

DESIGN and AS-BUILT CONSTRUCTION REPORT

Temporary Sedimentation Structure

J1-A

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY



MAY 13 2004

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INTRODUCTION

Sedimentation Structure J1-A will be an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary sedimentation structure designed to control runoff and sediment from portions of J-1 and N-6 disturbed surface mining area and facilities at the Black Mesa Mine. The location of Structure J1-A and its watershed boundary are shown on Drawing No. 85400 (Sheet K-8 and L-8) and Drawing No. 85405.

This design report contains information specific to Structure J1-A. 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".

INSPECTION

The construction site of the proposed structure J1-A was inspected in August, 2003 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 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.

SITE DESCRIPTION

LAND USE

Structure J1-A has a 128.5-acre watershed and is located on a tributary of Wild Ram Valley Wash at the Black Mesa Mine. The watershed is classified as 76% reclaimed, 16% disturbed and 8% undisturbed.

DESIGN ANALYSES

GENERAL

Structure J1-A 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 ground surveys performed in 2003 by Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure J1-A is assumed to be category B-4 embankment. The embankment was constructed using Table 3-6, Attachment D, Chapter 6, as the guidance to construct stable embankment slopes. A homogenous earthen embankment, compacted in lifts to design specifications, and approximately 10-16 feet wide on top was constructed. A minimum upstream slope of a minimum 1.75:1 (horizontal to vertical) or flatter slope and a downstream slope of 2.5:1 or flatter slope was required. All embankment slopes were constructed at 2.5:1 or flatter. Based on the total embankment height of approximately 12.3 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 is an 18 to 19-foot wide riprap-lined trapezoidal channel.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure J1-A 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 earthen embankment 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 spillway for J1-A was analyzed using the 25-year, 6-hour storm. Structure J1-A was conservatively assumed to be full to the emergency spillway prior to the time of the 25-year storm event. The storage capacity of structure J1-A was analyzed using the 10-year, 24-hour storm. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging downstream to Wild Ram Valley Wash.

The following parameters were used in the hydrologic analysis:

	<u>J1-A</u>
1. Water Course length, L	0.5483 mi.
2. Elevation Difference, H	129 ft
3. Time of Concentration, T_c	0.1994 hr
4. SCS Curve Number	87
5. Rainfall Depth, 10-year, 24-hour storm	2.1 in
25-year, 6-hour	1.9 in
6. Drainage Area	128.5 acres

HYDRAULICS

The SEDCAD 4 and Dodson computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure and resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendix A, B, and C).

J1-A 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	112.47	135.1
Volume	ac-ft	10.54	8.87
Storage			
Peak Stage	msl	N/A	6571.1
Emergency Spillway Elevation	msl	6570.1	6570.1
Peak Storage	ac-ft	N/A	21.5
Storage Capacity	ac-ft	18.4	18.4
Outflow			
Peak Flow	msl	N/A	47.7
Spillway Elevation	msl	6570.1	6570.1
Embankment Crest Elevation	msl	6572.3	6572.3
Peak Stage	msl	--	6571.1
Freeboard	ft	--	1.2
Emergency Spillway Channel			
Flow Depth	ft	--	0.9
Critical Velocity	fps	--	4.1
Mannings "n"	--	--	0.030
Width	ft	--	18.0
Outflow Channel			
Slope	%	--	25
Normal Velocity	fps	--	6.6
Normal Depth	ft	--	0.38
Mannings "n"	--	--	.057
Riprap D ₅₀	in	--	6

EMERGENCY SPILLWAY AND OUTFLOW CHANNEL

The emergency spillway and outlet channel for J1-A will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Channel Depth	(Spillway)	2.2	ft
	(Outflow)	3.0	ft
Channel Width		18	ft
Channel Length	(Spillway)	34	ft
	(Outflow)	27	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0.4	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6570.1	ft

A 18' X 3' riprap-lined energy-dissipating basin was constructed beyond the toe of embankment as a transition into the downstream channel.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 2003 topographic mapping conducted for Peabody Western Coal Company. Structure J1-A is designed and constructed to contain approximately 18.4 acre-feet.

The calculations for the sediment load entering structure J1-A were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.34
3.	Slope Factor, LS	4.16
4.	Cover Factor, C	0.29
5.	Erosion Control Factor, P	0.85

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

the remaining storage volume available for storing sediment. The storage capacity of J1-A is shown on Exhibit 1, J1-A Stage Capacity Table, and the results of the sediment inflow analysis are summarized in the following table.

J1-A STORAGE

Total Storage Capacity	18.4 acre-ft
10-Year, 24-Hour Storm Inflow	10.54 acre-ft
Available Sediment Storage Capacity	7.86 acre-ft
Sediment Inflow Rate	0.779 acre-ft /yr
Sediment Storage Life	10.1 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	- Proposed J1-A Sedimentation Pond Design

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

**PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA**

PROJECT: J-1 AREA

STRUCTURE: J1-A POND

TIME OF CONCENTRATION

	<u>H (HI)</u>	<u>H (LO)</u>	<u>H</u>
ELEV. DIFFERENCE (H):	6687.5	6558.2	129.3

	<u>L (FT.)</u>	<u>L (MI.)</u>
WATERCOURSE LENGTH (L):	2895	0.5483

$$TC = [(11.9 \times (L^3)) / H]^0.385$$

TC = 0.1994

SCS CURVE NUMBER

	<u>COVER TYPE</u>	<u>HYDROLOGIC CONDITION</u>	<u>SOIL TYPE</u>	<u>CN</u>	<u>AREA (Ac.)</u>	<u>CN*AREA</u>
AREA1	RECLAIMED	AVG	B	86	98	8428
AREA2	DISTURBED	AVG	D	91	20.6	1874.6
AREA3	PJ	AVG	D	83	9.9	821.7
					TOTAL <u>AREA</u> 128.5	TOTAL <u>CN*AREA</u> 11124.3

CN =	87
------	----

DRAINAGE BASIN AREA

ACRES = 128.5 SQ. MILES= 0.200781

**PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA**

PROJECT: J1-A

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (Acres)	K*Area
Reclaimed	0.38	98	37.24
Disturbed	0.22	20.6	4.532
PJ	0.18	9.9	1.782
TOTAL:		128.5	43.55

Weighted K = Total K*Area/Total Area = 0.339

LENGTH SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
878	124	14.1%	0.6	8.0	8.25
509	37.5	7.4%	0.5	4.2	2.18
367	30	8.2%	0.5	4.7	2.05

Average LS = 4.16

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 > or = 9%

Where:

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

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Reclaimed	40	0	98	0.15	14.70	0.8	78.4
Disturbed	0	0	20.6	1	20.60	1	20.6
PJ	30	25	9.9	0.18	1.78	1	9.9
TOTAL			128.5		37.08		108.9

Weighted C = Total C*Area/ Total Area = 0.289

Weighted P = Total P*Area/ Total Area = 0.85

RAINFALL FACTOR:

R = 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J1-A

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

PARAMETER DESCRIPTION	VALUE
Soil Erodibility Factor	0.339
Length Slope Factor	4.16
Cover Factor	0.3
Practice Factor	0.8
Annual Rainfall Factor	40
Gross Annual Sediment Yield	13.79 <i>tons/acre/year</i>
Sediment Density	94 pcf
Gross Annual Sediment Yield	0.00674 <i>acre-feet/acre/year</i>
Sediment Delivery Ratio (SDR)*	90%
Estimated Annual Sediment Yield	0.0061 <i>acre-feet/acre/year</i>
Watershed Area	128.5 acres
Watershed Annual Sediment Yield	0.7790 <i>acre-feet/year</i>
Number of years	1 years
Required Pond Sediment Storage	0.779 <i>acre-feet</i>

*SDR = 0.95 for drainage basins less than 100 acres
SDR=0.90 for drainage basins greater than 100 acres

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

May 13, 2004

```
=====
                        PROGRAM INPUT DATA
=====
DESCRIPTION                                VALUE
-----
Flow Rate (cfs)..... 47.7
Channel Bottom Slope (ft/ft)..... 0.004
Manning's Roughness Coefficient (n-value)..... 0.03
Channel Left Side Slope (horizontal/vertical)..... 4.0
Channel Right Side Slope (horizontal/vertical)..... 4.0
Channel Bottom Width (ft)..... 18.0
=====
```

```
=====
                        COMPUTATION RESULTS
=====
DESCRIPTION                                VALUE
-----
Normal Depth (ft)..... 0.87
Flow Velocity (fps)..... 2.56
Froude Number..... 0.523
Velocity Head (ft)..... 0.1
Energy Head (ft)..... 0.97
Cross-Sectional Area of Flow (sq ft)..... 18.61
Top Width of Flow (ft)..... 24.93
=====
```

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Phone: (281)440-3787, Fax: (281)440-4742, Email: software@dodson-hydro.com
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J1-A 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)
18.00	3.0:1	3.0:1	25.0			

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	47.70 cfs	
Depth:	0.38 ft	
Top Width:	20.28 ft	
Velocity:	6.57 fps	
X-Section Area:	7.26 sq ft	
Hydraulic Radius:	0.356	
Froude Number:	1.93	
Manning's n:	0.0570	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

APPENDIX B

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

Temporary Sedimentation Structure
J1-A
Black Mesa Mine

Randy S. Lehn

Peabody Western Coal Company
P.O. Box 650
Kayenta, AZ 86033

General Information

Storm Information:

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

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	128.500	128.500	112.47	10.54

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	128.500	0.199	0.000	0.000	87.000	F	112.47	10.542
Σ		128.500						112.47	10.542

APPENDIX C

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

Temporary Sedimentation Structure
J1-A
25 YR-6 HR
Black Mesa Mine

Randy S. Lehn

Peabody Western Coal Company
P.O. Box 650
Kayenta, AZ 86033

General Information

Storm Information:

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

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	J1-A

#1
Pond

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	128.500	128.500	135.08	8.87
	Out			47.65	8.87

Structure Detail:***Structure #1 (Pond)****J1-A*

Pond Inputs:

Initial Pool Elev:	6,570.10
Initial Pool:	18.02 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,570.10	34.00	4.00:1	4.00:1	18.00

Pond Results:

Peak Elevation:	6,571.15
Dewater Time:	0.47 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)
6,560.00	0.000	0.000	0.000	
6,560.50	0.062	0.010	0.000	
6,561.00	0.248	0.083	0.000	
6,561.50	0.557	0.278	0.000	
6,562.00	0.990	0.660	0.000	
6,562.50	1.143	1.193	0.000	
6,563.00	1.308	1.805	0.000	
6,563.50	1.483	2.503	0.000	
6,564.00	1.670	3.291	0.000	
6,564.50	1.784	4.154	0.000	
6,565.00	1.902	5.075	0.000	
6,565.50	2.024	6.057	0.000	
6,566.00	2.150	7.100	0.000	
6,566.50	2.268	8.205	0.000	
6,567.00	2.389	9.369	0.000	
6,567.50	2.513	10.594	0.000	
6,568.00	2.640	11.882	0.000	
6,568.50	2.771	13.235	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,569.00	2.905	14.653	0.000	
6,569.50	3.042	16.140	0.000	
6,570.00	3.182	17.695	0.000	
6,570.10	3.210	18.015	0.000	Spillway #1
6,570.50	3.327	19.322	14.844	8.80
6,571.00	3.476	21.023	33.403	1.90
6,571.15	3.523	21.554	47.646	0.50 Peak Stage
6,571.50	3.629	22.799	81.074	
6,572.00	3.785	24.653	143.043	
6,572.30	3.880	25.802	187.850	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,560.00	0.000	0.000
6,560.50	0.000	0.000
6,561.00	0.000	0.000
6,561.50	0.000	0.000
6,562.00	0.000	0.000
6,562.50	0.000	0.000
6,563.00	0.000	0.000
6,563.50	0.000	0.000
6,564.00	0.000	0.000
6,564.50	0.000	0.000
6,565.00	0.000	0.000
6,565.50	0.000	0.000
6,566.00	0.000	0.000
6,566.50	0.000	0.000
6,567.00	0.000	0.000
6,567.50	0.000	0.000
6,568.00	0.000	0.000
6,568.50	0.000	0.000
6,569.00	0.000	0.000
6,569.50	0.000	0.000
6,570.00	0.000	0.000
6,570.10	0.000	0.000
6,570.50	14.844	14.844
6,571.00	33.403	33.403
6,571.50	81.074	81.074

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,572.00	143.043	143.043
6,572.30	187.850	187.850

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	128.500	0.199	0.000	0.000	87.000	F	135.08	8.869
Σ		128.500						135.08	8.869