INSPECTION REPORT

Sedimentation Structure

KM-E

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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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 inter-disciplinary 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
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	
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			Section I	Section II
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

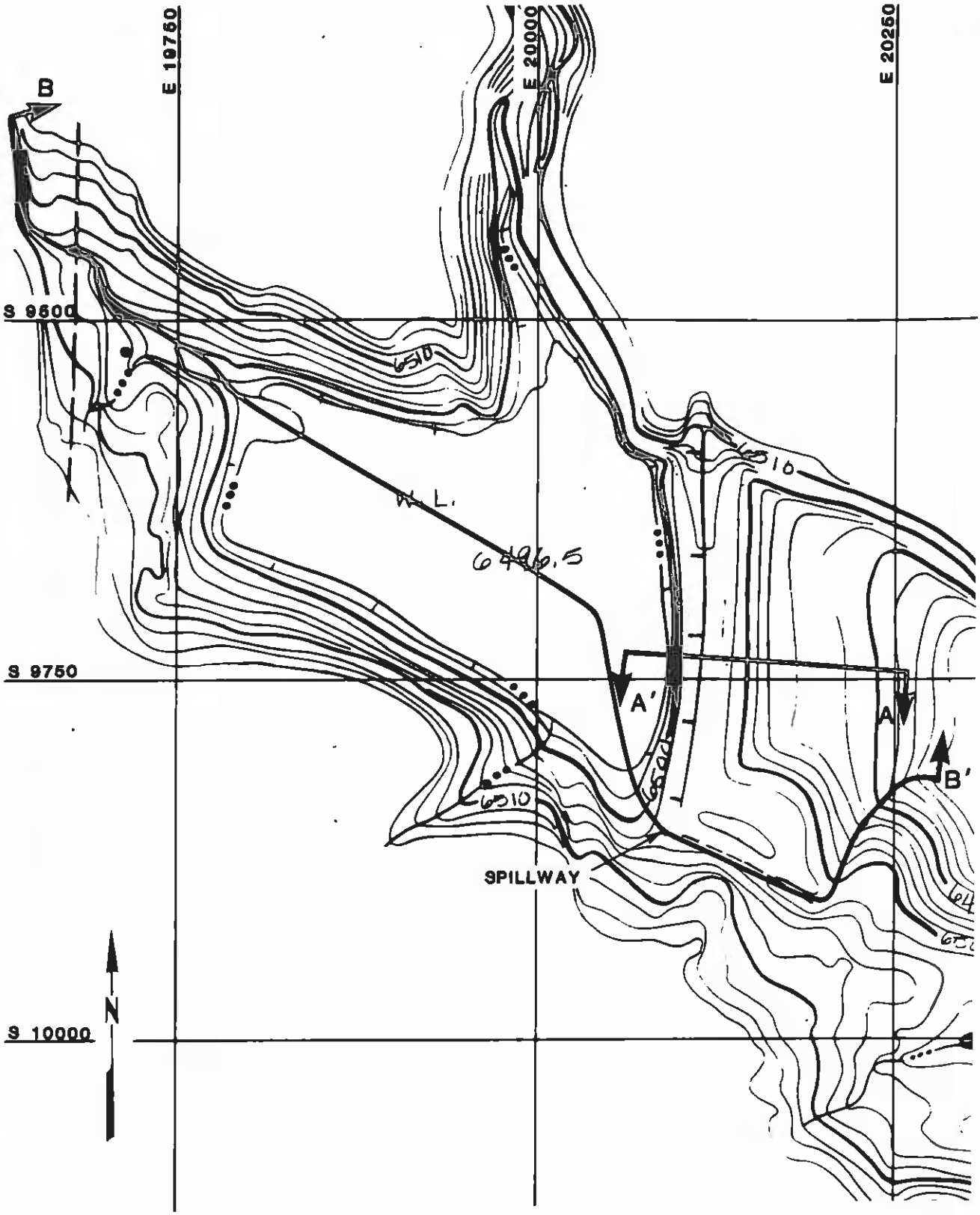
Plate 4 - Channel Profile KM-E, B-B'

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

Plate 6 - Spillway Stilling Basin Plan KM-E

Appendix A - Inspection Check List

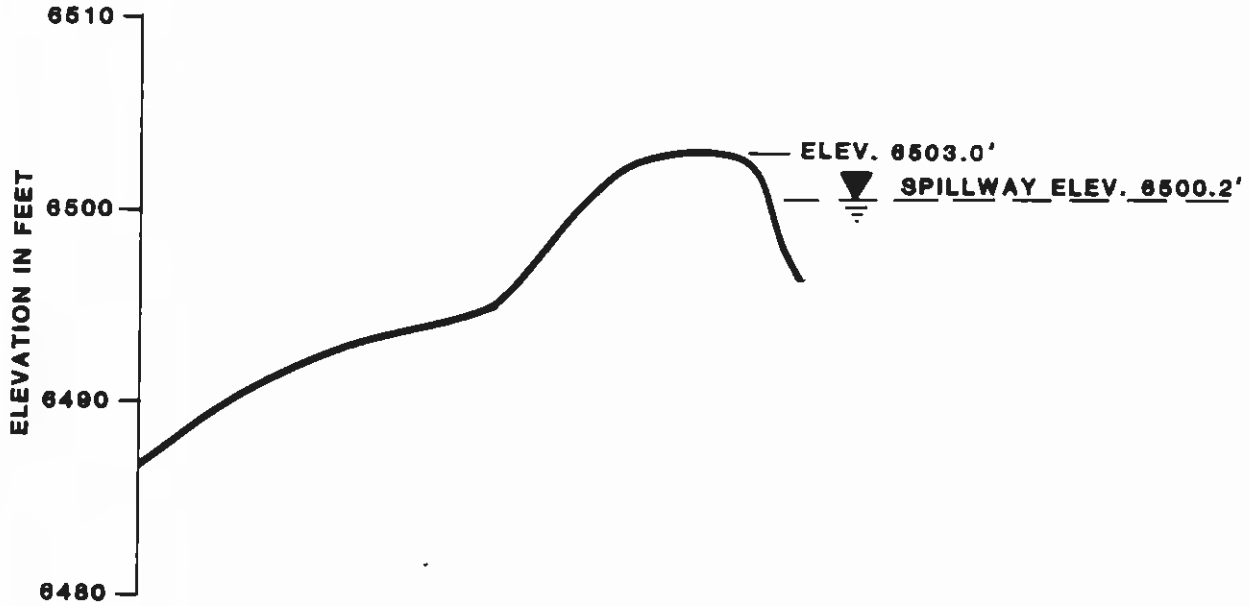
Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
KM-E

SCALE
0 100 200
FEET

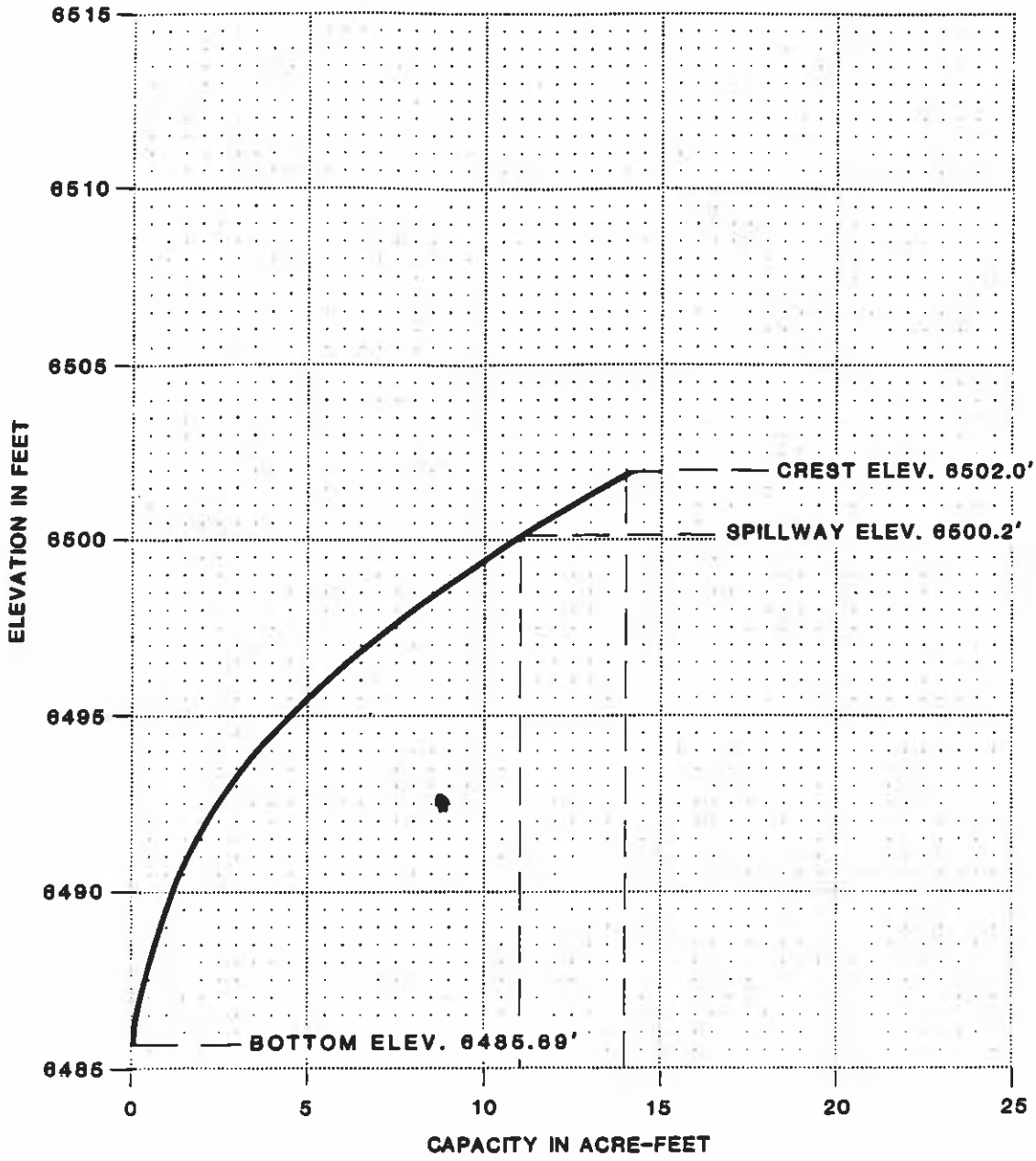
BY **Dames & Moore** Plate 1



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

FOR LOCATION SEE PLATE 1

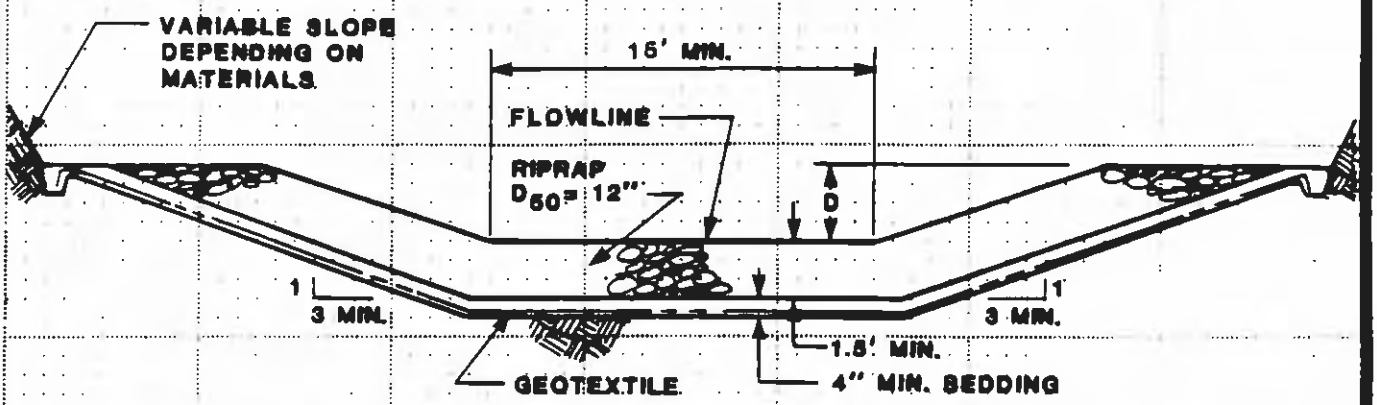
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

KM-E

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.9'

LENGTH = 30'

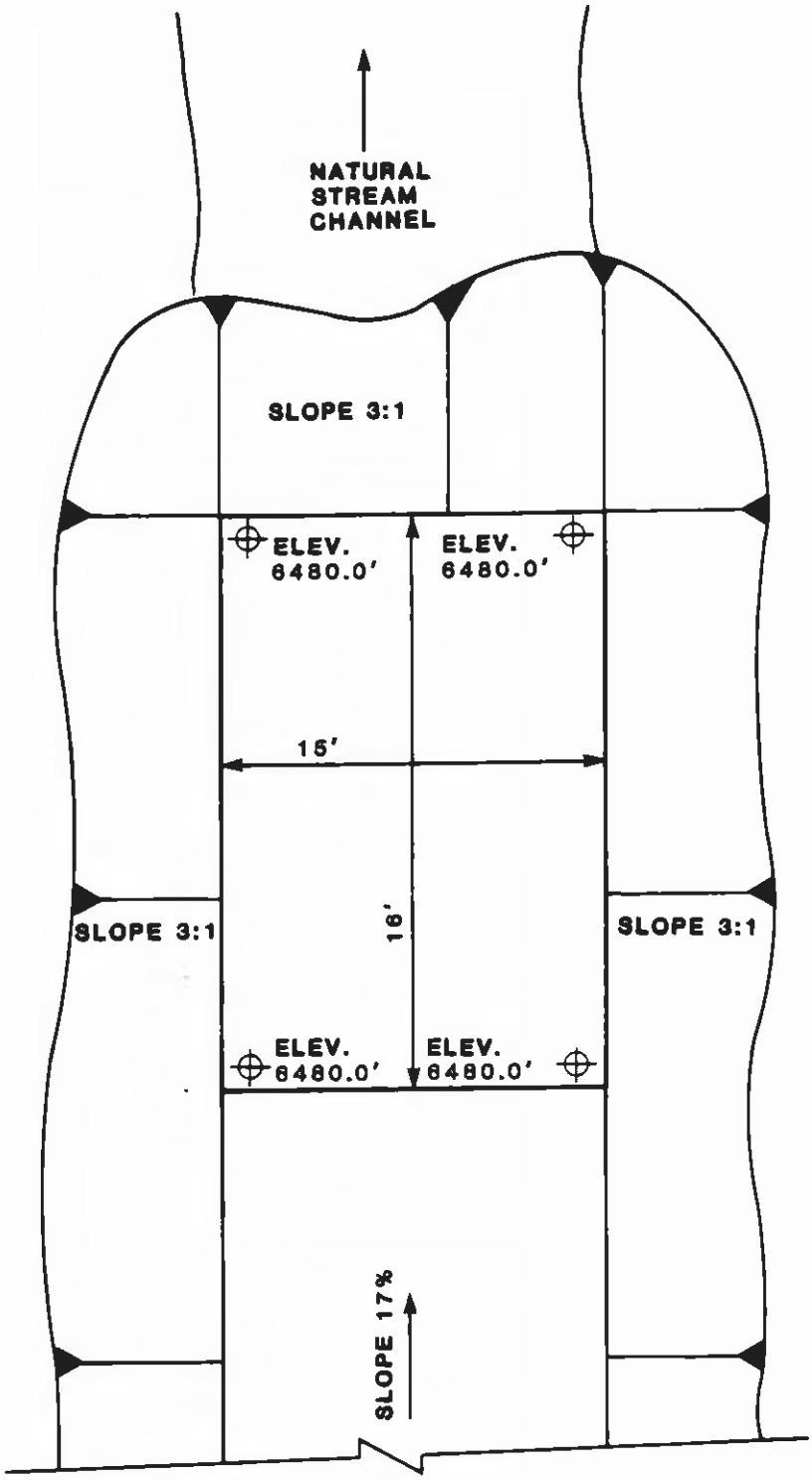
FLOWLINE ELEV. = 6600.20'

OUTFLOW CHANNEL

D = 2.01'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION KM-E

BY **Dames & Moore** Plate 5



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

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: KM - E
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			26°
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	
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			14° for 1st 30 Flatter to toe
a. Adequate grass cover?		X	
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?	X		Bulges from uneven construction
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	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			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?			Rock

Sediment Impoundment Name: KM-E
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:	X		12' at top 25' at bottom
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		Rills/gulleys
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		12' wide 30' long
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		Rock D50 6"
d. Outflow Channel:	X		12' w. all the way 90' long
Are side slopes eroding?		X	
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	Disturbed LAND % ?

9. GENERAL COMMENTS

OK

Canopy Cover - looks good but can't see all of the watershed

ground cover - same

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
KM-E SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6704 − 6500 = 204 ft.

WATER COURSE LENGTH = 8.0(400) = 3200 ft. = 0.606 mi.

$$T_c = \left(\frac{11.9\ (0.606)^3}{204}\right)^{0.385} = 0.188 \text{ hr.}$$

LAG TIME = $0.6T_c$ = 0.113 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
63.6 (63%)	P-J	ave.	D	0.63(83) = 52.3
37.8 (37%)	DISTURBED (DIRT RD.)	—	D	0.37(89) = 32.9
			EH #25	85.2

Use 86

DRAINAGE BASIN AREA

101.4 ACRE 0.158 SQ. MILE

(KM-FWP Fresh Water Pond SUBTRACTED)

KM-E1 = 12.4 AC 0.019 mi^2

Y S. DOLAN DATE 9-9-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE Peabody Coal Co 10139-011-22
SUBJECT Sediment Inflow
KM-E SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___ BY ___ DATE ___ TO EO ___

Universal Soil Loss Equation

Rainfall Factor

R = 40

Soil Erodibility Factor

Soil Type = EH # 25 (100%) = .22

K = .22

Slope Factor

Length (ft.)	Δ Elev (ft.)	Slope (%)	LS
800	100	12.5	5.44 (.30)
170	40	23.5	6.95 (.20
850	100	11.8	5.10 (.30)
400	80	20.0	8.16 (.10)
1000	70	7	2.61 (.10)
			use 5.63

Cover Factor

Area (ac.)	Cover Type	% Cover	Canopy (%)	Weighted C
63%	P-J	40	25	.63 (.14)
37%	disturbed	—	—	.37 (1.0)
				C = .458

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

Erosion Control Factor

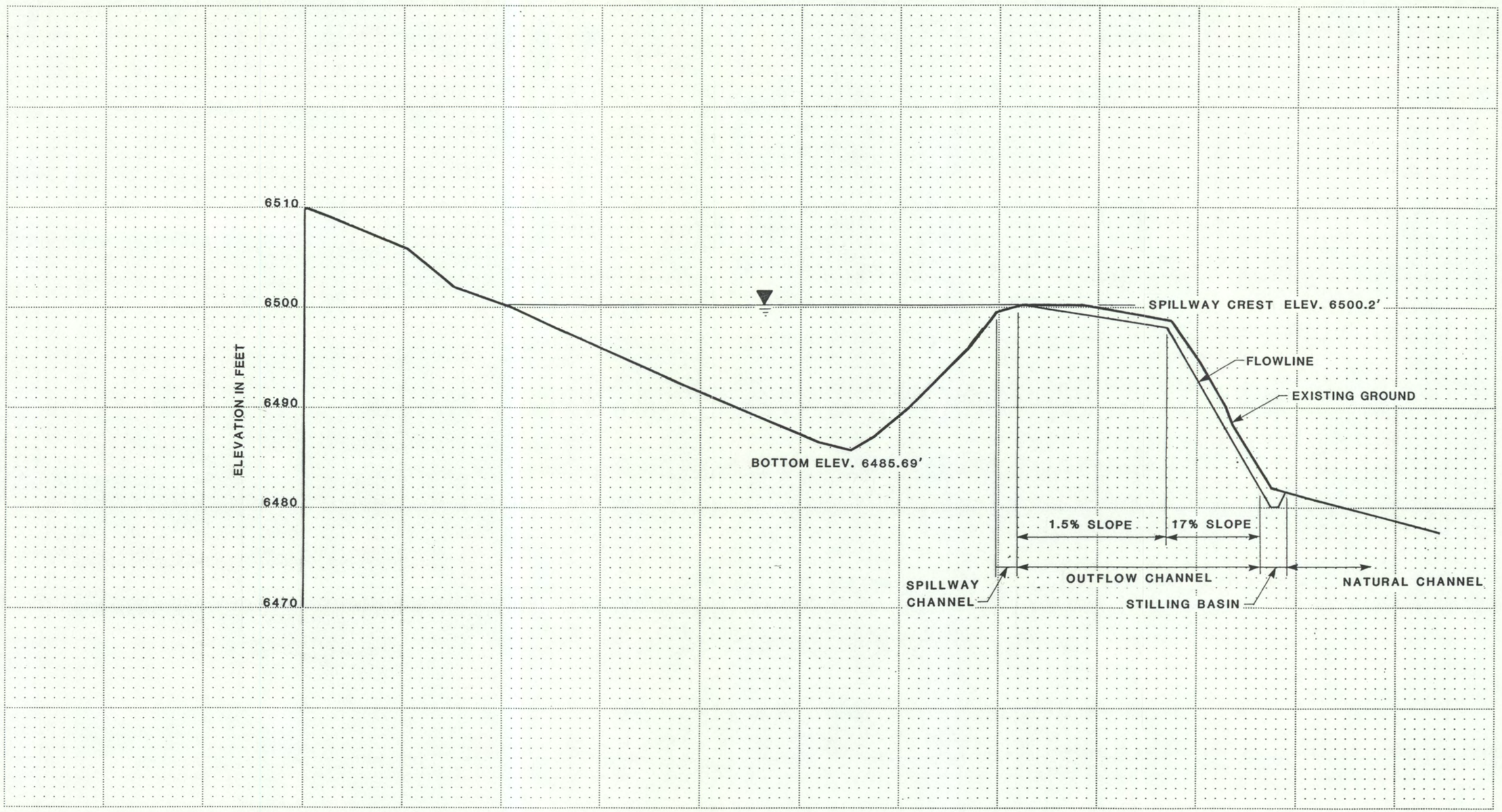
P = 1.0

Sediment Inflow

$A = 40(.22)(5.63)(.458)(1.0) = 22.69$ ton/acre/year

$A = 22.69\left(\frac{1}{2047}\right)(101.4)(.95) = 1.07$ acre-feet/year

Dames & Moore



SCALE
0 100 200
FEET

CHANNEL PROFILE B–B′
KM–E

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

KM-E1

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure KM-E1 is an earthen embankment, designed and constructed in 1979 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-E1 is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure KM-E1. 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-E1 was inspected on September 23, 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-E1 project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes maps developed in 1985 by Peabody Coal Company, which were 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-E1 has a 12.4-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 100% disturbed.

EMBANKMENT

Structure KM-E1 is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure KM-E1

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils/Scoria
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	5.5 ft
Crest Width	15 ft
Upstream Slope	3.5 H : 1 V
Downstream Slope . . .	3.5 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section KM-E1, A-A'.

ANALYSES

STABILITY

Structure KM-E1 is a category B-1 embankment. A standard category B-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-E1 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-E1 is located upstream from Structure KM-E. The two structures have a combined storage capacity that is less than 20 acre-feet. Therefore, the spillway for KM-E1 was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure KM-E1 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.265	mi
2.	Elevation Difference, H	71	ft
3.	Time of Concentration, T_c	0.108	h
4.	Lag time, $0.6T_c$	0.065	h
5.	SCS Curve Number	92	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	12.4	acres

HYDRAULICS

The existing corrugated metal pipe spillway is damaged and should be replaced by an open channel spillway. Therefore, the hydraulic analysis is presented in the remedial compliance plan.

Spillway Channel

The existing spillway for KM-E1 is a partially crushed 24-inch corrugated metal pipe (CMP).

Outflow Channel

The structure presently has no outflow channel.

STORAGE CAPACITY

The storage capacity analysis is presented in the remedial compliance plan.

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure KM-E1 indicated that the only geotechnical problem is rill and gully erosion on the upstream and downstream slopes. Correction of erosion is considered a periodic maintenance task and does not require remedial action.

HYDRAULICS

Structure KM-E1 has sufficient storage capacity when analyzed in series with Structure KM-E located downstream, but it does not have an adequate spillway or outflow channel. A trapezoidal spillway channel should be constructed at elevation 6608.90 feet. The existing CMP spillway should be abandoned. A trapezoidal outflow channel with the same bottom width as the spillway should be constructed along the alignment shown in Plate 1. The spillway and outflow 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 HEC-1 program was used to evaluate inflow to the sedimentation structure, outflow from the structure and the resulting water surface elevations. Both the 10-year and 25-year storms were routed through Structure KM-E1 and into Structure KM-E. The initial conditions and results of the analysis are summarized in the following table.

KM-E1 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	28	38	
Volume	acre-ft	1.37	1.16	
Storage				
Peak Stage	ft	6607.96	6610.11	
Spillway Elevation . .	ft	6608.90	--	
Peak Storage	acre-ft	1.37	--	
Storage Capacity . . .	acre-ft	1.71	--	
Outflow				
Peak Flow	cfs	0	26	
Embankment Crest Elevation	ft	--	6611.20	
Peak Stage	ft	--	6609.85	
Freeboard	ft	--	1.35	
Spillway Channel				
Flow Depth	ft	--	0.95	
Critical Velocity. . .	fps	--	2.7	
Manning's "n"		--	0.035	
Outflow Channel			Section I	Section II
Slope	%	--	5	10
Normal Velocity. . . .	fps	--	3.2	4.0
Normal Depth	ft	--	0.20	0.16
Manning's "n"		--	0.035	0.035

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-E1.

The calculations for the sediment load entering Structure KM-E1 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 1.50
4. Cover Factor, C 1.00
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 storage capacity of KM-E1 and the results of the sediment inflow analysis are summarized in the following table.

KM-E1 STORAGE

Total Storage Capacity	1.71	acre-ft
10-year, 24-hour Storm Inflow	1.37	acre-ft
Available Sediment Storage Capacity . .	0.34	acre-ft
Sediment Inflow Rate	0.058	acre-ft/yr
Sediment Storage Life	6	yrs

* * *

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

Plate 1 - Site Plan KM-E1

Plate 2 - Existing Maximum Cross Section KM-E1, A-A'

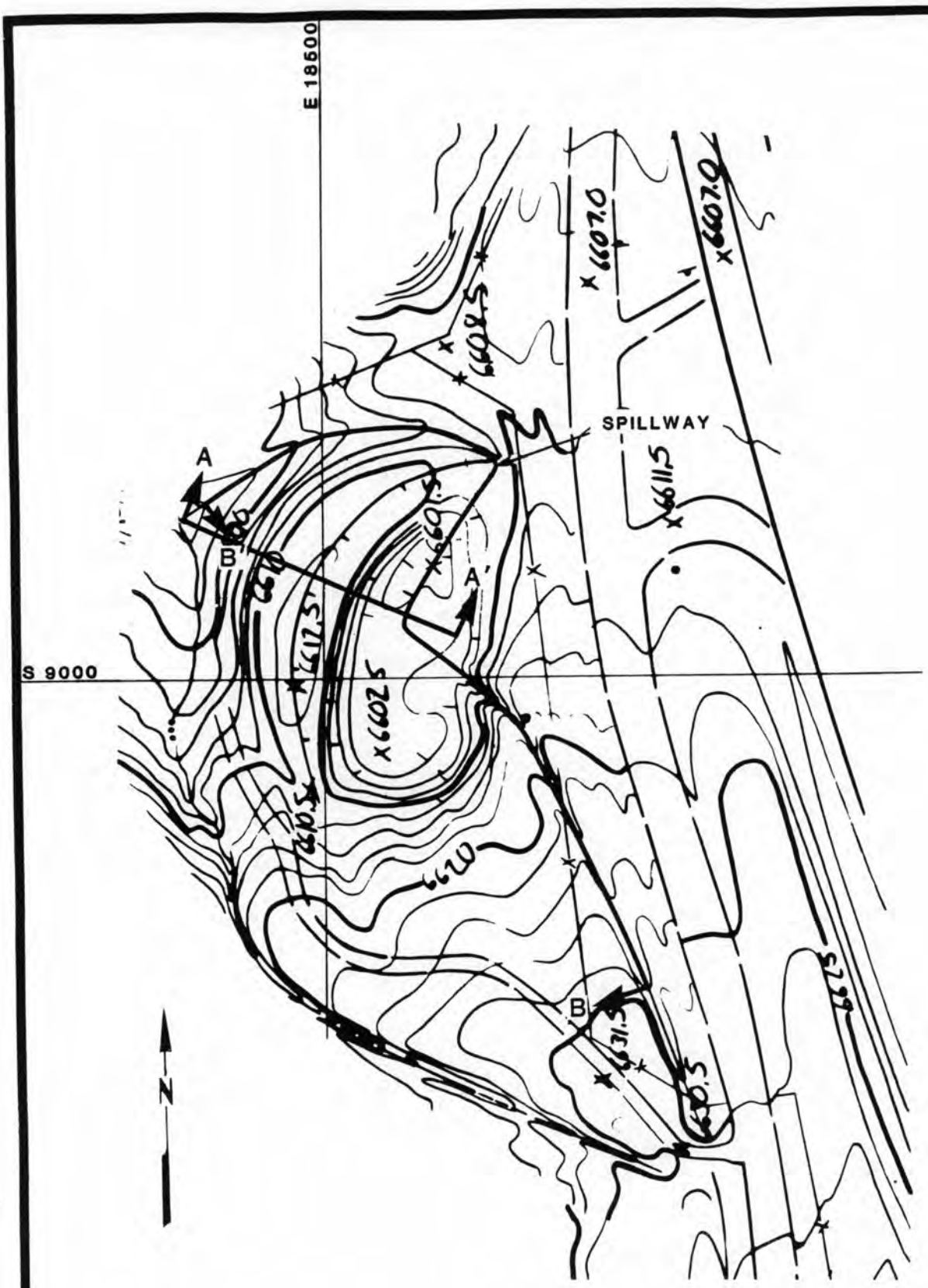
Plate 3 - Volume-Elevation Curve KM-E1

Plate 4 - Channel Profile KM-E1, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section KM-E1

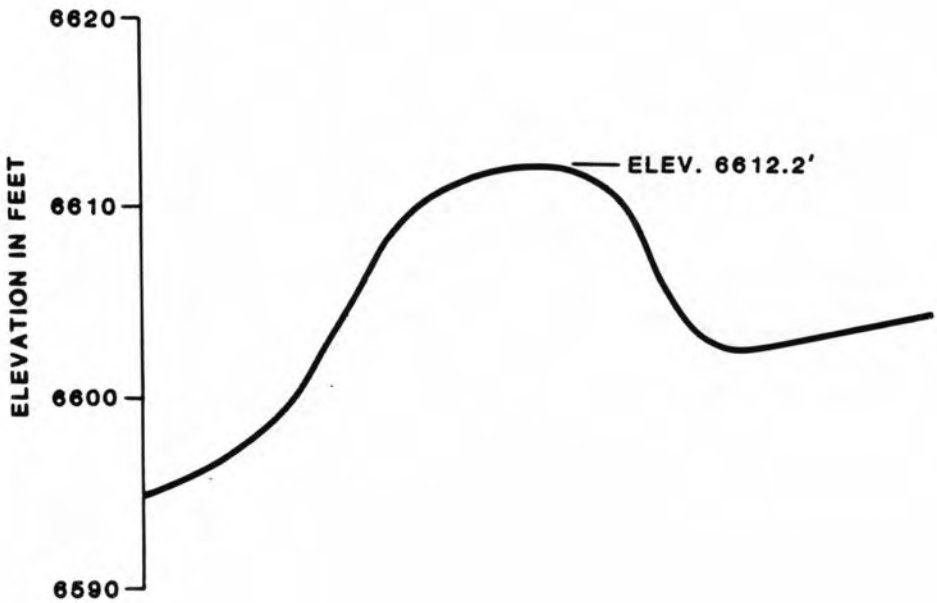
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
KM-E1

BY **Dames & Moore** Plate 1

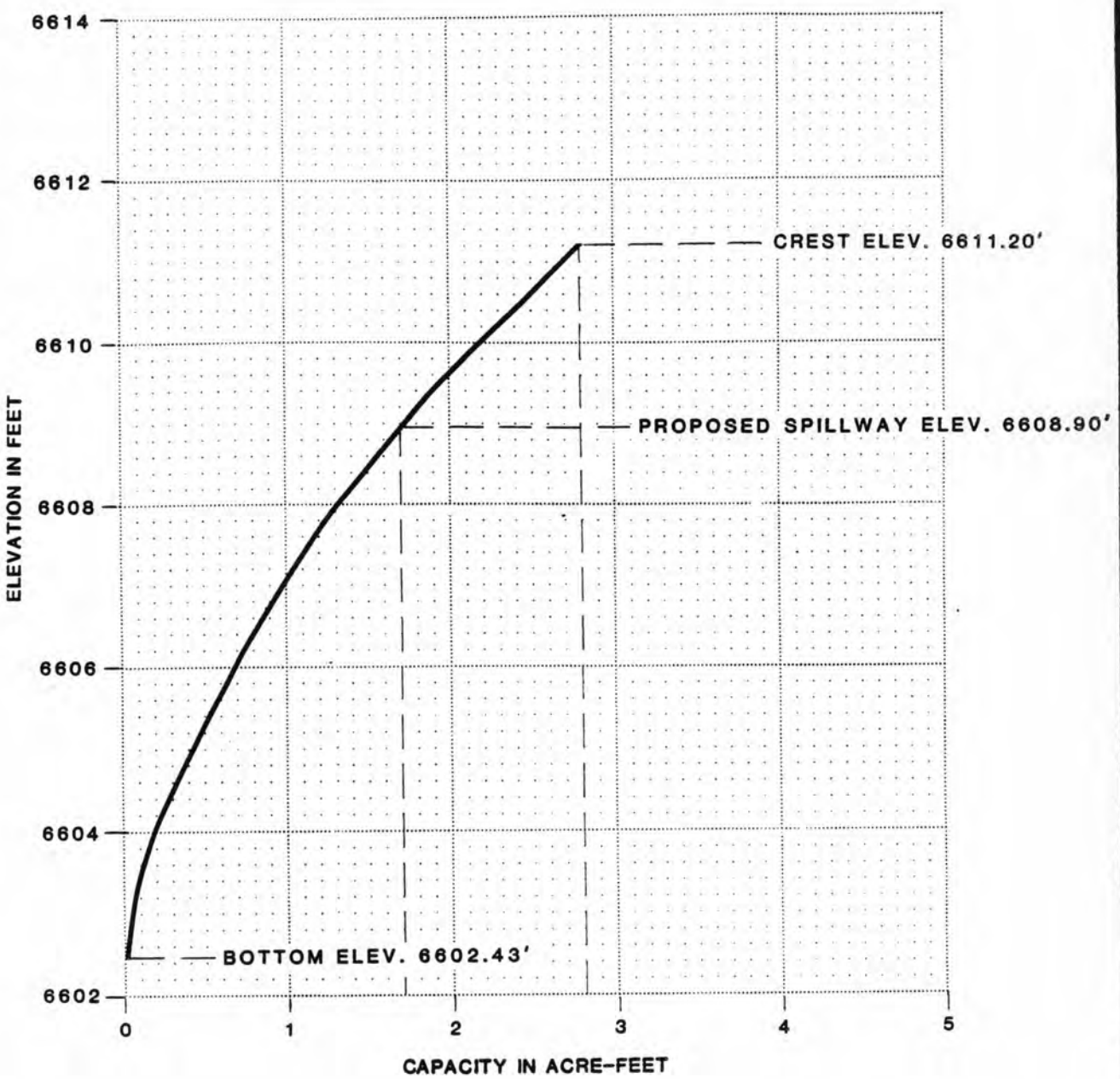


EXISTING MAXIMUM CROSS-SECTION A-A' KM-E1

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

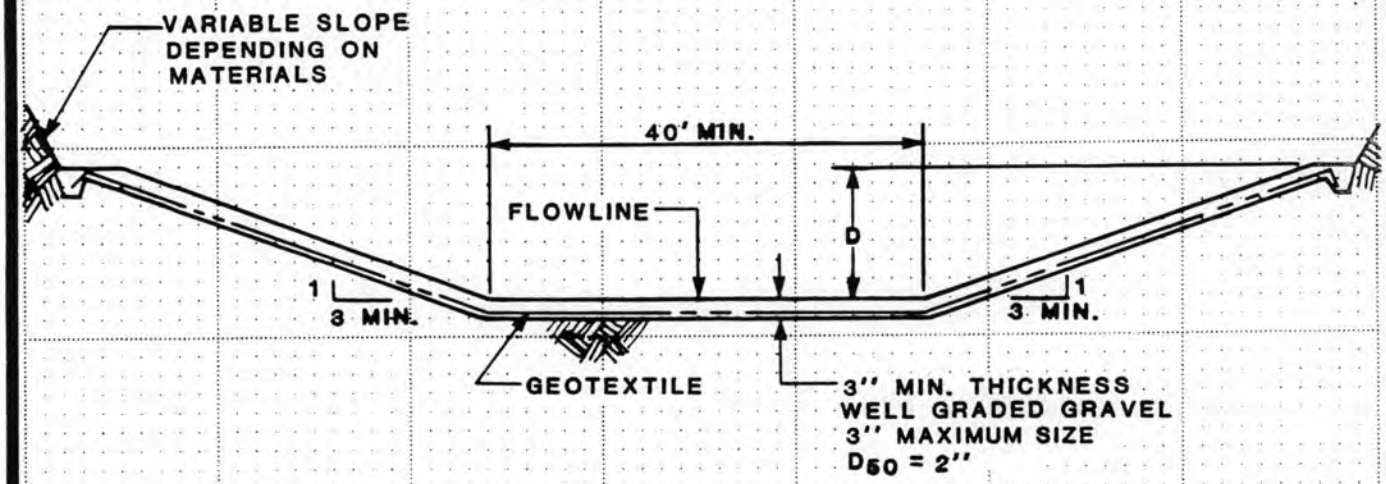
Plate 2



VOLUME-ELEVATION CURVE

KM-E1

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.0'

LENGTH = 30'

FLOWLINE ELEV.= 6608.90'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION KM-E1

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: KM-E1
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			WIDTH VARIES
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			Uneven 16°
a. Adequate grass cover?		X	
b. Any erosion?	X		Rills & sm. gullys
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?		X	
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			16°
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?			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	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			RM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Into Pond Several gulleys
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			RM

Sediment Impoundment Name: KM-E1
Page:

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			NA
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		24" CMP with entrance flare
Are side slopes eroding?			
Are side slopes sloughing?			NA
Bottom of channel eroding?			
Obstructed?	X		50% crushed at exit
Erosion protection?			NA
d. Outflow Channel:		X	
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?			

ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?		No	(Elev.) feet
b. Water present?	Yes		(Elev.) feet
c. Siltation?	Yes		
d. Watershed matches soil map?		No	

9. GENERAL COMMENTS

Crest elevation & width vary

Canopy Cover 10%

Ground Cover 35%

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
KM-E1 SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6678 − 6607 = 71 ft. ✓

WATER COURSE LENGTH = 3.5(400) = 1400 ft. = 0.265 mi. ✓

$$T_c = \left(\frac{11.9\ (0.265)^3}{71}\right)^{0.385} = 0.108 \text{ hr.} \checkmark$$

LAG TIME = $0.6 T_c$ = 0.065 hr. ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
3.6	paved road	—	D	(.29) (93)
8.8	gravel road	—	D	(.71) 91
				91.6

100 % mine

use 92 ✓

DRAINAGE BASIN AREA

12.4 ACRE 0.019 SQ. MILE ✓

BY S. DOLAN DATE 10-2-85
CHECKED BY BHM 11/5/85
COPY TO EO ___

FILE Peabody Coal Co 10139-011-22
SUBJECT Sediment Inflow
KM-el SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___ BY ___ DATE ___ TO EO ___

Universal Soil Loss Equation

Rainfall Factor

R = 40

Soil Erodibility Factor

Soil Type = 100% EM # 34 .22

K = .22 ✓

Slope Factor

Length (ft.)	Δ Elev (ft.)	Slope (%)	LS
1200	50	4.2	1.14

use 1.14 ✓

Cover Factor

Area (ac.)	Cover Type	% Cover	Canopy (%)	Weighted C
100%	disturbed			1.0

C = 1.0 ✓

Erosion Control Factor

P = 1.0

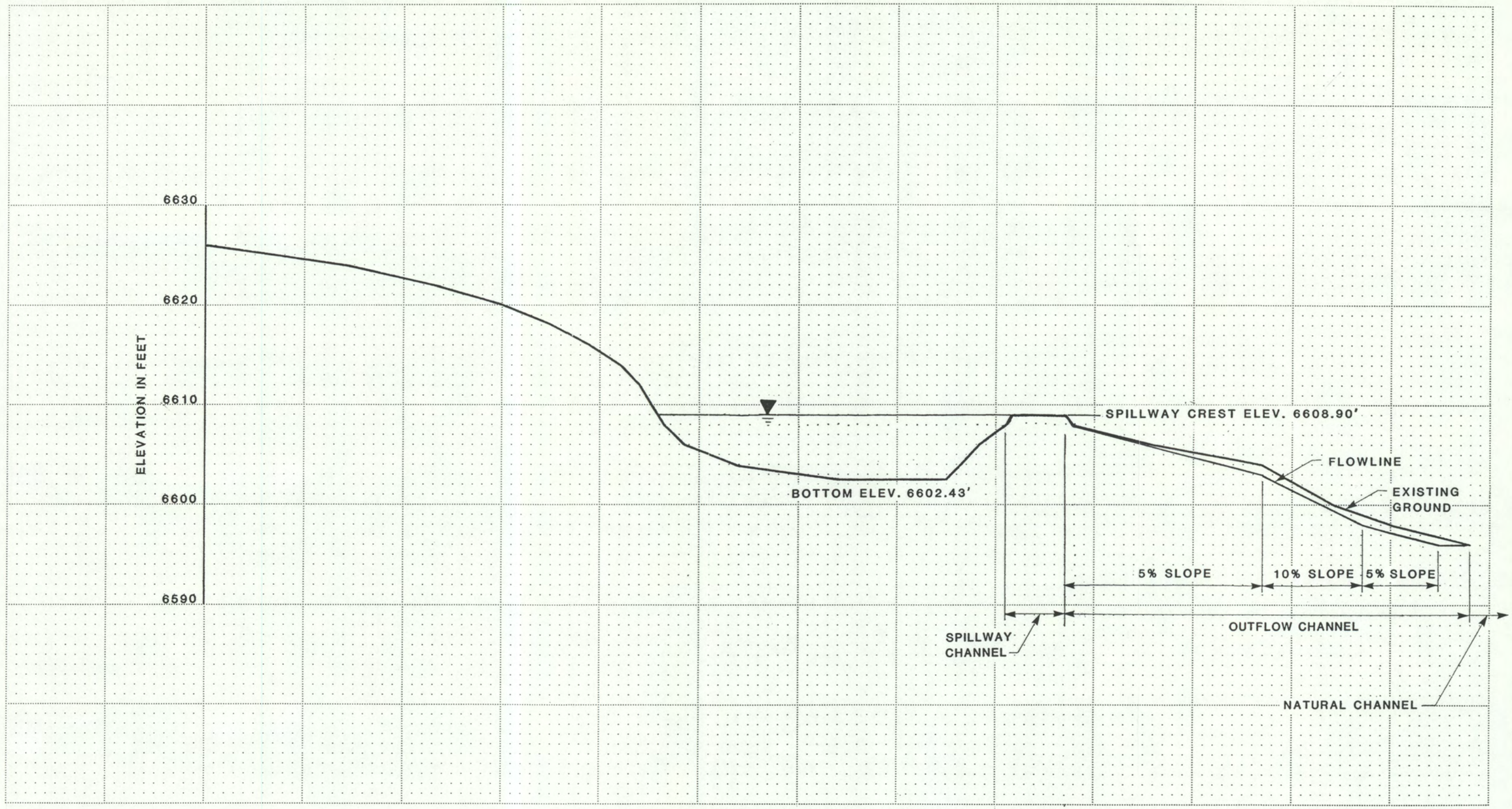
Sediment Inflow

$A = 40(.22)(1.14)(1.0)(1.0) = 10.03$ ton/acre/year ✓

$A = 10.03\left(\frac{1}{2047}\right)(12.4)(.95) = .058$ acre-feet/year ✓

BY ___ DATE ___ CHECKED BY BHM 11/5/85 COPY TO EO ___

Dames & Moore



SCALE
0 50 100
FEET

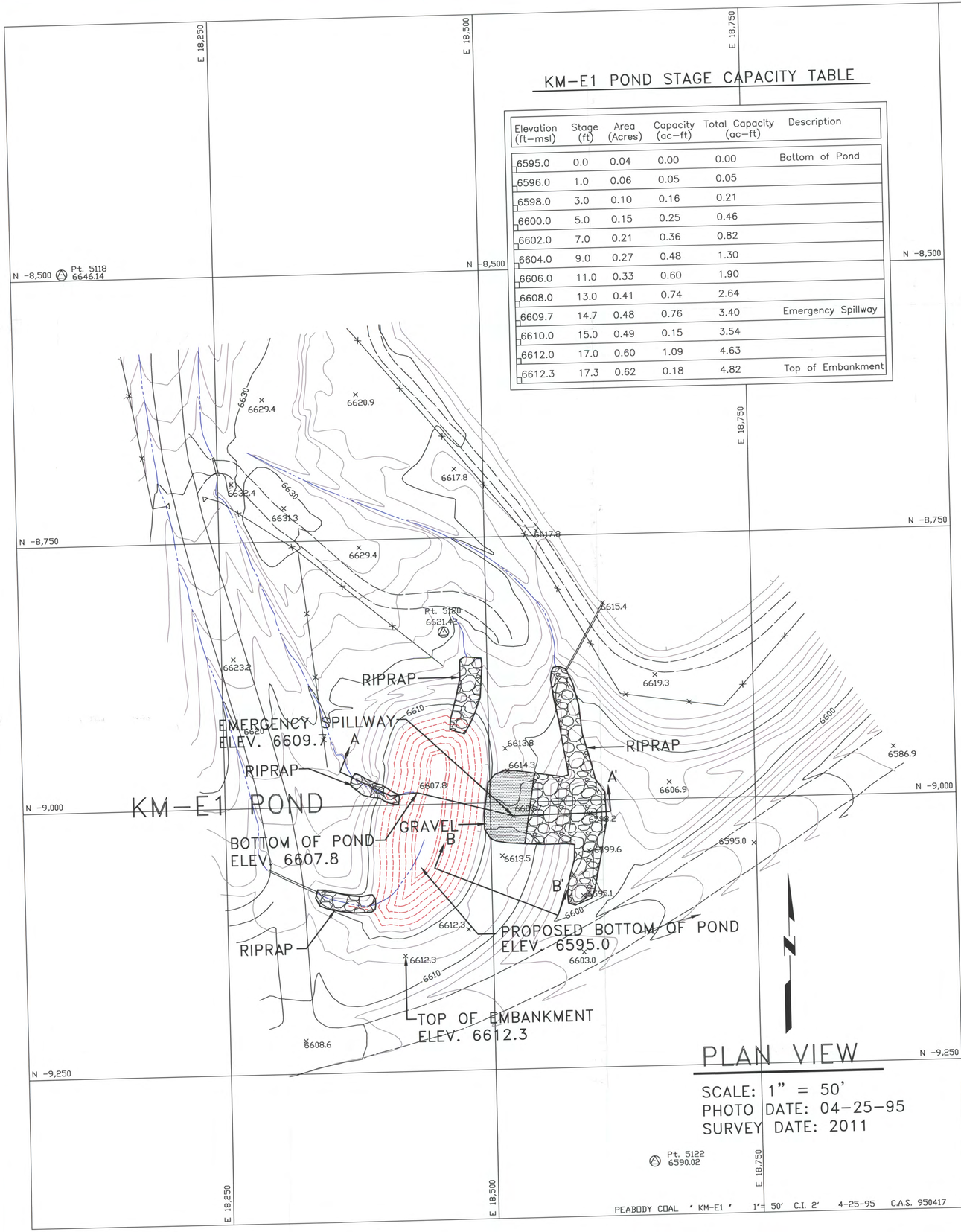
CHANNEL PROFILE B–B′
KM–E1

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

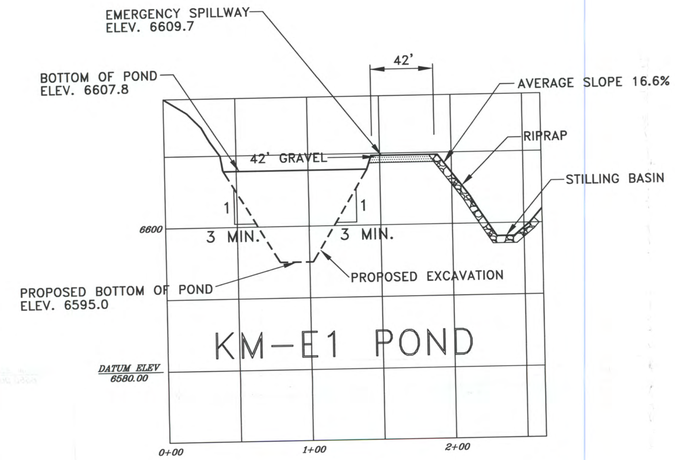
KM-E1 POND STAGE CAPACITY TABLE

Elevation (ft-msl)	Stage (ft)	Area (Acres)	Capacity (ac-ft)	Total Capacity (ac-ft)	Description
6595.0	0.0	0.04	0.00	0.00	Bottom of Pond
6596.0	1.0	0.06	0.05	0.05	
6598.0	3.0	0.10	0.16	0.21	
6600.0	5.0	0.15	0.25	0.46	
6602.0	7.0	0.21	0.36	0.82	
6604.0	9.0	0.27	0.48	1.30	
6606.0	11.0	0.33	0.60	1.90	
6608.0	13.0	0.41	0.74	2.64	
6609.7	14.7	0.48	0.76	3.40	Emergency Spillway
6610.0	15.0	0.49	0.15	3.54	
6612.0	17.0	0.60	1.09	4.63	
6612.3	17.3	0.62	0.18	4.82	Top of Embankment



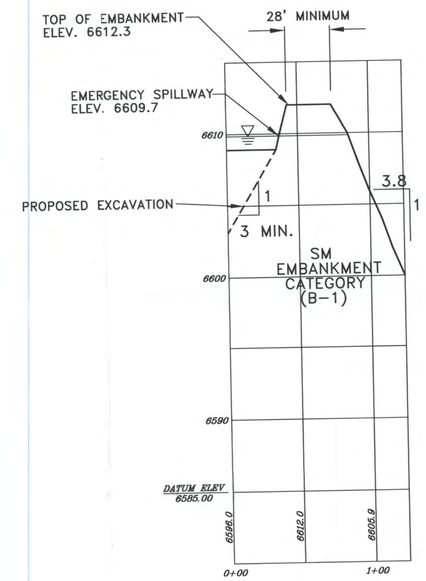
PLAN VIEW

SCALE: 1" = 50'
PHOTO DATE: 04-25-95
SURVEY DATE: 2011



PROFILE SECTION A – A'

VERT. SCALE: 1" = 10'
HORIZ. SCALE: 1" = 50'



CROSS SECTION B – B'

VERT. SCALE: 1" = 5'
HORIZ. SCALE: 1" = 50'

ENGINEER'S CERTIFICATION

Registered Professional Engineer (Civil)
CERTIFICATE NO. 37842
GARY ALTSISI
DATE SIGNED 2-15-11
ARIZONA, U.S.A.
Expires 9/30/2011

Gary Altsisi
Reclamation Supervisor
Peabody Western Coal Company

Arizona P.E. 37842

REVISIONS		
CHK'D	DATE	DESCRIPTION

EXHIBIT #1
KM-E1 POND
REMEDIAL DESIGN

KAYENTA MINE

PEABODY WESTERN COAL CO. P.O. BOX 650 KAYENTA, AZ. 86033

DESIGNED BY: G.A.	SCALE: AS SHOWN
DRAWN BY: G.A.	DRAWING DATE: 02/07/11
CHECKED BY: G.A.	PHOTO DATE: 04/25/95
C.I. : 2-FT	DWG FILE: KM-E1_REMEDIAL_FEB_2011.DWG

APPROVED
JUN 2011

PEABODY COAL ' KM-E1 ' 1"= 50' C.I. 2' 4-25-95 C.A.S. 950417

DESIGN REPORT

Sedimentation Structure

KM-TPB

Kayenta Mine

Navajo County, Arizona

PEABODY COAL COMPANY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
18782
JAMES GARY
SCHLENVOGT
Date Signed.....
ARIZONA, U.S.A.

James G. Schlenvogt

OCT 3 1 1987

NOV 4 1987

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Inspection	1
Site Description	1
Land Use	1
Embankment	1
Design Analyses	2
General	2
Stability	2
Hydrology	2
Hydraulics	3
Principal Spillway	4
Emergency Spillway Channel	4
Storage Capacity	4

PLATE 1 - Site Plan

PLATE 2 - Stage-Capacity Chart

PLATE 3 - Embankment Cross Section A-A'

PLATE 4 - Channel Profile B-B'

PLATE 5 - Emergency Spillway Typical Cross Section

APPENDIX A - Hydrology and Hydraulic Calculations

APPENDIX B - SEDIMOT II (Input and Output) 10-Year, 24-Hour

APPENDIX C - SEDIMOT II (Input and Output) 25-Year, 6-Hour

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Introduction

Sedimentation Structure KM-TPB will be an earthen embankment, designed and constructed by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from disturbed areas of the Kayenta Mine. The location of Structure KM-TPB is shown on Plate 1, Site Plan, Drawing No. 85400 (Sheet J-7), and Drawing No. 85405. The construction is requested to replace the concrete wall structure which failed August 24, 1987. The pond will be required to control sediment and runoff from the disturbance associated with the overland conveyor and Transfer Point "B".

This design report contains information specific to Structure KM-TPB. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company", December, 1985 (PAP), Chapter 6, Attachment D, Volume 2 along with the methods and results of analyses used for slope stability, hydrology, and hydraulics.

Inspection

The proposed site of Structure KM-TPB was inspected by a senior compliance engineer from Peabody Coal Company in August, 1987 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, rather the information in Chapter 6, Attachment D will be utilized for embankment design during construction.

Site Description

Land Use

Structure KM-TPB has a 38.2-acre tributary drainage area and is located on a small tributary of Yellow Water Canyon at the Kayenta Mine. The watershed is classified as 89 percent Pinon/Juniper and 11 percent disturbed.

Embankment

A homogeneous earthen embankment, a minimum of ten feet wide, was assumed for the hydraulic analysis and to develop the stage-capacity chart shown on Plate 2. Upstream and downstream slopes of 3:1 (horizontal to vertical) were used. The assumed slopes were not evaluated for geotechnical considerations such as slope stability since the foundation or

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embankment material types have not been determined.

Design Analyses

General

Structure KM-TPB was designed by a senior compliance engineer from Peabody Coal Company. 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 1984 for Peabody Coal Company and was used in the analyses of the structure.

Stability

The slopes of Structure KM-TPB 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 during construction and stable slopes will be chosen based on the category classification of the structure.

Hydrology

The hydrologic analysis was completed using the University of Kentucky's generalized computer program SEDIMOT II (see Appendix A, B, and C). Structure KM-TPB is not in series with any other structure nor does the structure fall under the guidelines of the 30 CFR Section 77.216 for MSHA size structures. Therefore, the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure KM-TPB was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1. Water Course length, L . . . . . 0.424 mi
2. Elevation Difference, H . . . . . 133 ft
3. Time of Concentration, T_c . . . . . 0.147 h
4. SCS Curve Number 85
5. Rainfall Depth, 10-year, 24-hour storm . . . . 2.1 in
   25-year, 6-hour storm . . . . 1.9 in
6. Drainage Area . . . . . 38.2 acres

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Hydraulics

The SEDIMOT II program was used to evaluate inflow to the planned 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-TPB HYDRAULICS

Units	10-Year 24-Hour Storm	25-Year 6-Hour Storm
Initial Reservoir Volume Condition	Empty	Full to the principal spillway elevation
Inflow		
Peak Flow . . . . . cfs	32.1	39.4
Volume . . . . . acre-ft	2.77	2.3
Storage		
Peak Stage . . . . . ft	7229.1	7232.1
Principal Spillway Elevation . . . . . ft	7230.00	7230.0
Peak Storage . . . . . acre-ft	2.77	4.1
Storage Capacity . . . . . acre-ft	3.12	5.1
Available Sediment Storage . . acre-ft	0.35	-
Sediment Inflow Rate . . . . . acre-ft/yr	0.052	-
Sediment Storage Life . . . . years	6.7	-
Outflow		
Peak Flow . . . . . cfs	0	14.9
Embankment Crest Elevation . . . . . ft	7234.5	7234.5
Peak Stage . . . . . ft	7229.1	7232.1
Freeboard . . . . . ft	5.4	2.4

Note: The principal spillway is an 18-inch drop inlet CMP which was analyzed as part of the SEDIMOT II computer analyses.

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Principal Spillway

The proposed spillway for KM-TPB is a drop inlet, corrugated metal pipe with the following dimensions:

Pipe Riser . . . . . 18 in.

Pipe Diameter . . . 18 in.

Pipe Length . . . .100 ft.

Pipe Slope . . . . . 2 percent

Inlet Elevation . . 7230.0

Emergency Spillway Channel

The emergency spillway channel for KM-TPB will be a trapezoidal channel with the following dimensions:

Channel Depth . . . . . .1.5 ft.

Channel Width . . . . . 15 ft.

Channel Length . . . . . 40 ft.

Side Slopes (Horizontal to Vertical) . .2:1 or flatter

Average Exit Slope . . . . . 0 percent

Inlet Elevation 7232.0

The outflow channel will require protection against erosion only at the outlet of the corrugated metal pipe and emergency spillway (see Plates 3 and 4).

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 2, Volume-Elevation Curve, KM-TPB.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.16
3. Slope Factor, LS 1.90
4. Cover Factor, C 0.240
5. Erosion Control Factor, P 1.0

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour

NOV

storm, and the remaining storage volume available for storing sediment. The proposed storage capacity of KM-TPB and the results of the sediment inflow analysis are summarized in the following table.

KM-TPB STORAGE

Total Storage Capacity	3.12	acre-ft
10-year, 24-hour Storm Inflow	2.77	acre-ft
Available Sediment Storage Capacity	0.35	acre-ft
Sediment Inflow Rate	0.052	acre-ft/yr
Sediment Storage Life	6.7	years

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

Plate 1 - Site Plan KM-TPB

Plate 2 - Stage-Capacity Chart

Plate 3 - Embankment Cross Section A-A'

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

Plate 5 - Emergency Spillway Typical Cross Section

Appendix A - Hydrology and Hydraulic Calculations

Appendix B - SEDIMOT II (Input and Output) 10-Year, 24-Hour Storm

Appendix C - SEDIMOT II (INput and Output) 10-Year, 24-Hour Storm

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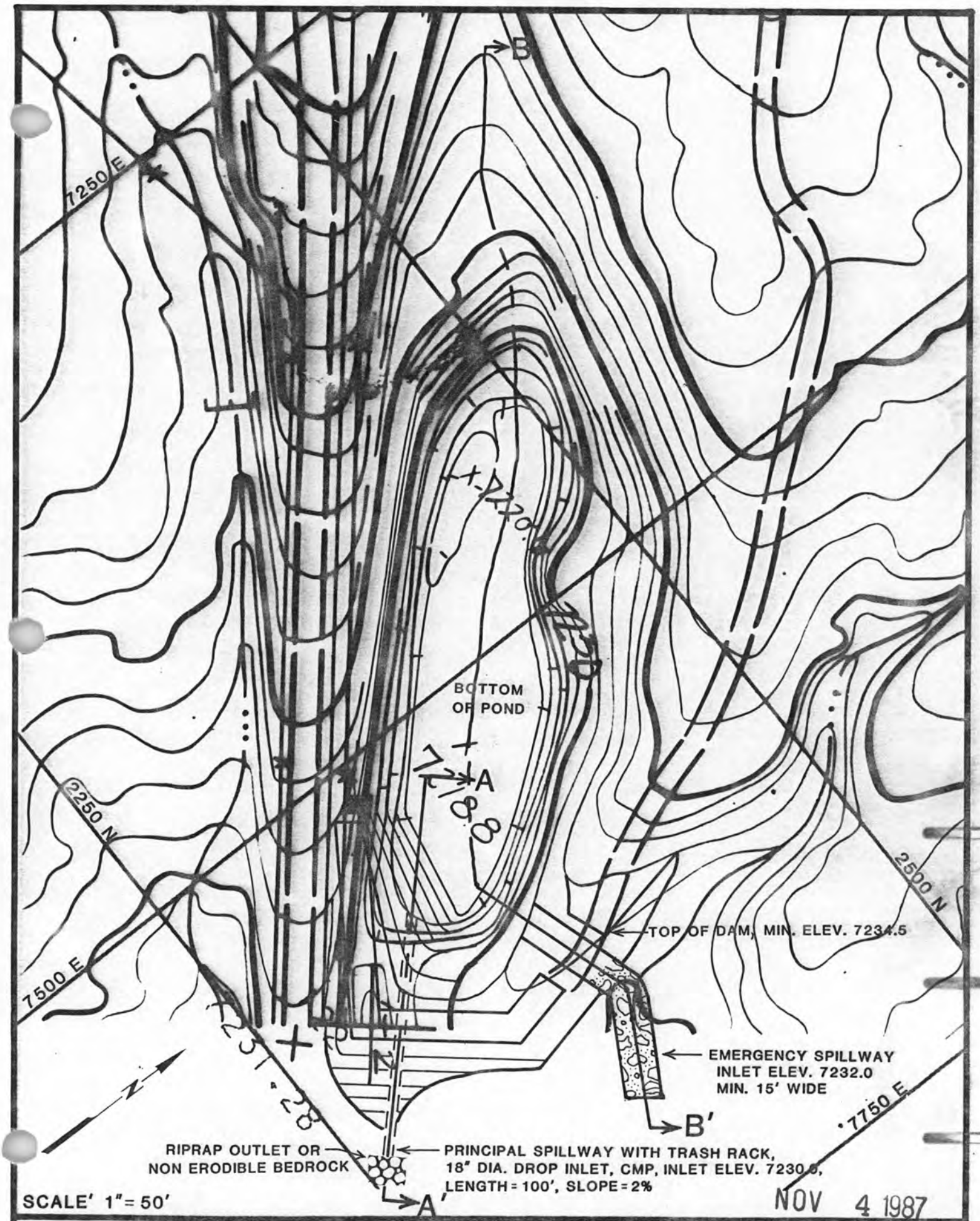

SITE PLAN KM-TPB | BY: PEABODY COAL COMPANY Plate 1

Stage-Capacity Chart

PLATE 2

NOV 4 1987

KM-TPB

Stage-Capacity Chart

Elevation (Ft-Msl)	Stage (Ft.)	Area (Acres)	Capacity (Ac-Ft)	Total Capacity (Ac-Ft)	Description
7234.0	15.2	0.576	1.070	5.10	
7232.0	13.2	0.494	0.914	4.03	Emergency Spillway
7230.0	11.2	0.420	0.782	3.12	Principal Spillway
7228.0	9.2	0.362	0.687	2.33	
7226.0	7.2	0.325	0.609	1.65	
7224.0	5.2	0.284	0.519	1.04	
7222.0	3.2	0.235	0.413	0.52	
7220.0	1.2	0.178	0.107	0.11	
7218.8	0	0	0	0	Bottom of Pond

PLATE 2

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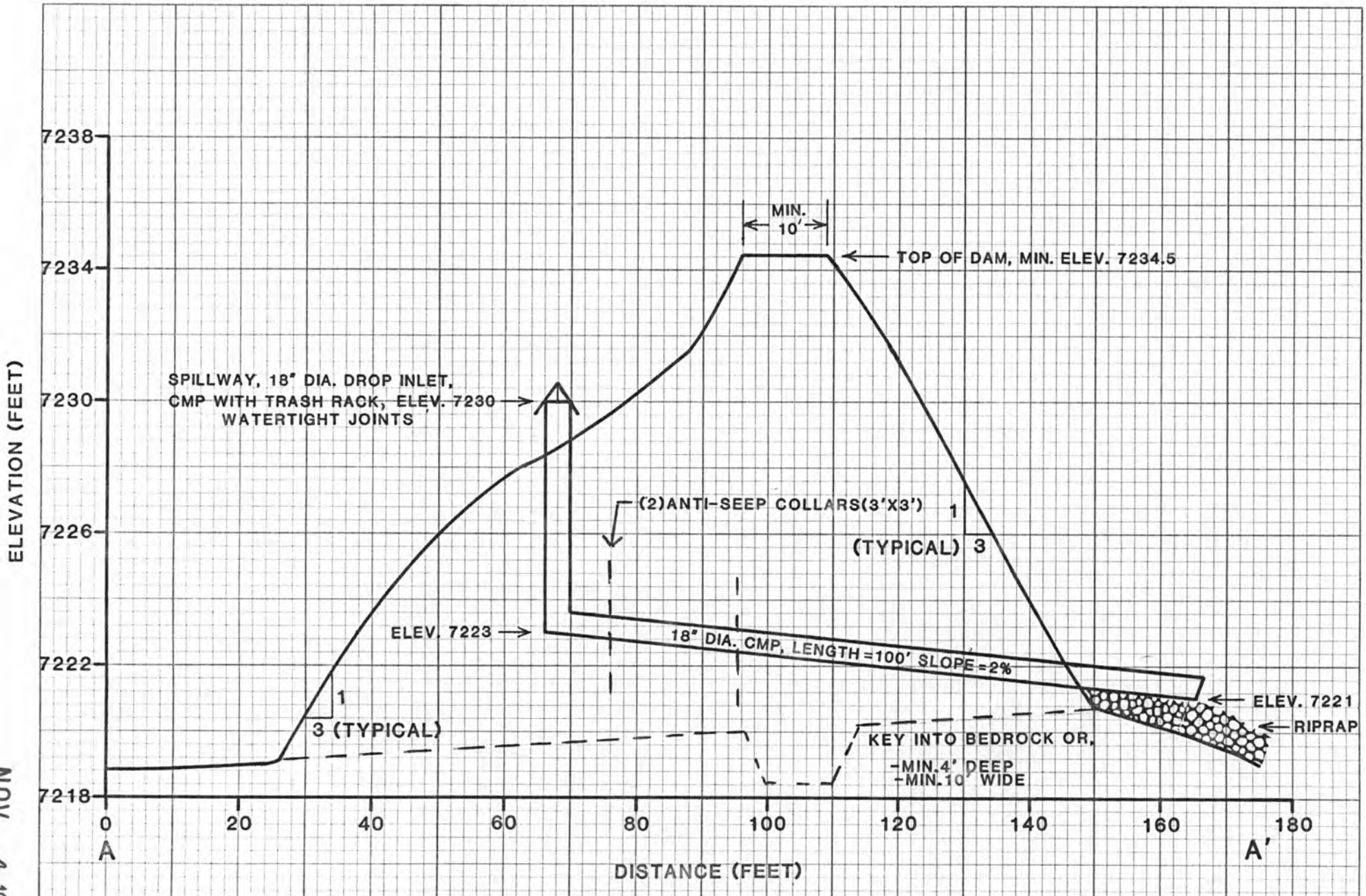
K+E 10 X 10 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

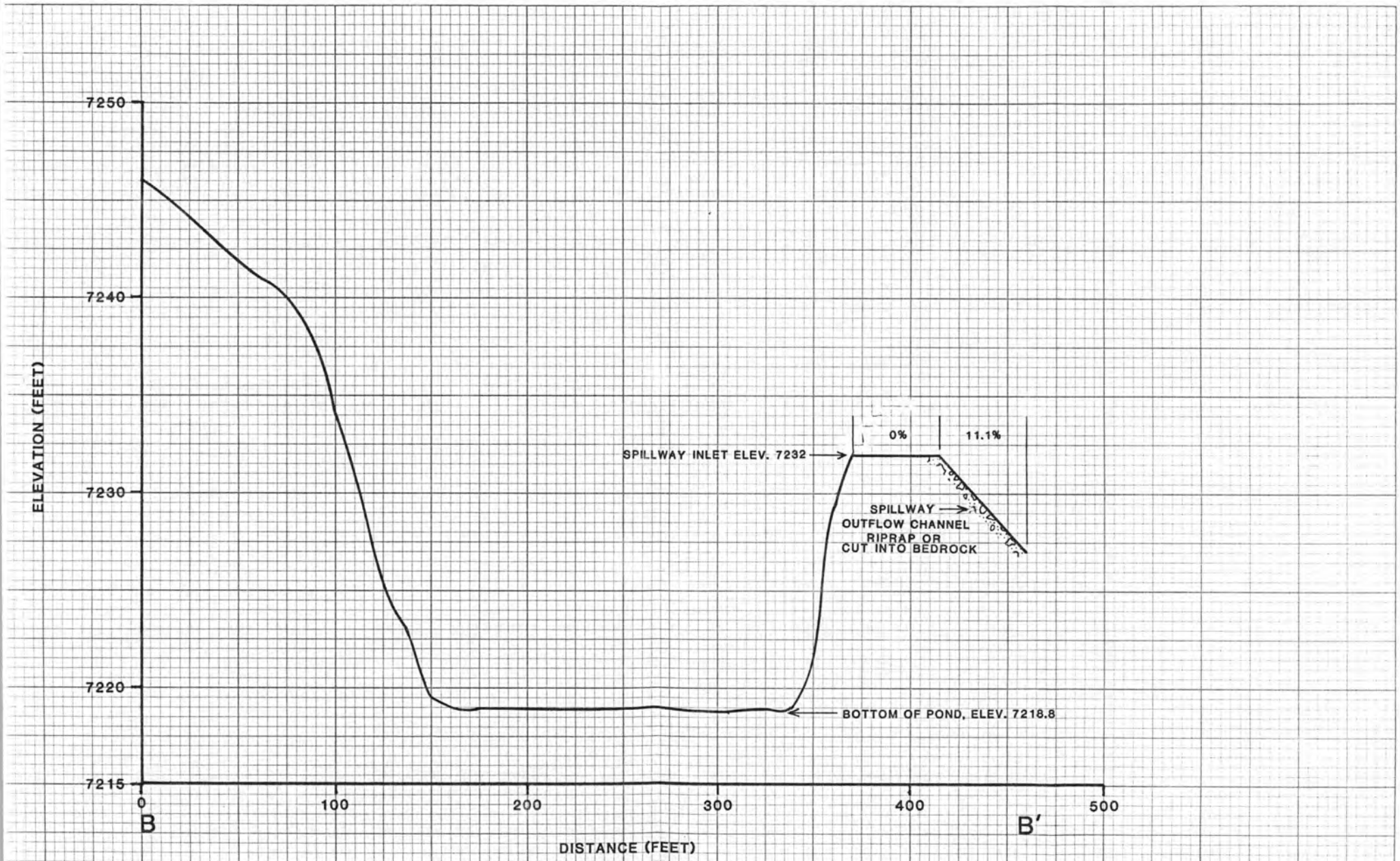


HORT. SCALE: 1"=20'
VERT. SCALE: 1"=4'

EMBANKMENT CROSS SECTION A-A'
KM-TPB

BY: PEABODY COAL COMPANY
PLATE 3

NOV 4 1987



HORT. SCALE: 1"=50'
VERT. SCALE: 1"=5'

CHANNEL PROFILE B-B′
KM-TPB

BY: PEABODY COAL COMPANY

PLATE 4

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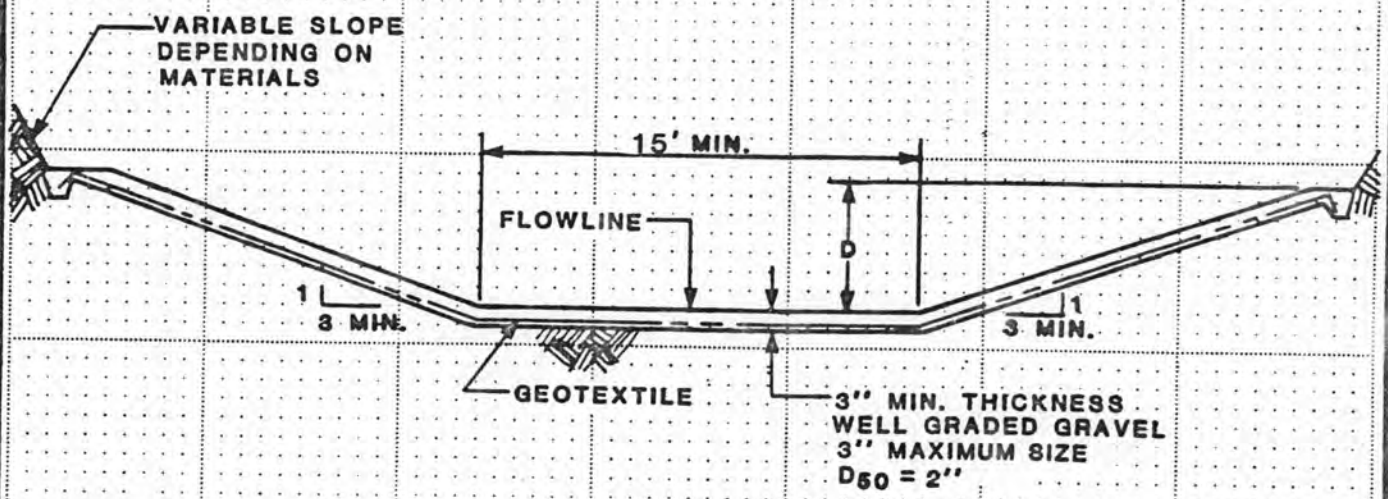

SPILLWAY CHANNEL

D =1.5'

LENGTH = 40'

FLOWLINE ELEV.= 7232.0

OUTFLOW CHANNEL

D =1.5'

EMERGENCY SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION

KM-TPB

BY PEABODY COAL CO. Plate 5

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APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

NOV 4 1987

KM-TPB

Time of Concentration

Elevation Difference = 7362 - 7229 = 133 ft.

Water Course Length = 5.6(400) = 2240 ft. = 0.424 mi.

$$T_c = \left(\frac{11.9\ (0.424)^3}{133}\right)^{0.385} = 0.147 \text{ hr.}$$

SCS Curve Number

Drainage Area (ac)	Cover Type	Hydrologic Condition	Soil Type	Weighted Curve Number
34.0 (89%)	P-J	average	D	83 (.89)
4.2 (11%)	disturbed		D	94 (.11)
				84.2

Use: 85

Drainage Basin Area

38.2 Acre

Universal Soil Loss Equation

Rainfall Factor:

K = 40

Soil Erodibility Factor:

Soil Type = 100% EH #24 1.0(.16)

K = .16

Slope Factor:

Length (ft)	Elev Difference (ft)	Slope (1%)	LS
600	40	6.7	1.9

Use: 1.9

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Cover Factor:

Area (ac)	Cover Type	% Cover	Canopy (%)	Weighted C
34.0 (89%)	P-J	40	25	.89(.16)
4.2 (11%)	disturbed	-	-	.11(1.0)
				C = .24

Erosion Control Factor:

P = 1.0

Sediment Inflow:

$$A = (40)(.16)(1.9)(.24)(1.0) = 2.92 \quad \text{ton/acre/year}$$

$$A = \frac{2.92(38.2)(1)(.95)}{2047} = .052 \quad \text{acre-feet/year}$$

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APPENDIX B

SEDIMOT II (Input and Output)

10-Year, 24-Hour Storm

NOV 4 1987

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KM-TPB POND (10-YEAR,24-HOUR)
       2       2
    2.10    24.0    0.10    1.00
       1       2
       1
    2.50    1.50    1.25
       1      11
  2.0000  0.3000  0.1500  0.0750  0.0400  0.0200  0.0100   0.005   0.002   0.001
 0.0001
  100.00   99.00   87.00   74.00   66.00   52.00   42.00   36.00   26.00   22.00
    0.00
       1
    0.00    0.00    0.00
       1       2       1       1       1
   38.20  85.000   0.147   0.000   0.000   0.000   1.000   1.000   0.000
   0.160   600.0    6.70   0.240   1.000
    0.10    1.00   40.00
       3       0       9     500       2       1       0
   0.000    1.20    3.20    5.20    7.20    9.20   11.20   13.20   15.20
    0.00   0.178   0.235   0.284   0.325   0.362   0.420   0.494   0.576
   18.00   18.00    1.00    0.50   140.0    3.10    0.60   0.025    9.00   11.20
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NOV 4 1987

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UNIVERSITY OF KENTUCKY COMPUTER MODEL
OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
FOR MORE INFORMATION CONTACT THE AGRICULTURAL
ENGINEERING DEPARTMENT

THE UK MODEL IS A DESIGN MODEL DEVELOPED TO PREDICT
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MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

VERSION DATE 5-25-83

DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
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CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL

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WATERSHED IDENTIFICATION CODE

KM-TPB POND (10-YEAR,24-HOUR)

****

18" CMP DROP INLET

SPILLWAY

NOV 4 1987

INPUT PARTICLE SIZE-PERCENT FINER DISTRIBUTIONS

SIZE,MM	2.000	0.300	0.150	0.075	0.040	0.020
	0.010	0.005	0.002	0.001	0.000	
PCT FINER NO. 1	100.000	99.000	87.000	74.000	66.000	52.000
	42.000	36.000	26.000	22.000	0.000	

**********INPUT VALUES**********

STORM DURATION	=	24.00	HOURS
PRECIPATION DEPTH	=	2.10	INCHES
SPECIFIC GRAVITY	=	2.50	
LOAD RATE EXPONENT FACTOR	=	1.50	
SUBMERGED BULK SPECIFIC GRAVITY	=	1.25	

NOV 1 1987

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* * * * * * * * * * * * * * * * * * * * * * *
    JUNCTION  1, BRANCH  1, STRUCTURE  1
* * * * * * * * * * * * * * * * * * * * * * *
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*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X	UNIT HYDRO
1	38.20	85.00	0.147	0.000	0.000	0.00	1.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	0.16	600.0	6.70	0.240	1.0	0.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	32.10	0.87	85.49	0.014	0.932	1.000

NOTE: SEDIMENT DOES NOT INCLUDE POSSIBLE DEPOSITION BY DELIVERY RATIO 2

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

RUNOFF VOLUME	=	2.7668	ACRE-FT
PEAK DISCHARGE	=	32.0979	CFS
AREA	=	38.2000	ACRES
TIME OF PEAK DISCHARGE	=	12.10	HRS
BETA	=	1.0000	
RAINFALL EROSITIVITY FACTOR	=	24.21	EI UNIT
PEAK CONCENTRATION	=	42025.10	MG/L
PEAK SETTLEABLE CONCENTRATION	=	17.91	ML/L
PEAK SETTLEABLE CONCENTRATION	=	22387.70	MG/L
TOTAL SEDIMENT YIELD	=	85.4872	TONS
REPRESENTATIVE PARTICLE SIZE	=	0.0137	MM
TIME OF PEAK CONCENTRATION	=	12.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	14.50	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	9.36	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	9.36	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	0.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	2.44	ML/L

NOV 4 1987

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POND RESULTS

* *

***** CONTROL VARIABLES OPTIONS *****

FLOW	FRACTN	ISDO	NRHP	NSP	NCSTR
3	0	2	500	9	0

***** DROP SPILLWAY INPUTS *****

ENTRANCE LOSS COEFFICIENT	=	1.0000	
BEND LOSS COEFFICIENT	=	0.5000	
WEIR COEFFICIENT	=	3.1000	
ORIFICE COEFFICIENT	=	0.6000	
MANNING COEFFICIENT	=	0.0250	
BARREL DIAMATER	=	18.00	INCHES
RISER DIAMETER	=	18.00	INCHES
LENGTH OF PIPE	=	140.00	FEET
VERTICAL HEAD DROP	=	9.00	FEET

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
0.00	0.000	0.00	0.00	0.00
1.20	0.178	0.60	0.00	0.11
3.20	0.235	2.42	0.00	0.52
5.20	0.284	4.17	0.00	1.04
7.20	0.325	5.86	0.00	1.65
9.20	0.362	7.53	0.00	2.33
11.20	0.420	9.12	0.00	3.12
13.20	0.494	10.58	12.03	4.03
15.20	0.576	11.93	14.80	5.10

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.117	ACRE-FT
DEAD STORAGE	=	40.00	PERCENT
TIME INCREMENT OUTFLOW	=	0.10	HRS
VISCOSITY	=	0.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	2.767	ACRE-FT
OUTFLOW ROUTED VOLUME	=	2.767	ACRE-FT
STORM VOLUME DISCHARGED (PLUG FLOW)	=	0.903	ACRE-FT

POND VOLUME AT PEAK STAGE	=	4.003	ACRE-FT
PEAK STAGE	=	13.139	FT
PEAK INFLOW RATE	=	32.098	CFS
PEAK DISCHARGE RATE	=	11.668	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	42025.10	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	14658.30	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	0.0036	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	4.50	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	12629.71	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	4295.61	MG/L
BASIN TRAP EFFICIENCY	=	80.65	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	14.25	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	0.92	HRS
DETENTION TIME INCLUDING STORED FLOW	=	12.06	HRS
SEDIMENT LOAD DISCHARGED	=	16.54	TONS

PERIOD OF SIGNIFICANT CONCENTRATION= 14.90 HRS

VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	0.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	0.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	0.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	0.00	ML/L

*** RUN COMPLETED ****

NOV 4 1987

APPENDIX C

SEDIMOT II (Input and Output)

25-Year, 6-Hour Storm

NOV 4 1987

```
KM-TPB POND (25-YEAR, 6-HOUR)
       2       2
    1.90     6.0    0.10    1.00
       1       2
       1
    2.50    1.50    1.25
       1      11
  2.0000  0.3000  0.1500  0.0750  0.0400  0.0200  0.0100   0.005   0.002   0.001
 0.0001
  100.00   99.00   87.00   74.00   66.00   52.00   42.00   36.00   26.00   22.00
    0.00
       1
    0.00    0.00    0.00
       1       2       1       1       1
   38.20  85.000   0.147   0.000   0.000   0.000   1.000   1.000   0.000
   0.160   600.0    6.70   0.240   1.000
    0.10    1.00   40.00
       3       0       9     500       2       1       0
   0.000    1.20    3.20    5.20    7.20    9.20   11.20   13.20   15.20
    0.00   0.178   0.235   0.284   0.325   0.362   0.420   0.494   0.576
   18.00   18.00    1.00    0.50   140.0    3.10    0.60   0.025    9.00   11.20
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NOV 4 1987

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WATERSHED IDENTIFICATION CODE

KM-TPB POND (25-YEAR, 6-HOUR)

****

18" CMP DROP INLET

SPILLWAY

NOV 4 1987

INPUT PARTICLE SIZE-PERCENT FINER DISTRIBUTIONS

SIZE,MM	2.000	0.300	0.150	0.075	0.040	0.020
	0.010	0.005	0.002	0.001	0.000	
PCT FINER NO. 1	100.000	99.000	87.000	74.000	66.000	52.000
	42.000	36.000	26.000	22.000	0.000	

**********INPUT VALUES**********

STORM DURATION	=	6.00	HOURS
PRECIPATION DEPTH	=	1.90	INCHES
SPECIFIC GRAVITY	=	2.50	
LOAD RATE EXPONENT FACTOR	=	1.50	
SUBMERGED BULK SPECIFIC GRAVITY	=	1.25	

NOV 4 1987

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* * * * * * * * * * * * * * * * * * * * * * * *
    JUNCTION  1, BRANCH  1, STRUCTURE  1
* * * * * * * * * * * * * * * * * * * * * * * *
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*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X	UNIT HYDRO
1	38.20	85.00	0.147	0.000	0.000	0.00	1.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	0.16	600.0	6.70	0.240	1.0	0.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	39.41	0.72	86.48	0.013	0.910	1.000

NOTE: SEDIMENT DOES NOT INCLUDE POSSIBLE DEPOSITION BY DELIVERY RATIO 2

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

RUNOFF VOLUME	=	2.3006	ACRE-FT
PEAK DISCHARGE	=	39.4086	CFS
AREA	=	38.2000	ACRES
TIME OF PEAK DISCHARGE	=	3.10	HRS
BETA	=	1.0000	
RAINFALL EROSITIVITY FACTOR	=	33.96	EI UNIT
PEAK CONCENTRATION	=	42188.18	MG/L
PEAK SETTLEABLE CONCENTRATION	=	17.61	ML/L
PEAK SETTLEABLE CONCENTRATION	=	22018.55	MG/L
TOTAL SEDIMENT YIELD	=	86.4827	TONS
REPRESENTATIVE PARTICLE SIZE	=	0.0127	MM
TIME OF PEAK CONCENTRATION	=	3.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	3.80	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	11.16	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	11.16	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	0.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	1.08	ML/L

NOV 4 1987

* *

POND RESULTS

* *

***** CONTROL VARIABLES OPTIONS *****

FLOW	FRACTN	ISDO	NRHP	NSP	NCSTR
3	0	2	500	9	0

***** DROP SPILLWAY INPUTS *****

ENTRANCE LOSS COEFFICIENT	=	1.0000	
BEND LOSS COEFFICIENT	=	0.5000	
WEIR COEFFICIENT	=	3.1000	
ORIFICE COEFFICIENT	=	0.6000	
MANNING COEFFICIENT	=	0.0250	
BARREL DIAMATER	=	18.00	INCHES
RISER DIAMETER	=	18.00	INCHES
LENGTH OF PIPE	=	140.00	FEET
VERTICAL HEAD DROP	=	9.00	FEET

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
0.00	0.000	0.00	0.00	0.00
1.20	0.178	0.60	0.00	0.11
3.20	0.235	2.42	0.00	0.52
5.20	0.284	4.17	0.00	1.04
7.20	0.325	5.86	0.00	1.65
9.20	0.362	7.53	0.00	2.33
11.20	0.420	9.12	0.00	3.12
13.20	0.494	10.58	12.03	4.03
15.20	0.576	11.93	14.80	5.10

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.117	ACRE-FT
DEAD STORAGE	=	40.00	PERCENT
TIME INCREMENT OUTFLOW	=	0.10	HRS
VISCOSITY	=	0.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	2.301	ACRE-FT
OUTFLOW ROUTED VOLUME	=	2.300	ACRE-FT
STORM VOLUME DISCHARGED (PLUG FLOW)	=	0.433	ACRE-FT

NOV 4 1987

POND VOLUME AT PEAK STAGE	=	4.084	ACRE-FT
PEAK STAGE	=	13.300	FT
PEAK INFLOW RATE	=	39.409	CFS
PEAK DISCHARGE RATE	=	12.172	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	42188.18	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	15309.60	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	0.0107	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	13.42	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	13213.38	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	2700.63	MG/L
BASIN TRAP EFFICIENCY	=	90.02	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	9.02	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	0.92	HRS
DETENTION TIME INCLUDING STORED FLOW	=	8.44	HRS
SEDIMENT LOAD DISCHARGED	=	8.63	TONS

PERIOD OF SIGNIFICANT CONCENTRATION= 7.90 HRS

VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	0.01	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	0.01	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	0.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	0.00	ML/L

*** RUN COMPLETED ****

NOV 4 1987

```
KM-TPB POND (25-YEAR, 6-HOUR)
       2       2
    1.90     6.0    0.10    1.00
       1       2
       1
    2.50    1.50    1.25
       1      11
  2.0000  0.3000  0.1500  0.0750  0.0400  0.0200  0.0100   0.005   0.002   0.001
 0.0001
  100.00   99.00   87.00   74.00   66.00   52.00   42.00   36.00   26.00   22.00
    0.00
       1
    0.00    0.00    0.00
       1       2       1       1       1
   38.20  85.000   0.147   0.000   0.000   0.000   1.000   1.000   0.000
   0.160   600.0    6.70   0.240   1.000
    0.10    1.00   40.00
       3       0       9     500       1       1       0
   0.000    1.20    3.20    5.20    7.20    9.20   11.20   13.20   15.20
    0.00   0.178   0.235   0.284   0.325   0.362   0.420   0.494   0.576
    0.00    0.00    0.00    0.00    0.00    0.00    0.00   12.03  113.80
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NOV 4 1987

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      CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL

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*******************************************
    WATERSHED IDENTIFICATION CODE
    -----------------------------
    KM-TPB POND (25-YEAR, 6-HOUR)
*******************************************
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15' WIDE EMERGENCY SPILLWAY

NOV 4 1987

INPUT PARTICLE SIZE-PERCENT FINER DISTRIBUTIONS

SIZE,MM	2.000	0.300	0.150	0.075	0.040	0.020
	0.010	0.005	0.002	0.001	0.000	
PCT FINER NO. 1	100.000	99.000	87.000	74.000	66.000	52.000
	42.000	36.000	26.000	22.000	0.000	

**********INPUT VALUES**********

STORM DURATION	=	6.00	HOURS
PRECIPATION DEPTH	=	1.90	INCHES
SPECIFIC GRAVITY	=	2.50	
LOAD RATE EXPONENT FACTOR	=	1.50	
SUBMERGED BULK SPECIFIC GRAVITY	=	1.25	

NOV 4 1987

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* * * * * * * * * * * * * * * * * * * * * * *
   JUNCTION  1, BRANCH  1, STRUCTURE  1
* * * * * * * * * * * * * * * * * * * * * * *
```

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X	UNIT HYDRO
1	38.20	85.00	0.147	0.000	0.000	0.00	1.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	0.16	600.0	6.70	0.240	1.0	0.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	39.41	0.72	86.48	0.013	0.910	1.000

NOTE: SEDIMENT DOES NOT INCLUDE POSSIBLE DEPOSITION BY DELIVERY RATIO 2

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

RUNOFF VOLUME	=	2.3006	ACRE-FT
PEAK DISCHARGE	=	39.4086	CFS
AREA	=	38.2000	ACRES
TIME OF PEAK DISCHARGE	=	3.10	HRS
BETA	=	1.0000	
RAINFALL EROSITIVITY FACTOR	=	33.96	EI UNIT
PEAK CONCENTRATION	=	42188.18	MG/L
PEAK SETTLEABLE CONCENTRATION	=	17.61	ML/L
PEAK SETTLEABLE CONCENTRATION	=	22018.55	MG/L
TOTAL SEDIMENT YIELD	=	86.4827	TONS
REPRESENTATIVE PARTICLE SIZE	=	0.0127	MM
TIME OF PEAK CONCENTRATION	=	3.10	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	3.80	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	11.16	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	11.16	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	0.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	1.08	ML/L

NOV 4 1987

* *

POND RESULTS

* *

***** CONTROL VARIABLES OPTIONS *****

FLOW	FRACTN	ISDO	NRHP	NSP	NCSTR
3	0	1	500	9	0

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
0.00	0.000	0.00	0.00	0.00
1.20	0.178	0.60	0.00	0.11
3.20	0.235	2.42	0.00	0.52
5.20	0.284	4.17	0.00	1.04
7.20	0.325	5.86	0.00	1.65
9.20	0.362	7.53	0.00	2.33
11.20	0.420	9.12	0.00	3.12
13.20	0.494	10.58	12.03	4.03
15.20	0.576	11.93	113.80	5.10

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	3.117	ACRE-FT
DEAD STORAGE	=	40.00	PERCENT
TIME INCREMENT OUTFLOW	=	0.10	HRS
VISCOSITY	=	0.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	2.301	ACRE-FT
OUTFLOW ROUTED VOLUME	=	2.300	ACRE-FT
STORM VOLUME DISCHARGED (PLUG FLOW)	=	0.465	ACRE-FT
POND VOLUME AT PEAK STAGE	=	4.061	ACRE-FT
PEAK STAGE	=	13.256	FT
PEAK INFLOW RATE	=	39.409	CFS
PEAK DISCHARGE RATE	=	14.870	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	42188.18	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	15310.00	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	0.0118	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	14.72	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	12739.14	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	2743.73	MG/L
BASIN TRAP EFFICIENCY	=	89.72	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	8.91	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	0.90	HRS
DETENTION TIME INCLUDING STORED FLOW	=	8.30	HRS
SEDIMENT LOAD DISCHARGED	=	8.89	TONS

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```
PERIOD OF SIGNIFICANT CONCENTRATION=        8.00   HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE
  CONCENTRATION DURING PERIOD OF
  SIGNIFICANT CONCENTRATION            =       0.01   ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE
  CONCENTRATION DURING PEAK 24 HOUR
  PERIOD                               =       0.01   ML/L
ARITHMETIC AVERAGE SETTLEABLE
  CONCENTRATION DURING PERIOD OF
  SIGNIFICANT CONCENTRATION            =       0.00   ML/L
ARITHMETIC AVERAGE SETTLEABLE
  CONCENTRATION DURING PEAK 24 HOUR
  PERIOD                               =       0.00   ML/L


                    *** RUN COMPLETED ****
```

NOV 4 1987

Peabody

PEABODY COAL COMPANY
Western Division

1300 South Yale
Flagstaff, Arizona 86001
(602) 774-5253

July 2, 1987

Mr. Steve Fuller
Chief, Compliance Section
Water Management Division
U.S. Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, CA 94105

ATTN: W-4-1

Dear Mr. Fuller:

This letter and the enclosed information addresses the issue of seeps from ponds and dams at the Black Mesa mining complex raised in Mr. Ronald Clawson's May 26, 1987 inspection report. The information is provided pursuant to your June 4, 1987 letter and Recommendation 3 on Page 6 of the above-referenced report.

Peabody has performed a survey of all 156 water retention structures existing at the Black Mesa complex. The survey was designed to provide data regarding any actual or potential seeps or flows of water from locations other than the spillways of these structures. The results of the survey are as follows. Evidence of water was found to exist at or within 200 feet downstream of the embankment of 19 structures. A summary of Peabody's findings regarding these structures may be found in Exhibit 1 attached to this letter.

There is no reason to believe a relationship exists between the dams and downstream evidence of moisture for the following seven structures: CWB, J3-C, J16-I, J27-B, J28-G, N6-F, and N13-C. For example, the water below J27-B (which is not currently holding any water) emanates from a known spring which is periodically sampled in accordance with Peabody's mining permit.

Since many of the ephemeral washes on the Black Mesa leasehold have intermittent reaches due to surfacing alluvial ground water or springs, a damp spot or minor flow in a wash is not uncommon and certainly does not represent conclusive evidence of a seeping dam. As examples, no water is currently being held by Ponds CWB and J3-C; however, water or evidence of moisture exists at the downstream toes of the embankments. (Note: Neither of these structures,

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if discharging, would be NPDES sampling points since the J2-A dam is downstream and would collect and treat such discharges.) Thus, existence of moisture or water at or below the embankment of 10 of the remaining 12 structures listed in Exhibit 1 may or may not be evidence of a leaking or seeping pond. Several factors must be considered when judging the status of these structures including construction notes, the location of the damp spots, and the existence and location of recognizable flows.

Based upon our review, it is evident that only 2 of the 156 dams are yielding a measurable flow capable of being sampled - J-7 and J16-A. The flows below these structures were sampled and the results may be found in Exhibit 2. J-7 is seeping at the toe and abutment. J16-A is leaking a minor amount of water from the decant system; however, the water is being contained in the immediate vicinity of the dam and not discharged to Moenkopi Wash.

The remaining ten structures listed in Exhibit 1 may be seeping to some extent. For example, the damp spots on the embankment and at the toe of N6-C would imply a minor seep; however, the damp spot in the channel approximately 50 feet downstream is most likely unrelated to the structure. There are no measurable flows associated with these structures.

When reviewing this situation, the following facts should be considered.

1. The sediment dams are required by law. Although alternative sediment control may be employed in limited cases (e.g., silt fence, straw bales, etc.), principal sediment control is through the use of dams.
2. The principal purpose of sediment dams is to collect runoff from disturbed lands, provide for detention and settling of solids, and allow controlled releases of water.
3. All earthen dams which consistently retain water will leak. Larger earthen dams are designed with filter systems to allow for such leakage in a controlled fashion which protects the stability of the structure.
4. Water which seeps through an embankment is filtered and poses no environmental threat.
5. The existing NPDES permit was written to address spillway discharges which are the direct result of precipitation events. Non "event"-type discharges were considered and not felt to be significant at the time the permit was drafted. This knowledge is from

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participating with the State in the drafting process. Discharges through spillways have been sampled and reported in accordance with NPDES Permit AZ0022179.

6. Peabody is required by its mining permit to maintain an elaborate ground and surface water monitoring program. This program has not detected any adverse impacts from any surface mining activities.
7. Peabody recognized the existence of certain difficulties associated with the current NPDES permit and requested modifications in December, 1984. If adopted, the modifications would address concerns outlined in the inspection report.
8. Leaking or seeping ponds are obviously not a common or widespread phenomenon at the Black Mesa complex.

If you have any questions or wish any additional information regarding the issues outlined in the May 26, 1987 inspection report, please contact me.

Respectfully,

Gary L. Melvin

Gary L. Melvin
Senior Manager
Environmental Affairs

bd

Enclosures

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EXHIBIT 1

Dam Survey Results
Black Mesa Mining Complex
June, 1987

Structure	NPDES Pond*	Impounding Water	Comments
J-7	Yes	Yes	Water flowing from toe and abutment of dam. Flow rate estimated to be 10 gpm. Flowing water was sampled.
J16-I	Yes	Yes	Damp spot in channel approximately 15 feet downstream of embankment.
J16-A	Yes	Yes	Water leaking from decant system. Flow rate estimated to be 1.5 gpm. Flowing water was sampled. Water is being collected in a depression and is not discharging to Moenkopi Wash.
J21-T4	No	Yes	Water seeping from toe of dam. Flow is diffuse, not capable of being measured or sampled.
J27-B	Yes	No	Diffuse seep in channel beginning approximately 10 feet downstream of embankment. Extremely low flow, not capable of being sampled. Water is from a spring.
J28-G	No	Yes	Damp spot in channel approximately 30 feet downstream of embankment.
N6-F	Yes	No	Damp spot approximately 50 feet downstream of embankment. Water in channel approximately 160 feet downstream of embankment.
N10-A	No	Yes	Water seeping from abutment of dam. Flow is diffuse, not capable of being measured or sampled.
N13-E	Yes	Yes	Damp spot approximately 15 feet downstream from embankment.

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EXHIBIT 1 Con't)

Dam Survey Results
Black Mesa Mining Complex
June, 1987

Structure	NPDES Pond*	Impounding Water	Comments
N14-P	Yes	Yes	Minor signs of dampness on embankment.
TPF-D	No	Yes	Damp spot at toe of dam and in channel. Water in channel approximately 100 feet downstream of embankment. Flow is diffuse, not capable of being measured or sampled.
CWA	No	Yes	Water seeping at toe and abutment of dam. Flow is diffuse, not capable of being measured or sampled.
CWB	No	No	Damp spot at toe of embankment.
J3-C	No	No	Standing water at toe of embankment and in downstream channel. Damp spot in channel.
J3-D	Yes	Yes	Damp spot at toe of embankment.
J3-E	Yes	Yes	Standing water at toe of embankment and in downstream channel.
J7-I	Yes	Yes	Water seeping at the toe of the embankment. Damp spot downstream. Flow is diffuse, not capable of being measured or sampled.
WW9	Yes	Yes	Standing water at toe of embankment. Damp spot downstream.
N6-C	Yes	Yes	Damp spots on embankment, at toe of dam and approximately 50 feet downstream of embankment.

*Structures having the potential to discharge to the waters of the United States (no downstream dam).

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EXHIBIT 2 -

Sample Analysis Results

Structure: J-7
Date : 6/24/87
Time : 0940
pH : 8.12
Settleable Solids: <0.1 ml/l
Oil and Grease : 0.488 mg/l
Flow : 5 gpm

Structure: J16-A
Date : 7/1/87
Time : 1100
pH : 8.03
Settleable Solids: <0.1 ml/l
Oil and Grease : 0.3 mg/l
Flow : 1.5 gpm

INSPECTION REPORT

Sedimentation Structure

KM-TPB1

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure KM-TPB1 is a concrete dam, 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-TPB1 is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure KM-TPB1. 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-TPB1 was inspected on September 13, 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-TPB1 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-TPB1 has a 4.64-acre tributary drainage area and is located near Yellow Water Canyon at the Kayenta Mine. The watershed is classified as 52% Pinion/Juniper and 48% disturbed.

DAM

Structure KM-TPB1 is a concrete dam with a totally incised storage area. Physical characteristics of the dam are listed in the following table:

Structure KM-TPB1

Dam	Concrete
Foundation	Sandstone
Right Abutment	Sandstone
Left Abutment	Sandstone
Height	2.7 ft
Crest Width	11.5 in.
Upstream Slope	Vertical
Downstream Slope	Vertical

The dam is doweled into the sandstone with No. 4 reinforcing steel for a depth of 12 inches on 2 foot centers. A cross-section of the dam is shown on Plate 2, Existing Maximum Cross Section KM-TPB1, A-A'.

ANALYSES

STABILITY

Structure KM-TPB1 is a concrete wall which serves as both the dam and overflow spillway. The structure was analyzed by assuming a concrete strength of fc' equal to 3,000 pounds per square inch (psi), No. 4 reinforcing steel with an fy = 60,000 psi, sediment up half the height of the wall and ice load due to a 6-inch-thick ice layer at the top of the wall. The wall thickness is considered adequate, however, the steel is insufficient according to ACI 318-83 code. The consequence of the wall not meeting the ACI code could result in cracks in the wall and potential failure. However, the wall is only 2.7 feet high and is considered to be stable.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure KM-TPB1 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 KM-TPB1 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.106	mi
2.	Elevation Difference, H	35	ft
3.	Time of Concentration, T_c	0.049	h
4.	Lag time, $0.6T_c$	0.029	h
5.	SCS Curve Number	89	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	4.64	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-TPB1 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	10	13
Volume	acre-ft	0.4	0.36
Storage			
Peak Stage	ft	7242.76	7242.85
Spillway Elevation . .	ft	7242.50	--
Peak Storage	acre-ft	--	--
Storage Capacity . . .	acre-ft	0.127	--
Outflow			
Peak Flow	cfs	8	13
Maximum Allowable Water Surface . . .	ft	--	7243.50
Peak Stage	ft	--	7242.85
Freeboard	ft	--	0.65
Spillway			
Flow Depth	ft	--	0.35

Spillway

The existing spillway for KM-TPB1 is an 18-foot-long concrete sharp crested weir.

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, KM-TPB1.

The calculations for the sediment load entering Structure KM-TPB1 were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.16
3. Slope Factor, LS 2.60
4. Cover Factor, C 0.552
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 KM-TPB1 and the results of the sediment inflow analysis are summarized in the following table.

KM-TPB1 STORAGE

Total Storage Capacity	0.127	acre-ft
10-year, 24-hour Storm Inflow	0.4	acre-ft
Available Sediment Storage Capacity . .	0	acre-ft
Sediment Inflow Rate	0.02	acre-ft/yr
Sediment Storage Life	0	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure KM-TPB1 indicated no cracks in the concrete.

HYDRAULICS

The spillway capacity of Structure KM-TPB1 is adequate but the storage capacity is inadequate. The storage capacity should be increased to 0.46 acre-feet by excavating the pond as shown on Plates 1 and 4. Riprap with a D50 of 12 inches should be placed for a distance of 5 feet below the concrete overflow weir as a protection against scour that could undercut the dam. Riprap should also be placed to a flow depth of 1.3 feet above each side of the weir, to prevent erosion around the edges of the weir.

Enlarging the storage capacity to 0.46 acre-feet gives additional sediment storage. The analysis of these conditions is summarized in the following table.

KM-TPB1 HYDRAULICS FOR REDESIGNED SPILLWAY

	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	10	13
Volume	acre-ft	0.4	0.36
Storage			
Peak Stage	ft	7242.18	7242.82
Spillway Elevation . .	ft	7242.50	--
Peak Storage	acre-ft	0.42	--
Storage Capacity . . .	acre-ft	0.46	--
Available Sediment Storage Capacity . .	acre-ft	0.04	--
Sediment Inflow Rate .	acre-ft/yr	0.02	--
Sediment Storage Life.	yrs	2	--
Outflow			
Peak Flow	cfs	0	11
Maximum Allowable Water Surface . . .	ft	--	7244.00
Peak Stage	ft	--	7242.82
Freeboard	ft	--	1.18
Spillway			
Flow Depth	ft	--	0.32

* * *

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

Plate 1 - Site Plan KM-TPB1

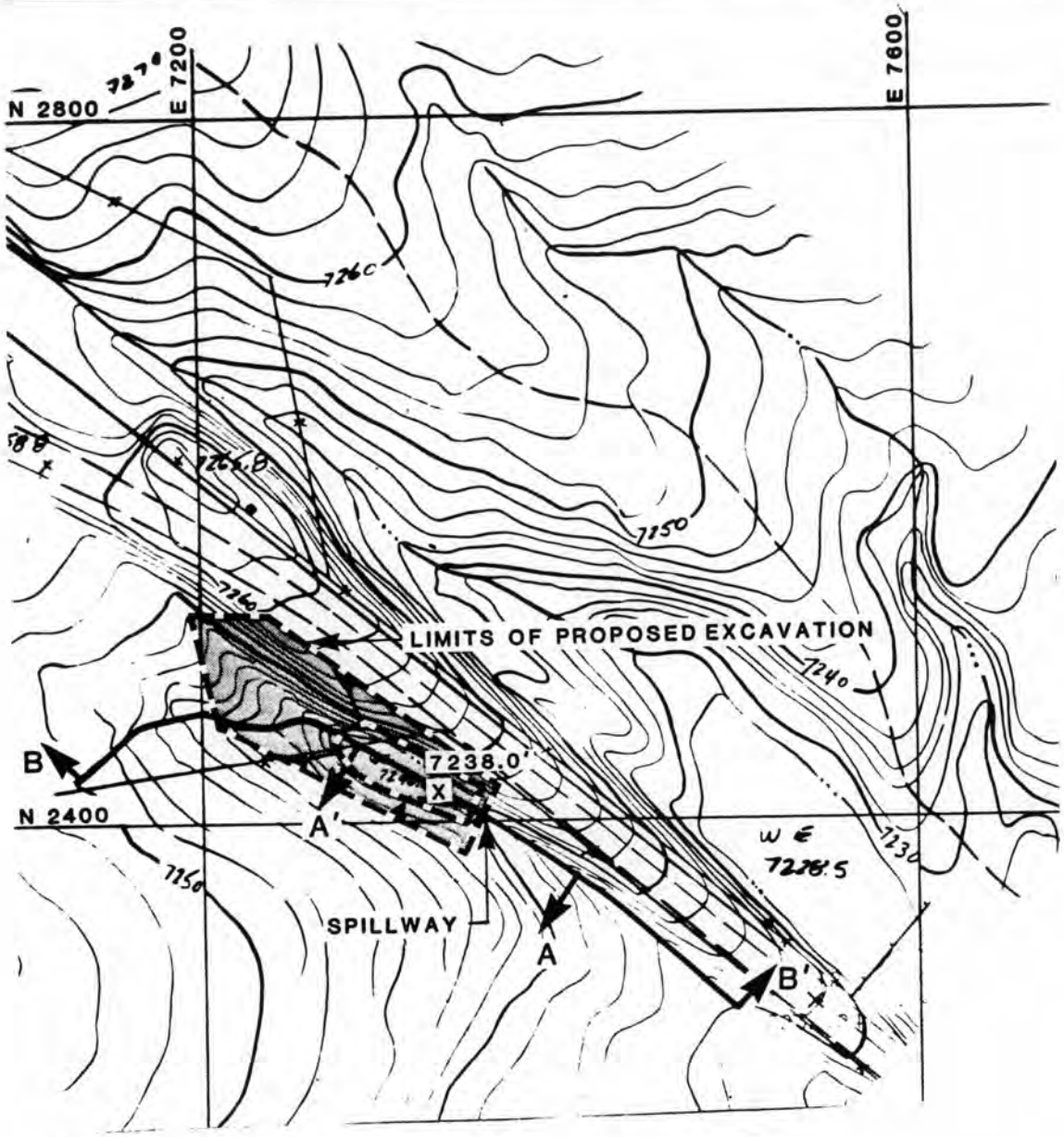
Plate 2 - Existing Maximum Cross Section KM-TPB1, A-A'

Plate 3 - Volume-Elevation Curve KM-TPB1

Plate 4 - Channel Profile KM-TPB1, B-B'

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SCALE
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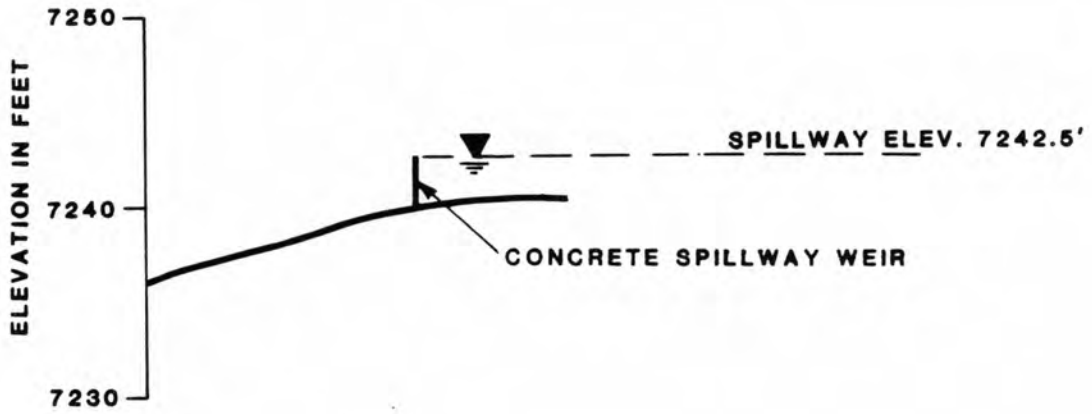
FEET

SITE PLAN
KM-TPB1

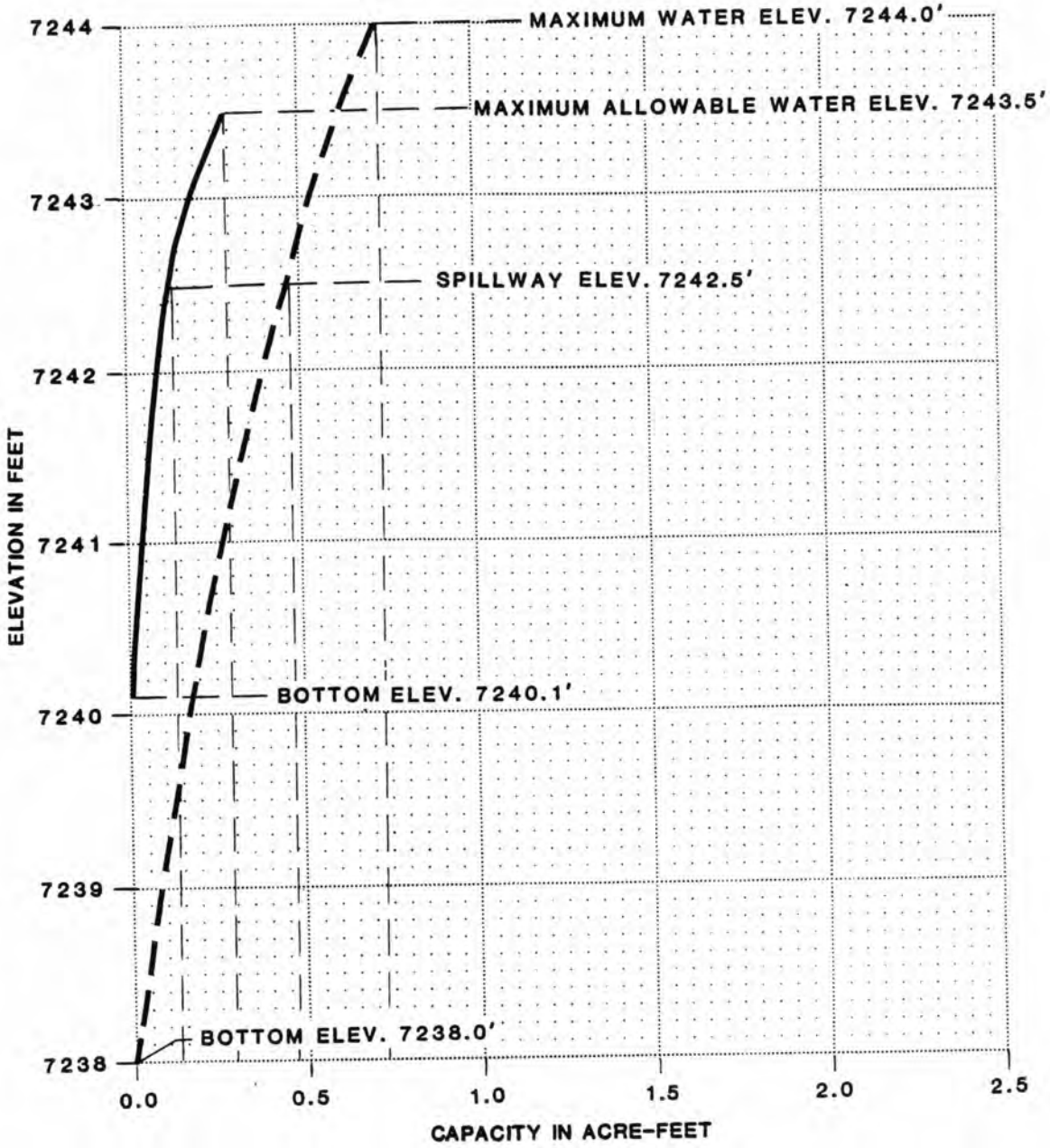
BY **Dames & Moore** Plate 1



EXISTING MAXIMUM CROSS-SECTION A-A' KM-TPB1

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 2



EXISTING VOLUME
PROPOSED VOLUME

VOLUME-ELEVATION CURVE KM-TPB1

BY **Dames & Moore** Plate 3

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: KM-TPB1
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			Concrete 11.5" w
a. Any visual settlements?			
b. Misalignment?			
c. Cracking?			
2. UPSTREAM SLOPE			
a. Adequate grass cover?			
b. Any erosion?			
c. Are trees growing on slope?			
d. Longitudinal cracks?			
e. Transverse cracks?			
f. Adequate riprap protection?			
g. Any stone deterioration?			
h. Visual depressions or bulges?			
i. Visual settlements?			
j. Animal burrows?			
3. DOWNSTREAM SLOPE			
a. Adequate grass cover?			
b. Any erosion?			
c. Are trees growing on slope?			
d. Longitudinal cracks?			
e. Transverse cracks?			
f. Visual depressions or bulges?			
g. Visual settlements?			
h. Is the toe drain dry?			
i. Are the relief wells flowing?			
j. Are boils present at the toe?			
k. Is seepage present?			
l. Animal burrows?			
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?			Rock Fill for Conveyor access road.
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Rills into Pond
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			gray soil

Sediment Impoundment Name: KM-TPB1
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			Concrete overflow
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:			Right abutment is washed out allowing water to flow around concrete weir. Should be repaired GDeanth 9/28/85
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?			
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.) 1.65' below crest feet
c. Siltation?	X		
d. Watershed matches soil map?		X	

9. GENERAL COMMENTS

Would help to have notch in concrete to direct overflow.

Canopy 30
Ground 40

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-2
SUBJECT SEDIMENT POND HYDROLOGY
KM - TP B1 SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 7278 − 7243 = 35 ft.

WATER COURSE LENGTH = 1.4(400) = 560 ft. = 0.106 mi.

$$T_c = \left(\frac{11.9\,(0.106)^3}{35}\right)^{0.385} = 0.049 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.030 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
2.4 (52%)	P-J	average	D	83(.52)
2.2 (48%)	disturbed (bare)		D	94 (.48)
				88.28
		100%	#42	
				use 89

DRAINAGE BASIN AREA

4.64 ACRE 0.007 SQ MILE

BY S. DOLAN DATE 9-23-95
CHECKED BY ___
COPY TO EO ___

FILE HARLEY COAL CO 10139-011-22
SUBJECT SEDIMENT INFLOW
KM - TPB1 SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

K = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EM #42 (1.0)(.16)

K = .16

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
2100	110	5.3	2.60

use 2.6

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
48%	disturbed	—	—	.48 (1.0)
52%	P-J	40	25	.52 (.14)
				C = .56

EROSION CONTROL FACTOR

P = 1.0

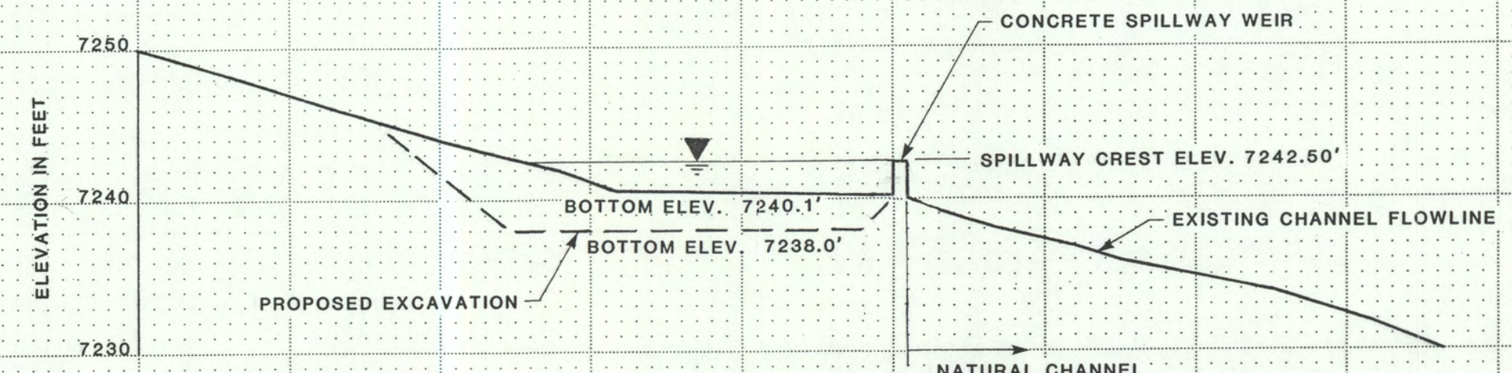
SEDIMENT INFLOW

$A = 40(.16)(2.6)(.56)(1.0) = 9.32$ ton/acre/year

$A = 9.32\left(\frac{1}{2047}\right)(4.64)(.95) = .020$ acre-feet/year

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

Dames & Moore



SCALE
0 50 100
FEET

CHANNEL PROFILE B–B'
KM–TPB1

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

MW-A

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure MW-A is an earthen embankment, designed and constructed in 1979 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 MW-A is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure MW-A. 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 MW-A was inspected on September 3, 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 MW-A 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 MW-A has a 7.67-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 100% disturbed.

EMBANKMENT

Structure MW-A is a homogeneous earthen embankment classified as a in-wash embankment. Physical characteristics of the embankment are listed in the following table:

Structure MW-A

Embankment	Alluvial Soils with Residual Sandstone/Shale Soils
Foundation	Alluvial Soils
Right Abutment	Alluvial Soils
Left Abutment	Haul Road Fill
Height	13.8 ft
Crest Width	15 ft
Upstream Slope	2.5 H : 1 V
Downstream Slope . . .	4 H : 1 V

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

ANALYSES

STABILITY

Structure MW-A is a category C-1 embankment. A standard category C-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 = 4.0 H : 1 V
4. Normal pool with steady seepage saturation conditions

The MW-A 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 MW-A 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 MW-A was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.674	mi
2.	Elevation Difference, H	126	ft
3.	Time of Concentration, T_c	0.330	h
4.	Lag time, $0.6T_c$	0.200	h
5.	SCS Curve Number	91	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	7.67	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.

MW-A 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	12	15
Volume	acre-ft	0.86	0.75
Storage			
Peak Stage	ft	6277.66	6289.28
Spillway Elevation . .	ft	6288.80	--
Peak Storage	acre-ft	0.86	--
Storage Capacity . . .	acre-ft	9.17	--
Outflow			
Peak Flow	cfs	0	2
Embankment Crest Elevation	ft	--	6290.40
Peak Stage	ft	--	6289.26
Freeboard	ft	--	1.14
Spillway Channel			
Flow Depth	ft	--	0.46
Critical Velocity. . .	fps	--	1.5
Manning's "n"		--	0.035
Outflow Channel			
Slope	%	--	1
Normal Velocity. . . .	fps	--	0.9
Normal Depth	ft	--	0.11
Manning's "n"		--	0.035

Spillway Channel

The existing spillway for MW-A has a trapezoidal channel with the following dimensions:

Channel depth	2.8	ft
Channel width	18	ft
Channel length	50	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, MW-A.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.216
3. Slope Factor, LS 2.40
4. Cover Factor, C 1.0
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 MW-A and the results of the sediment inflow analysis are summarized in the following table.

MW-A STORAGE

Total Storage Capacity	9.17	acre-ft
10-year, 24-hour Storm Inflow	0.86	acre-ft
Available Sediment Storage Capacity . .	8.31	acre-ft
Sediment Inflow Rate	0.074	acre-ft/yr
Sediment Storage Life	112	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure MW-A indicated that the only geotechnical problem is rill and gully erosion on the upstream slope and the right and left abutments. Gully erosion is also undermining the right side slopes of the spillway. Correction of erosion is considered a periodic maintenance task and does not require remedial action.

HYDRAULICS

The storage capacity and spillway capacity of Structure MW-A 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.

* * *

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

Plate 1 - Site Plan MW-A

Plate 2 - Existing Maximum Cross Section MW-A, A-A'

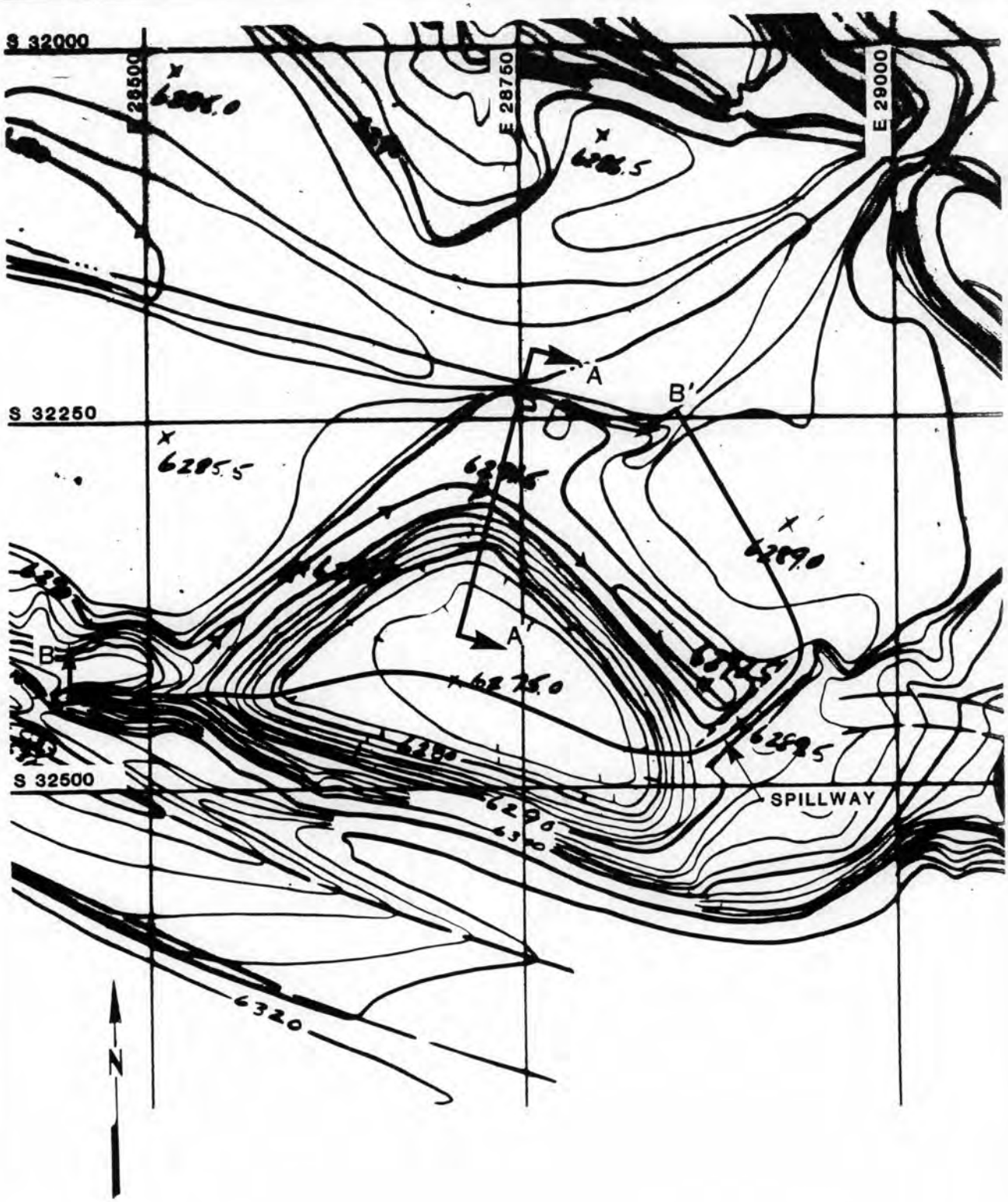
Plate 3 - Volume-Elevation Curve MW-A

Plate 4 - Channel Profile MW-A, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section MW-A

Appendix A - Inspection Check List

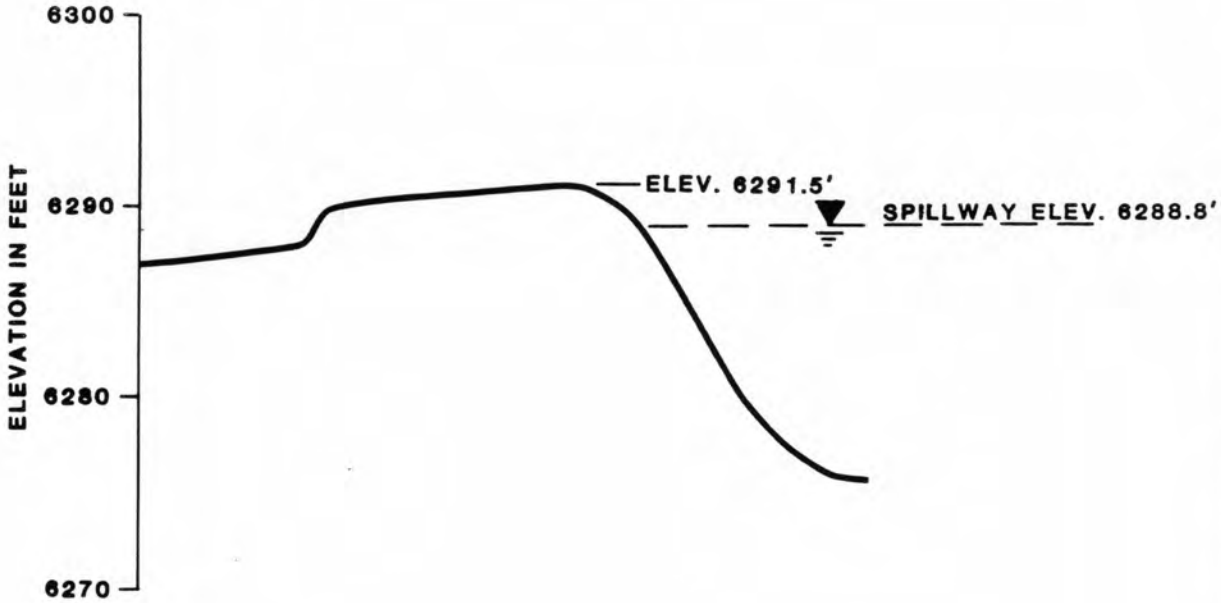
Appendix B - Hydrology and Hydraulic Calculations



SCALE
0 100 200
FEET

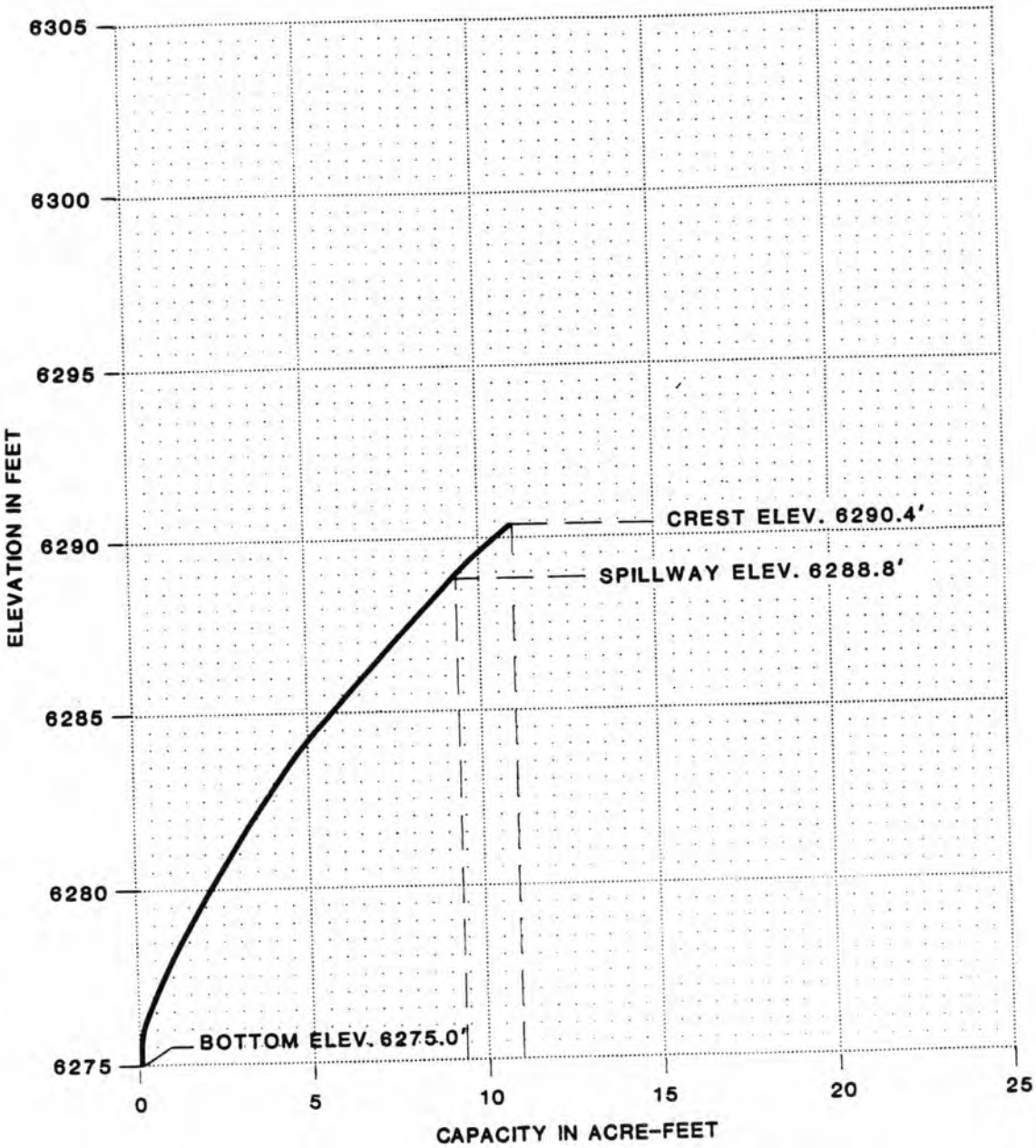
SITE PLAN
MW-A

BY **Dames & Moore** Plate 1



EXISTING
MAXIMUM CROSS-SECTION
A-A'
MW-A

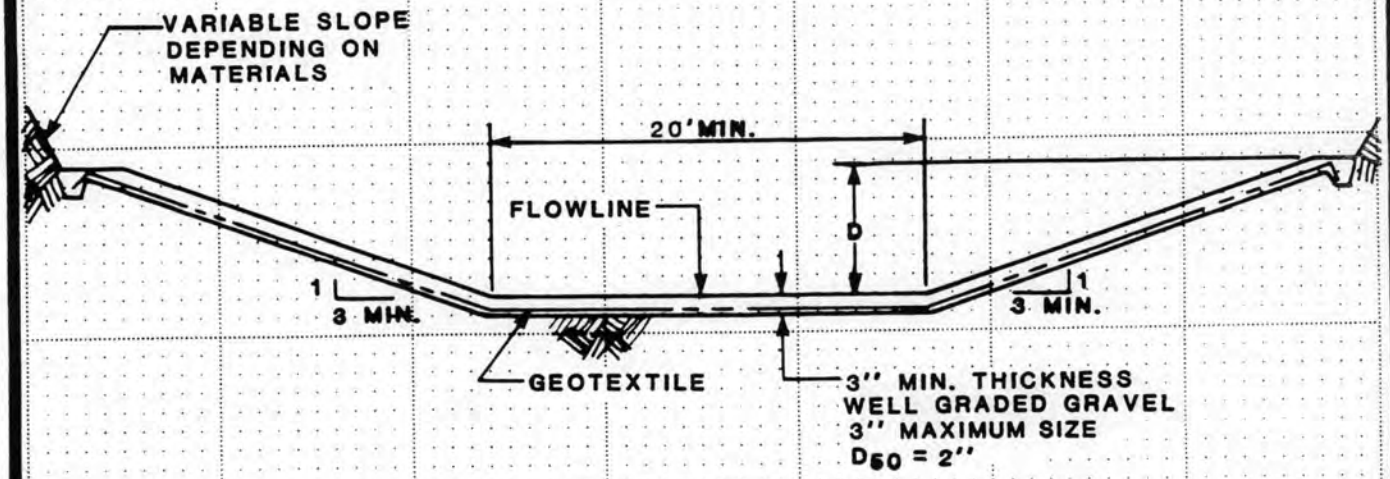
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

MW-A

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.5'

LENGTH = 50'

FLOWLINE ELEV.=6288.80'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION

MW-A

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: MW-A
Page: 4

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		
b. Any erosion?	X		minor rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		
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?	X		
b. Any erosion?		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	
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?	X		gulleys
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			SM brown
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		gulleys
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Fill/Road

Sediment Impoundment Name: MW-A
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		Towards R.A.
b. Approach Channel:		X	NA - Face of U.S. dam
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?	X		gulley
Obstructed?			
Erosion protection?		X	
c. Spillway Channel:		X	
Are side slopes eroding?		X	Right slope low See sketch
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:		X	
Are side slopes eroding?			NA
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?			

Sediment Impoundment Name: MW-A
Page: 6

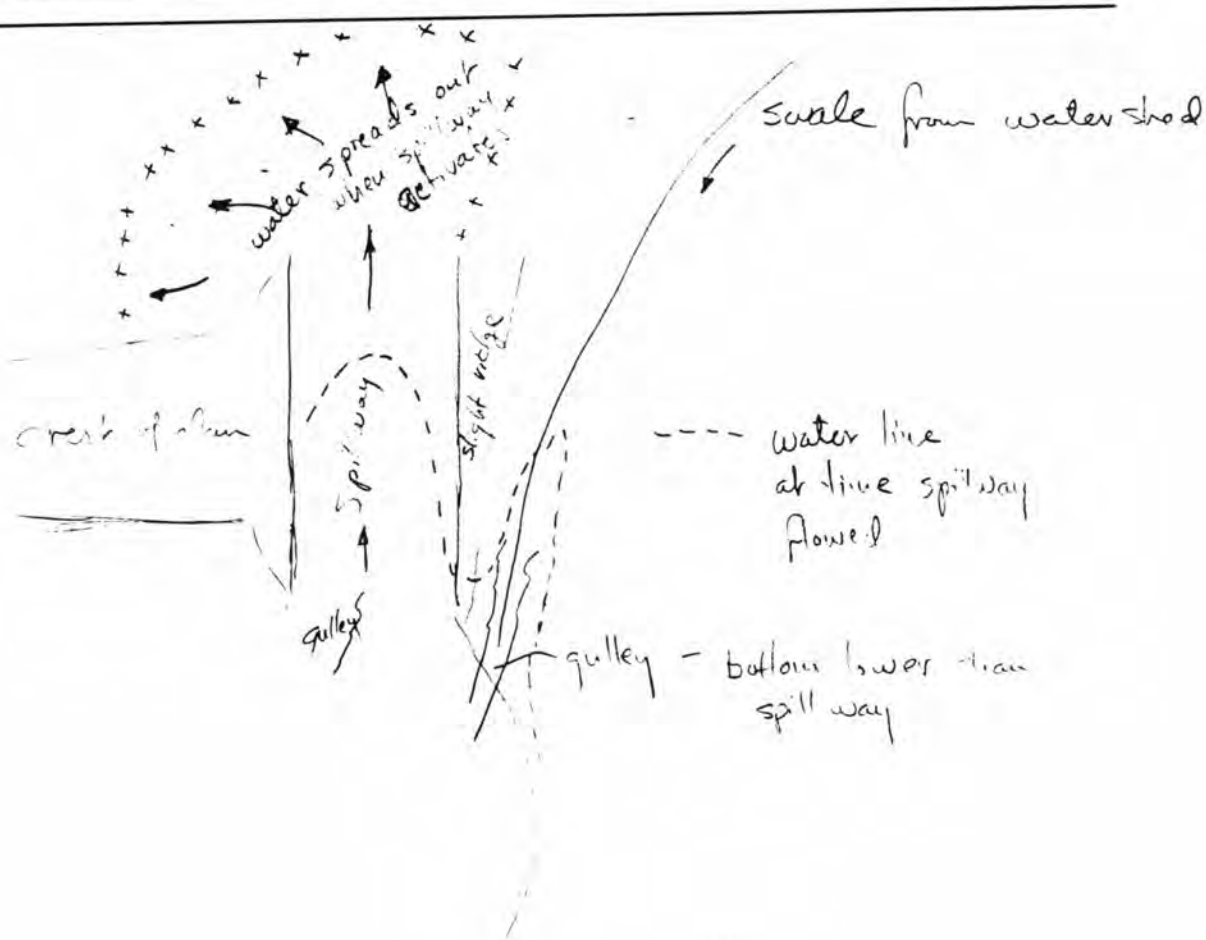
ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?		X	(Elev.) feet
b. Water present?	X		(Elev.) feet
c. Siltation?	X		
d. Watershed matches soil map?		X	disturbed bare ?

9. GENERAL COMMENTS

More sediment inflow from haul road than from watershed

ground cover 20%

canopy cover ≤10%

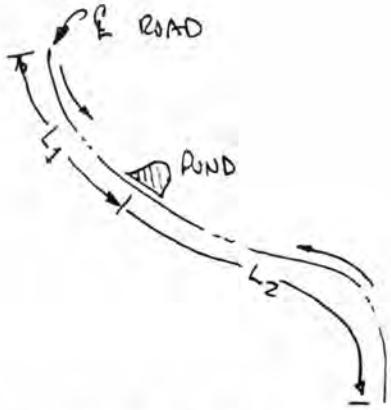


APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10129-011-22
SUBJECT SEDIMENT POND HYDROLOGY
MW-A SHEET 1 OF 1

MW-A DRAINS A PORTION OF A HAUL ROAD



$L_1 = 1660'$

Δ ELEV = 6390 − 6314 = 76'

SLOPE = 4.6%

$L_2 = 3560'$

Δ ELEV = 6440 − 6314 = 126'

SLOPE = 3.5%

TIME OF CONCENTRATION:

ASSUME OVERLAND FLOW VELOCITY OF 3 FT/SEC. FOR 4% SLOPE

$T_c = 3560/3 = 1187$ sec. = 19.8 min = 0.33 hr.

LAG TIME = $0.6\,T_c$ = 0.20 hr.

SCS CURVE NUMBER:

WATERSHED IS 100% GRAVEL ROAD

HYDROLOGIC CONDITION D (SOIL TYPE EH #23)

CN = 91

DRAINAGE BASIN AREA:

7.67 acres = 0.012 mi²

REVISIONS
BY ____ DATE ____ TO EO ____
BY ____ DATE ____ TO EO ____

BY G Dent DATE 6/10/95
CHECKED BY ____
COPY TO EO ____

Dames & Moore

945 1 (3-72) PRINTED IN U.S.A.

Purpose: A time of concentration from which a lag time can be computed must be obtained for hydrograph construction representing runoff from a watershed. Various methods of estimating time of concentration, T_c, are as follows

A. ESTIMATING T_c FROM STREAM HYDRAULICS (SCS GUIDE)

1. Obtain stream reaches and channel cross-sections from field surveys
2. Find approximate channel bankfull discharge for each reach.
3. Compute average velocity for the bankfull discharge of each reach.
4. Use the average velocity and the valley length of the reach to compute travel time through each reach.
5. Add travel times of reaches to get T_c.

Note: Appendix B "Hydraulic Computations" presents methods of computing flows in natural channels.

B. ESTIMATING T_c FROM VELOCITY ESTIMATES AND WATERCOURSE LENGTHS

Velocity Estimate Guide

U.S. Navy - Technical Publication Navdocks TP-PW-5 Table 8B, March 1953

Average slope of channel from farthest point to outlet, in percent	Average velocity, feet per second
1 to 2	2.0
2 to 4	3.0
4 to 6	4.0
6 to 10	5.0

Texas Highway Department Rational Design of Culverts and Bridges, October 1944

Slope in percent	Average velocity, feet per second		
	Woodlands (upper portion watershed)	Pastures (upper portion watershed)	Natural channel well defined
0 - 3	1.0	1.5	1.0
4 - 7	2.0	3.0	3.0
8 - 11	3.0	4.0	5.0
12 - 15	3.5	4.5	8.0

Figure 30. Time of concentration estimates. (Sheet 1 of 2.) 288-D-2461.

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT INFLOW
MW-A SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 80% EH #23 .8(.18)
20% EH #27 .2(.36)
.216

K = .216

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
1750	40	2.3	.53 (.40)
1200	100	8.3	3.64 (.60)
		use	2.40

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
100%	disturbed	—	—	1.0

C = 1.0

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

EROSION CONTROL FACTOR

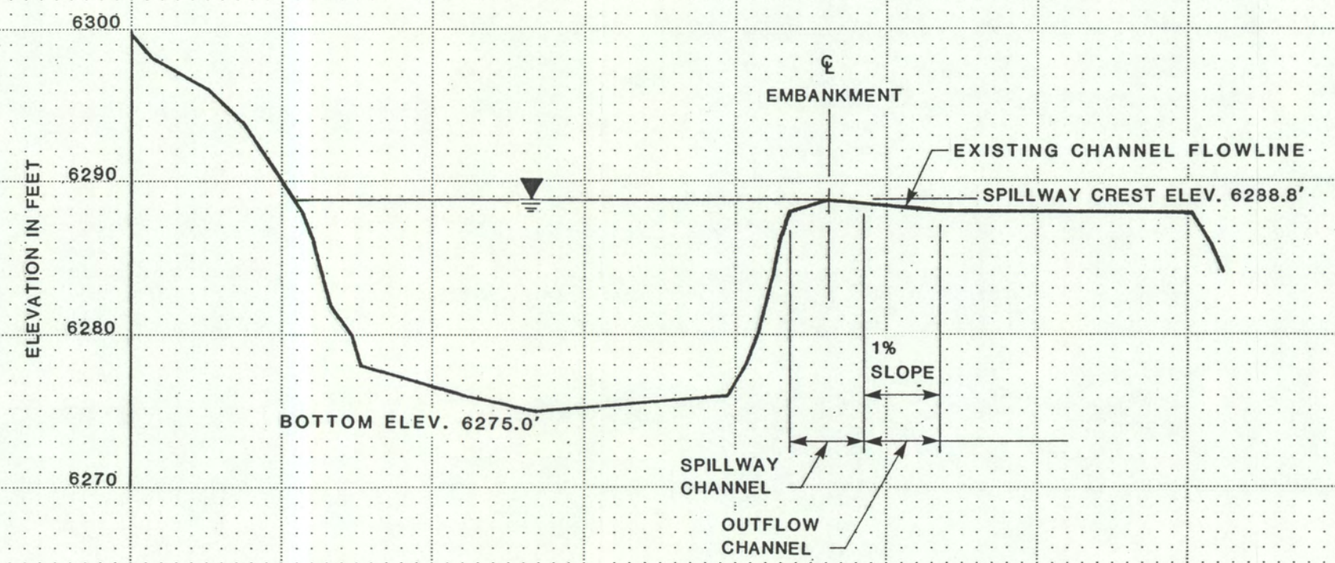
P = 1.0

SEDIMENT INFLOW

$A = 40(.216)(2.4)(1.0)(1.0) = 20.74$ ton/acre/year

$A = 20.74\left(\frac{1}{2047}\right)(7.67)(.95) = .074$ acre-feet/year

Dames & Moore



SCALE
0 100 200
FEET

CHANNEL PROFILE B–B′
MW–A

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

MW-B

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure MW-B is an earthen embankment, designed and constructed in 1979 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 MW-B is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure MW-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

Structure MW-B was inspected on September 3, 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 MW-B 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 MW-B has a 48.0-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 54% Sagebrush/grass, 43% Pinion/Juniper, and 3% disturbed.

EMBANKMENT

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

Structure MW-B

Embankment	Residual Sandstone Soils
Foundation	Alluvium/Residual Sandstone Soils
Right Abutment	Haul Road Fill
Left Abutment	Sandstone
Height	9.4 ft
Crest Width	11 ft
Upstream Slope	2.25 H : 1 V
Downstream Slope . . .	2 H : 1 V, 1.6 H : 1 V, 1.3 H : 1 V left abut. center right abut.

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

ANALYSES

STABILITY

Structure MW-B is a category A-3 embankment. A standard category A-3 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 = 15 ft
2. Maximum upstream slope = 1.75 H : 1 V
3. Maximum downstream slope = 3.25 H : 1 V
4. Normal pool with steady seepage saturation conditions

The MW-B embankment is lower in height; however, 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 MW-B 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 MW-B was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.576	mi
2.	Elevation Difference, H	242	ft
3.	Time of Concentration, T_c	0.166	h
4.	Lag time, $0.6T_c$	0.099	h
5.	SCS Curve Number	72	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	48.0	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.

MW-B 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	21	23
Volume	acre-ft	1.44	1.04
Storage			
Peak Stage	ft	6307.57	6313.96
Spillway Elevation . .	ft	6313.30	--
Peak Storage	acre-ft	1.44	--
Storage Capacity . . .	acre-ft	4.79	--
Outflow			
Peak Flow	cfs	0	5
Embankment Crest Elevation	ft	--	6315.60
Peak Storage	ft	--	6313.96
Freeboard	ft	--	1.64
Spillway Channel			
Flow Depth	ft	--	0.66
Critical Velocity. . .	fps	--	1.8
Manning's "n"		--	0.040

Approach Channel

The existing approach channel for MW-B has a U-shaped channel with following dimensions:

Channel width	13-14	ft
Channel length	30	ft
Slope	20	percent

Spillway Channel

The existing spillway for MW-B has a trapezoidal channel with the following dimensions:

Channel depth	2.3	ft
Channel width	34	ft
Channel length	24	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, MW-B.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.201
3. Slope Factor, LS 11.88
4. Cover Factor, C 0.111
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 MW-B is shown on Plate 3, Volume-Elevation Curve, MW-B, and the results of the analysis are summarized in the following table.

MW-B STORAGE

Total Storage Capacity	4.79	acre-ft
10-year, 24-hour Storm Inflow	1.44	acre-ft
Available Sediment Storage Capacity . .	3.35	acre-ft
Sediment Inflow Rate	0.236	acre-ft/yr
Sediment Storage Life	14	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure MW-B indicated that the geotechnical problems consist of rill and gully erosion on the downstream slope and a steep and uneven downstream slope. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The downstream slope is uneven due to either lack of fine grading after initial construction or shallow surficial slope failures. The downstream slope should be flattened to 3.25 horizontal to 1 vertical to meet stability requirements. This flatter slope was selected due to a foundation slope greater than 5 percent. The downstream toe of this embankment needs to be riprapped to protect the slope from undercutting by flows in the Moenkopi Wash.

HYDRAULICS

The storage capacity and spillway capacity of Structure MW-B are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. The proposed embankment relocation provides the opportunity to construct a new spillway and outflow channel in a location that minimizes the difficulties in providing adequate erosion protection. A trapezoidal outflow channel constructed along the alignment B-B' shown in Plate 1 will have a much flatter slope than a channel at the existing spillway location. 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.

Relocating the embankment reduces the storage capacity. The analysis of these conditions is summarized in the following table.

MW-B HYDRAULICS FOR RELOCATED EMBANKMENT

	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	21	23	
Volume	acre-ft	1.44	1.04	
Storage				
Peak Stage	ft	6308.50	--	
Spillway Elevation . .	ft	6313.30	--	
Peak Storage	acre-ft	1.44	--	
Storage Capacity . . .	acre-ft	3.64	--	
Available Sediment Storage Capacity . .	acre-ft	2.20	--	
Sediment Inflow Rate .	acre-ft/yr	0.236	--	
Sediment Storage Life.	yrs	9	--	
Outflow				
Peak Flow	cfs	0	8	
Embankment Crest Elevation	ft	--	6315.60	
Peak Stage	ft	--	6314.10	
Freeboard	ft	--	1.50	
Spillway Channel				
Flow Depth	ft	--	0.80	
Critical Velocity. . .	fps	--	2.2	
Manning's "n"		--	0.035	
Outflow Channel			Section I	Section II
Slope	%	--	26	20
Normal Velocity. . . .	fps	--	4.0	3.8
Normal Depth	ft	--	0.08	0.09
Manning's "n"		--	0.035	0.035

* * *

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

Plate 1 - Site Plan MW-B

Plate 2 - Existing Maximum Cross Section MW-B, A-A'

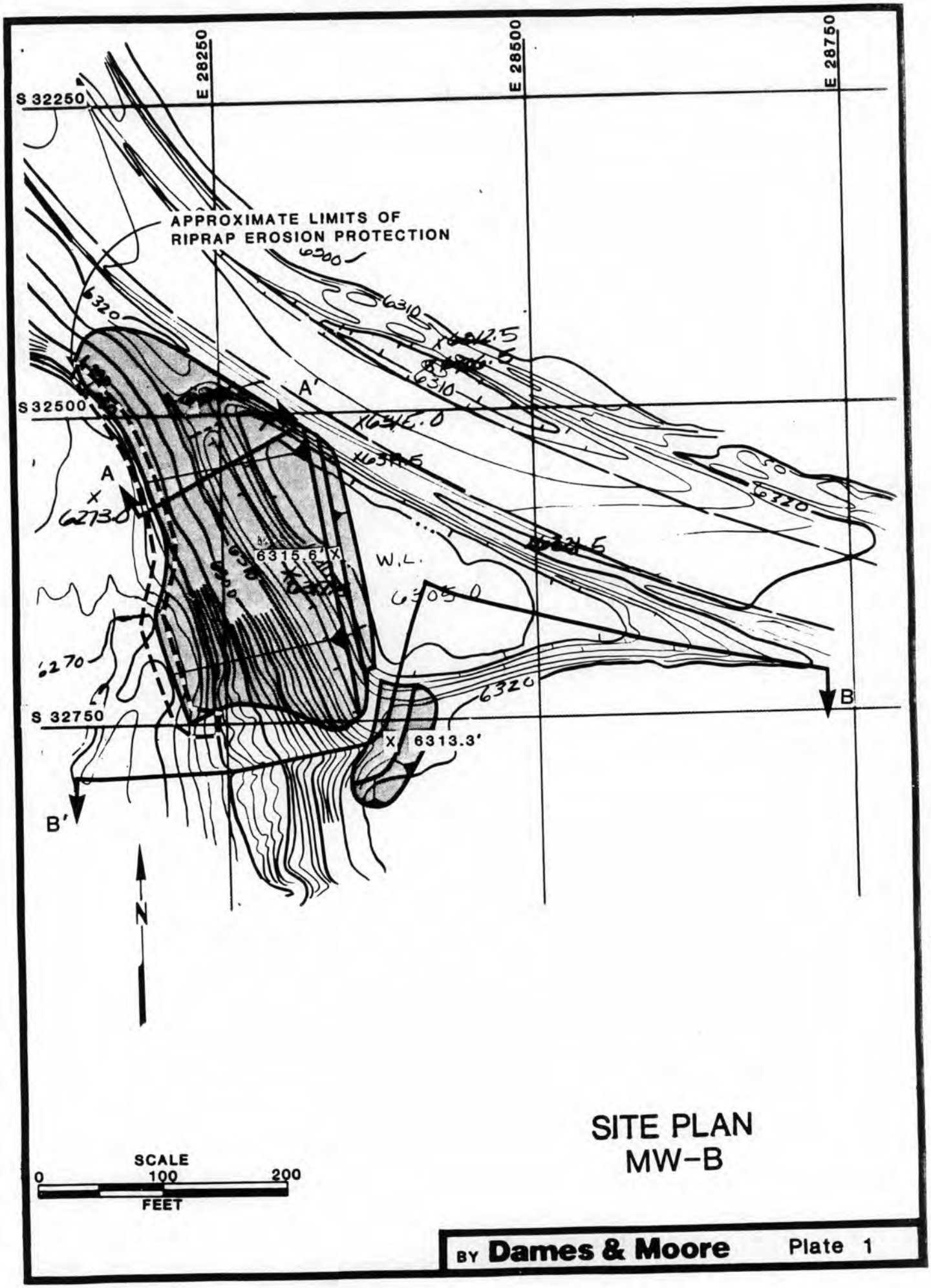
Plate 3 - Volume-Elevation Curve MW-B

Plate 4 - Channel Profile MW-B, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section MW-B

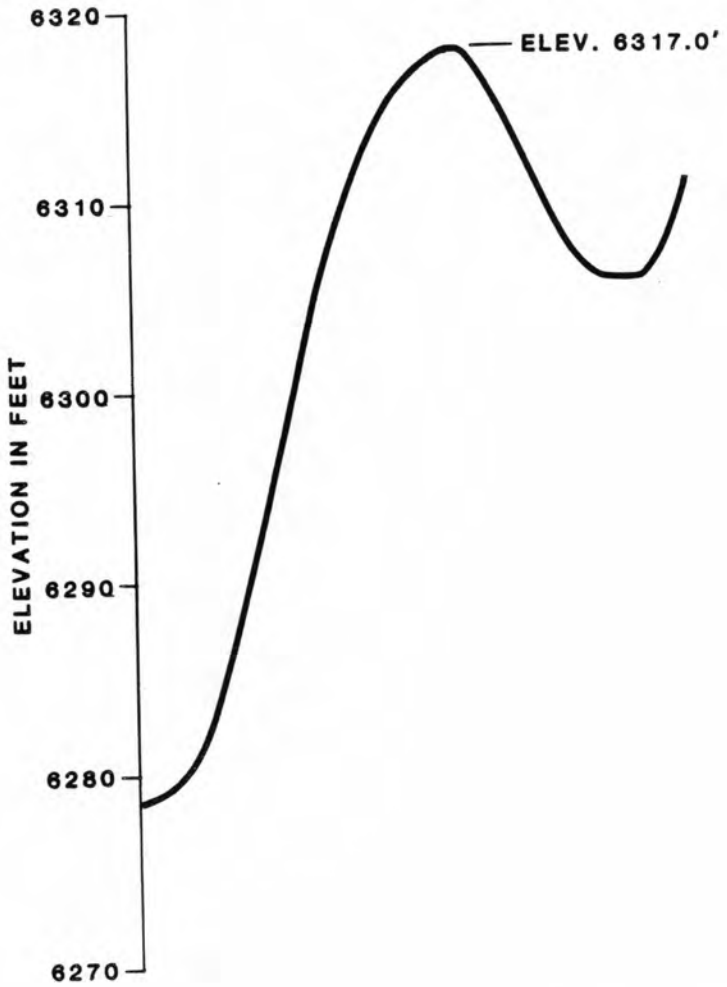
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
MW-B

BY **Dames & Moore** Plate 1

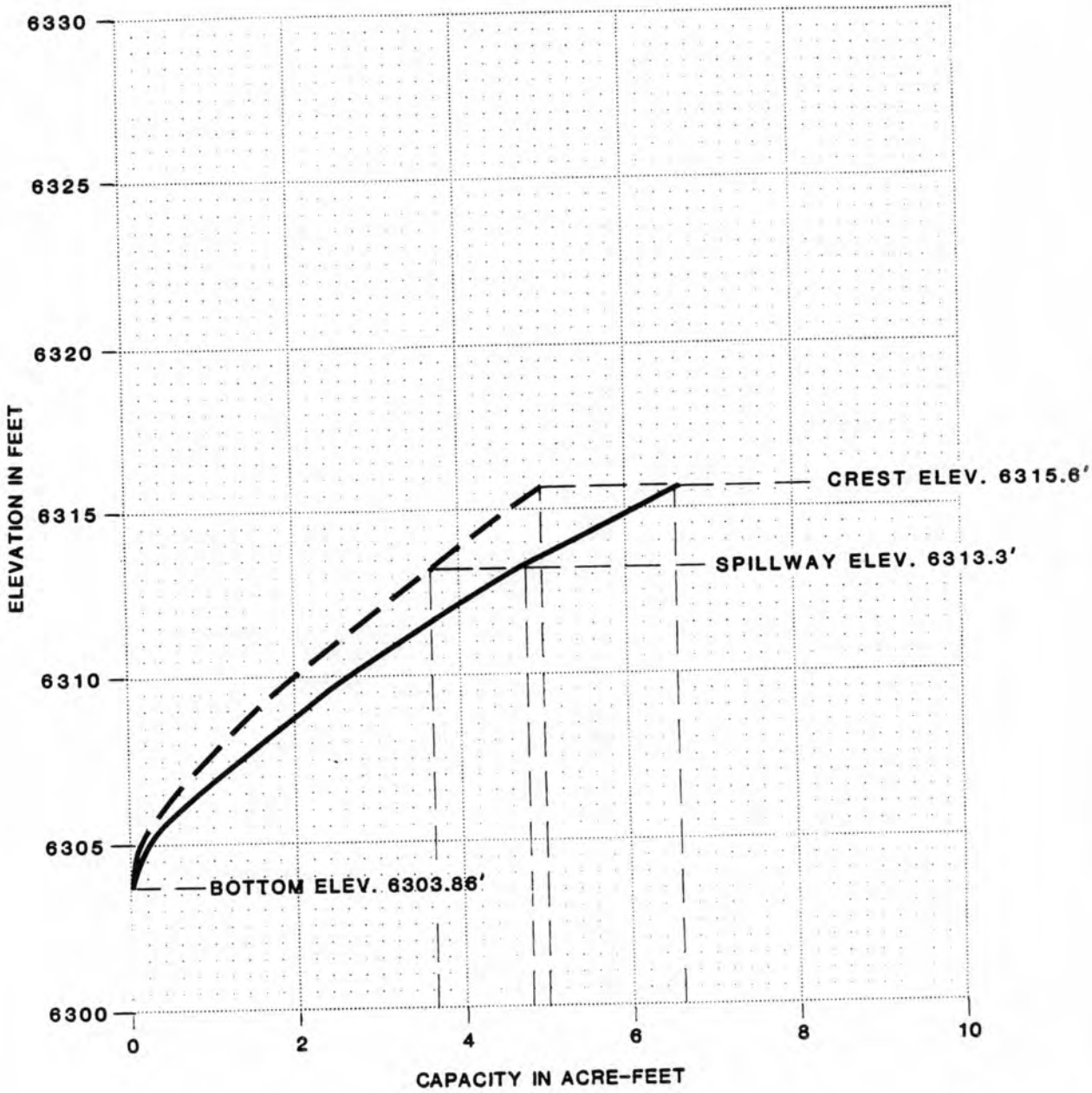


EXISTING
MAXIMUM CROSS-SECTION
A-A'
MW-B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

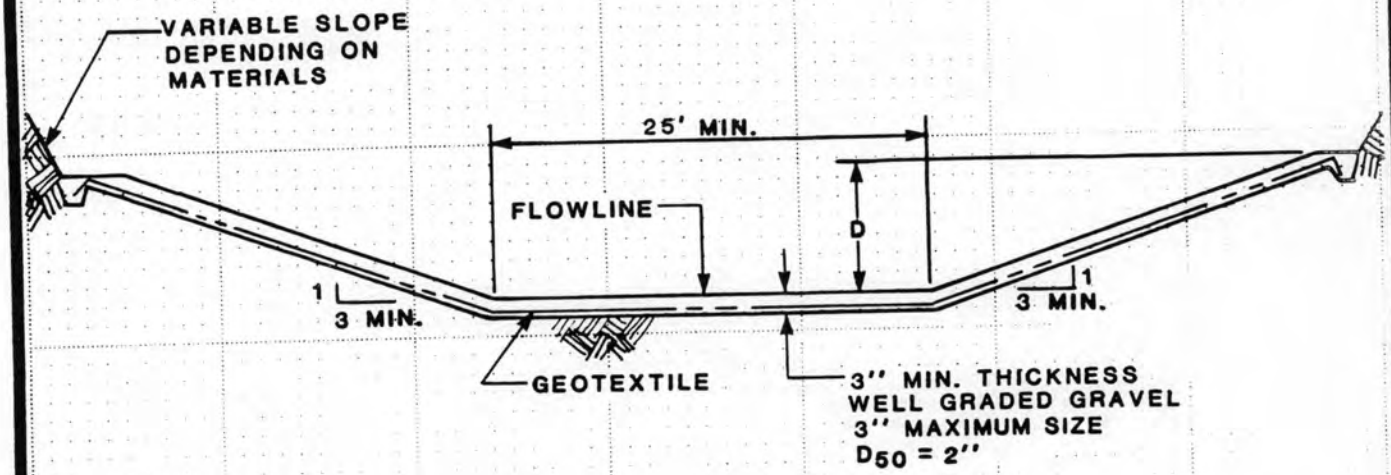
Plate 2



EXISTING VOLUME
PROPOSED VOLUME

VOLUME-ELEVATION CURVE
MW-B

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.8'

LENGTH = 30'

FLOWLINE ELEV.= 6313.30'

OUTFLOW CHANNEL

D = 1.0'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION MW-B

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: MWB
Page: 4

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	20%
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?		X	
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?		X	20% spots
b. Any erosion?	X		gulleys
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?	X		due to construction - unaven
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			Roadway
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Fill gray sm w/sm gravel
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?			Rock/sm

Sediment Impoundment Name: MW-B
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		Adjacent to R. Abut
b. Approach Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:		X	ON FACE OF DAM
Are side slopes eroding?			NA
Are side slopes sloughing?			NA
Bottom of channel eroding?	X		
Obstructed?			
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?			

Sediment Impoundment Name: MW-B
Page: 6

ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?		X	(Elev.) feet
b. Water present?	X		(Elev.) feet
c. Siltation?	X		some
d. Watershed matches soil map?		X	Reclaimed

9. GENERAL COMMENTS

Downstream slope surface uneven / appears to be due to extra material added surface not trimmed at end of construction

Crest is S shaped.

Gulleys on d.s. face near spillway Hard to tell whether spillway ever ran or due to local run off.

Canopy Cover ≤ 20 %
Ground cover 75 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
Sheet K-10 MW-B SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6555 − 6313 = 242 ft.

WATER COURSE LENGTH = 7.6(40c) = 3040 ft. = 0.576 mi.

$$T_c = \left(\frac{11.9(0.576)^3}{242}\right)^{0.385} = 0.166 \text{ hr.}$$

LAG TIME = $0.6T_c$ = 0.099 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)		COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
25.9	(54%)	S-G	fair	C-D	66 (.54)
20.6	(43%)	P-J	fair	C-D	76 (.43)
1.4	(3%)	HARD RD.	—	D	91 (.03)
					71.05
				70% EH #32 - C	
				30% EH #23 - D	

use 72

DRAINAGE BASIN AREA

48.0 ACRE 0.075 SQ MILE

BY S. DOLAN DATE 9-9-85
CHECKED BY ___
COPY TO EO ___

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FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT INFLOW
MW-B SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___ BY ___ DATE ___ TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 30 % EH #23 .3(.18)
70 % EH #32 .7(.21)
.201

K = .201

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
450	140	31.1	17.9 (.50)
500	50	10.0	3.1 (.20)
500	90	18.0	7.7 (.30)
			use 11.88

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
54 %	S-G	60	25	.54 (.082)
43 %	P-J	60	25	.43 (.085)
3 %	disturbed	—	—	.03 (1.0)
				C = .111

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

EROSION CONTROL FACTOR

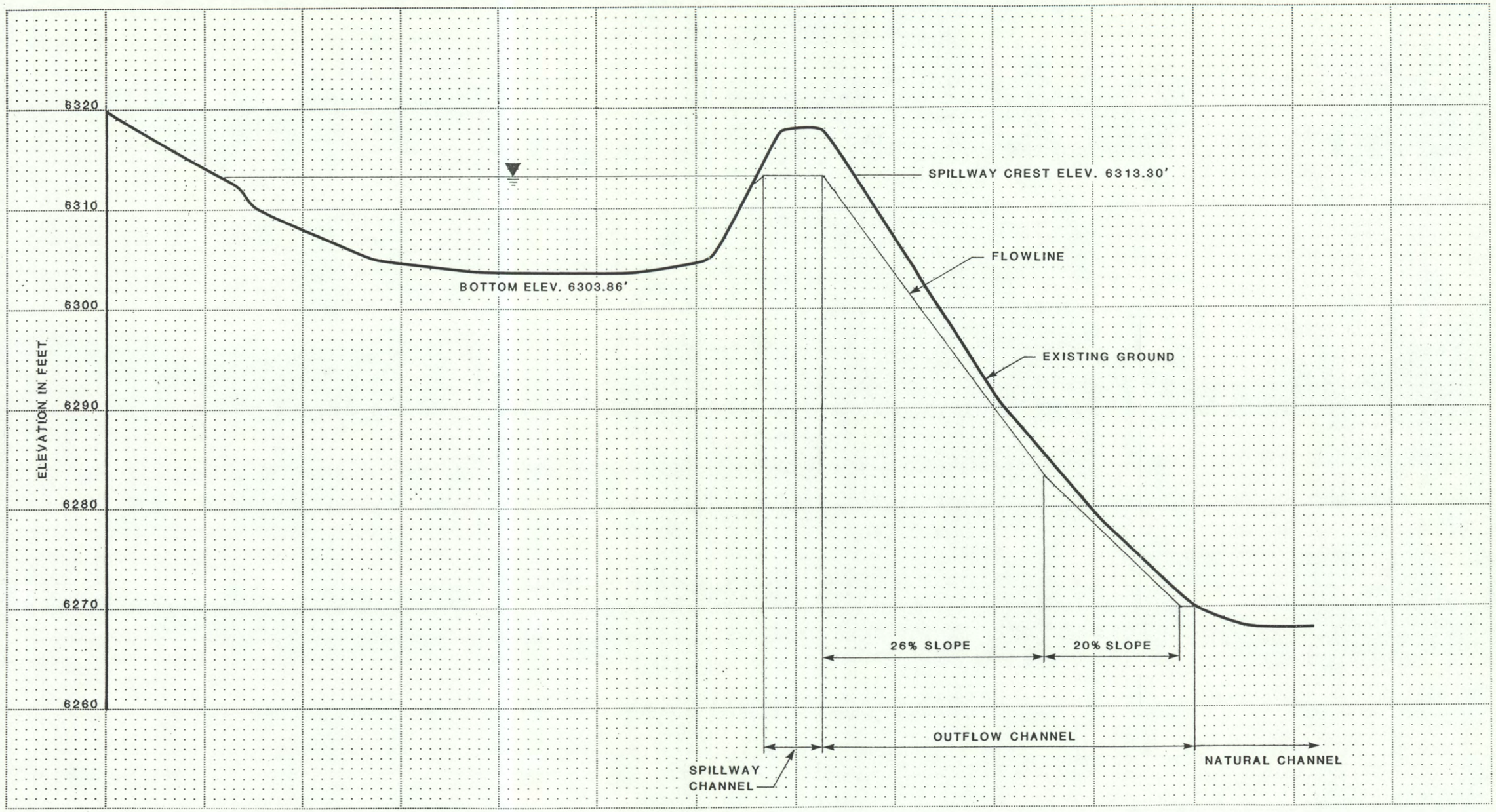
P = 1.0

SEDIMENT INFLOW

$A = 40(.201)(11.88)(.111)(1.0) = 10.60$ ton/acre/year

$A = 10.60\left(\frac{1}{2047}\right)(48.)(.95) = .236$ acre-feet/year

Dames & Moore



SCALE
0 50 100
FEET

CHANNEL PROFILE B-B'
MW-B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4