

INSPECTION REPORT
Sedimentation Structure
KM-E
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 KM-E is an earthen embankment, designed and constructed in 1980 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 KM-E is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure KM-E. 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 KM-E was inspected on September 4, 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 KM-E 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 KM-E has a 101.4-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 63% Pinion/Juniper and 37% disturbed.

EMBANKMENT

Structure KM-E is a homogeneous earthen embankment classified as a cross-valley embankment. Physical characteristics of the embankment are listed in the following table:

Structure KM-E

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	6 ft
Crest Width	18 ft
Upstream Slope	2.1 H : 1 V
Downstream Slope	4 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section KM-E, A-A'.

ANALYSES

STABILITY

Structure KM-E is a category A-1 embankment. A standard category A-1 embankment has static and seismic factors of safety equal to or greater than 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 10 ft
2. Maximum upstream slope = 1.5 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The KM-E 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 KM-E is located downstream from Structure KM-E1. The two structures have a combined storage capacity that is less than 20 acre-feet. Therefore, the spillway for KM-E was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure KM-E was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1. Water Course length, L	0.606	mi
2. Elevation Difference, H	204	ft
3. Time of Concentration, T_c	0.188	h
4. Lag time, $0.6T_c$	0.113	h
5. SCS Curve Number	86	
6. Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
25-year, 6-hour storm. .	1.9	in.
7. Drainage Area	101.4	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.

KM-E 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	144	176
Volume	acre-ft	7.86*	6.42*
Storage			
Peak Stage	ft	6498.01	6502.14
Spillway Elevation . .	ft	6500.20	—
Peak Storage	acre-ft	7.90	—
Storage Capacity . . .	acre-ft	11.1	--
Outflow			
Peak Flow	cfs	0	83
Embankment Crest			
Elevation	ft	—	6502.00
Peak Stage	ft	—	6502.14
Freeboard	ft	—	Overtop

*Inflow volume for tributary drainage area between Structures
KM-E and KM-E1.

Spillway Channel

The existing spillway for KM-E has a trapezoidal channel with the following dimensions:

Channel depth	3 ft
Channel width	12 ft
Channel length	30 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	0 percent

Rock provides some, however inadequate, erosion protection within the channel.

Outflow Channel

The existing outflow channel for KM-E has a U-shaped channel with the following dimensions:

Channel width	12 ft
Channel length	90 ft

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, KM-E.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.22
3. Slope Factor, LS 5.63
4. Cover Factor, C 0.458
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 Structure KM-E and the results of the sediment inflow analysis are summarized below.

KM-E STORAGE

Total Storage Capacity	11.10 acre-ft
10-year, 24-hour Storm Inflow	7.90 acre-ft
Available Sediment Storage Capacity	3.20 acre-ft
Sediment Inflow Rate	1.07 acre-ft/yr
Sediment Storage Life	3 yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure KM-E indicated that the geotechnical problem is rill and gully erosion on the upstream slope and the bottom of the approach channel. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The downstream slope of the embankment is uneven due to, in our opinion, lack of fine grading after construction. The slope should be trimmed smooth to prevent the

masking of potential problems in the future. This task is considered a one time remedial action.

HYDRAULICS

The storage capacity of Structure KM-E is adequate but the spillway capacity is inadequate. The structure does not have an adequate outflow channel. The embankment crest should be raised to elevation 6503.20 feet in order to provide adequate freeboard for the 25-year storm. A trapezoidal outflow channel with the same bottom width as the spillway and a stilling basin should be constructed along the alignment shown in Plate 1. The channel and stilling basin profile is shown in Plate 4 and required dimensions are shown in Plate 5 and Plate 6. The spillway, outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5.

Raising the embankment crest elevation to 6503.20 feet increases the freeboard but it does not change the storage capacity or sediment storage life. The analysis of these conditions is summarized in the following table.

KM-E HYDRAULICS FOR REDESIGNED SPILLWAY

	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	144	176
Volume	acre-ft	7.86*	6.42*
Storage			
Peak Stage	ft	6498.01	6502.11
Spillway Elevation . .	ft	6500.20	—
Peak Storage	acre-ft	7.90	—
Storage Capacity . . .	acre-ft	11.10	—
Available Sediment			
Storage Capacity . .	acre-ft	3.20	—
Sediment Inflow Rate .	acre-ft/yr	1.07	—
Sediment Storage Life.	yrs	3	—
Outflow			
Peak Flow	cfs	0	80
Embankment Crest			
Elevation	ft	—	6503.20
Peak Stage	ft	—	6502.11
Freeboard	ft	—	1.09
Spillway Channel			
Flow Depth	ft	—	1.91
Critical Velocity. . .	fps	—	5.0
Manning's "n"		—	0.040
Outflow Channel			
			<u>Section I</u> <u>Section II</u>
Slope	%	—	1.5 17
Normal Velocity. . . .	fps	—	4.2 9.3
Normal Depth	ft	—	1.05 0.52
Manning's "n"		—	0.040 0.040

*Inflow volume for tributary drainage area between Structures
KM-E and KM-E1.

* * *

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

Plate 1 - Site Plan KM-E

Plate 2 - Existing Maximum Cross Section KM-E, A-A'

Plate 3 - Volume-Elevation Curve KM-E

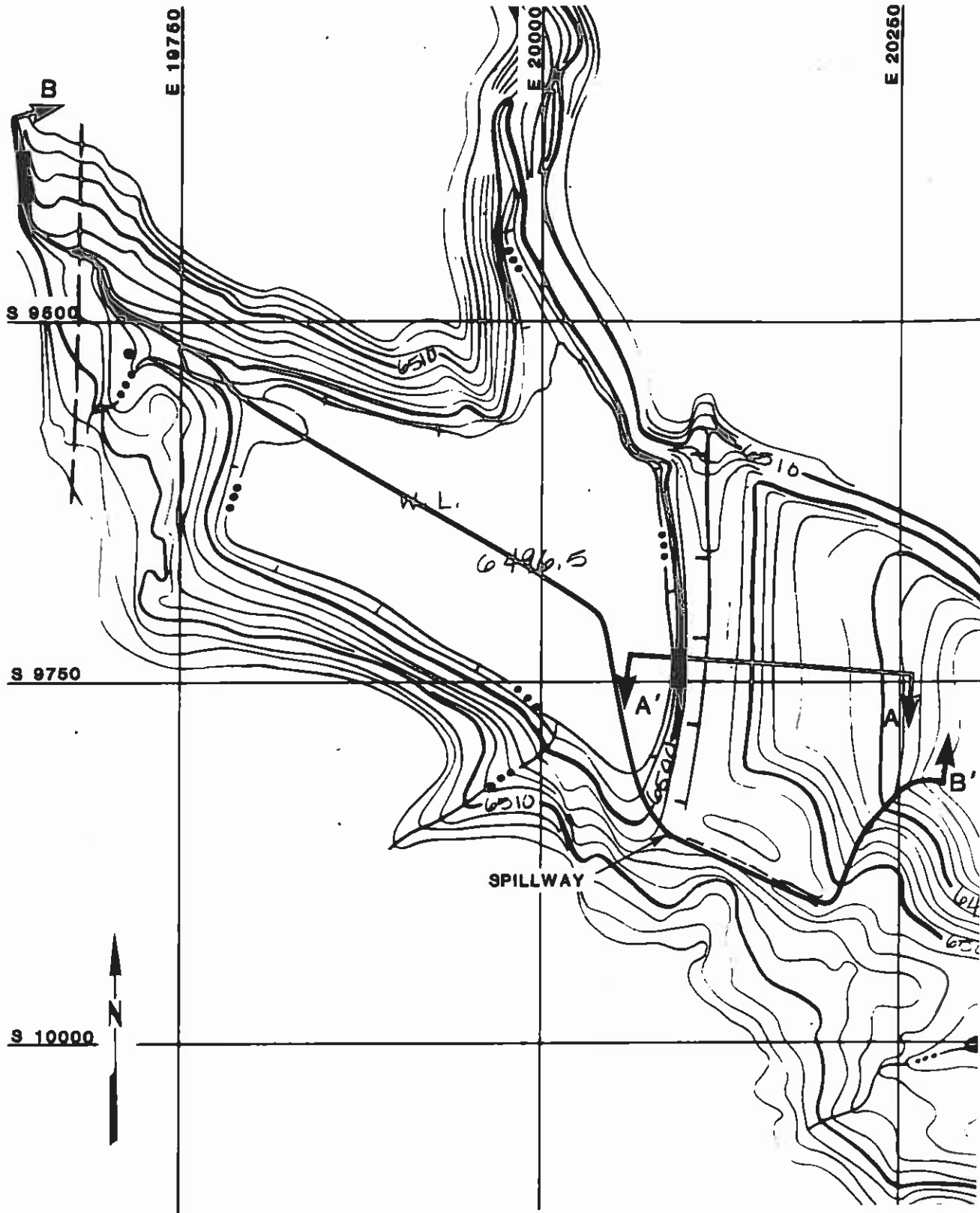
Plate 4 - Channel Profile KM-E, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section KM-E

Plate 6 - Spillway Stilling Basin Plan KM-E

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations

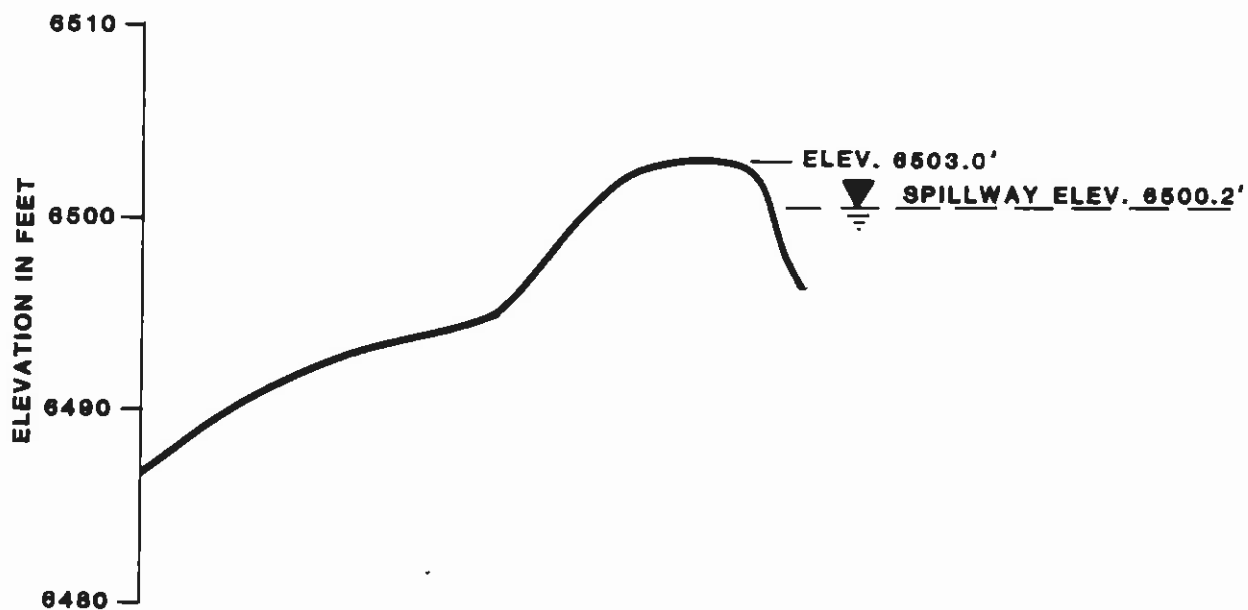


**SITE PLAN
KM-E**

0 SCALE 100 200
FEET

BY **Dames & Moore**

Plate 1

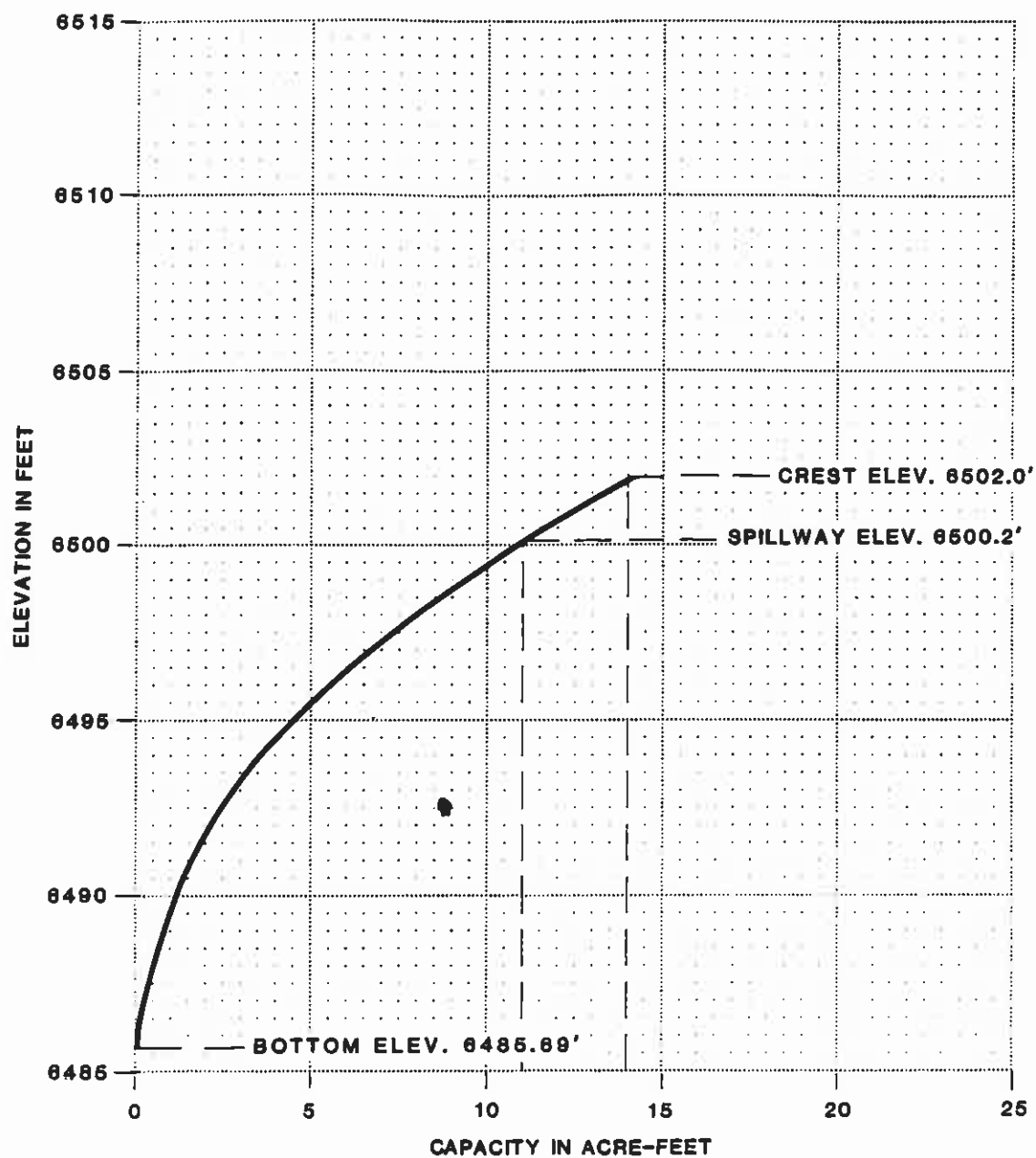


EXISTING
MAXIMUM CROSS-SECTION
A-A'
KM-E

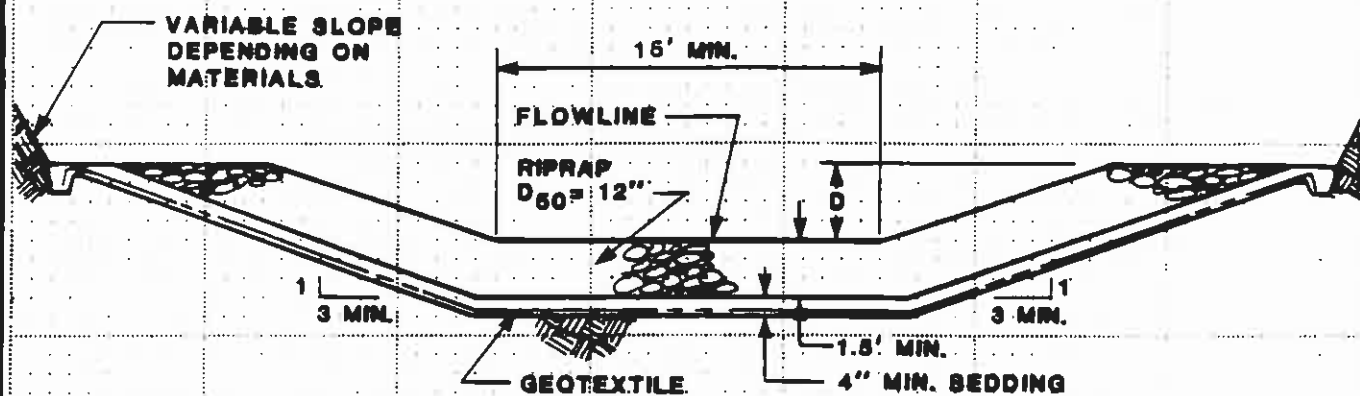
FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

Plate 2



VOLUME-ELEVATION
CURVE
KM-E



SPILLWAY CHANNEL

$D \approx 2.9'$

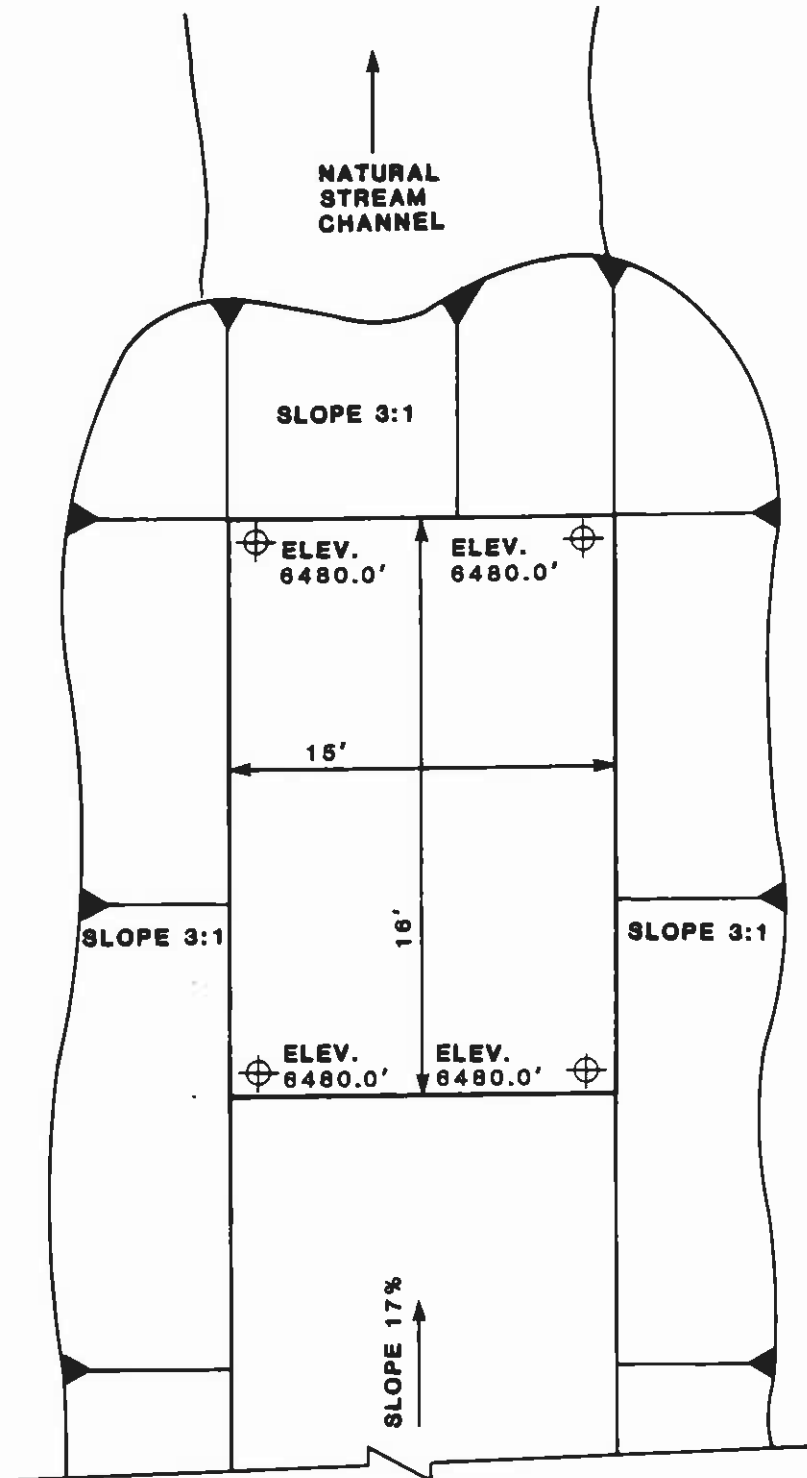
LENGTH $\approx 30'$

FLOWLINE ELEV. $\approx 8600.20'$

OUTFLOW CHANNEL

$D = 2.01'$

**SPILLWAY AND
OUTFLOW CHANNEL
CROSS SECTION
KM-E**



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 4.1'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAMBED = 2.2'

SPILLWAY STILLING BASIN PLAN KM-E