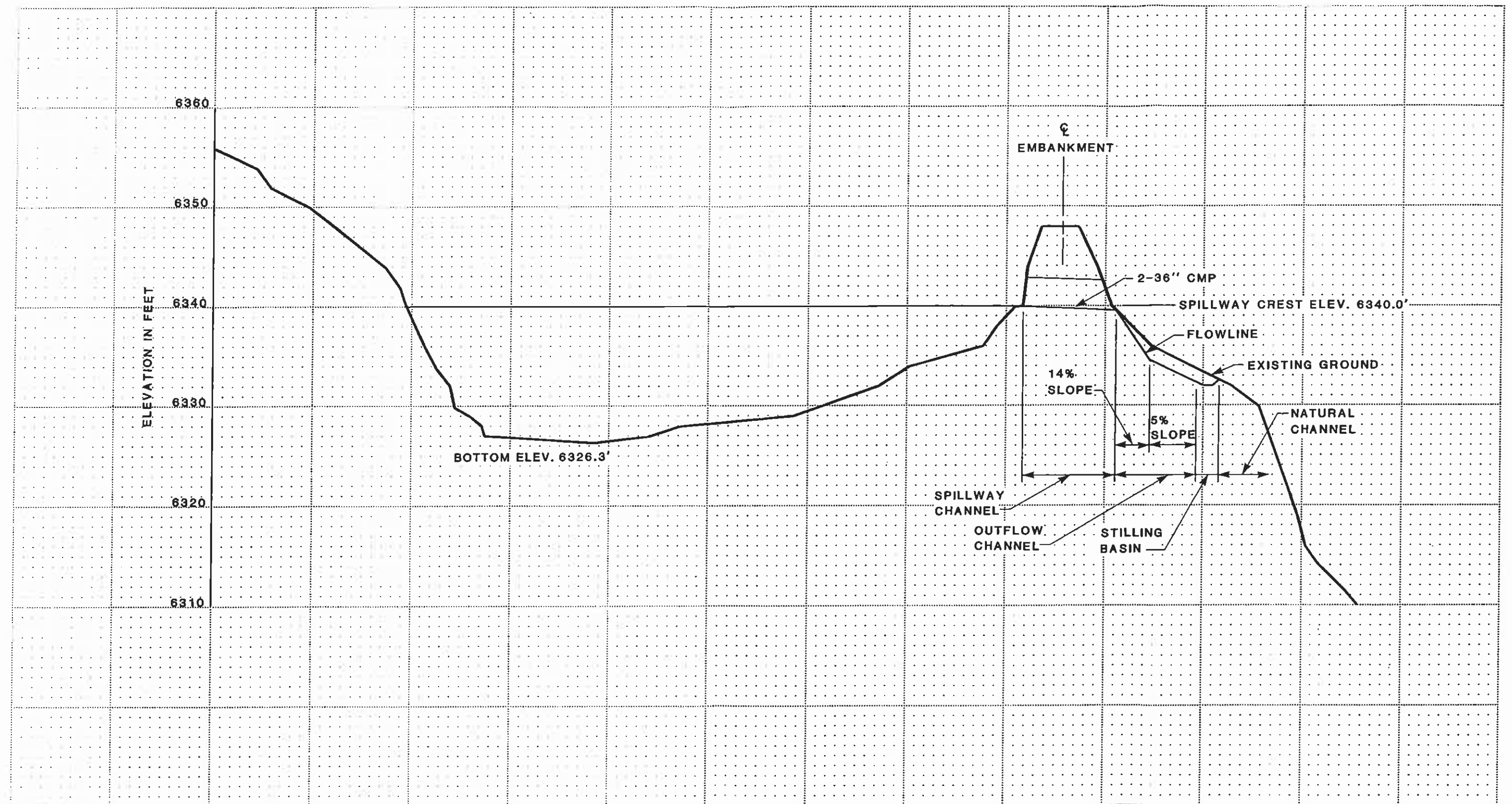
FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

Plate 2

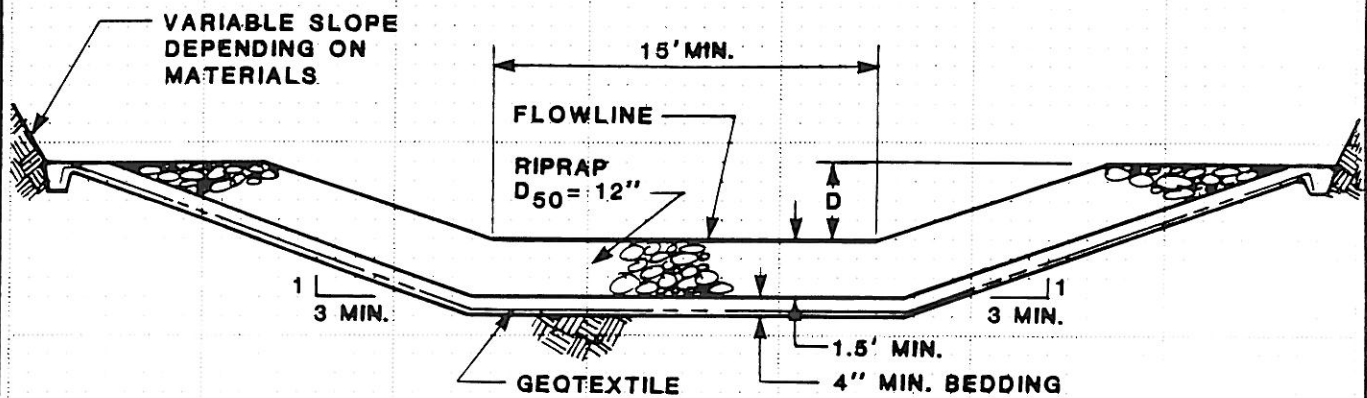


VOLUME-ELEVATION
CURVE
J7-1



CHANNEL PROFILE B-B'
J7-1

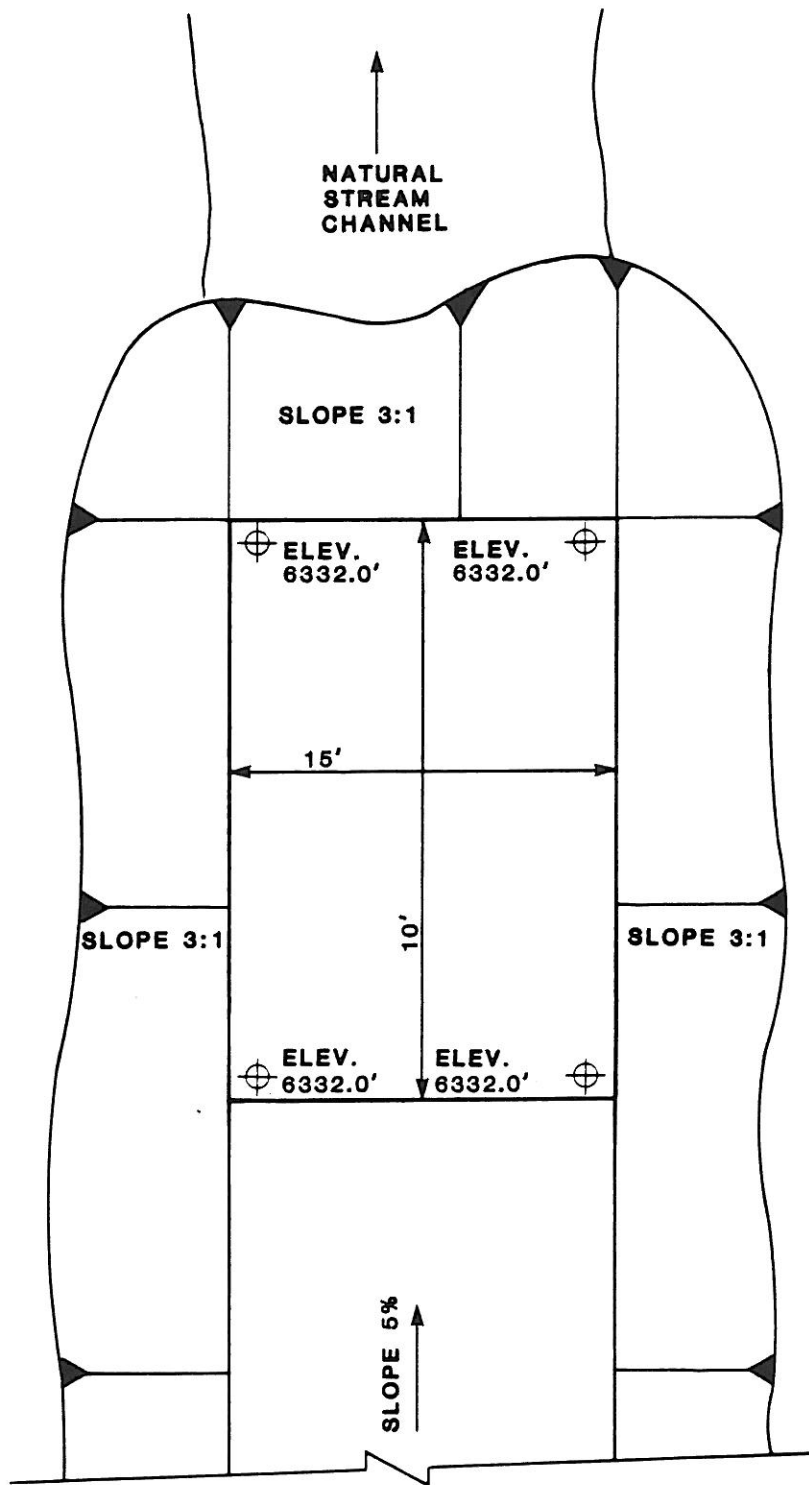




OUTFLOW CHANNEL

$D = 1.5'$

OUTFLOW CHANNEL CROSS SECTION J7-1



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 3.0'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAMBED = 1.3'

SPILLWAY STILLING BASIN PLAN J7-1

APPENDIX A
INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			
a. Adequate grass cover?	X		5% towards R. About 70% grass L. About.
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	Partial Grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			
a. Adequate grass cover?			
b. Any erosion?	X		5' deep 6' wide gully X
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?			NA
i. Are the relief wells flowing?			NA
j. Are boils present at the toe?		X	
k. Is seepage present?	X		thru sandstone/water standing
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?	X		2' wide gully into Pond
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

Heavy erosion at toe

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		Near left abutment
b. Approach Channel:		X	
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			2-36" CMP
Are side slopes eroding?			NA
Are side slopes sloughing?			NA
Bottom of channel eroding?			NA
Obstructed?	X		tumbleweeds at both ends
Erosion protection?			NA
d. Outflow Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		Partial Rock DSU 24" 1st 50'
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?			Could not tell.
d. Watershed matches soil map?	X		

9. GENERAL COMMENTS

Minor change in Watershed / Public watering area (2%)
 Canopy cover 10%
 ground cover 80%
 water at toe of d.s. slope thru
 Sandstone, water loving plants growing.
 " Does not appear to affect stability of " structure

APPENDIX B
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6475 - 6340 = 135 ft.

WATER COURSE LENGTH = 2500 ft. = 0.473 mi.

$$T_c = \left(\frac{11.9 (0.473)^3}{135} \right)^{0.385} = 0.166 \text{ hr.}$$

LAG TIME = $0.6 T_c = 0.099 \text{ hr.}$

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
77.1 (66%)	DIST	—	C-D	$0.66(93) = 61.4$
36.7 (31%)	S-G	Fair	C-D	$0.31(68) = 21.0$
3.2 (3%)	REL.	Fair	C-D	$0.03(81) = 2.4$
				84.8
				60% EH#23 - D
				40% EH#32 - C

USE 85

DRAINAGE BASIN AREA

117.1 AC. 0.183 SQ. MI.

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

$$R = 40$$

SOIL ERODIBILITY FACTOR

SOIL TYPE = 60% EH# 23
 40% EH# 32

$$\begin{aligned} 0.6(0.18) &= 0.108 \\ 0.4(0.21) &= 0.084 \\ \hline &0.192 \end{aligned}$$

$$K = 0.192$$

SLOPE FACTOR

<u>LENGTH (ft.)</u>	<u>Δ ELEV (ft.)</u>	<u>SLOPE (%)</u>	<u>LS</u>
1600	70	4	0.46
900	50	6	2.02
1500	35	2	0.45

$$U_{SC} = 1.0$$

COVER FACTOR

<u>AREA (ac)</u>	<u>COVER TYPE</u>	<u>% COVER</u>	<u>CANOPY (%)</u>	<u>WEIGHTED C</u>
60%	DIST	-	-	0.66 (1.10)
31%	S-G	60	25	0.31 (.082)
3%	RECLAIMED	-	-	0.03 (.15)

$$C = .690$$

EROSION CONTROL FACTOR

$$P = 1.0$$

SEDIMENT INFLOW

$$A = 40(0.192)(1)(0.690)(1.0) = 5.36 \quad \text{ton/acre/year}$$

$$A = 5.36 \left(\frac{1}{2047} \right) (17.1) (0.90) = 0.273 \quad \text{acre-feet/year}$$

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