INSPECTION REPORT

Sedimentation Structure

J28-G

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J28-G is an earthen embankment, designed and constructed in 1982 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Kayenta Mine. The location of Structure J28-G is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J28-G. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure J28-G was inspected on September 12, 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 J28-G project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

Peabody Coal Company. The survey data developed in August 1984 was used in the analyses of the structure. Results of the field inspection are included in this report as Appendix A.

SITE DESCRIPTION

LAND USE

Structure J28-G has a 59.4-acre tributary drainage area and is located near Reed Valley at the Kayenta Mine. The watershed is classified as 46% disturbed, 43% Pinion/Juniper, and 11% Sagebrush/grass.

EMBANKMENT

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

Structure J28-G

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	18.5 ft
Crest Width	12 ft
Upstream Slope	2.6 H : 1 V
Downstream Slope . . .	2.1 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J28-G, A-A'.

ANALYSES

STABILITY

Structure J28-G is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 30 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J28-G 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 J28-G is not in series with any other structure and therefore the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure J28-G was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.303	mi
2.	Elevation Difference, H	102	ft
3.	Time of Concentration, T_c	0.110	h
4.	Lag time, $0.6T_c$	0.066	h
5.	SCS Curve Number	84	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	59.4	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.

J28-G 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	85	111
Volume	acre-ft	4.26	3.47
Storage			
Peak Stage	ft	6791.76	6803.62
Spillway Elevation . .	ft	6802.90	—
Peak Storage	acre-ft	4.26	--
Storage Capacity . . .	acre-ft	23.90	--
Outflow			
Peak Flow	cfs	0	5
Embankment Crest Elevation	ft	--	6805.00
Peak Stage	ft	--	6803.62
Freeboard	ft	--	1.83
Spillway Channel			
Flow Depth	ft	--	0.72
Critical Velocity. . .	fps	--	2.0
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	6
Normal Velocity. . . .	fps	--	2.2
Normal Depth	ft	--	0.12
Manning's "n"		--	0.040

Spillway Channel

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

Channel depth	4.2	ft
Channel width	20	ft
Channel length	30	ft
Side slopes (horizontal to vertical). .	2:1	
Average exit slope	0	percent

There is presently no erosion protection within the channel.

Outflow Channel

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

Channel width	20	ft
Channel length	300	ft
Average exit slope	8	percent

There is presently no erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, J28-G.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.32
3. Slope Factor, LS 3.53
4. Cover Factor, C 0.535
5. Erosion Control Factor, P 1.0

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. The existing storage capacity of J28-G is shown on Plate 3, Volume-Elevation Curve, J28-G, and the results of the analysis are summarized in the following table.

J28-G STORAGE

Total Storage Capacity	23.90	acre-ft
10-year, 24-hour Storm Inflow	4.26	acre-ft
Available Sediment Storage Capacity . .	19.64	acre-ft
Sediment Inflow Rate	0.666	acre-ft/yr
Sediment Storage Life	29	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J28-G indicated that the only geotechnical problem is rill erosion on the side slopes of the spillway channel and the right abutment. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The upstream slope of the embankment is uneven and should be trimmed smooth.

The downstream slope should be flattened to 2.5 horizontal to 1 vertical to meet stability requirements. The reason for this action is that the present condition may mask evidence of potential future problems.

HYDRAULICS

The storage capacity of Structure J28-G exceeds the maximum allowable capacity of 20 acre-feet. The spillway elevation should be reduced to 6801.0 feet, resulting in a storage capacity of 19.22 acre-feet.

The reduced storage capacity and spillway capacity of Structure J28-G are adequate; however, the spillway and outflow channel do not have adequate erosion protection. Improvements to the trapezoidal outflow channel should be made 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.

Lowering the spillway elevation to 6801.00 feet decreases the storage capacity and increases the freeboard. The analysis of these conditions is summarized in the following table.

J28-G 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	85	111	
Volume	acre-ft	4.26	3.47	
Storage				
Peak Stage	ft	6791.76	—	
Spillway Elevation . .	ft	6801.00	—	
Peak Storage	acre-ft	4.26	—	
Storage Capacity . . .	acre-ft	19.22	—	
Available Sediment Storage Capacity . .	acre-ft	14.96	—	
Sediment Inflow Rate .	acre-ft/yr	0.666	--	
Sediment Storage Life.	yrs	22	—	
Outflow				
Peak Flow	cfs	0	6	
Embankment Crest Elevation	ft	—	6805.00	
Peak Stage	ft	--	6801.83	
Freeboard	ft	—	3.17	
Spillway Channel				
Flow Depth	ft	—	0.83	
Critical Velocity. . .	fps	--	2.10	
Manning's "n"		—	0.035	
Outflow Channel			Section I	Section II
Slope	%	--	1.5	6
Normal Velocity. . . .	fps	—	1.6	2.49
Normal Depth	ft	—	0.18	0.12
Manning's "n"		--	0.035	0.035

* * *

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

Plate 1 - Site Plan J28-G

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

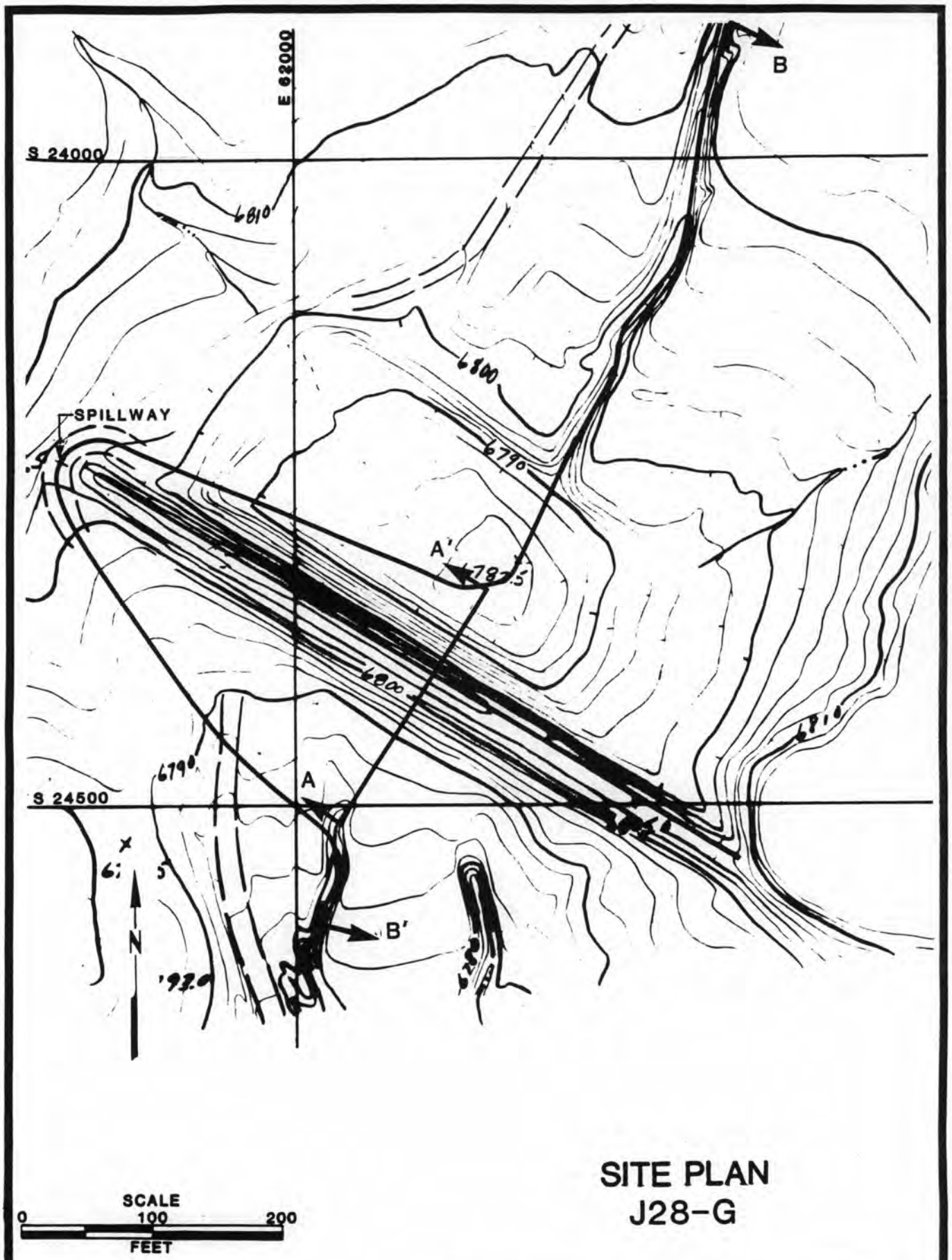
Plate 3 - Volume-Elevation Curve J28-G

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

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

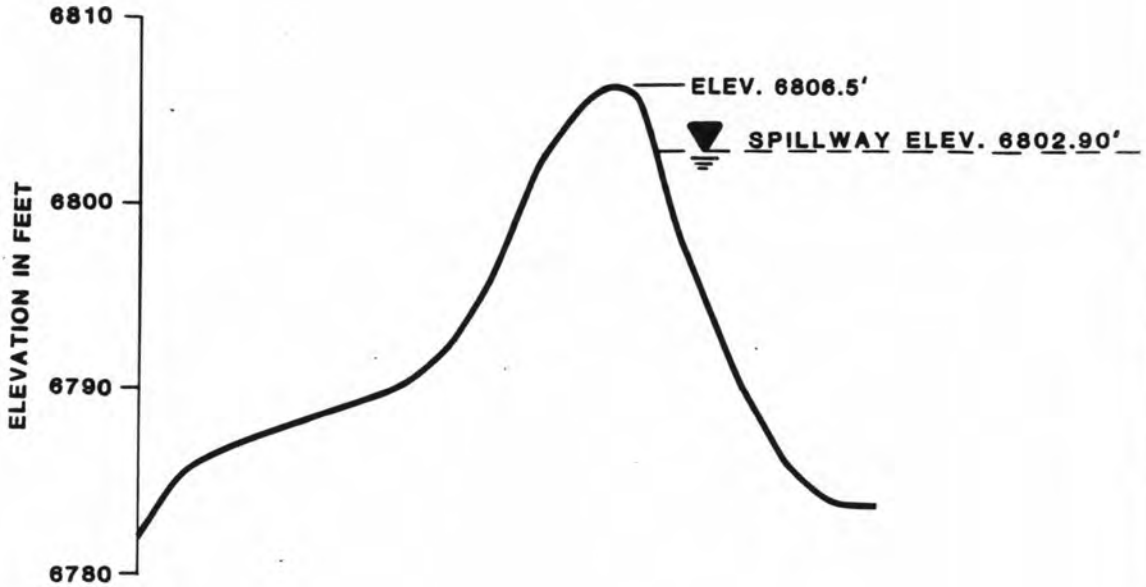
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



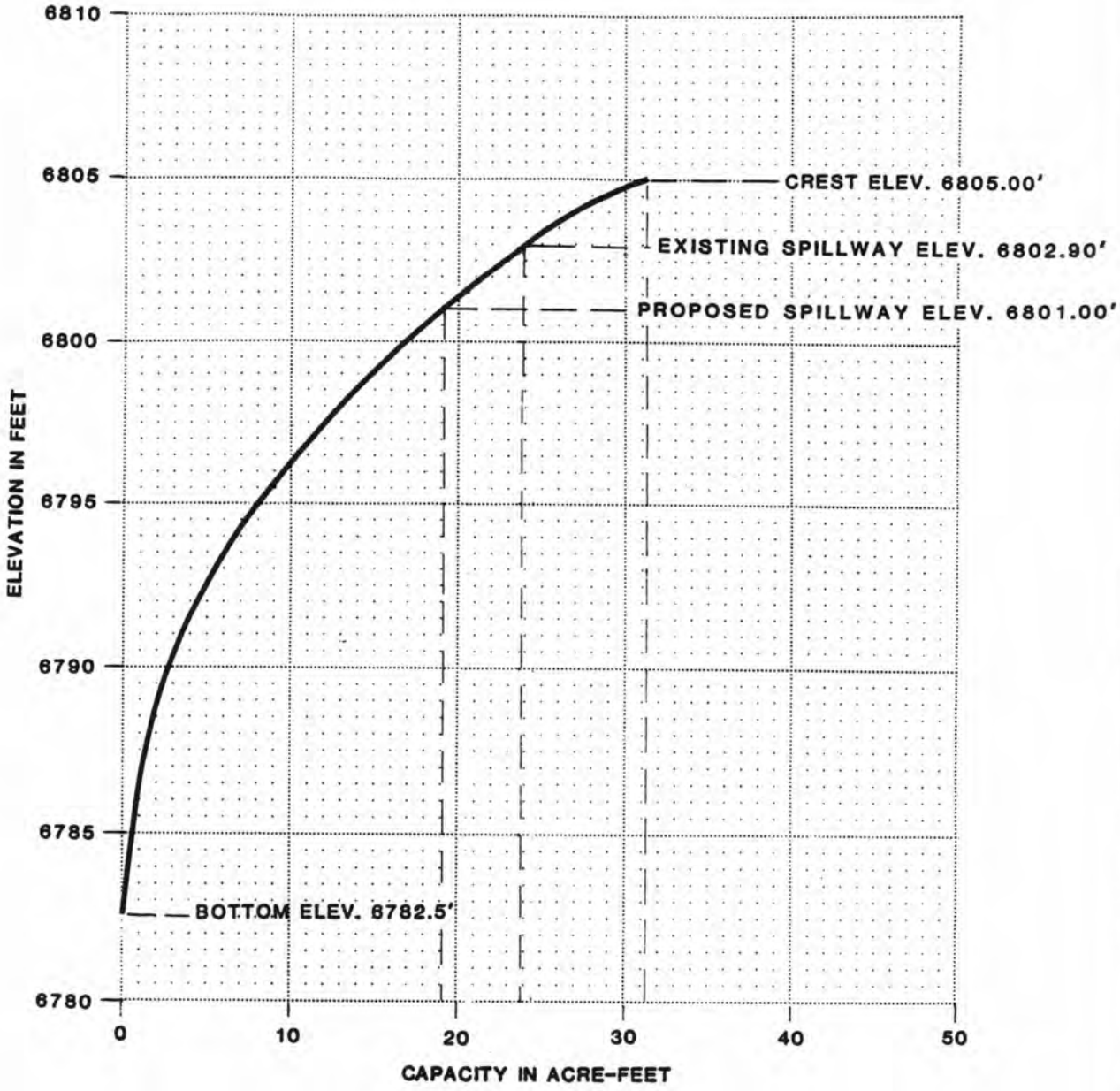
SITE PLAN
J28-G

BY **Dames & Moore** Plate 1



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

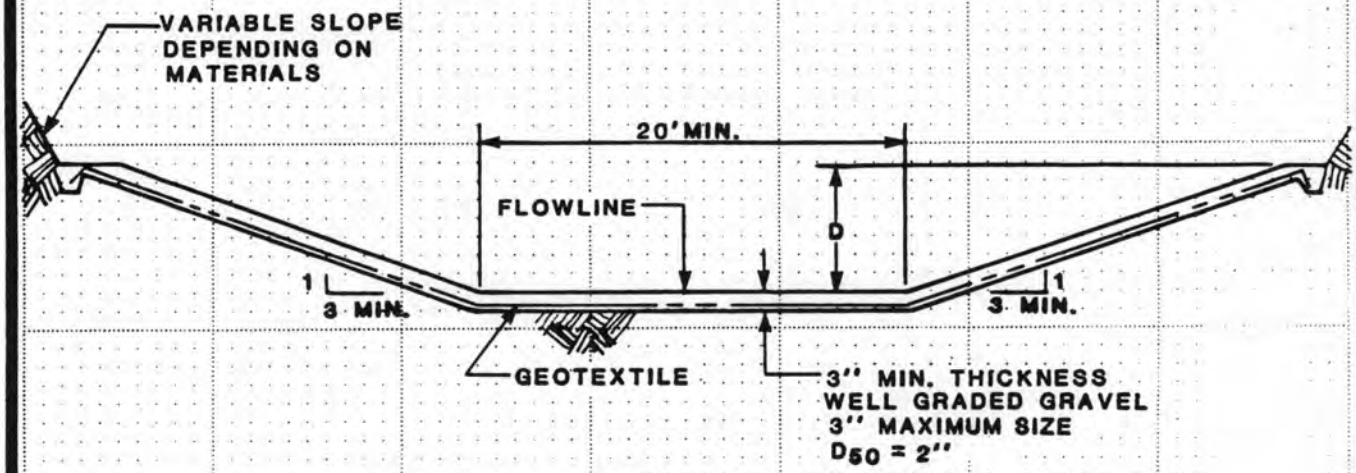
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

J28-G

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.9'

LENGTH = 30'

FLOWLINE ELEV.= 6801.00'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J28-G

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J28-G
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			Rounded 12' w
a. Any visual settlements?		X	
b. Misalignment?			
c. Cracking?			
2. UPSTREAM SLOPE			21° VERY ROUGH, gouged slope towards L.A.
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. Adequate riprap protection?		X	
g. Any stone deterioration?			NA
h. Visual depressions or bulges?	X		Rough see note
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			26°
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		Rills into spillway
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			gray SM

Sediment Impoundment Name: J28-G
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		20' W 30' L 0% Slope 4.2' below crest
Are side slopes eroding?	X		Rills from R.A & dam
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		20' W ≈ 300' + 8% Slope
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	

9. GENERAL COMMENTS

Recently graded, no signs of cracks noted on 3-6-85 by WKW

Canopy 25 %
Ground 35 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J28-G SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6905 − 6803 = 102 ft.

WATER COURSE LENGTH = 4.0 (400) − 1600 ft. = 0.303 mi.

$$T_c = \left(\frac{11.9\,(0.303)^3}{102}\right)^{0.385} = 0.110 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.066 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
27.3	disturbed	—	C	91 (.46)
25.5	P-J	average	C	78 (.43)
6.6	S-G	average	C	73 (.11)
				83.4

100 % EH #26

use 84

DRAINAGE BASIN AREA

59.4 ACRE 0.093 SQ MILE

BY S. DOLAN DATE 10-2-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE Peabody Coal Co 10134-011-22
SUBJECT Sediment Inflow
J28-G 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% ~~EH~~ #26 = .32

K = .32

Slope Factor

Length (ft.)	Δ Elev (ft.)	Slope (%)	LS
800	40	5%	1.52 (.3)
500	50	10	3.06 (.35)
500	75	15	5.73 (.35)
			= 3.53

Cover Factor

Area (ac)	Cover Type	% Cover	Canopy (%)	Weighted C
46%	disturbed	—	—	.46 (1.0)
43%	P-J	40	25	.43 (.14)
11%	S-G	40	25	.11 (.13)
				C = .535

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

Erosion Control Factor

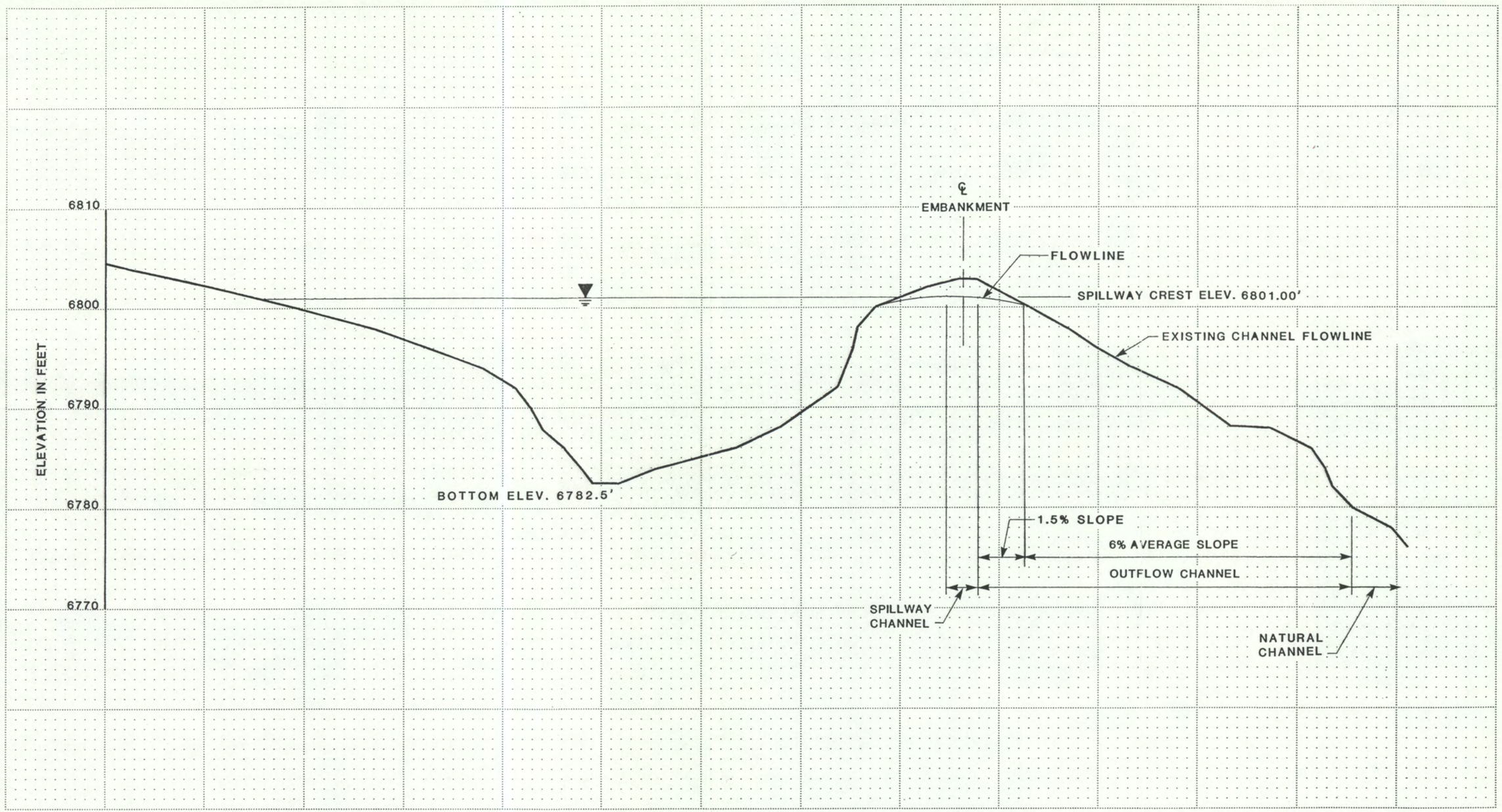
P = 1.0

Sediment Inflow

$$A = 40(.32)(3.53)(.535)(1.0) = 24.17 \text{ ton/acre/year}$$

$$A = (24.17)\left(\frac{1}{2047}\right)(59.4)(.95) = .666 \text{ acre-feet/year}$$

Dames & Moore

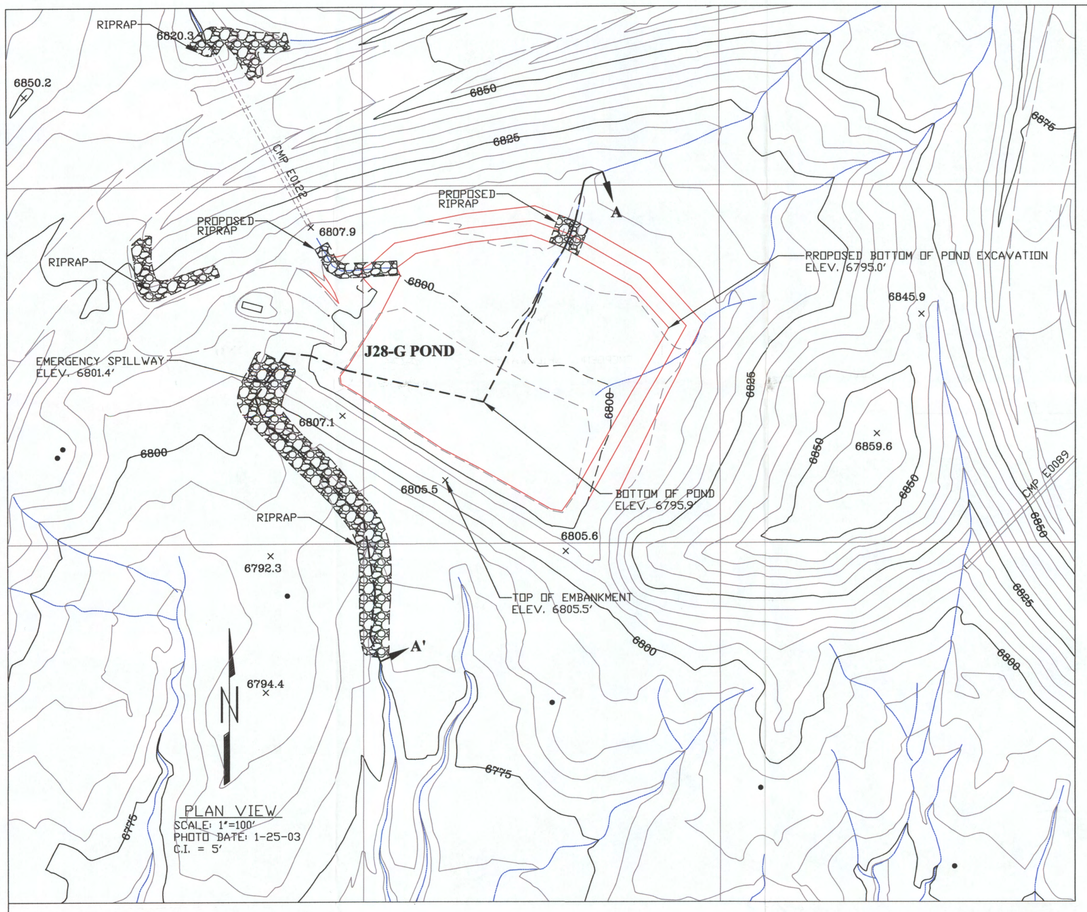


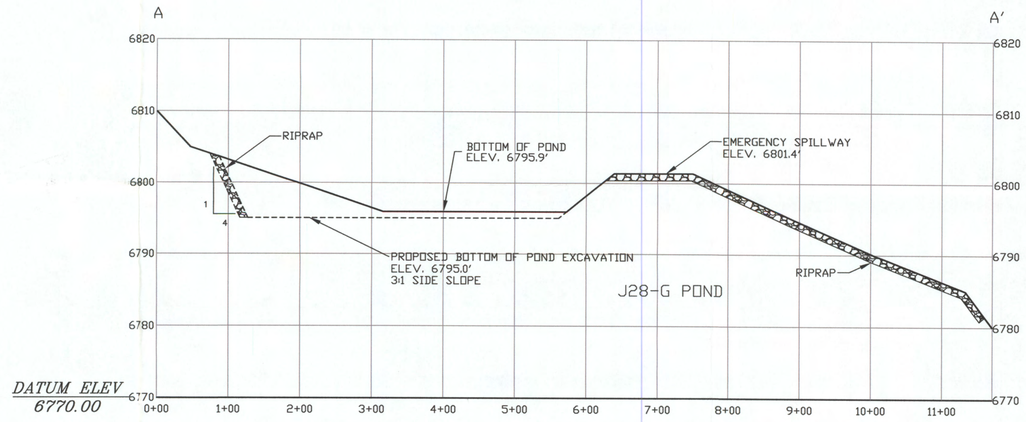
SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
J28-G

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4





PROFILE SECTION A-A'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'

J28-G POND STAGE CAPACITY (REMEDIAL DESIGN)

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	CAPACITY (AC.-FT.)	TOTAL CAPACITY (AC.-FT.)	DESCRIPTION
6795.0	0.00	2.54	0.00	0.00	BOTTOM OF POND
6800.0	5.0	3.21	14.38	14.38	
6801.4	6.4	3.47	4.68	19.05	EMERGENCY SPILLWAY
6805.0	10.0	4.13	13.68	32.73	
6805.5	10.5	4.27	2.10	34.83	TOP OF EMBANKMENT

ENGINEER'S CERTIFICATION

Registered Professional Engineer (Civil) CERTIFICATE NO. 37842 GARY ALTSISI Date signed 4-20-11 ARIZONA, USA

EXPIRES: 09/30/2011

Gary Altsisi Arizona P.E. 37842
Reclamation Supervisor
Peabody Western Coal Company

JUL 2011 APPROVED

EXHIBIT #1
J28-G POND
REMEDIAL DESIGN

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

DESIGNED BY: G.A.	SCALE: AS SHOWN
DRAWN BY: G.A.	DRAWING DATE: 4-12-11
CHECKED BY: G.A.	PHOTO DATE: 1-25-03
CONTOUR INTERVAL: 5'	DWG FILE: J28-G REMEDIAL APR 2011.DWG

INSPECTION REPORT

J28-SL Sewage Lagoon

Temporary Impoundment Structure

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

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

MAR 07 2000

APPROVED
OCT 2000

Revised 03/07/00

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APPENDIX A Hydrology Calculations
APPENDIX B SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event
EXHIBIT #1 J28-SL Temporary Sewage Lagoon Structure

OCT 2000
APPROVED

INTRODUCTION

Sewage Lagoon Structure J28-SL is an earthen embankment, consisting of four partially incised cells which make-up the J28-SL impoundment. The structure was designed and constructed in approximately 1983 by Peabody Western Coal Company as a temporary impoundment structure to contain sewage wastewater at the Kayenta Mine. The location of Structure J28-SL and its watershed boundary are shown on Exhibit 1, Drawing No. 85400 (Sheet M-9), Drawing No. 85405, and Drawing No. 85408. The site-specific general construction plans are shown on the attached Exhibit 1.

This inspection report contains information specific to Structure J28-SL. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona, for Peabody Western 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, and in Chapter 6, Pages 11 to 49, "Sediment and Water Control Facility Plan" and "Sedimentation Ponds and Impoundments" sections.

SYSTEM OPERATION

Sewage waste disposal at J28-SL consists of a very typical sewage lagoon treatment system whereby wastewater gravity flows into the upper cell or Pond (A). Once Pond A is filled, wastewater flows through an overflow weir trough and manhole into the next pond (Pond B), and so on, until it reaches Pond D. Waste is prevented from discharging from the ponds by elevated berms surrounding the lagoon system. Historically, only Pond A holds waste water, while Ponds B, C, and D hold minimal water or are dry. This report demonstrates that J28-Sl Impoundment has the capacity to contain the 100-Year, 6-Hour Storm with no discharge. As such, no remedial work will be required for this structure.

OCT 2000
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INSPECTION

The J28-SL site was inspected in December 1999 by a Registered Professional Engineer from Peabody Western Coal Company to assure that the existing structure is stable and no adverse conditions exist for this structure. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design to assure that the existing embankment configuration is stable.

SITE DESCRIPTION

LAND USE

The tributary area for structure J28-SL is limited to the ponds surface, basin, and crest. The total watershed area is 5.0 acres and is located in a small tributary of Moenkopi Wash. MSHA Dam, J16-A, is located downstream of the J28-SL structure.

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DESIGN ANALYSES

GENERAL

Structure J28-SL was designed under the supervision of a Registered Professional Engineer from Peabody Western 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 Western Coal Company files includes topographic maps developed from aerial photography flown in 1993 and 1997 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure J28-SL is a category A-3 embankment. The structure consists of four partially incised impoundments (labeled Ponds A, B, C, & D). The slopes are approximately 3.0:1 (horizontal to vertical). Based on a maximum pond depth of 11 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6; therefore, the side slopes will be stable.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A and B). Structure J28-SL is classified as a low hazard, Class A, structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. Each impoundment structure contains less than 20 acre-feet and is less than 20 vertical feet in depth. The J28-SL structure does not have a designed emergency spillway; however, adequate storage will be maintained in the lowest pond (Pond D) in the four pond series above the normal operating level to contain the storm run-off from the 100-year, 6-hour storm event, with no discharge through the Pond D overflow trough. To assure that adequate storm water storage volume is available, the maximum operating water level in Pond D will be maintained at or below elevation 6806.3. It is not anticipated that all ponds in the system will fill, however, if this happens, waste will be pumped from the last pond and held in a holding tank for proper disposal. Chapter 6 contains PWCC's dewatering equipment list and dewatering plan, etc. As stated previously, only Pond A has been noted to hold water in the past. The system is conservative since it assumes that Ponds A, B, & C are full at the time of the design storm event.

The following parameters were used in the hydrologic analysis:

		100yr-6hr Storm	
1.	Water Course length, L	0.004	mi.
2.	Elevation Difference, H	0.6	ft
3.	Time of Concentration, T_c	0.005	hr
4.	SCS Curve Number	95	
5.	Rainfall Depth, 100-year, 6-hour storm	2.4	in
6.	Drainage Area	5.0	acres

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OCT 2000

The cumulative storage capacity for all four ponds, as measured from the bottom of each pond to the invert of their overflow troughs, is shown below.

Pond A	ac-ft	2.79
Pond B	ac-ft	0.53
Pond C	ac-ft	0.41
Pond D	ac-ft	3.12
Total	ac-ft	6.85

The SEDCAD4 computer program was used to evaluate inflow to the impoundment structure. The initial conditions and results of the analysis for Pond D are summarized in the following table (supporting calculations are presented in Appendices A and B).

J28-SL POND D HYDROLOGY TABLE

	Units	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to 6806.3
Inflow		
Peak Flow	cfs	12.2
Volume	ac-ft	0.78
Storage (Pond D)		
Peak Stage	msl	6807.8
Operational Elev.	msl	6806.3
Peak Op. Level Capacity	ac-ft	2.33
Pond D Storage Capacity	ac-ft	3.12
Storage Available for Stormwater	ac-ft	1.38
Top of Impoundment	msl	6809.8
Minimum Freeboard	ft	1.0

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Notes: The Peak Operational Level Capacity figure reflects available pond storage up to the defined Operational Elevation of Pond D, the lowest pond in the four pond series. As indicated on the above table, Pond D will have 1.38 ac-ft of capacity always available for stormwater. The required runoff capacity is 0.78 ac-ft. (100-year, 6-hour storm).

INLET AND OUTLET STRUCTURES

Waste water gravity flows into Pond A of Structure J28-SL through a pipe from the adjacent Kayenta Mine Facilities. An overflow trough has been installed in each Pond to allow wastewater to discharge from Pond to Pond. An emergency overflow trough, manhole, and 6" diameter PVC discharge pipe are installed in Pond D's outlet; however, since 1983, no discharge has occurred. The discharging system is shown graphically on Exhibit 1.

* * *

The following appendices and drawing are attached and complete this design report.

APPENDIX A	Hydrology Calculations
APPENDIX B	SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event
Exhibit # 1	J28-SL Temporary Sewage Lagoon Structure

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APPENDIX A

Hydrology Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J28 AREA

STRUCTURE: J28 Sewage Lagoon

TIME OF CONCENTRATION:

Start Elevation (ft) =	6839.4
End Elevation (ft) =	6838.8
Elevation Difference, E (ft) =	0.6
Watercourse Length (ft) =	20
Watercourse Length, L (mi) =	0.004
Tc = (11.9L^3/E)^0.385 =	0.005 hours

ROUTING PARAMETERS:

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD4. Input and output parameters are shown on the SEDCAD4 printouts in Appendices C.

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Disturbed		95	5	475
TOTAL:			5	475

Weighted CN = Total CN*Area/ Total Area = 95

DRAINAGE BASIN AREA:

5.0 Acres

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J28 SL SEWAGE LAGOON, POND A

Elevation-Area-Capacity Table

Elevation	Area (ac)	Capacity (ac-ft)
6,829.10	0.010	0.000
6,829.60	0.128	0.029
6,830.00	0.310	0.114
6,830.10	0.314	0.145
6,830.60	0.336	0.307
6,831.10	0.359	0.481
6,831.60	0.382	0.666
6,832.10	0.406	0.863
6,832.60	0.431	1.073
6,833.10	0.456	1.294
6,833.60	0.483	1.529
6,834.10	0.510	1.777
6,834.60	0.542	2.040
6,835.10	0.574	2.319
6,835.60	0.586	2.609
6,835.90	0.594	2.786
6,836.10	0.621	2.907
6,836.60	0.688	3.234
6,837.10	0.759	3.596
6,837.60	0.834	3.994
6,837.90	0.880	4.251

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J28 SL SEWAGE LAGOON, POND B

Elevation-Area-Capacity Table

Elevation	Area (ac)	Capacity (ac-ft)
6,819.70	0.010	0.000
6,820.00	0.260	0.032
6,820.70	0.285	0.223
6,821.70	0.322	0.526
6,822.70	0.361	0.867
6,823.70	0.403	1.249
6,824.70	0.447	1.673
6,825.00	0.460	1.809
6,825.70	0.483	2.139
6,826.70	0.518	2.639
6,827.70	0.553	3.175
6,828.70	0.590	3.746
6,829.50	0.620	4.230

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J28 SL SEWAGE LAGOON, POND C

Elevation-Area-Capacity Table

Elevation	Area (ac)	Capacity (ac-ft)
6,808.90	0.010	0.000
6,809.90	0.249	0.103
6,810.00	0.290	0.130
6,810.90	0.324	0.406
6,811.90	0.363	0.749
6,812.90	0.405	1.133
6,813.90	0.449	1.560
6,814.90	0.495	2.032
6,815.00	0.500	2.082
6,815.90	0.532	2.546
6,816.90	0.569	3.097
6,817.90	0.608	3.685
6,818.90	0.647	4.313
6,819.70	0.680	4.844

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J28 SL SEWAGE LAGOON, POND D

Elevation-Area-Capacity Table

Elevation	Area (ac)	Capacity (ac-ft)
6,799.30	0.010	0.000
6,799.80	0.144	0.032
6,800.00	0.240	0.070
6,800.30	0.251	0.144
6,800.80	0.269	0.274
6,801.30	0.288	0.413
6,801.80	0.308	0.562
6,802.30	0.329	0.721
6,802.80	0.339	0.888
6,803.30	0.350	1.061
6,803.80	0.360	1.238
6,804.30	0.371	1.421
6,804.80	0.427	1.620
6,805.00	0.450	1.708
6,805.30	0.461	1.844
6,805.80	0.481	2.080
6,806.30	0.501	2.325
6,806.80	0.521	2.581
6,807.30	0.541	2.846
6,807.80	0.560	3.121
6,808.30	0.584	3.407
6,808.80	0.610	3.706
6,809.30	0.627	4.015
6,809.80	0.650	4.334

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APPENDIX B

SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event

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PEABODY WESTERN
KAYENTA MINE
J28 SL SEWAGE LAGOON

100-year, 6-hour

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DJK

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.400 inches

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Sewage Lagoons

#1
Null

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Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	5.000	5.000	12.19	0.78

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Structure Detail:

Structure #1 (Null)

Sewage Lagoons

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	5.000	0.005	0.000	0.000	95.000	F	12.19	0.778
	$\sum$	**5.000**						**12.19**	**0.778**

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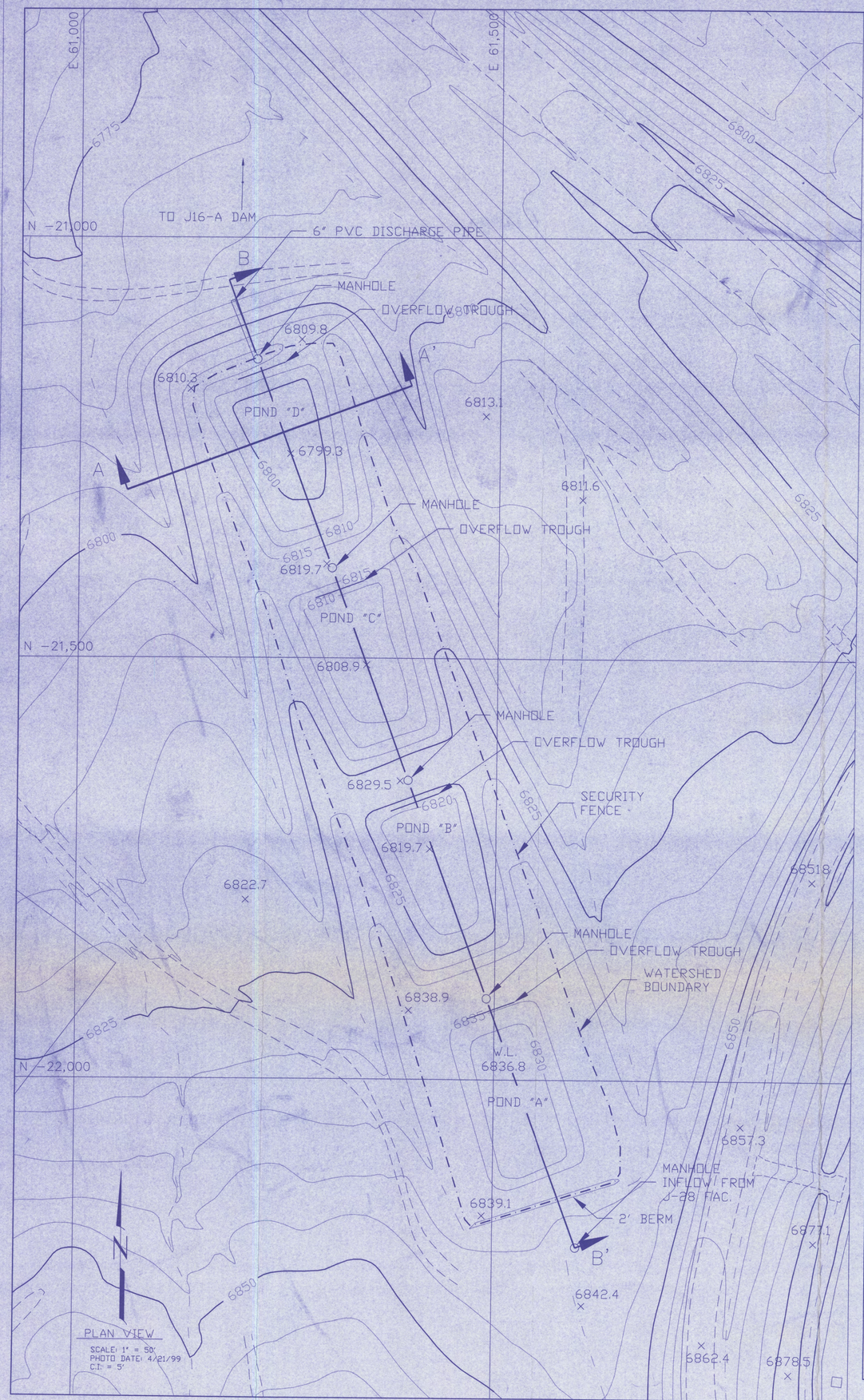
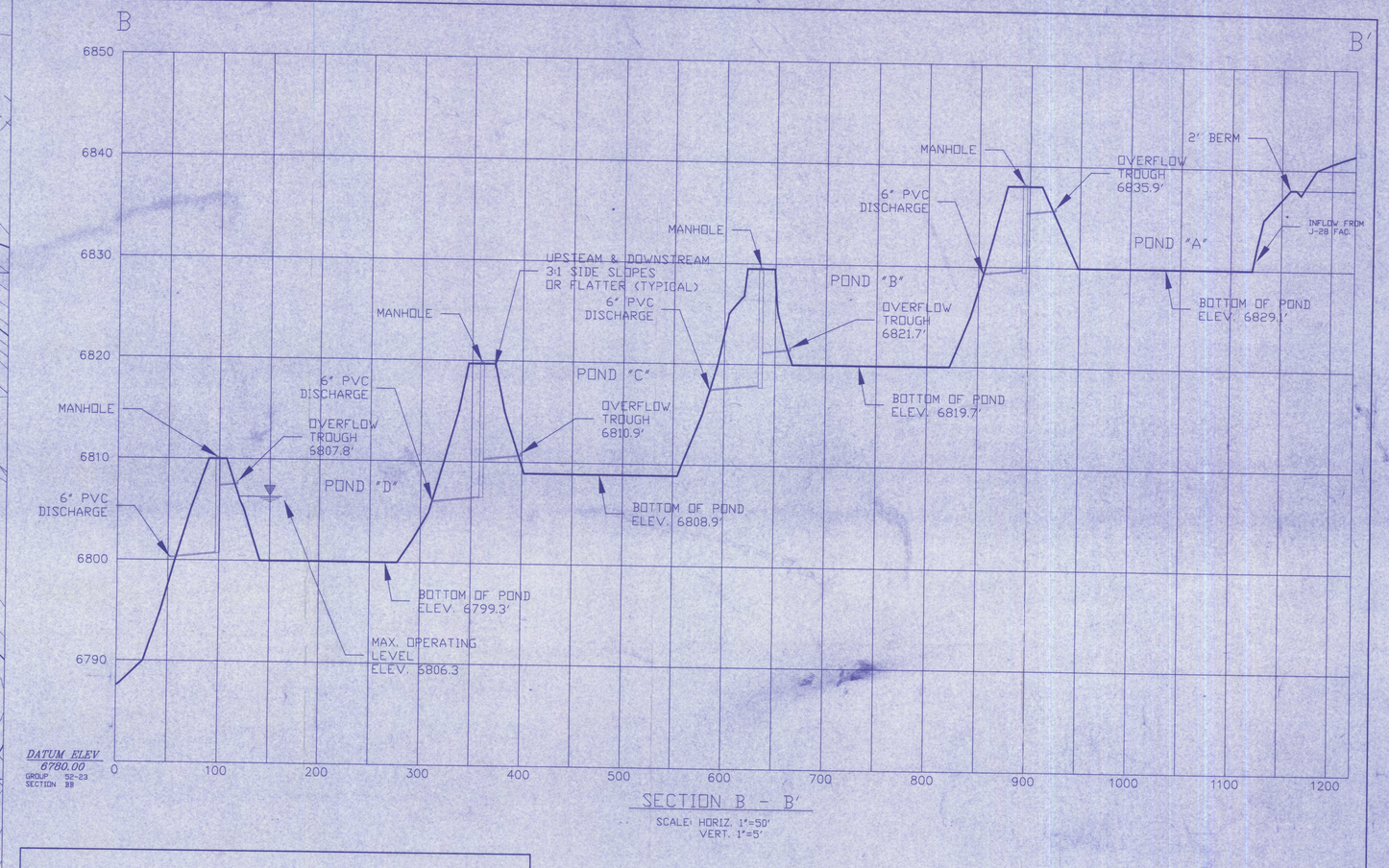
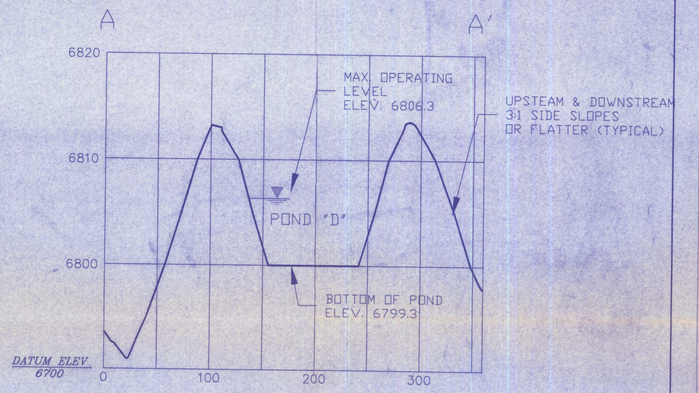




SECTION B - B'

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



SECTION A - A'

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

J28 SL TEMPORARY SEWAGE LAGOON STRUCTURE

POND A

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	TOT. CAP. (AC.-FT.)	DESCRIPTION
6829.1	0.0	0.01	0.00	BOTTOM OF POND
6830.0	0.9	0.31	0.11	
6833.1	3.0	0.46	1.29	
6835.0	4.9	0.56	2.26	
6835.9	6.8	0.59	2.79	OVERFLOW TROUGH INVERT
6837.9	8.8	1.02	4.25	TOP OF POND

POND B

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	TOT. CAP. (AC.-FT.)	DESCRIPTION
6819.7	0.0	0.01	0.00	BOTTOM OF POND
6820.0	0.3	0.26	0.03	
6821.7	2.0	0.32	0.53	OVERFLOW TROUGH INVERT
6823.7	4.0	0.40	1.25	
6827.7	8.0	0.55	3.18	
6829.5	9.8	0.62	4.23	TOP OF POND

POND C

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	TOT. CAP. (AC.-FT.)	DESCRIPTION
6808.9	0.0	0.01	0.00	BOTTOM OF POND
6810.0	1.1	0.29	0.13	
6810.9	2.0	0.32	0.41	OVERFLOW TROUGH INVERT
6813.9	5.0	0.45	1.56	
6817.9	9.9	0.61	3.69	
6819.7	10.8	0.68	4.84	TOP OF POND

POND D

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	TOT. CAP. (AC.-FT.)	DESCRIPTION
6799.3	0.0	0.01	0.00	BOTTOM OF POND
6800.0	0.7	0.24	0.07	
6803.3	4.0	0.35	1.06	
6806.3	7.0	0.50	2.33	MAX. OPERATING LEVEL
6807.8	8.5	0.56	3.12	OVERFLOW TROUGH INVERT
6808.8	10.6	0.61	3.71	
6809.8	10.5	0.65	4.33	TOP OF POND

NOTES:
1) General location, see Drawing No. 85400, Sheet M-9 and Drawing No. 85405.
2) See Chapter 6, Kayenta PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) J28-SL is an existing structure constructed in approximately 1983.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.

ENGINEER'S CERTIFICATION

JAMES D. HELENVOLT
ENGINEERING & RECLAMATION MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE MAR 0 7 2000

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REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT 1
J28-SL TEMPORARY
SEWAGE LAGOON STRUCTURE

KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

DESIGNED BY: MW	SCALE: 1"=50'
DRAWN BY: JMB	DRAWING DATE: 02-04-00
CHECKED BY: JOS	PHOTO DATE: 04-21-99
CONTOUR INT.: 5'	DWG FILE: LAGOON2.DWG

mce_ce\acad dwg\ponds\kmine\design\307j28sl.dwg

DESIGN REPORT

Temporary Sedimentation Structure

KM-A3

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

AUG 2001 APPROVED

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

FEB 07 2001

Revised 02/07/2001

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EXHIBIT #1 -KM-A3 Pond Revised Design

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INTRODUCTION

Sedimentation Structure KM-A3 is an earthen embankment, designed and constructed in 1982 by Peabody Western Coal Company as a temporary sedimentation structure to control runoff and sediment from portions of the N-8 Facilities disturbance area at the Kayenta Mine. With this design report, PWCC proposes to increase the capacity of the pond structure by raising the top of embankment and spillway approximately 2 feet, primarily on the West End of the structure. The location of Structure KM-A3 and its watershed boundary are shown on Drawing No. 85400 (Sheet K-7) and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit #1.

This design report contains information specific to Structure KM-A3. Structure KM-A3 is currently in series with Structure KM-A2. However, KM-A2 is filled with sediment and is no longer useful as a sediment pond. KM-A2 will be reclaimed and will no longer be used as a sedimentation structure. The embankment and emergency spillway of KM-A3 will be raised approximately 2 feet to contain the required storm event, the sediment for the combined KM-A2 and KM-A3 watershed areas, and provide storage for the N-8 Facilities wash-down water. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona, for Peabody Western 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, and in Chapter 6, Pages 11 to 42, "Sediment and Water Control Facility Plan".

INSPECTION

The remedial construction site for Structure KM-A3 was inspected in October, 2000 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist to prevent the successful remedial construction of this structure. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design and will be utilized during construction to construct a stable embankment.

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SITE DESCRIPTION

LAND USE

The KM-A3 Structure has a watershed (which includes the KM-A2 watershed) of 66.1 acres and is located on a tributary upstream of the Yellow Water Canyon Wash at the Kayenta Mine. The watershed is classified as 61% disturbed and 39% undisturbed.

DESIGN ANALYSES

GENERAL

Structure KM-A3 is an existing sedimentation structure designed and constructed in 1982 by Peabody Western Coal Company. Dames and Moore reviewed the design in 1985. Revisions were made in the design in 1996 under the supervision of a Registered Professional Engineer. The design was reviewed again in 2000 and an additional revision is recommended. PWCC proposes to raise the embankment to an elevation of 6507.5'msl and the emergency spillway invert to elevation of 6505.0' msl in order to increase the capacity of the pond, (see to Exhibit #1). 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 is used in the analyses of the structure and contained in the Peabody Western Coal Company files including topographic maps developed from aerial photography flown in 1996.

STABILITY

Structure KM-A3 is a Category B-3 embankment. The structure is a homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 12 feet wide on top. The minimum upstream slopes are 2H: 1V and minimum downstream slopes are 3H: 1V and these slopes will be utilized during remedial construction. Based on the total embankment height of approximately 13.5 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable. The emergency spillway will be a minimum 20-foot wide, riprap-lined, trapezoidal channel.

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HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure KM-A3 is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the emergency spillway invert elevation. The structure is a temporary sediment containment structure and therefore, the spillway was designed to safely pass the peak flow from the 25-year, 6-hour storm event. The structure was conservatively assumed to be full to the emergency spillway at the time of 25-year storm event. The storage capacity of structure KM-A3 was analyzed using the 10-year, 24-hour storm event. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage and wash-down water volume, without discharging into the Yellow Water Canyon Wash.

There is assumed to be a base flow which enters the KM-A3 Pond from the N-8 Facilities wash-down water. The water volume is too intermittent to quantify the water storage volume. To assure that adequate storage below the emergency spillway elevation will always be present in the pond to contain the runoff volume from the 10-year, 24-hour storm, a maximum water level will be maintained in the pond at approximately elevation 6503' or to allow approximately 12.3 ac.-ft. of storage for sediment and wash-down water runoff. A stake will be placed at the 6503' elevation or approximately 4.8 ac.-ft. below the emergency spillway. The survey stake will be checked periodically by PWCC personnel. The water level will be maintained at or below this elevation. If the water level rises to the survey stake elevation, PWCC will implement the dewatering plan described in Chapter 6, "Maintenance and Reclamation" section.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.417 mi.
2.	Elevation Difference, H	170 ft
3.	Time of Concentration, T_c	0.131 hr
4.	SCS Curve Number	85
5.	Rainfall Depth, 10-year, 24-hour storm	2.1 in

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	25-year, 6-hour storm	1.9 in
6.	Drainage Area	66.1 acres

HYDRAULICS

The SEDCAD4 and Flow Master computer programs were 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 (supporting calculations are presented in Appendices A, B, and C).

The ponding area will continue to be bisected by an access road with a 48-inch CMP to equalize the water level on both sides of the road (see Cell No. 1 & Cell No. 2, Exhibit #1). A low spot (elevation 6505.5') will be graded in the road embankment to form a spillway capable of safely passing the peak flow from the 25-year, 6-hour storm from Cell No. 1 to Cell No. 2. Riprap will be placed from the spillway into Cell No. 2 as shown on Exhibit #1. In addition to the 48-inch CMP, this will allow water to overflow from Cell No. 1 to Cell No. 2 during emergency inflow conditions.

The embankment crest will be at elevation 6507.5' and the emergency spillway crest at elevation 6505.0'. The storage capacity of the revised structure is adequate for local inflow from the KM-A3 and KM-A2 watersheds. The existing trapezoidal spillway and outflow channel will be revised as shown on Exhibit #1.

Design parameters for the spillway and outflow channel are shown on the following table.

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KM-A3 SEDIMENTATION POND HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	25-Yr, 6-Hr Storm	
Initial Reservoir Volume Condition		Empty	Full to emergency spillway	
Inflow				
Peak Flow	cfs	52.8	64.3	
Volume	ac-ft	4.8	4.0	
Storage				
Peak Stage	msl	N/A	6505.7	
Emerg. Spillway Elev.	msl	6505.0	6505.0	
Peak Storage	ac-ft	N/A	19.0	
Storage Capacity	ac-ft	19.3	17.1	
Outflow				
Peak Flow	cfs	N/A	17.6	
Spillway Elevation	msl	6505.0	6505.0	
Embankment Crest Elev.	msl	6507.5	6507.5	
Peak Stage	msl	--	6505.7	
Freeboard	ft	--	1.8	
Emergency Spillway Channel				
Flow Depth	ft	--	0.7	
Critical Slope	%	--	2.0	
Mannings "n"	--	--	0.03	
Width	ft	--	20	
Outflow Channel				
Slope	%	--	33	10.5
Normal Velocity	fps	--	4.5	4.0
Normal Depth	ft	--	0.19	0.21
Mannings "n"	--	--	0.061	0.042
Riprap D_{50}	in	--	3	1.5

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for KM-A3 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

Minimum Channel Depth	(Spillway)	1.7	ft
	(Outflow)	1.2	ft
Channel Width		20	ft
Channel Length	(Spillway)	27	ft
	(Outflow)	30	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	33	%
Spillway Elevation		6505.0	ft

A minimum 15-foot long riprap-lined channel will be constructed beyond the toe of the embankment as a transition into the downstream channel.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit #1) is based on the 1996 aerial topographic mapping conducted for Peabody Western Coal Company. Structure KM-A3 is designed to contain approximately 17.1 acre-feet.

The calculations for the sediment load entering structure KM-A3 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.22
3.	Slope Factor, LS	5.39
4.	Cover Factor, C	0.66
5.	Erosion Control Factor, P	1.0

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The hydrologic analysis estimates the storage volume required to contain the 10-year, 24-hour storm. The storage capacity of structure KM-A3 and the results of the sediment inflow analysis are summarized in the following table.

Total Storage Capacity	17.1 ac-ft
10-year, 24-hour Storm Inflow Volume	4.8 ac-ft
Maximum Allowable Water Level	6503' msl
Sediment/Wash-down Water Volume Available	12.3 ac-ft
Sediment Inflow Rate	0.91 ac-ft/yr.
Sediment Storage Life	13.5 yrs

* * *

The following appendices and drawing are attached and complete this design report.

Appendix A- Hydrology, Hydraulic, and Sedimentation Calculations

Appendix B- SEDCAD4 (Input and Output) 10-Year, 24-Hour Storm Event

Appendix C- SEDCAD4 (Input and Output) 25-Year, 6-Hour Storm Event

Exhibit #1- KM-A3 Pond Revised Design

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: KM AREA

STRUCTURE: KM-A3 Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	6720
End Elevation (ft) =	6550
Elevation Difference, E (ft) =	170
Watercourse Length (ft) =	2200
Watercourse Length, L (mi) =	0.417
Tc = (11.9L^3/E)^0.385 =	0.131 hours

ROUTING PARAMETERS:

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD4. Input and output parameters are shown on the SEDCAD4 printouts in Appendices C.

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Disturbed	B	86	8.1	696.6
Disturbed	D	94	32.4	3045.6
PJ	B	65	11.1	721.5
SG	D	79	12.2	963.8
PJ	D	83	2.3	190.9
TOTAL:			66.1	5618.4

Weighted CN = Total CN*Area/ Total Area = 85

DRAINAGE BASIN AREA: 66.1

RAINFALL FACTOR:

R = 40

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: KM-A3 Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
24	0.16	46.9	7.50
27	0.36	19.2	6.91
TOTAL:		66.1	14.42

Weighted K = Total K*Area/ Total Area = 0.22

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
150	60	40.0%	0.6	21.8	8.87
300	60	20.0%	0.6	11.3	6.55
160	15	9.4%	0.5	5.4	1.59
250	85	34.0%	0.6	18.8	10.31
200	65	32.5%	0.6	18.0	8.62
390	15	3.8%	0.4	2.2	0.87
420	15	3.6%	0.4	2.0	0.84
460	185	40.2%	0.6	21.9	17.46
150	1.5	1.0%	0.3	0.6	0.17
160	25	15.6%	0.6	8.9	3.36
200	2	1.0%	0.3	0.6	0.19
200	45	22.5%	0.6	12.7	5.86

Average LS = 5.39

The LS Factor was calculated by:

LS = (Slope Length/72.6)^m(10.8*sin(slope angle) + 0.03) for Slopes < 9%*

LS = (Slope Length/72.6)^m(16.8*sin(slope angle) - 0.5) for Slopes > 9%*

Where:

Slope < 3% *m = 0.3*
Slope = 4% *m = 0.4*
5% > Slope < 10% *m = 0.5*
Slope > 10% *m = 0.6*

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COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Undisturbed	40%	25%	25.5	0.13	3.32	1.00	25.50
Disturbed	0%	0%	40.6	1.00	40.60	1.00	40.60
TOTAL:			66.1		43.92		66.10

Weighted C = Total C*Area/ Total Area = 0.664

Weighted P = Total P*Area/ Total Area = 1.000

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: KM-A3 POND

The following spreadsheet calculates the predicted sediment yield for the project area. The gross sediment yie is determined according to the Revised Universal Soil Loss Equation.

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.22	
Length Slope Factor	5.39	
Cover Factor	0.66	
Practice Factor	1.00	
Gross Annual Sediment Yield	31.24	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0153	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0137	acre-feet/acre/year
Watershed Area	66.1	acres
Watershed Annual Sediment Yield	0.91	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	0.91	acre-feet

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KM-A3 Pond Spillway Outflow Channel

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
20.00	3.0:1	3.0:1	10.5	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.60 cfs	
Depth:	0.21 ft	1.21 ft
Top Width:	21.28 ft	27.28 ft
Velocity:	4.01 fps	
X-Section Area:	4.39 sq ft	
Hydraulic Radius:	0.206	
Froude Number:	1.55	
Manning's n:	0.0420	
Dmin:	1.00 in	
D50:	1.50 in	
Dmax:	3.00 in	

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KM-A3 Pond Spillway Outflow Channel

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
20.00	3.0:1	3.0:1	33.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.60 cfs	
Depth:	0.19 ft	1.19 ft
Top Width:	21.13 ft	27.13 ft
Velocity:	4.53 fps	
X-Section Area:	3.89 sq ft	
Hydraulic Radius:	0.183	
Froude Number:	1.86	
Manning's n:	0.0610	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

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MEMORANDUM

MONTGOMERY WATSON

Date: 6-13-01

To: Jim Schlenvogt

From: Craig Burger/Tom Leidich

Subject: HEC-RAS modeling of flow to overtop stream bank

The Hydrologic Engineering Center's River Analysis System (HEC-RAS) was utilized to determine the stream flow that would result in overtopping of the stream bank and flow into the KM-A3 sediment control pond at the Peabody Western Mine in Kayenta, Arizona. Cross sections were generated in AutoCAD at 13 locations on the stream alignment. A Manning's number of 0.025 was selected for the stream bottom and the areas outside the stream channel based on a site visit. Steady flow water surface profiles were calculated by the HEC-RAS model based on the input.

A flow of 1,321 cfs resulted in a computed water level of 6506.1 ft at cross section 12 (see attached drawing and summary tables) where the crest of the embankment is at an elevation of approximately 6507.8 ft. Cross section 12 is expected to have the highest flow as the stream constricts at this location. The resulting 1.7 ft of freeboard is conservative compared to the approximately 3 ft of freeboard observed during the 1,321 cfs flow event on August 20, 2000.

A flow of 2,000 cfs resulted in a computed water level of 6507.5 ft at cross section 12 where the crest of the embankment is at an elevation of approximately 6507.8 ft. The computed results are believed to be conservative based on comparison with the freeboard observed during the 1,321 cfs flow event.

A flow of 3,000 cfs resulted in a computed water level of 6509.2 ft at cross section 12. Raising the embankment to 6509.2 ft (approximately 1.5 ft of fill) from cross section 10 to cross section 12 will result in an embankment that can contain a 3,000 cfs flow event based on the computed results. Summaries of the computed results, a figure showing the cross section locations, and the cross sections used in the model are attached.

Attachments

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HEC-RAS Plan: asbuilt River: Peabody Stream Reach: by pond

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
by pond	13	1321.00	6502.00	6506.35	6506.35	6507.25	0.003707	8.80	203.01	105.71	0.78
by pond	12	1321.00	6502.00	6506.12	6504.84	6506.41	0.001120	4.53	324.95	126.38	0.43
by pond	11	1321.00	6500.00	6505.41		6506.19	0.002319	7.10	190.28	54.48	0.62
by pond	10	1321.00	6500.00	6505.49		6505.96	0.001229	5.92	261.75	82.80	0.47
by pond	9	1321.00	6500.00	6504.84		6505.76	0.003080	7.68	173.69	52.02	0.71
by pond	8	1321.00	6500.00	6504.37		6505.44	0.004011	8.32	159.16	49.29	0.80
by pond	7	1321.00	6500.00	6504.28		6505.15	0.003440	7.50	177.01	61.24	0.74
by pond	6	1321.00	6500.00	6504.11		6504.95	0.003264	7.37	179.25	55.84	0.72
by pond	5	1321.00	6498.00	6503.19	6503.19	6504.66	0.005868	9.80	138.24	49.83	0.96
by pond	4	1321.00	6498.00	6501.55	6502.24	6503.93	0.015493	12.39	106.59	48.14	1.47
by pond	3	1321.00	6498.00	6501.92	6501.92	6503.15	0.007005	8.89	148.57	61.37	1.01
by pond	2	1321.00	6498.00	6502.15	6500.98	6502.46	0.001587	4.49	294.18	113.89	0.49
by pond	1	1321.00	6498.00	6500.99	6500.99	6502.15	0.007117	8.68	152.23	66.02	1.01

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HEC-RAS Plan: asbuilt River: Peabody Stream Reach: by pond

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
by pond	13	2000.00	6502.00	6507.35	6506.97	6508.14	0.002615	8.60	316.14	120.33	0.68
by pond	12	2000.00	6502.00	6507.52		6507.78	0.000681	4.43	522.07	156.12	0.35
by pond	11	2000.00	6500.00	6506.58		6507.58	0.002169	8.14	257.81	60.53	0.63
by pond	10	2000.00	6500.00	6506.79		6507.31	0.001041	6.39	382.67	101.48	0.45
by pond	9	2000.00	6500.00	6505.88		6507.10	0.003007	8.95	231.02	58.79	0.73
by pond	8	2000.00	6500.00	6505.32		6506.79	0.003990	9.78	208.94	55.91	0.83
by pond	7	2000.00	6500.00	6505.46		6506.44	0.002614	8.05	265.90	89.09	0.68
by pond	6	2000.00	6500.00	6505.25		6506.28	0.002702	8.19	250.90	69.30	0.69
by pond	5	2000.00	6498.00	6504.20	6504.20	6506.01	0.005119	10.98	192.36	56.86	0.94
by pond	4	2000.00	6498.00	6502.26	6503.19	6505.29	0.015189	13.98	143.50	56.73	1.50
by pond	3	2000.00	6498.00	6502.48	6502.73	6504.32	0.008148	10.91	184.40	67.58	1.12
by pond	2	2000.00	6498.00	6503.12	6501.60	6503.49	0.001264	4.94	411.82	129.00	0.46
by pond	1	2000.00	6498.00	6501.81	6501.81	6503.21	0.006679	9.49	210.78	76.23	1.01

Critical Reach

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HEC-RAS Plan: asbuilt River: Peabody Stream Reach: by pond

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
by pond	13	3000.00	6502.00	6509.05	6507.69	6509.62	0.001305	7.41	538.31	137.60	0.51
Critical Reach → by pond	12	3000.00	6502.00	6509.16		6509.40	0.000456	4.39	824.10	196.64	0.30
by pond	11	3000.00	6500.00	6507.84		6509.19	0.002239	9.56	337.92	68.26	0.66
by pond	10	3000.00	6500.00	6508.25		6508.85	0.000952	7.05	547.79	129.13	0.45
by pond	9	3000.00	6500.00	6507.02	6506.48	6508.61	0.003027	10.38	324.55	109.57	0.76
by pond	8	3000.00	6500.00	6506.86	6506.84	6508.33	0.002829	10.08	353.96	143.07	0.73
by pond	7	3000.00	6500.00	6507.19		6508.00	0.001538	7.70	463.53	133.60	0.55
by pond	6	3000.00	6500.00	6506.71		6507.87	0.002155	8.85	375.57	117.21	0.64
by pond	5	3000.00	6498.00	6505.47	6505.47	6507.61	0.004393	12.12	269.81	64.88	0.91
by pond	4	3000.00	6498.00	6503.08	6504.33	6506.94	0.013650	15.84	195.31	68.45	1.49
by pond	3	3000.00	6498.00	6503.78	6503.80	6505.65	0.005158	11.09	281.76	81.73	0.95
by pond	2	3000.00	6498.00	6504.17	6502.34	6504.65	0.001166	5.63	556.92	149.29	0.46
by pond	1	3000.00	6498.00	6502.92	6502.92	6504.40	0.004709	9.84	325.29	137.11	0.89

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----- Pearson Type III Distribution Reports -----

Data for: FLUM15, Annual Series, Minimum Peak Discharge 0.0

Year	Maximum Peak CFS	Year	Maximum Peak CFS
1980	140.000	1981	329.089
1982	210.000	1983	155.000
1984	547.625	1985	119.700
1986	1400.000	1987	970.000
1988	340.000	1989	860.000
1990	1400.000	1991	400.000
1992	270.000	1993	120.000
1994	35.000	1995	35.000
1996	680.000	1997	1496.379
1998	169.388	1999	879.501

Log Mean = 2.50595
Log Skew = -0.43864
Log Std. Dev. = 0.49235
Log Coef. of Skew = -0.43864

Tr (Years)	%Tr	KTr	KTr*S	Log(Qtr)	QTr
1.0001	99.99	-4.6836	-2.3060	0.2000	1.5847
1.0005	99.95	-4.0211	-1.9798	0.5261	3.3585
1.0010	99.90	-3.7220	-1.8326	0.6734	4.7141
1.0020	99.80	-3.4127	-1.6802	0.8257	6.6943
1.0050	99.50	-2.9846	-1.4695	1.0365	10.8767
1.0101	99.00	-2.6426	-1.3011	1.2049	16.0279
1.0204	98.00	-2.2805	-1.1228	1.3832	24.1635
1.0256	97.50	-2.1586	-1.0628	1.4431	27.7418
1.0417	96.00	-1.8919	-0.9315	1.5745	37.5370
1.0526	95.00	-1.7597	-0.8664	1.6396	43.6082
1.1111	90.00	-1.3192	-0.6495	1.8565	71.8539
1.2500	80.00	-0.8133	-0.4004	2.1055	127.5093
1.4286	70.00	-0.4668	-0.2298	2.2761	188.8491
1.6667	60.00	-0.1828	-0.0900	2.4160	260.5940
1.7532	57.04	-0.1051	-0.0517	2.4542	284.5908
2.0000	50.00	0.0729	0.0359	2.5418	348.2063
2.3277	42.96	0.2462	0.1212	2.6272	423.8280
2.5000	40.00	0.3192	0.1571	2.6631	460.3509
3.3333	30.00	0.5724	0.2818	2.7878	613.4603
5.0000	20.00	0.8556	0.4213	2.9272	845.7186
10.0000	10.00	1.2254	0.6033	3.1093	1286.0504
20.0000	5.00	1.5110	0.7439	3.2499	1777.8220
25.0000	4.00	1.5909	0.7833	3.2892	1946.4590
40.0000	2.50	1.7447	0.8590	3.3650	2317.2003
50.0000	2.00	1.8118	0.8920	3.3980	2500.3007
100.0000	1.00	2.0005	0.9850	3.4909	3096.7105
200.0000	0.50	2.1651	1.0660	3.5719	3732.0506
500.0000	0.20	2.3545	1.1592	3.6652	4625.7491
1000.0000	0.10	2.4809	1.2215	3.7274	5338.3182
[illegible]00.0000	0.05	2.5954	1.2779	3.7838	6078.7393
[illegible]000.0000	0.01	2.8254	1.3911	3.8970	7889.1768

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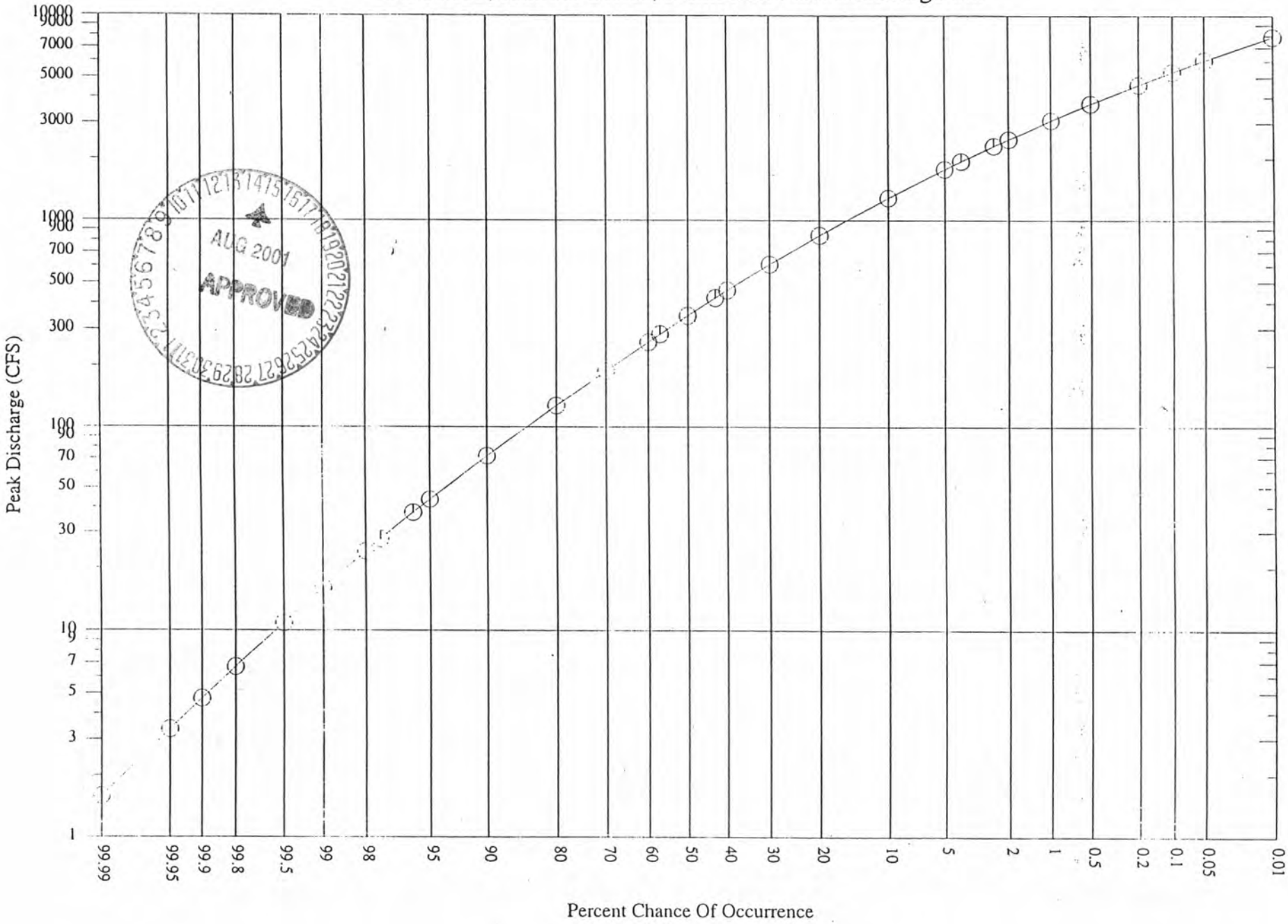
FLUM15, Annual Series, Minimum Peak Discharge 0.0



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APPENDIX B

SEDCAD4 (Input and Output) 10-Year, 24-Hour Storm Event

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PEABODY WESTERN

KM-3A Pond

10-year, 24-hour

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AUG 2001

DJK

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	2.100 inches

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond Km-3

#1
Pond

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	66.100	66.100	52.84	4.79
	Out			0.00	0.00

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Structure Detail:

Structure #1 (Pond)

Pond Km-3

Pond Inputs:

Initial Pool Elev:	6,494.01
Initial Pool:	17.12 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,505.00	22.00	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	6,499.62
Dewater Time:	0.00 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,494.00	0.010	0.000	0.000		
6,494.01	0.011	0.000	0.000		
6,494.50	0.059	0.016	0.000		
6,495.00	0.147	0.065	0.000		
6,495.50	0.274	0.169	0.000		
6,496.00	0.440	0.346	0.000		
6,496.50	0.616	0.608	0.000		
6,497.00	0.821	0.966	0.000		
6,497.50	1.056	1.434	0.000		
6,498.00	1.320	2.027	0.000		
6,498.50	1.481	2.727	0.000		
6,499.00	1.651	3.510	0.000		
6,499.50	1.831	4.380	0.000		
6,499.62	1.880	4.610	0.000	0.00	Peak Stage
6,500.00	2.020	5.342	0.000		
6,500.50	2.081	6.367	0.000		
6,501.00	2.143	7.424	0.000		

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,501.50	2.206	8.511	0.000		
6,502.00	2.270	9.630	0.000		
6,502.50	2.341	10.782	0.000		
6,503.00	2.413	11.971	0.000		
6,503.50	2.486	13.195	0.000		
6,504.00	2.560	14.457	0.000		
6,504.50	2.664	15.763	0.000		
6,505.00	2.771	17.122	0.000		Spillway #1
6,505.50	2.879	18.534	2.599		
6,506.00	2.990	20.001	48.727		
6,506.50	3.111	21.527	102.916		
6,507.00	3.234	23.113	174.092		
6,507.50	3.360	24.761	262.576		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,494.00	0.000	0.000
6,494.01	0.000	0.000
6,494.50	0.000	0.000
6,495.00	0.000	0.000
6,495.50	0.000	0.000
6,496.00	0.000	0.000
6,496.50	0.000	0.000
6,497.00	0.000	0.000
6,497.50	0.000	0.000
6,498.00	0.000	0.000
6,498.50	0.000	0.000
6,499.00	0.000	0.000
6,499.50	0.000	0.000
6,500.00	0.000	0.000
6,500.50	0.000	0.000
6,501.00	0.000	0.000
6,501.50	0.000	0.000
6,502.00	0.000	0.000
6,502.50	0.000	0.000
6,503.00	0.000	0.000
6,503.50	0.000	0.000

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Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,504.00	0.000	0.000
6,504.50	0.000	0.000
6,505.00	0.000	0.000
6,505.50	2.599	2.599
6,506.00	48.727	48.727
6,506.50	102.916	102.916
6,507.00	174.092	174.092
6,507.50	262.576	262.576

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	66.100	0.131	0.000	0.000	85.000	F	52.84	4.788
	$\sum$	**66.100**						**52.84**	**4.788**

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APPENDIX C

SEDCAD4 (Input and Output) 25-Year, 6-Hour Storm Event

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PEABODY WESTERN
KM-3A Pond

25-year, 6-hour

AUG 2001
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DJK

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.900 inches

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AUG 2001

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond Km-3

#1
Pond

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	66.100	66.100	64.30	3.98
	Out			17.57	3.98

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Structure Detail:

Structure #1 (Pond)

Pond Km-3

Pond Inputs:

Initial Pool Elev:	6,505.00
Initial Pool:	17.12 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,505.00	22.00	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	6,505.66
Dewater Time:	1.84 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,494.00	0.010	0.000	0.000	
6,494.50	0.058	0.015	0.000	
6,495.00	0.146	0.065	0.000	
6,495.50	0.273	0.168	0.000	
6,496.00	0.440	0.344	0.000	
6,496.50	0.616	0.607	0.000	
6,497.00	0.821	0.965	0.000	
6,497.50	1.056	1.433	0.000	
6,498.00	1.320	2.026	0.000	
6,498.50	1.481	2.726	0.000	
6,499.00	1.651	3.508	0.000	
6,499.50	1.831	4.379	0.000	
6,500.00	2.020	5.341	0.000	
6,500.50	2.081	6.366	0.000	
6,501.00	2.143	7.422	0.000	
6,501.50	2.206	8.509	0.000	
6,502.00	2.270	9.628	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,502.50	2.341	10.781	0.000		
6,503.00	2.413	11.970	0.000		
6,503.50	2.486	13.194	0.000		
6,504.00	2.560	14.456	0.000		
6,504.50	2.664	15.762	0.000		
6,505.00	2.771	17.120	0.000		Spillway #1
6,505.50	2.879	18.533	2.599	41.15	
6,505.66	2.916	19.009	17.572	2.90	Peak Stage
6,506.00	2.990	20.000	48.727		
6,506.50	3.111	21.525	102.916		
6,507.00	3.234	23.111	174.092		
6,507.50	3.360	24.760	262.576		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,494.00	0.000	0.000
6,494.50	0.000	0.000
6,495.00	0.000	0.000
6,495.50	0.000	0.000
6,496.00	0.000	0.000
6,496.50	0.000	0.000
6,497.00	0.000	0.000
6,497.50	0.000	0.000
6,498.00	0.000	0.000
6,498.50	0.000	0.000
6,499.00	0.000	0.000
6,499.50	0.000	0.000
6,500.00	0.000	0.000
6,500.50	0.000	0.000
6,501.00	0.000	0.000
6,501.50	0.000	0.000
6,502.00	0.000	0.000
6,502.50	0.000	0.000
6,503.00	0.000	0.000
6,503.50	0.000	0.000
6,504.00	0.000	0.000
6,504.50	0.000	0.000

AUG 2001
APPROVED

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,505.00	0.000	0.000
6,505.50	2.599	2.599
6,506.00	48.727	48.727
6,506.50	102.916	102.916
6,507.00	174.092	174.092
6,507.50	262.576	262.576

AUG 2001
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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	66.100	0.131	0.000	0.000	85.000	F	64.30	3.981
	Σ	**66.100**						**64.30**	**3.981**

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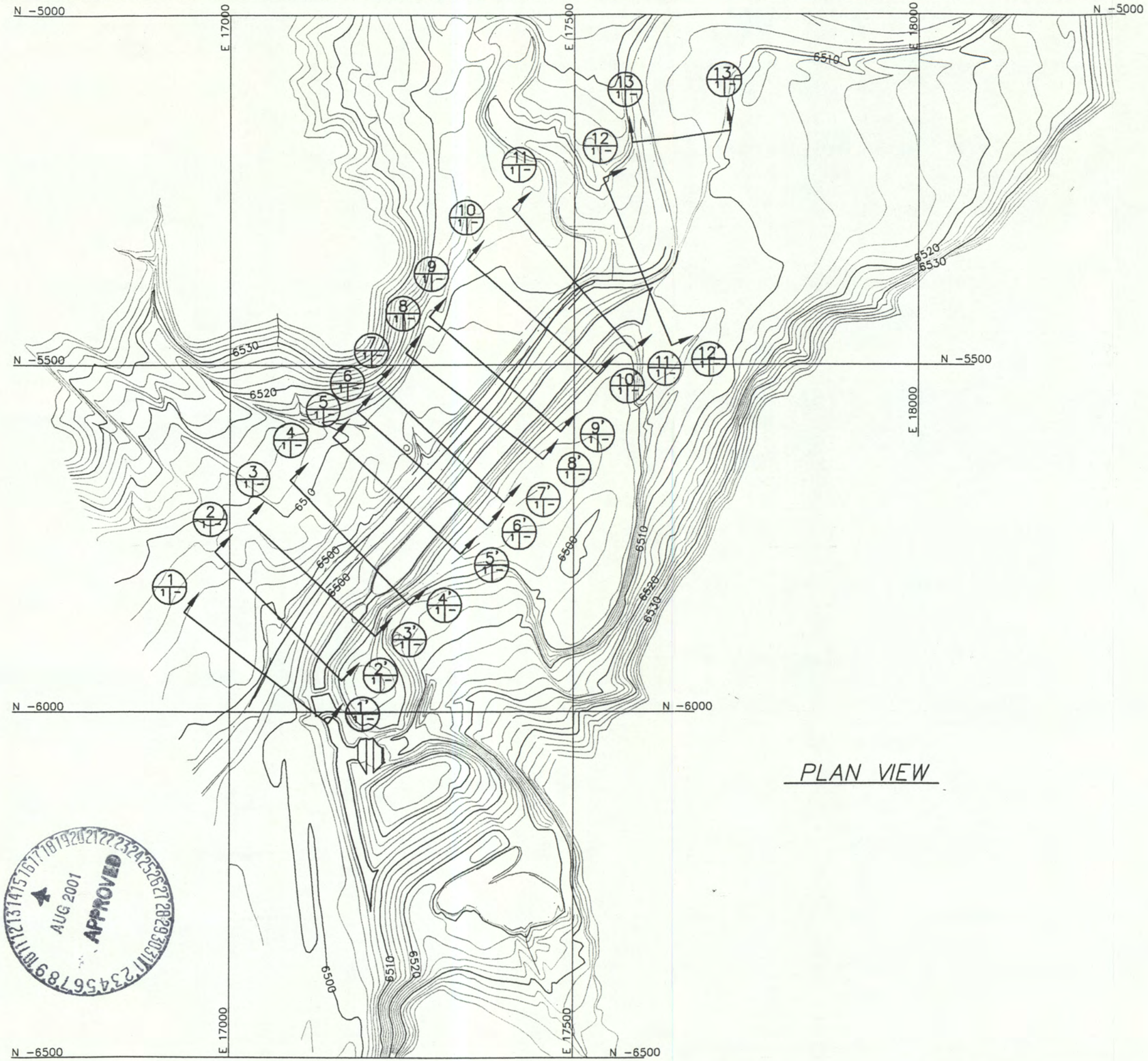
AUG 2001



PLAN VIEW

SCALE

100' 0 100' 200'

CONTOUR INTERVAL 2FT.

APPROVED AUG 2001

REV. NO.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Draft	5/01	C.Burger	T.Holm	T.Leidich

PEABODY WESTERN COAL COMPANY

PROJECT:

DRAWING TITLE: KM-A3 POND PLAN VIEW

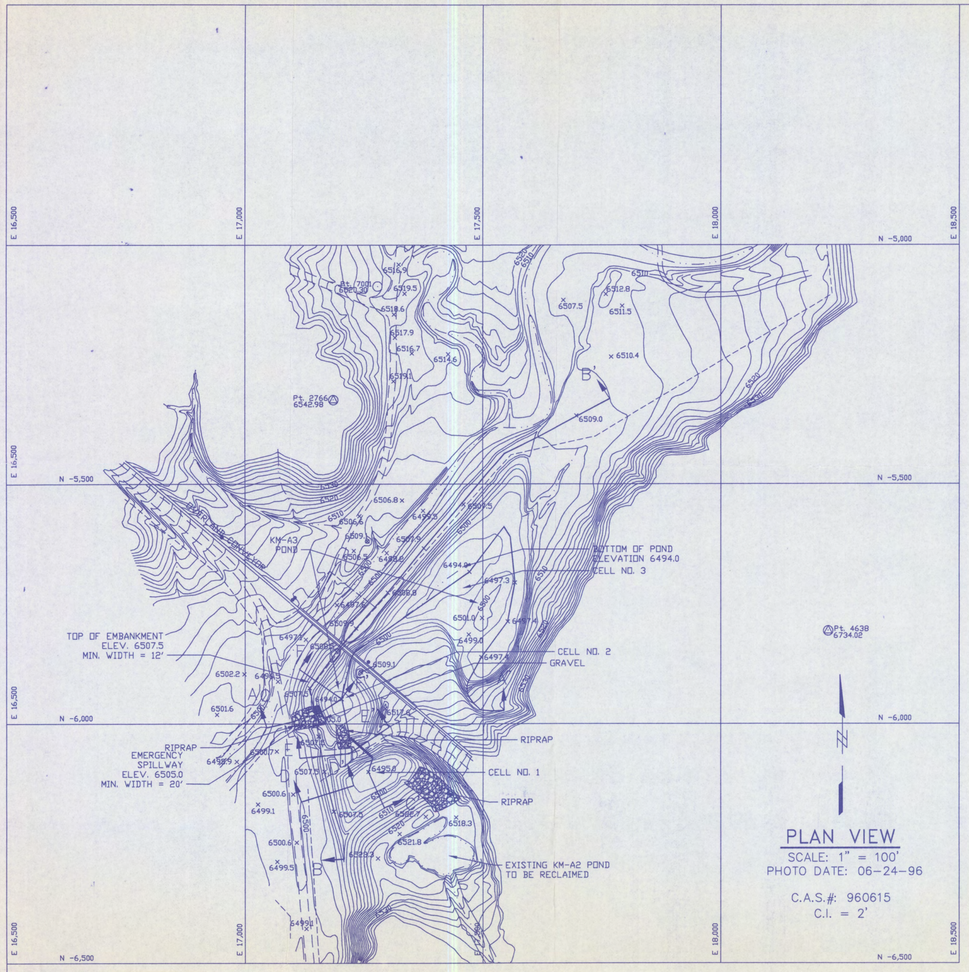
MONTGOMERY WATSON

Sheet 1 Of 1 Sheets

SCALE: As Shown

DRAWING No. 1

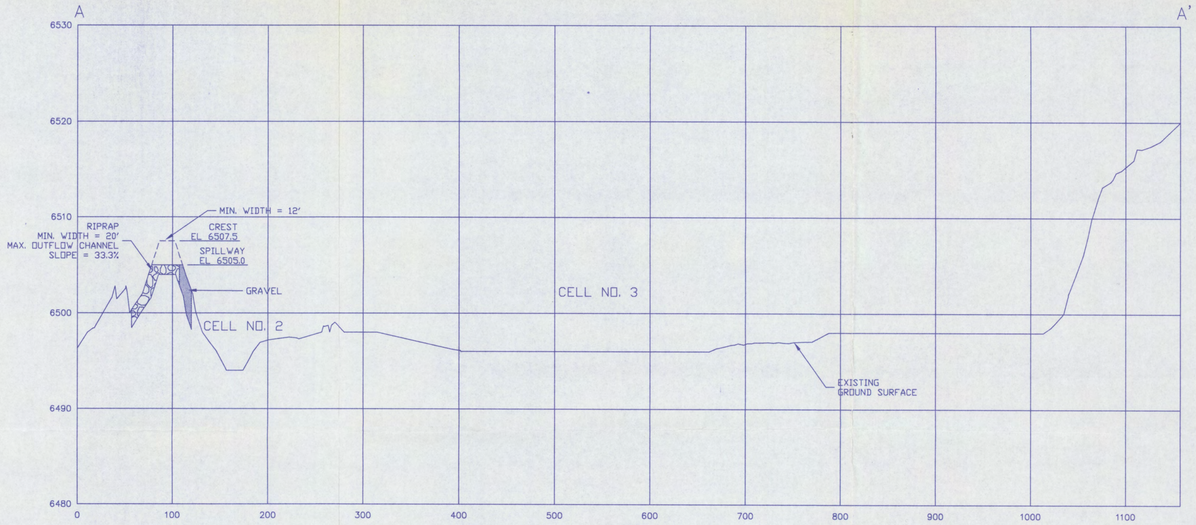
AutoCAD FILE: KM-A3 Pond.dwg PROJECT NUMBER: 2470172



PLAN VIEW

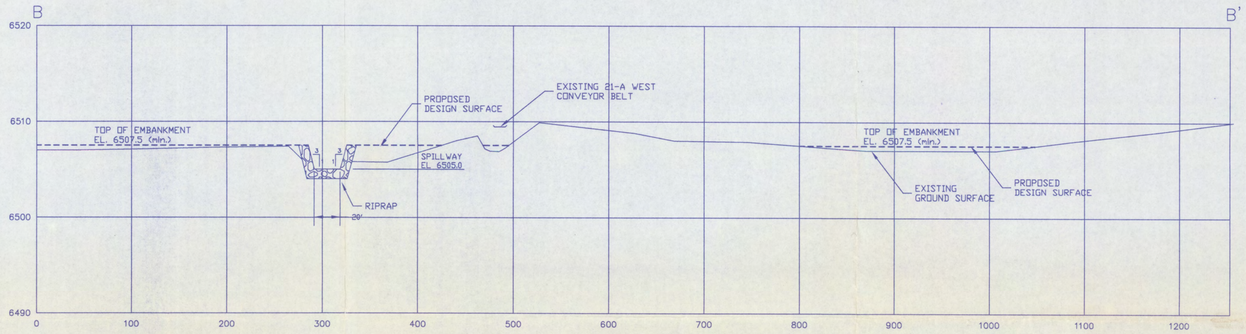
SCALE: 1" = 100'
PHOTO DATE: 06-24-96

C.A.S.#: 960615
C.I. = 2'



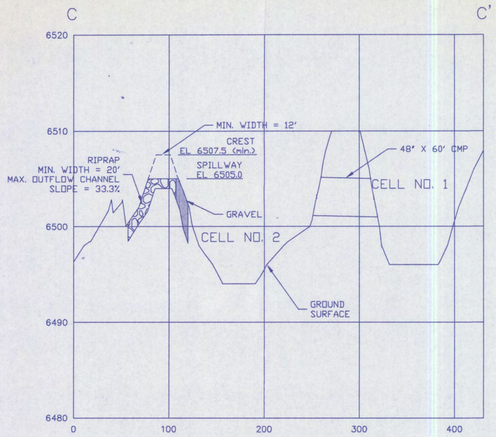
SECTION A – A'

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



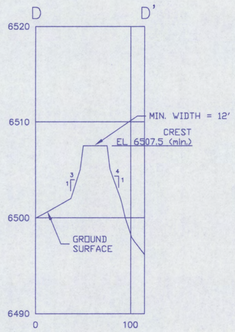
SECTION B – B'

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



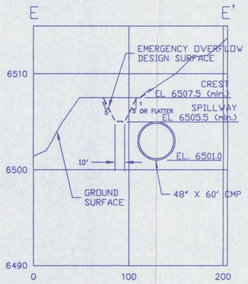
SECTION C – C'

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



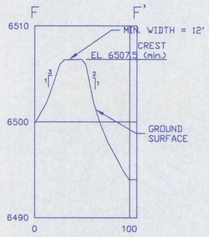
SECTION D – D'

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



SECTION E – E'

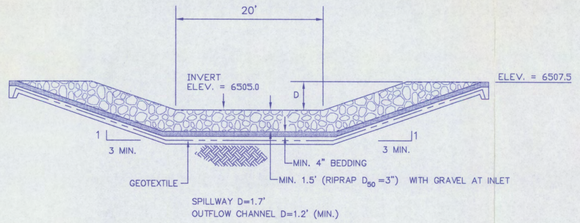
SCALE: HORIZ. 1"=50'
VERT. 1"=5'



SECTION F – F'

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

NOTE: MIN. REQUIRED UPSTREAM SLOPES = 2H:1V,
MIN. REQUIRED DOWNSTREAM SLOPES = 3H:1V



KM-A3 POND
TYPICAL CROSS-SECTION OF EMERGENCY SPILLWAY

NOT TO SCALE

APPROVED AUG 2001

KM-A3 POND STAGE-CAPACITY TABLE

Elevation (ft-msl)	Stage (ft)	Area (Acres)	Capacity (ac-ft)	Description
6494.0	0.0	0.01	0.00	BOTTOM OF POND
6496.0	2.0	0.44	0.34	
6498.0	4.0	1.32	2.03	
6500.0	6.0	2.02	5.34	
6502.0	8.0	2.27	9.63	
6504.0	10.0	2.56	14.46	
6505.0	11.0	2.77	17.12	EMERGENCY SPILLWAY
6506.0	12.0	2.99	20.00	
6507.5	12.5	3.36	24.76	TOP OF EMBANKMENT

NOTE: MAXIMUM SEDIMENT/BASE INFLOW ELEVATION = 6503.0 OR THE ELEVATION BELOW THE E.S. TO STORE 4.8 AC.-FT.

NOTES:

1) General Location, See Drawing No. 85400, Sheet K-7.
2) See Chapter 6, Kayenta PAP for Construction Specifications.
3) See Volume 2, Chapter 6, Attachment D, Sections 1-3 for Descriptions of Geotechnical Evaluation.
4) Salvage Topsoil in Accordance with Approved Topsoil Salvage Plan.
5) Reclamation of the Disturbed Area Shall be in Accordance with the Approved Reclamation Plan.

ENGINEER'S CERTIFICATION

JAMES G. SCHULTZ
ENGINEERING & RECLAMATION MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE: FEB 07 2001

REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
KM-A3 POND
REVISED DESIGN

KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P.O BOX 650 KAYENTA, ARIZONA 86033

DESIGNED BY: MW	SCALE: AS SHOWN
DRAWN BY: TH	DRAWING DATE: 12/2000
CHECKED BY: JGS	PHOTO DATE: 06-24-96
CONTOUR INT.: 2'	

DWG FILE: 020701_KMA3Pond.dwg

INSPECTION REPORT

Sedimentation Structure

KM-B

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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Outflow Channel	6
STORAGE CAPACITY	6
REMEDIAL COMPLIANCE PLAN	7
GEOTECHNICS	7
HYDRAULICS	8

APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INSPECTION REPORT

Sedimentation Structure

KM-D

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
13376
LUTZ
KUNZE
Date Signed 11-22-85
ARIZONA, U.S.A.

Dames & Moore
10139-011-22

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APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure KM-D 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-D is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure KM-D. 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-D was inspected on September 5, 1985 by an interdisciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the KM-D 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-D has a 19.1-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 65% disturbed and 35% Pinion/Juniper.

EMBANKMENT

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

Structure KM-D

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	8.1 ft
Crest Width	12 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-D, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

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

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.356	mi
2.	Elevation Difference, H	124	ft
3.	Time of Concentration, T_c	0.123	h
4.	Lag time, $0.6T_c$	0.074	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	19.1	acres

HYDRAULICS

Structure KM-D does not have a spillway. Therefore, the hydraulic analysis is presented in the remedial compliance plan.

Spillway Channel

The structure does not have a spillway channel.

Outflow Channel

The structure presently has no outflow channel.

STORAGE CAPACITY

Analysis of the storage capacity is presented in the remedial compliance plan.

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

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

HYDRAULICS

Structure KM-D has sufficient storage capacity but it does not have a spillway or outflow channel. A trapezoidal spillway channel should be constructed at elevation 6545.0 feet. The embankment crest elevation should be raised to elevation 6547.60 feet. The outflow channel and stilling basin should be constructed along the alignment shown in Plate 1. The spillway channel, outflow channel, and stilling basin profile is shown in Plate 4 and the required dimensions are shown in Plate 5. The spillway, outflow channel, and stilling basin should be protected against erosion using geotextile and riprap 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-C and into Structure KM-D. The initial conditions and results of the analysis are summarized in the following table.

KM-D 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	35	85	
Volume	acre-ft	1.78*	1.48*	
Storage				
Peak Stage	ft	6543.33	6546.59	
Spillway Elevation . .	ft	6545.00	--	
Peak Storage	acre-ft	2.21	--	
Storage Capacity . . .	acre-ft	3.23	--	
Outflow				
Peak Flow	cfs	0	49	
Embankment Crest Elevation	ft	--	6547.60	
Peak Stage	ft	--	6546.59	
Freeboard	ft	--	1.01	
Spillway Channel				
Flow Depth	ft	--	1.59	
Critical Velocity . .	fps	--	4.4	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	6	24
Normal Velocity . . .	fps	--	5.6	8.7
Normal Depth	ft	--	0.53	0.35
Manning's "n"		--	0.040	0.040

*Inflow volume for tributary drainage area between Structures KM-C and KM-D.

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-D.

The calculations for the sediment load entering Structure KM-D 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 3.00
4. Cover Factor, C 0.70
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. Structure KM-D is located downstream from Structure KM-C and receives excess flow from KM-C during the 10-year, 24-hour storm. Therefore, the storage capacity of the two structures must be combined to determine the available sediment storage life. The 10-year, 24-hour storm was routed through KM-C and into KM-D. The results of this analysis are summarized below.

KM-C AND KM-D COMBINED STORAGE

	KM-C	KM-D	Total	
Total Storage Capacity	2.14	3.23	5.37	acre-ft
10-year, 24-hour Storm Inflow	2.57	1.78	4.35	acre-ft
Available Sediment Storage Capacity . .	--	--	1.02	acre-ft
Sediment Inflow Rate	0.22	0.164	0.384	acre-ft/yr
Sediment Storage Life	--	--	3	yrs

* * *

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

Plate 1 - Site Plan KM-D

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

Plate 3 - Volume-Elevation Curve KM-D

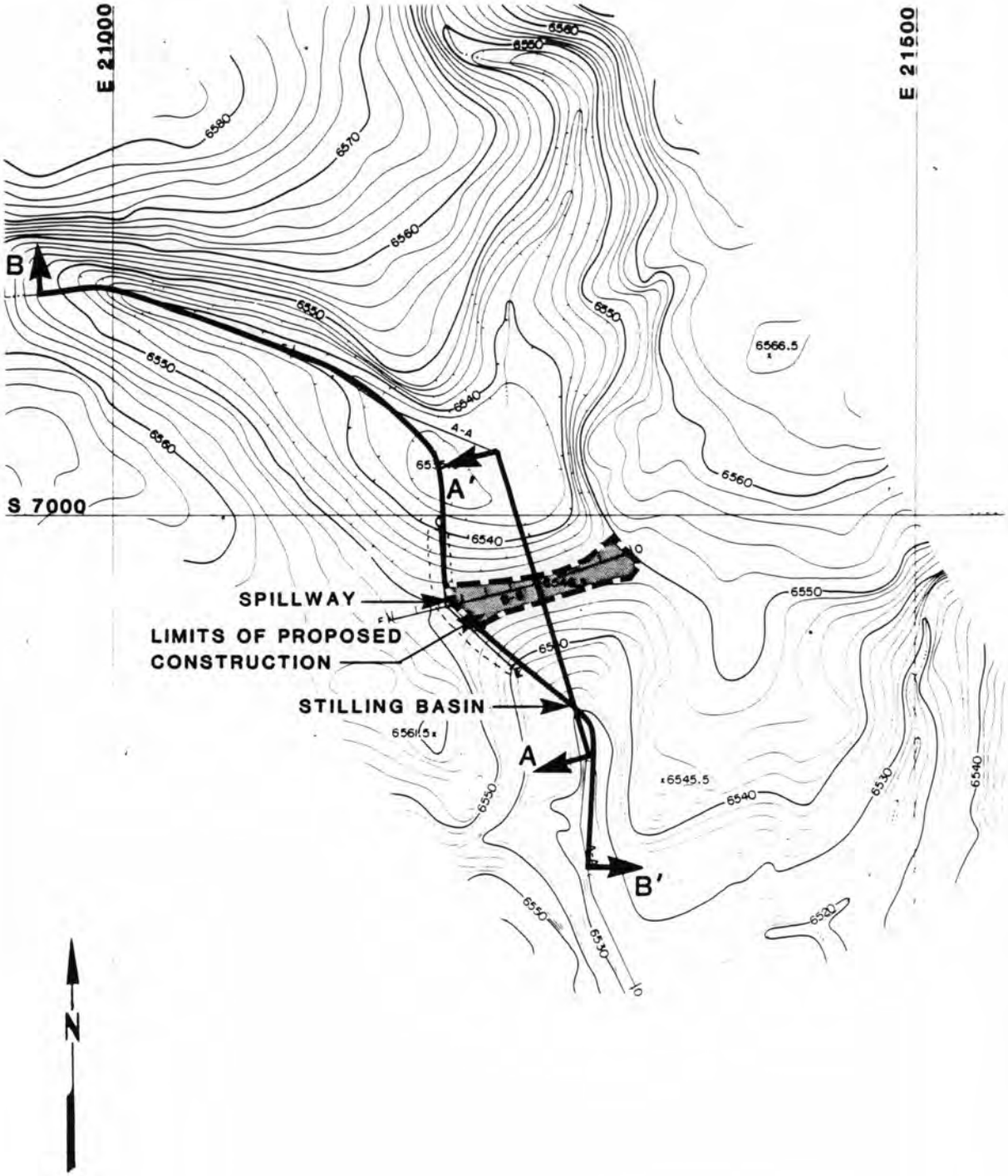
Plate 4 - Channel Profile KM-D, B-B'

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

Plate 6 - Spillway Stilling Basin Plan KM-D

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SCALE
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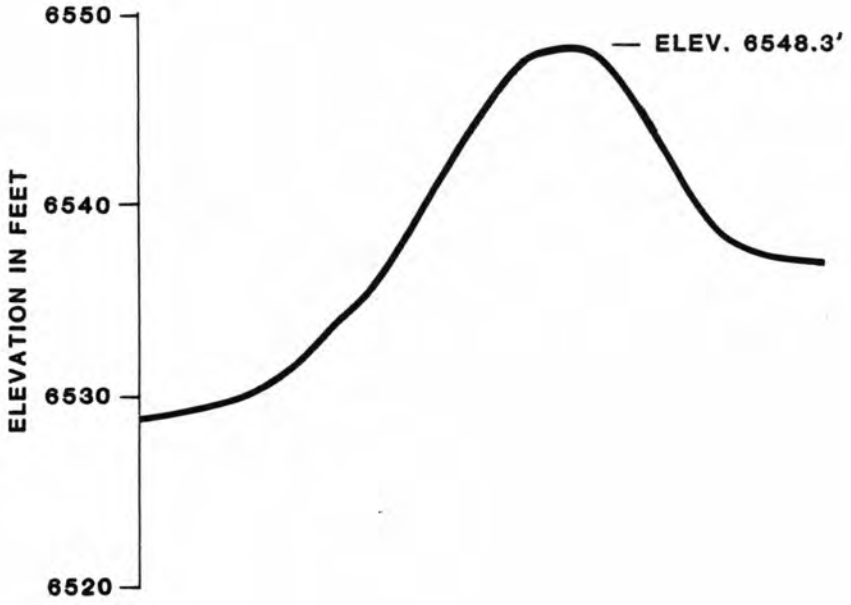
FEET

SITE PLAN
KM-D

BY **Dames & Moore** Plate 1

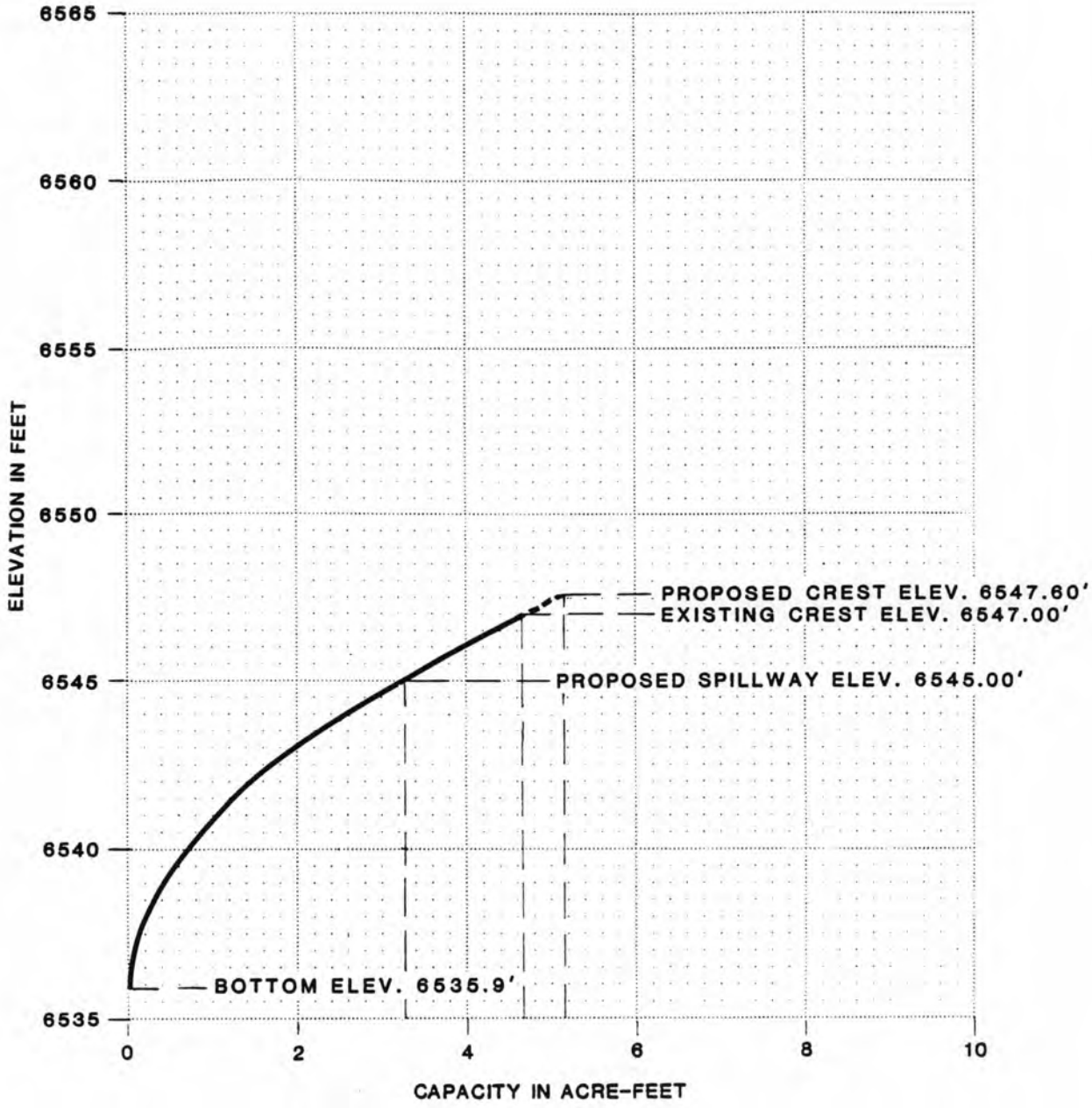


EXISTING MAXIMUM CROSS-SECTION A-A' KM-D

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

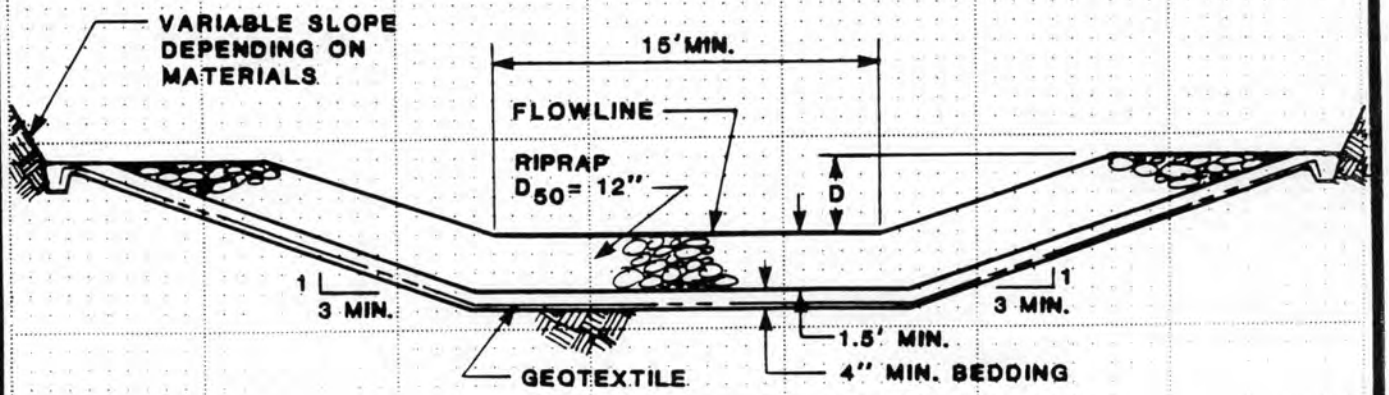
Plate 2



VOLUME-ELEVATION CURVE

KM-D

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.6'

LENGTH = 30'

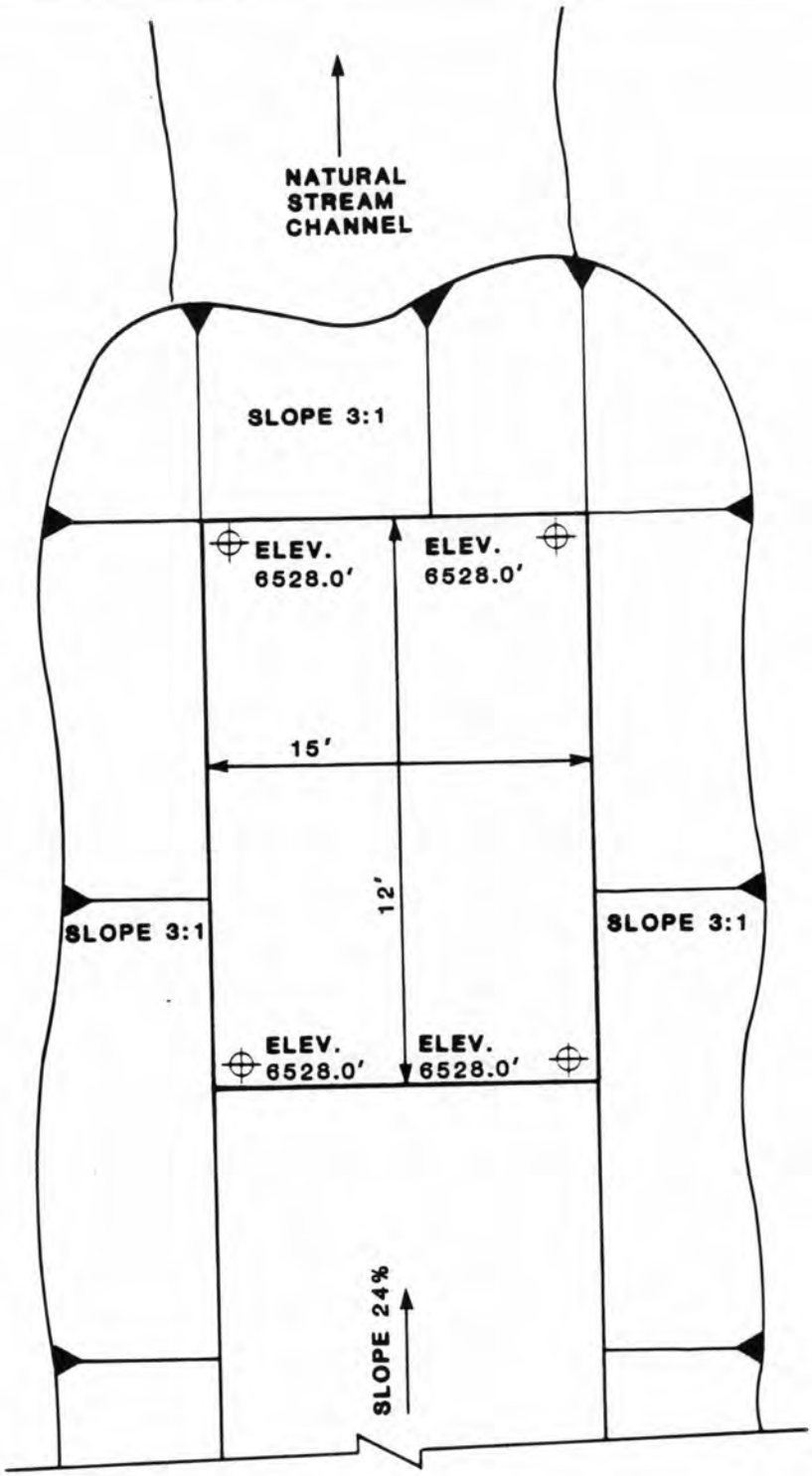
FLOWLINE ELEV. = 6545.00'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION KM-D

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 3.3'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAMBED = 1.8'

SPILLWAY STILLING BASIN PLAN

KM-D

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: KM-D
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			12'
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			16°
a. Adequate grass cover?	X		70
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		Grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			16°
a. Adequate grass cover?	X		70
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	
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

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			No Spillway
a. Location:			See Comment
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?			
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: KM - D
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	

9. GENERAL COMMENTS

No Spill way - Should be on embankment towards L.A.

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

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

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6670 − 6546 = 124 ft.

WATER COURSE LENGTH = 4.7 (400) = 1880 ft. = 0.356 mi.

$$T_c = \left(\frac{11.9\,(0.356)^3}{124}\right)^{0.385} = 0.123 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.074 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)		COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
6.6	(35%)	P-J	ave	D	0.35 (83) = 29.1
12.5	(65%)	DISTURBED (GRAVEL RD)	—	D	0.65 (91) = 59.2
					88.3

50% EH #33
50% EH #25

USE 89

DRAINAGE BASIN AREA

19.1 ACRE 0.030 SQ MILE

CHECKED BY S. DOLAN DATE 9-10-85
COPY TO EO ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =	50%	EH # 33	.5 (.22)
	50%	EH # 22	.5 (.22)

K = .22

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
800	50	7%	2.35 (60%)
300	40	14%	3.98 (40%)

use 3.00

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
35%	P-J	40	25	.35 (.14)
65%	disturbed			.65 (1.0)

C = .70

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

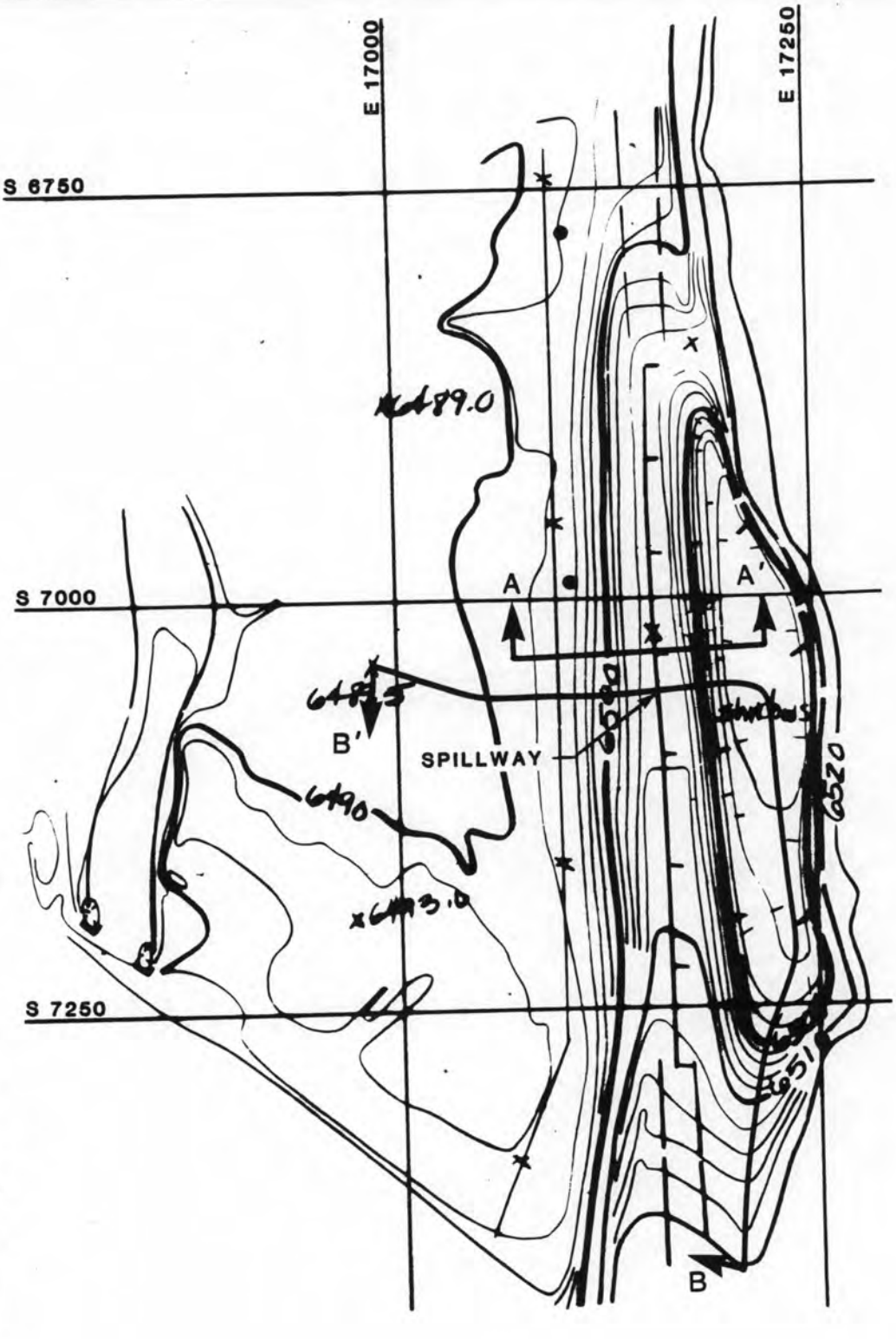
EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.22)(3.00)(.70)(1.0) = 18.48$ ton/acre/year

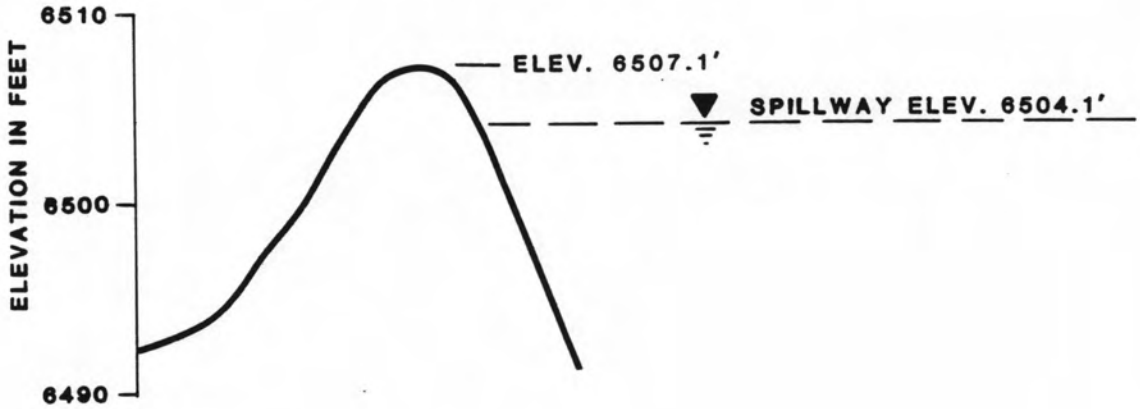
$A = 18.48\left(\frac{1}{2047}\right)(19.1)(.95) = .164$ acre-feet/year

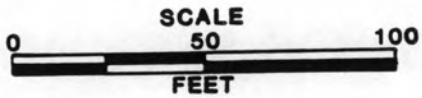


SITE PLAN
KM-B

SCALE
0 100 200
FEET

BY **Dames & Moore** Plate 1



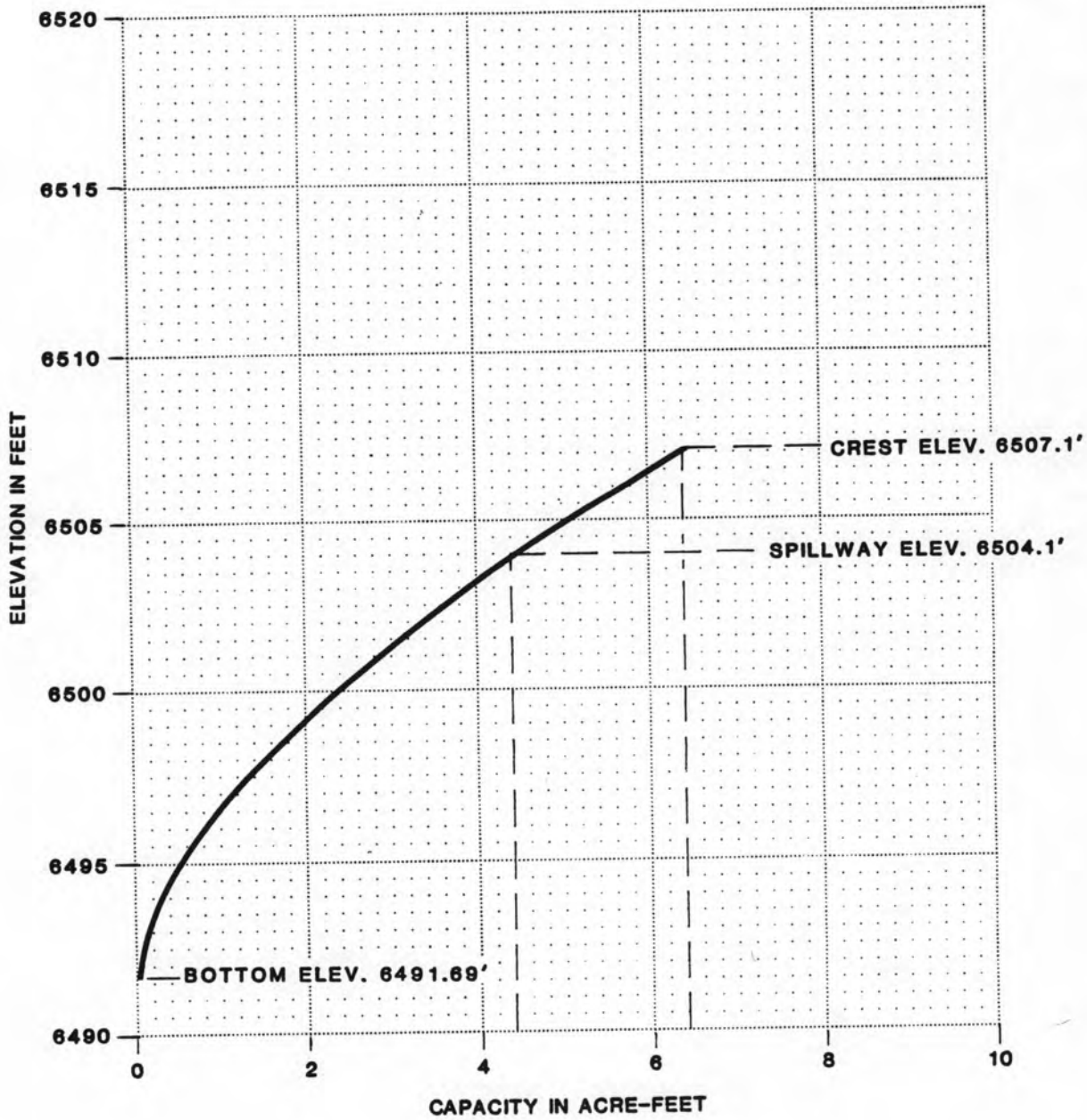


MAXIMUM CROSS-SECTION
A-A'
KM-B

FOR LOCATION SEE PLATE 1

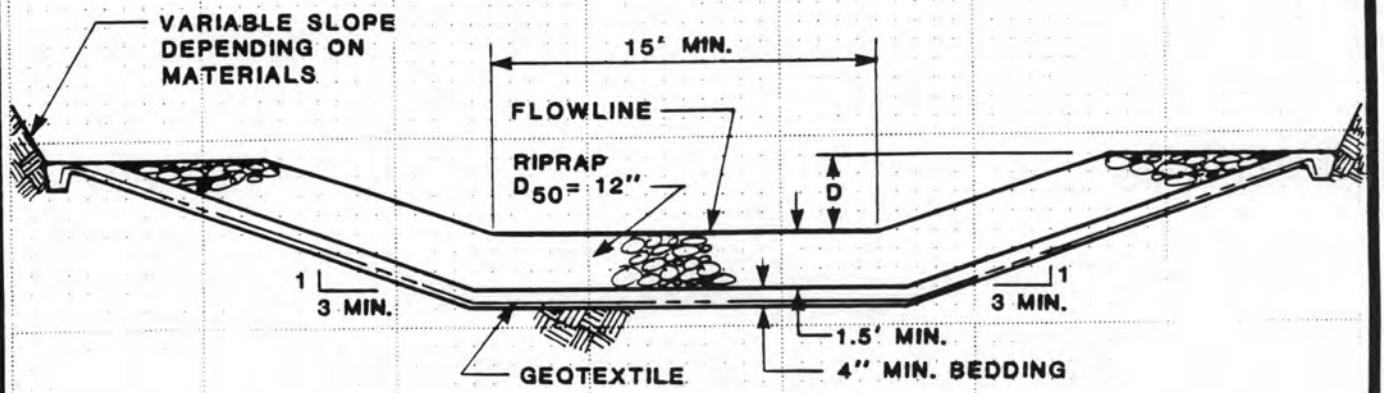
BY **Dames & Moore**

Plate 2



VOLUME-ELEVATION CURVE
KM-B

BY **Dames & Moore** Plate 3



OUTFLOW CHANNEL

D = 1'

OUTFLOW CHANNEL CROSS SECTION KM-B

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: KM-B
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			21' wide
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			28°
a. Adequate grass cover?	X		75%
b. Any erosion?	X		1 Gulley / Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		GRASS
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			17°
a. Adequate grass cover?	X		50%
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		Some Sloughing of Steep ABUT. in Pond
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Rock / brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Major Gulley into Pond - U.S
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Fill from Navajo 41 / Rock

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		Near RA
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
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?	X		ENTRANCE RIPRAP 8 WIDE 50 LONG
d. Outflow Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		GRASS 80% + ROCK
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.) feet
c. Siltation?	X		
d. Watershed matches soil map?		X	

9. GENERAL COMMENTS

CANOPY COVER
GROUND COVER

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

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

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6610 − 6504 = 106 ft.

WATER COURSE LENGTH = 4.0(400) = 1600 ft. = 0.303 mi.

$$T_c = \left(\frac{11.9\,(0.303)^3}{106}\right)^{0.385} = 0.109 \text{ hr.}$$

LAG TIME = $0.6T_c$ = 0.065 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
5.7 (25%)	DISTURBED	—	D	0.25(91) = 22.75
16.8 (75%)	P-J	avg.	D EH #24	0.75(83) = 62.25
				85.0

USE 85

DRAINAGE BASIN AREA

22.5 ACRE 0.035 SQ. MILE

Y. S. DOLAN DATE 9-10-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

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

FILE PEABODY COAL CO 10129-01-22
SUBJECT SEDIMENT INFLOW
KM-B SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

K = 47

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% ~~CH~~ # 24 1.0 (.16)

K = 0.16

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
500	160	32	19.8 (.8)
200	80	40	17.9 (.2)

use 19.4

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
25% disturbed	—	—	—	.25 (1.0)
.75	P-J	40	25	.75 (.14)

C = 0.355

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

EROSION CONTROL FACTOR

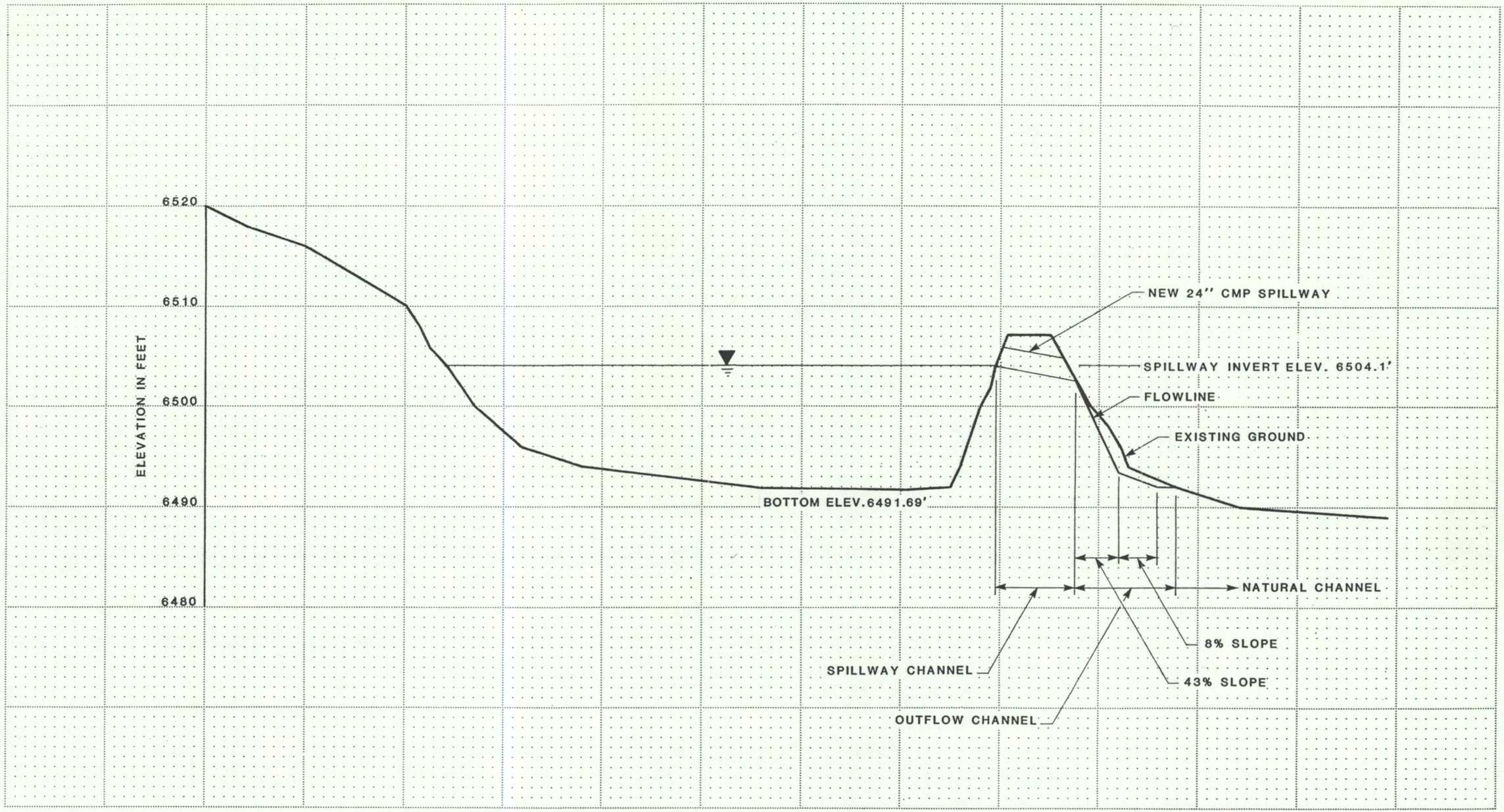
P = 1.0

SEDIMENT INFLOW

$A = 47(.16)(19.4)(.355)(1.0) = 44.08$ ton/acre/year

$A = 44.08\left(\frac{1}{2047}\right)(22.5)(.95) = .46$ acre-feet/year

Dames & Moore



SCALE
0 50 100
FEET

CHANNEL PROFILE B-B'
KM-B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

KM-C

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

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APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure KM-C 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-C is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure KM-C. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure KM-C was inspected on September 5, 1985 by an interdisciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the KM-C project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

Peabody Coal Company. The survey data developed in August 1984 was used in the analyses of the structure. Results of the field inspection are included in this report as Appendix A.

SITE DESCRIPTION

LAND USE

Structure KM-C has a 33.9-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 56% Pinion/Juniper and 44% disturbed.

EMBANKMENT

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

Structure KM-C

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	9.7 ft
Crest Width	10 ft
Upstream Slope	2.4 H : 1 V
Downstream Slope . . .	3.3 H : 1 V

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

ANALYSES

STABILITY

Structure KM-C 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 = 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 KM-C embankment is lower in height and has flatter slopes than the category standard; therefore, the embankment has factors of safety greater than the design minimum.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure KM-C is located upstream from Structure KM-D. The two structures have a combined storage capacity that is less than 20 acre-feet. Therefore, the spillway for KM-C was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure KM-C was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.258	mi
2.	Elevation Difference, H	139	ft
3.	Time of Concentration, T_c	0.081	h
4.	Lag time, $0.6T_c$	0.049	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	33.9	acres

HYDRAULICS

Structure KM-C does not have a spillway. Therefore, the hydraulic analysis is presented in the remedial compliance plan.

Spillway Channel

The structure presently has no spillway channel.

Outflow Channel

The structure presently has no outflow channel.

STORAGE CAPACITY

Analysis of the storage capacity is presented in the remedial compliance plan.

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure KM-C indicated that there are no geotechnical problems.

HYDRAULICS

Structure KM-C has sufficient storage capacity but it does not have a spillway or outflow channel. A trapezoidal spillway channel should be constructed at elevation 6564.0 feet. The dam crest should be raised to elevation 6566.6 feet. 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 riprap 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. The initial conditions and results of the analysis are summarized in the following table.

KM-C HYDRAULICS FOR NEW 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	61	75	
Volume	acre-ft	2.57	2.06	
Storage				
Peak Stage	ft	6564.93	—	
Spillway Elevation . .	ft	6564.00	--	
Peak Storage	acre-ft	--	--	
Storage Capacity . . .	acre-ft	2.14	--	
Outflow				
Peak Flow	cfs	1	45	
Embankment Crest Elevation	ft	--	6566.60	
Peak Stage	ft	--	6565.54	
Freeboard	ft	--	1.06	
Spillway Channel				
Flow Depth	ft	--	1.54	
Critical Velocity. . .	fps	--	4.2	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	4	23
Normal Velocity. . . .	fps	--	4.8	8.3
Normal Depth	ft	--	0.57	0.34
Manning's "n"		--	0.040	0.040

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-C.

The calculations for the sediment load entering Structure KM-C 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 3.06
4. Cover Factor, C 0.52
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. Constructing a new spillway at structure KM-C reduces the storage capacity so that the structure does not have sufficient storage capacity by itself. However, KM-C together with Structure KM-D located downstream gives sufficient storage for the combined drainage basin. The 10-year, 24-hour storm was routed through KM-C and KM-D. The results of this analysis are summarized below.

KM-C AND KM-D COMBINED STORAGE

	KM-C	KM-D	Total	
Total Storage Capacity	2.14	3.23	5.37	acre-ft
10-year, 24-hour Storm Inflow	2.57	1.78	4.35	acre-ft
Available Sediment Storage Capacity . .	--	--	1.02	acre-ft
Sediment Inflow Rate	0.22	0.164	0.384	acre-ft/yr
Sediment Storage Life	--	--	3	yrs

* * *

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

Plate 1 - Site Plan KM-C

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

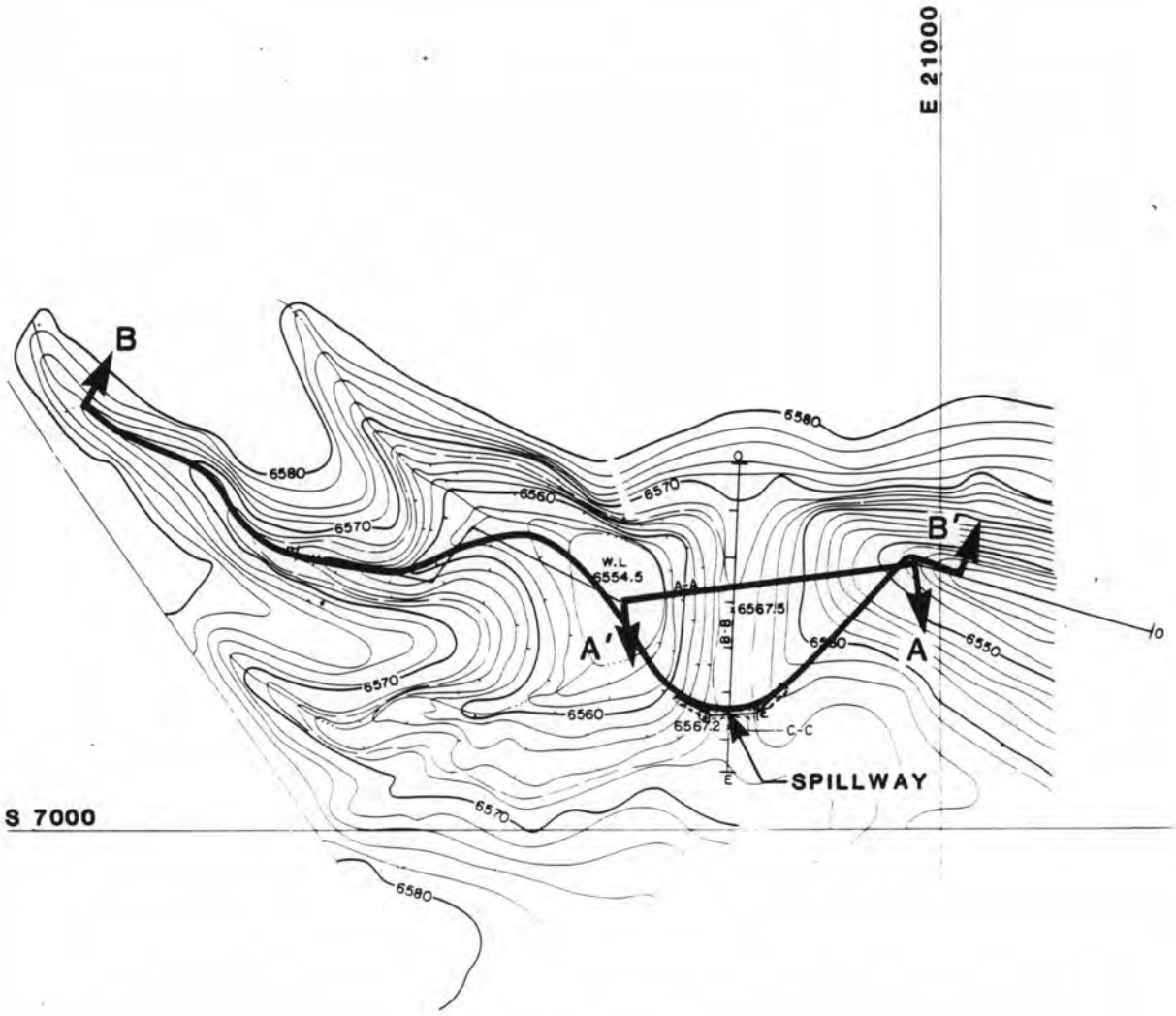
Plate 3 - Volume-Elevation Curve KM-C

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

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

Appendix A - Inspection Check List

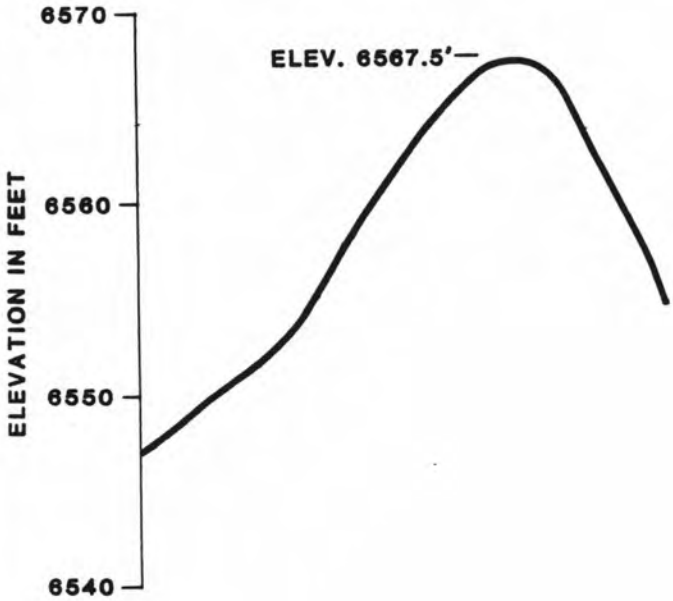
Appendix B - Hydrology and Hydraulic Calculations



SCALE
0 100 200
FEET

SITE PLAN
KM-C

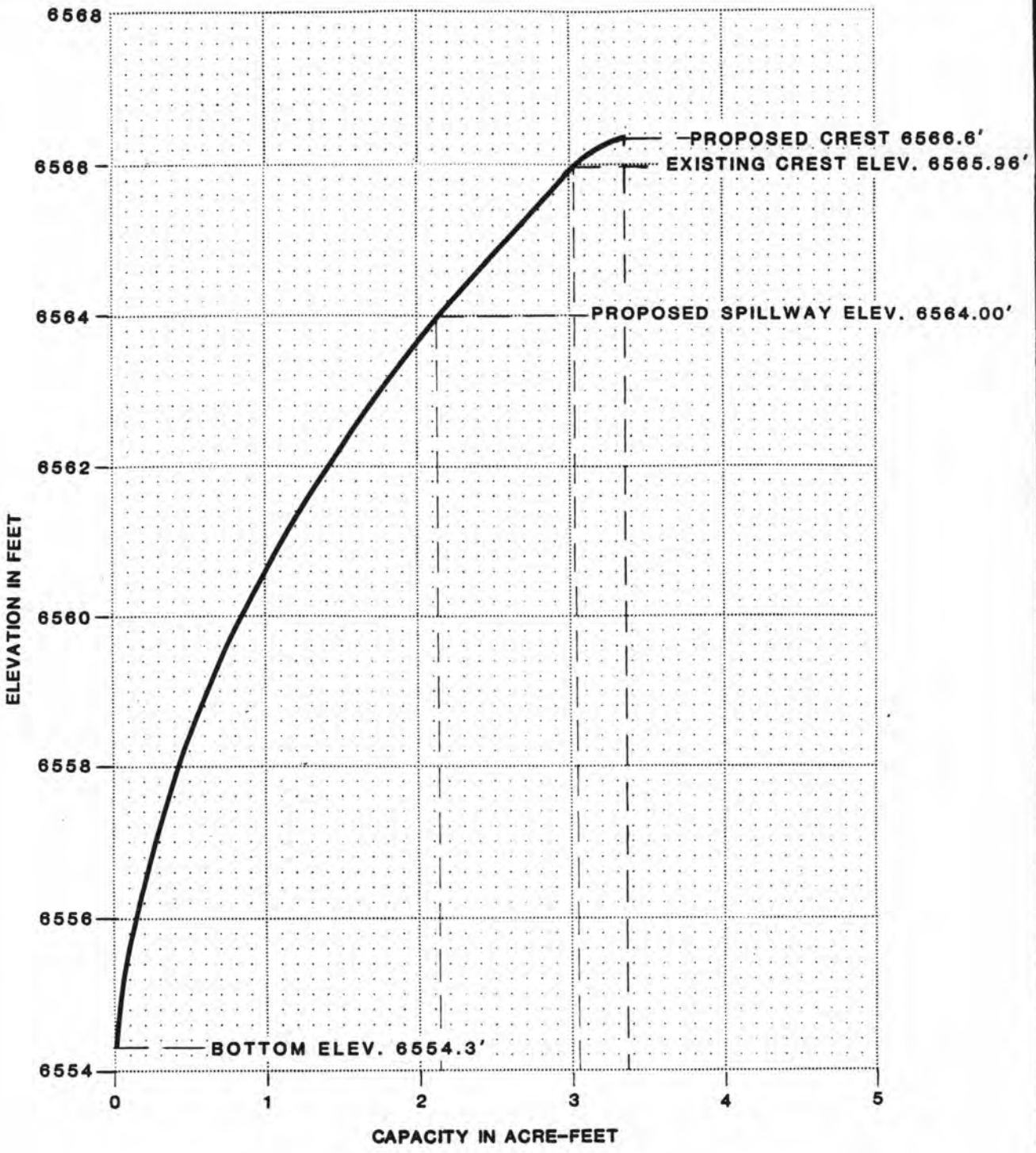
BY **Dames & Moore** Plate 1



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

FOR LOCATION SEE PLATE 1

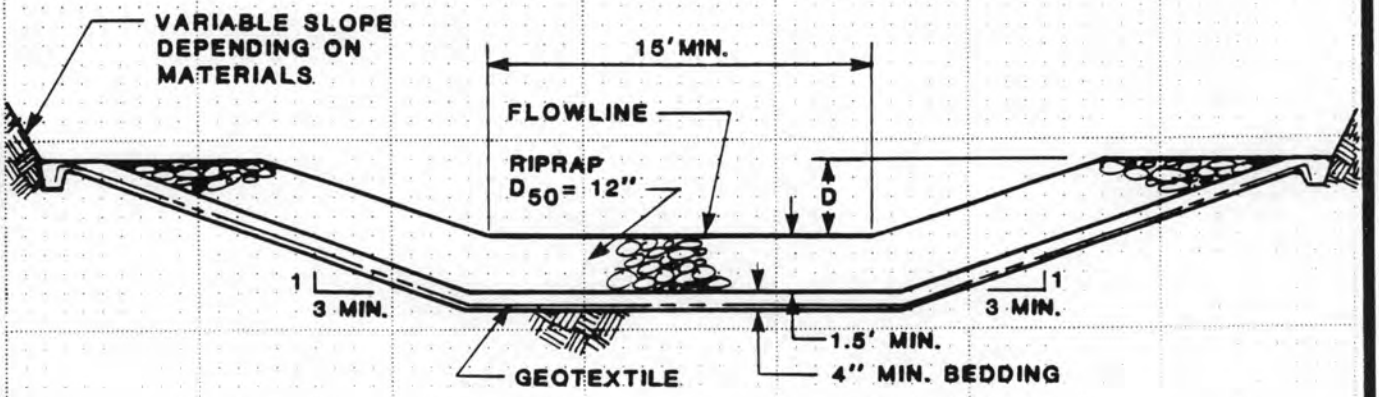
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

KM-C

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.6'

LENGTH = 30'

FLOWLINE ELEV. = 6564.00'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION KM-C

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: KM-C
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			10'w
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			23°
a. Adequate grass cover?	X		60%
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			17°
a. Adequate grass cover?	X		80%
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	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Redbrown sm rock shallow
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-C
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			NO SPILLWAY SEE COMMENT SECTION
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?			
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: KM-C
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	

9. GENERAL COMMENTS

SPILLWAY SHOULD BE IN R.A. & outlet channel down the face of the dam

Canopy cover 30 %
ground cover 60 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

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

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6704 − 6565 = 139 ft.

WATER COURSE LENGTH = 3.4(400) = 1360 ft. = 0.258 mi.

$$T_c = \left(\frac{11.9\,(0.258)^3}{139}\right)^{0.385} = 0.081 \text{ hr.}$$

LAG TIME = $0.6T_c$ = 0.049 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
19.0 (56%)	P-J	ave	D	0.56(83) = 46.5
14.9 (44%)	DISTURBED DIRT RD.	—	D	0.44(89) = 39.2
				85.7
			50% EH #33	
			50% EH #25	USE 86

DRAINAGE BASIN AREA

33.9 ACRE 0.053 SQ. MILE

BY S. DOLAN DATE 7-10-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 50% EH #33 .5(.22)
50% EH #25 .5(.22)

K = .22

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
500 ft	50	10%	3.06
500 ft	50	10%	3.06

use 3.06

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
56%	P-5	40	25	(.56).14
44%	disturbed	—	—	(.44)(1.0)

C = .52

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

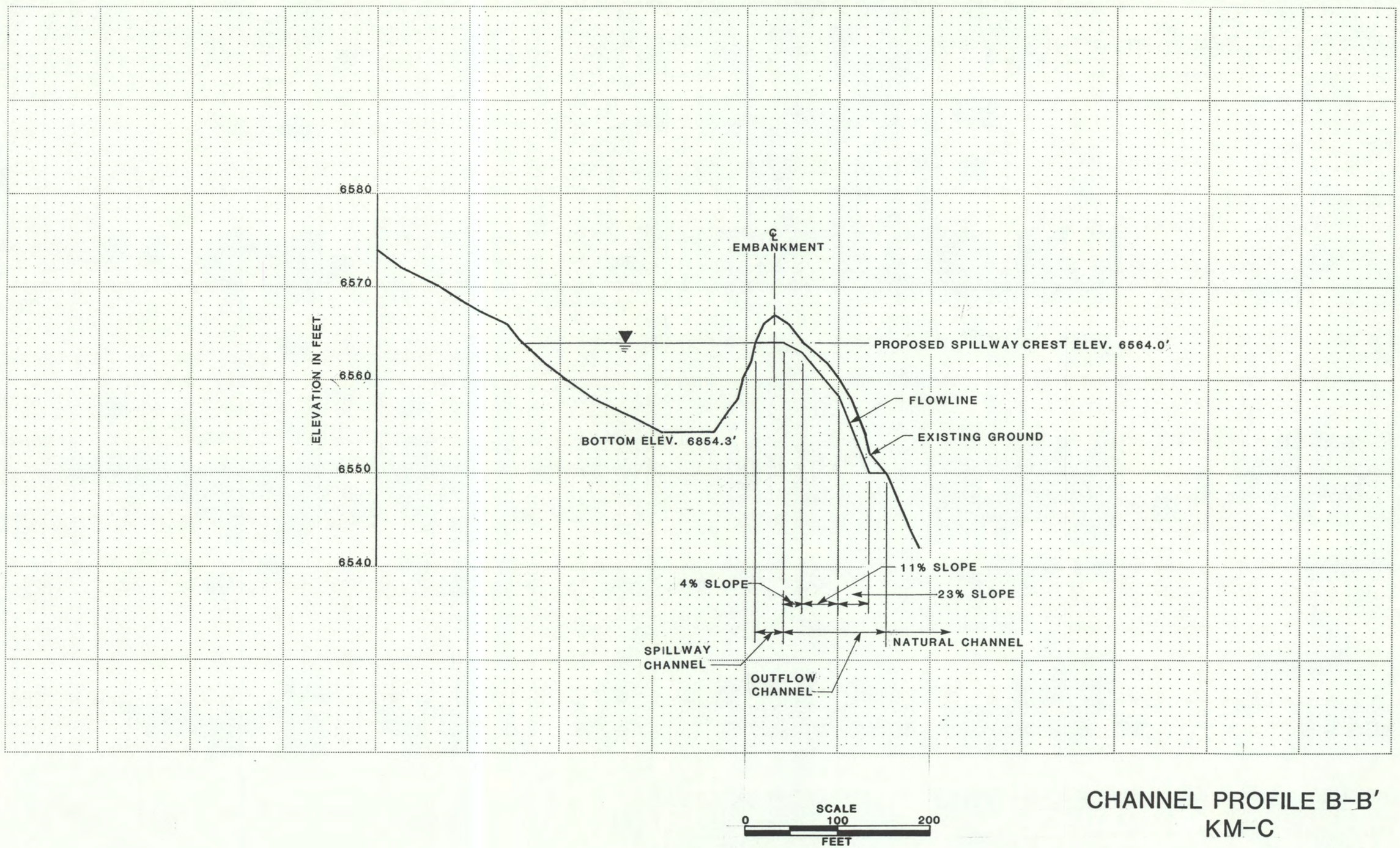
EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.22)(3.06)(.52)(1.0) = 14.00$ ton/acre/year

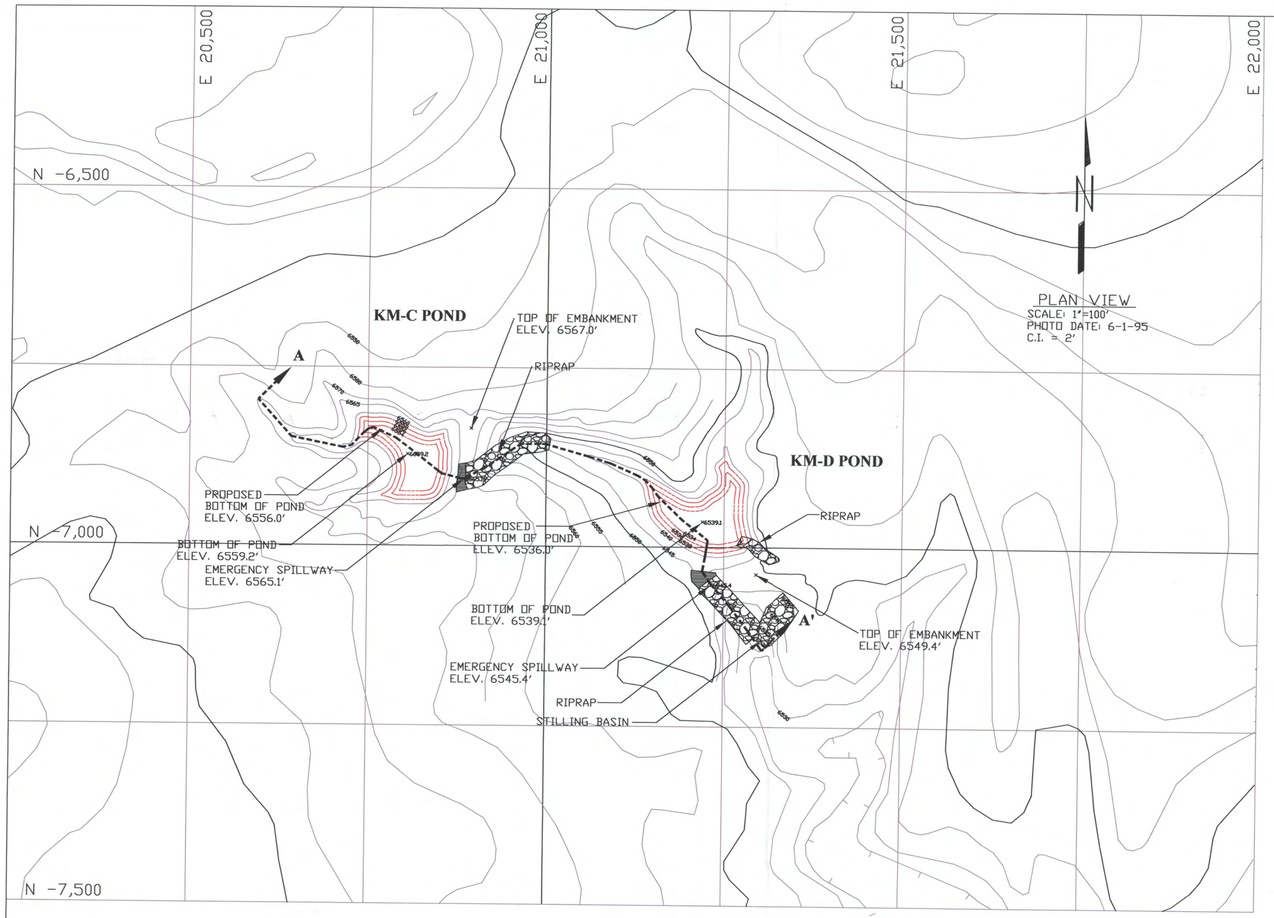
$A = 14.00\left(\frac{1}{2047}\right)(33.9)(.95) = .22$ acre-feet/year



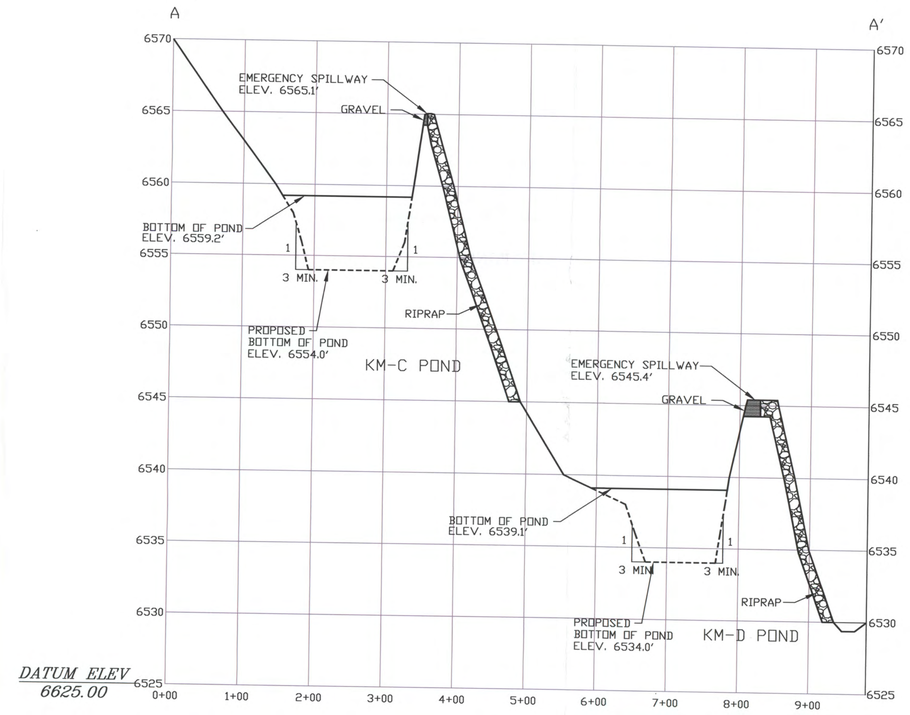
CHANNEL PROFILE B–B'
KM–C

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



PLAN VIEW
SCALE: 1"=100'
PHOTO DATE: 6-1-95
C.I. = 2'



PROFILE SECTION A-A'
SCALE: HORIZ. 1"=100'
VERT. 1"=5'

KM-C POND STAGE CAPACITY

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	CAPACITY (AC.-FT.)	TOTAL CAPACITY (AC.-FT.)	DESCRIPTION
6554.0	0.0	0.09	0.00	0.00	BOTTOM OF POND
6556.0	2.0	0.14	0.23	0.23	
6558.0	4.0	0.20	0.34	0.57	
6560.0	6.0	0.27	0.47	1.04	
6565.0	11.0	0.52	1.98	3.02	
6565.1	11.1	0.53	0.05	3.07	EMERGENCY SPILLWAY
6567.0	13.0	0.67	1.14	4.21	TOP OF EMBANKMENT

KM-D POND STAGE CAPACITY

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	CAPACITY (AC.-FT.)	TOTAL CAPACITY (AC.-FT.)	DESCRIPTION
6534.0	0.0	0.11	0.00	0.00	BOTTOM OF POND
6536.0	2.0	0.17	0.28	0.28	
6538.0	4.0	0.23	0.40	0.68	
6540.0	6.0	0.32	0.55	1.23	
6545.0	11.0	0.70	2.55	3.78	
6545.4	11.4	0.74	0.29	4.07	EMERGENCY SPILLWAY
6549.4	15.4	1.09	3.66	7.73	TOP OF EMBANKMENT

ENGINEER'S CERTIFICATION

Registered Professional Engineer (Civil)
CERTIFICATE NO. 37842
GARY ALTSISI
Date Signed: 2-17-11
ARIZONA, U.S.A.

EXPIRES: 09/30/2011

Gary Altsisi
Reclamation Supervisor
Peabody Western Coal Company

Arizona P.E. 37842

JUL 2011
APPROVED

EXHIBIT #1
KM-C & KM-D PONDS
REMEDIAL DESIGN

KAYENTA MINE

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

DESIGNED BY: G.A.	SCALE: AS SHOWN
DRAWN BY: G.A.	DRAWING DATE: 2-17-11
CHECKED BY: G.A.	PHOTO DATE: 6-1-95
CONTOUR INTERVAL: 2'	DWG FILE: KM-C KM-D REMEDIAL FEB 2001.DWG

INSPECTION REPORT

Sedimentation Structure

KM-D

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
13376
LUTZ
KUNZE
Date Signed 11-22-85
ARIZONA, U.S.A.

Dames & Moore
10139-011-22

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HYDRAULICS	4
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Outflow Channel	4
STORAGE CAPACITY	4
REMEDIAL COMPLIANCE PLAN	5
GEOTECHNICS	5
HYDRAULICS	5

APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure KM-D 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-D is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure KM-D. 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-D was inspected on September 5, 1985 by an interdisciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the KM-D 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-D has a 19.1-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 65% disturbed and 35% Pinion/Juniper.

EMBANKMENT

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

Structure KM-D

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	8.1 ft
Crest Width	12 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-D, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

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

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.356	mi
2.	Elevation Difference, H	124	ft
3.	Time of Concentration, T_c	0.123	h
4.	Lag time, $0.6T_c$	0.074	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	19.1	acres

HYDRAULICS

Structure KM-D does not have a spillway. Therefore, the hydraulic analysis is presented in the remedial compliance plan.

Spillway Channel

The structure does not have a spillway channel.

Outflow Channel

The structure presently has no outflow channel.

STORAGE CAPACITY

Analysis of the storage capacity is presented in the remedial compliance plan.

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

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

HYDRAULICS

Structure KM-D has sufficient storage capacity but it does not have a spillway or outflow channel. A trapezoidal spillway channel should be constructed at elevation 6545.0 feet. The embankment crest elevation should be raised to elevation 6547.60 feet. The outflow channel and stilling basin should be constructed along the alignment shown in Plate 1. The spillway channel, outflow channel, and stilling basin profile is shown in Plate 4 and the required dimensions are shown in Plate 5. The spillway, outflow channel, and stilling basin should be protected against erosion using geotextile and riprap 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-C and into Structure KM-D. The initial conditions and results of the analysis are summarized in the following table.

KM-D 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	35	85	
Volume	acre-ft	1.78*	1.48*	
Storage				
Peak Stage	ft	6543.33	6546.59	
Spillway Elevation . .	ft	6545.00	--	
Peak Storage	acre-ft	2.21	--	
Storage Capacity . . .	acre-ft	3.23	--	
Outflow				
Peak Flow	cfs	0	49	
Embankment Crest Elevation	ft	--	6547.60	
Peak Stage	ft	--	6546.59	
Freeboard	ft	--	1.01	
Spillway Channel				
Flow Depth	ft	--	1.59	
Critical Velocity . .	fps	--	4.4	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	6	24
Normal Velocity . . .	fps	--	5.6	8.7
Normal Depth	ft	--	0.53	0.35
Manning's "n"		--	0.040	0.040

*Inflow volume for tributary drainage area between Structures KM-C and KM-D.

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-D.

The calculations for the sediment load entering Structure KM-D 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 3.00
4. Cover Factor, C 0.70
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. Structure KM-D is located downstream from Structure KM-C and receives excess flow from KM-C during the 10-year, 24-hour storm. Therefore, the storage capacity of the two structures must be combined to determine the available sediment storage life. The 10-year, 24-hour storm was routed through KM-C and into KM-D. The results of this analysis are summarized below.

KM-C AND KM-D COMBINED STORAGE

	KM-C	KM-D	Total	
Total Storage Capacity	2.14	3.23	5.37	acre-ft
10-year, 24-hour Storm Inflow	2.57	1.78	4.35	acre-ft
Available Sediment Storage Capacity . .	--	--	1.02	acre-ft
Sediment Inflow Rate	0.22	0.164	0.384	acre-ft/yr
Sediment Storage Life	--	--	3	yrs

* * *

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

Plate 1 - Site Plan KM-D

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

Plate 3 - Volume-Elevation Curve KM-D

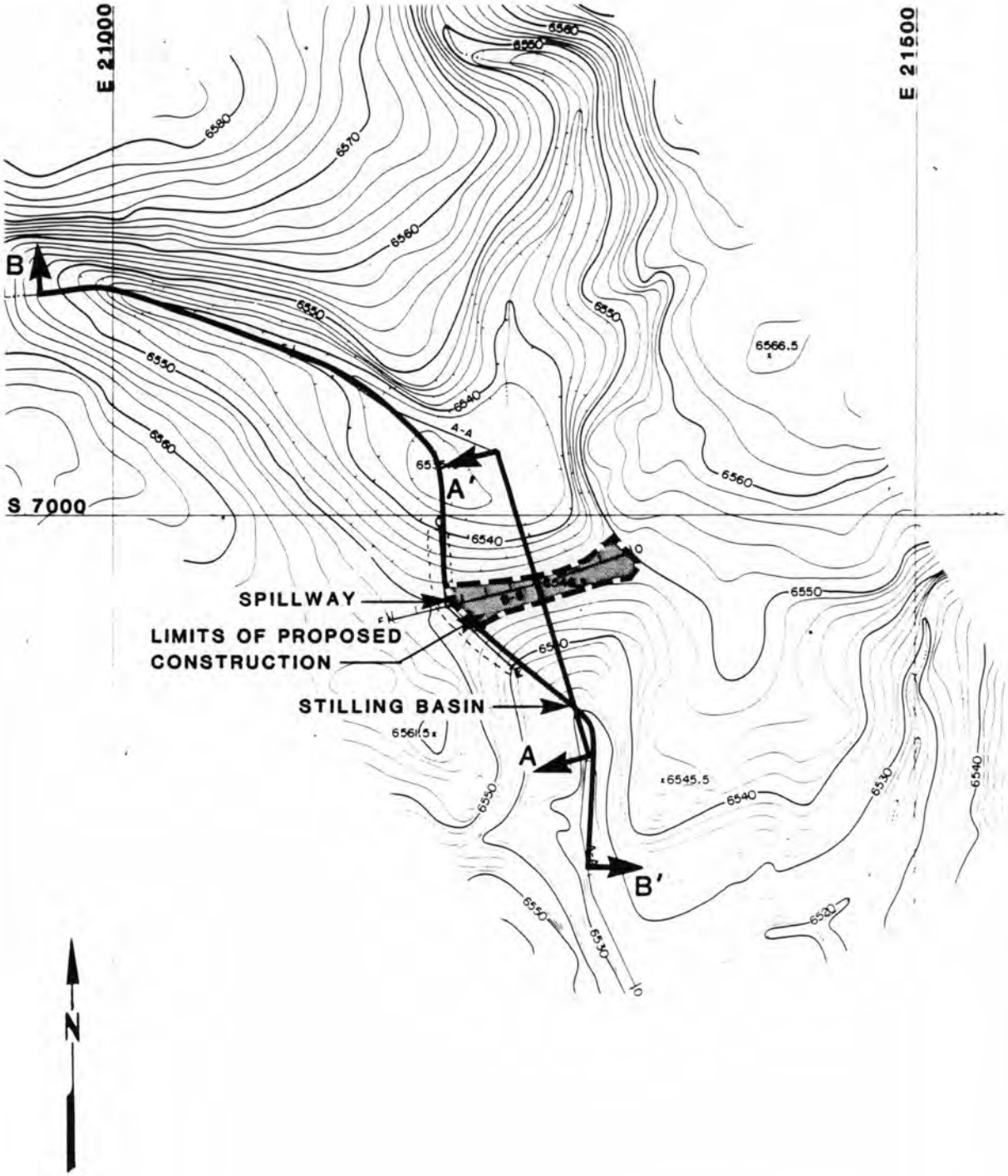
Plate 4 - Channel Profile KM-D, B-B'

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

Plate 6 - Spillway Stilling Basin Plan KM-D

Appendix A - Inspection Check List

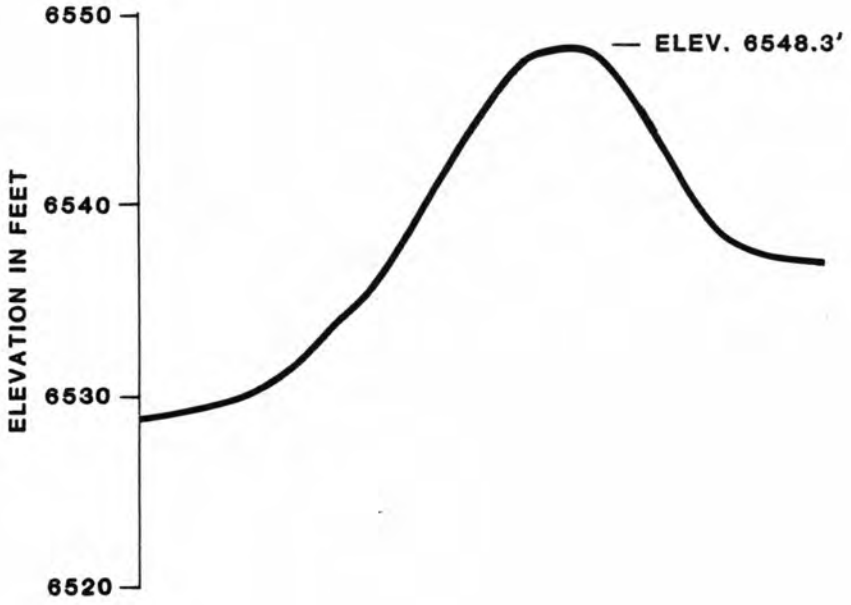
Appendix B - Hydrology and Hydraulic Calculations



SCALE
0 100 200
FEET

SITE PLAN
KM-D

BY **Dames & Moore** Plate 1

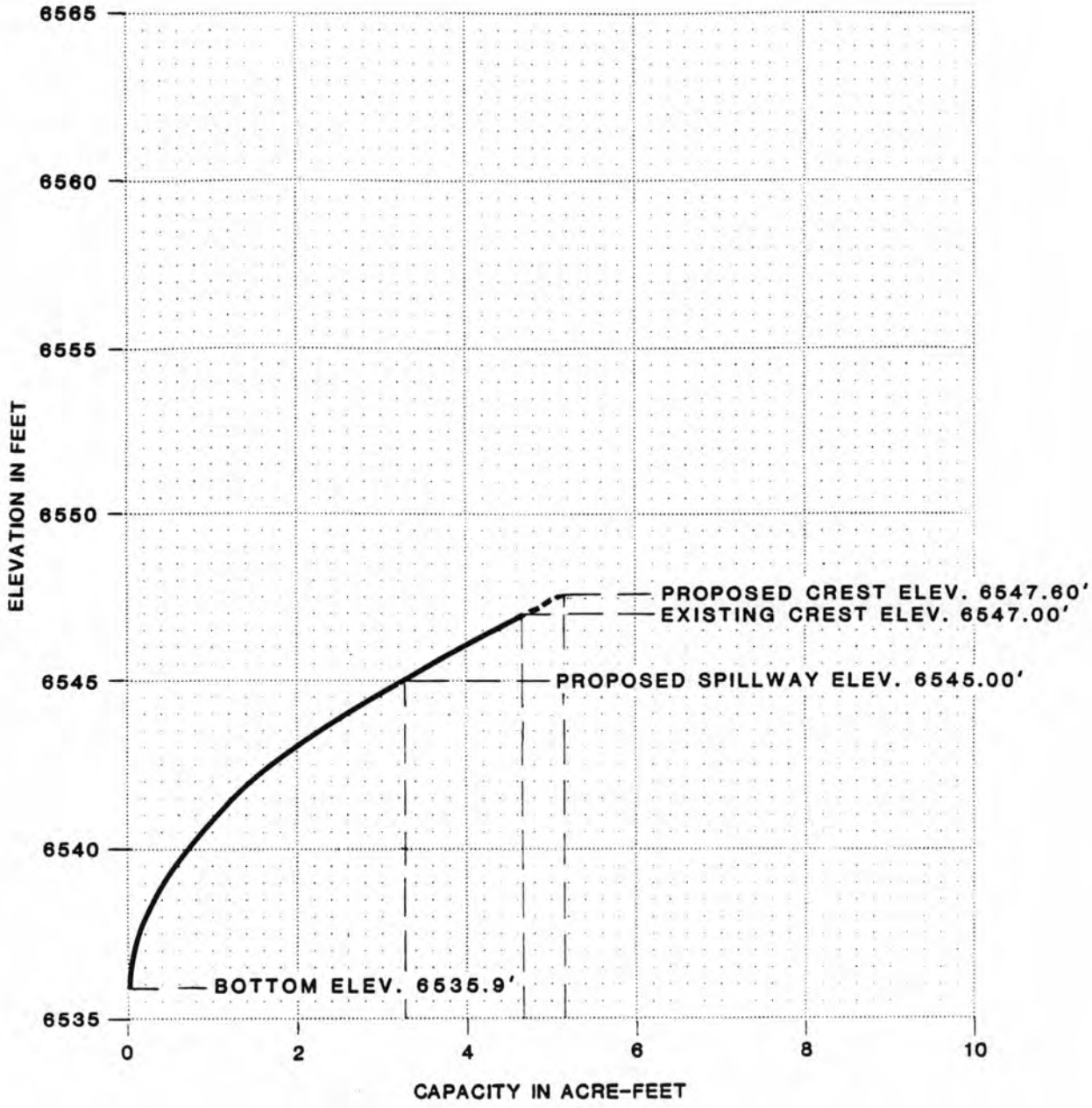


EXISTING MAXIMUM CROSS-SECTION A-A' KM-D

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

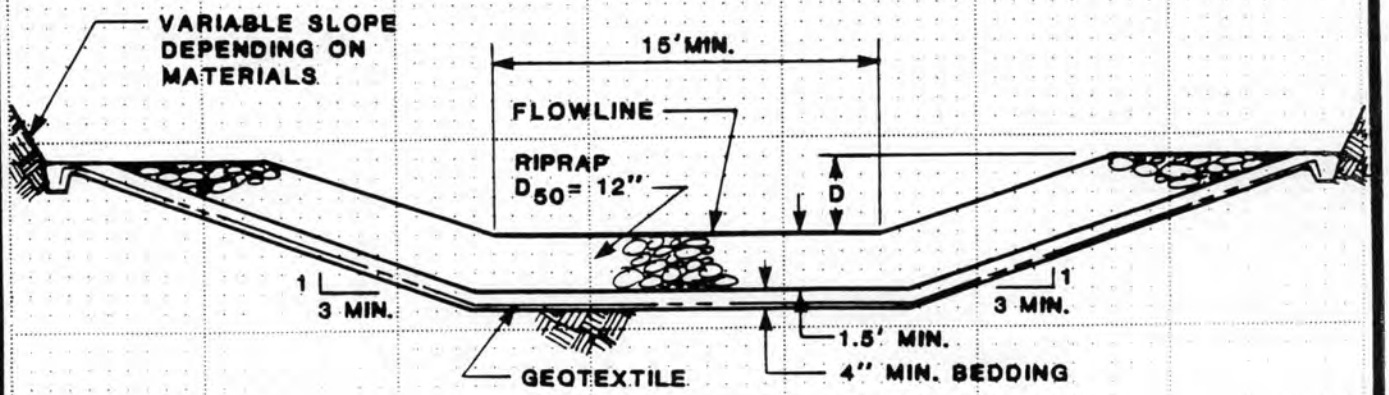
Plate 2



VOLUME-ELEVATION CURVE

KM-D

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.6'

LENGTH = 30'

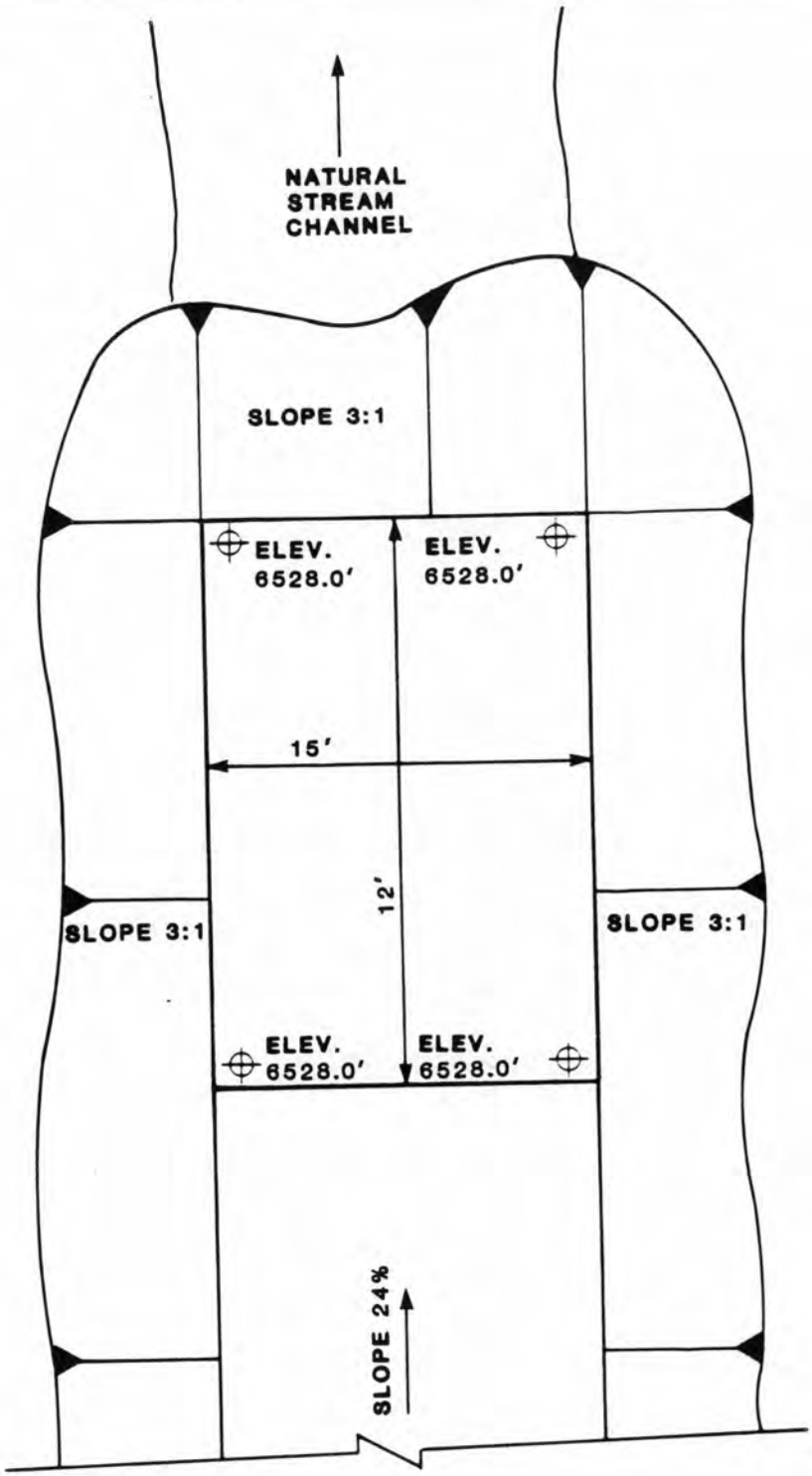
FLOWLINE ELEV. = 6545.00'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION KM-D

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 3.3'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAMBED = 1.8'

SPILLWAY STILLING BASIN PLAN

KM-D

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: KM-D
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			12'
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			16°
a. Adequate grass cover?	X		70
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		Grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			16°
a. Adequate grass cover?	X		70
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	
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

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			No Spillway
a. Location:			See Comment
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?			
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: KM - D
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	

9. GENERAL COMMENTS

No Spill way - Should be on embankment towards L.A.

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

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

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6670 − 6546 = 124 ft.

WATER COURSE LENGTH = 4.7 (400) = 1880 ft. = 0.356 mi.

$$T_c = \left(\frac{11.9\,(0.356)^3}{124}\right)^{0.385} = 0.123 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.074 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)		COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
6.6	(35%)	P-J	ave	D	0.35 (83) = 29.1
12.5	(65%)	DISTURBED (GRAVEL RD)	—	D	0.65 (91) = 59.2
					88.3

50% EH #33
50% EH #25

USE 89

DRAINAGE BASIN AREA

19.1 ACRE 0.030 SQ MILE

CHECKED BY S. DOLAN DATE 9-10-85
COPY TO EO ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =	50%	EH # 33	.5 (.22)
	50%	EH # 22	.5 (.22)

K = .22

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
800	50	7%	2.35 (60%)
300	40	14%	3.98 (40%)

use 3.00

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
35%	P-J	40	25	.35 (.14)
65%	disturbed			.65 (1.0)

C = .70

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

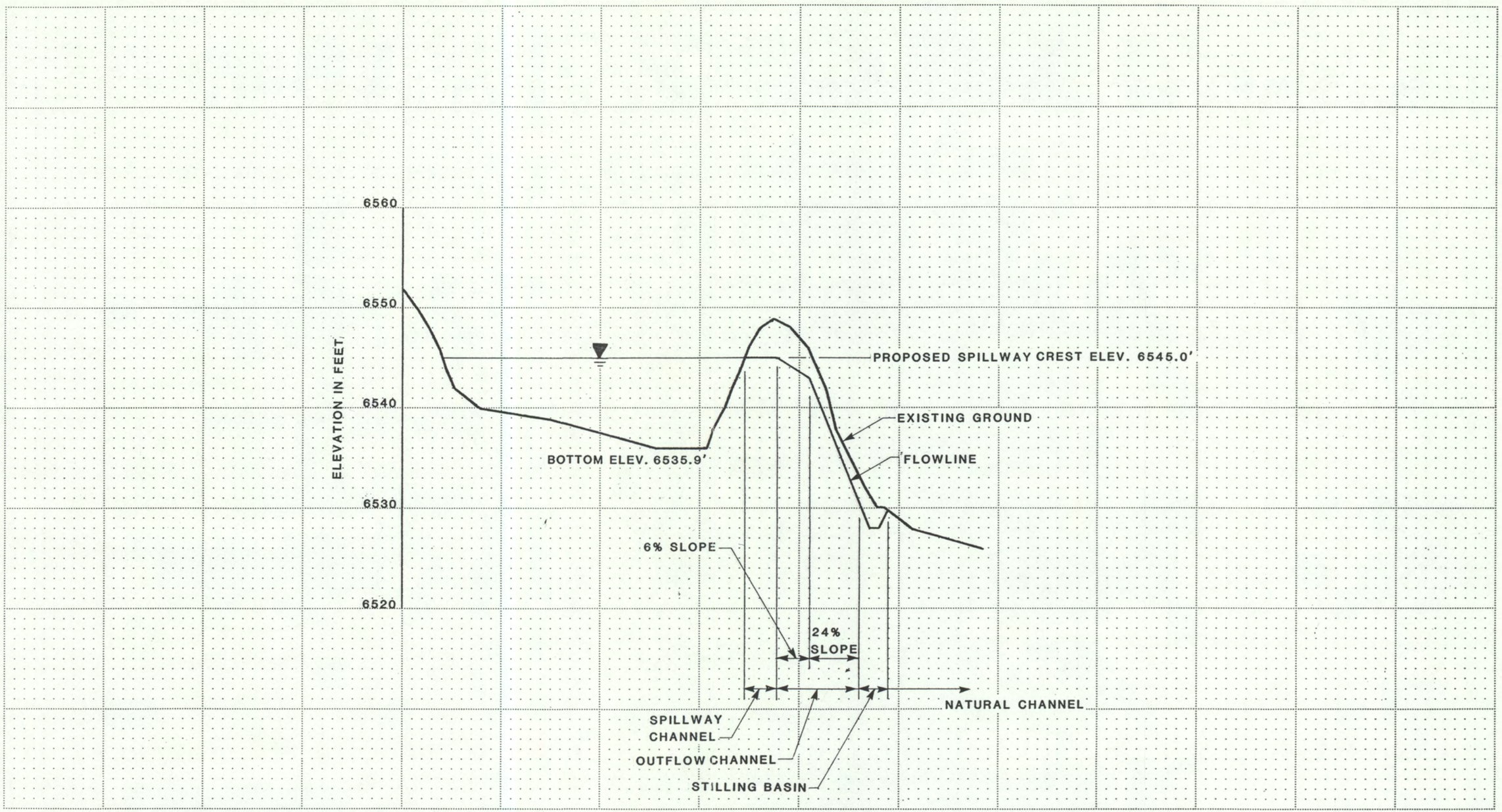
EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.22)(3.00)(.70)(1.0) = 18.48$ ton/acre/year

$A = 18.48\left(\frac{1}{2047}\right)(19.1)(.95) = .164$ acre-feet/year



SCALE
0 100 200
FEET

CHANNEL PROFILE B–B′
KM–D

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4