

521 I

DESIGN REPORT

Temporary Sedimentation Structure

J21-I

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY



TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION.....	1
INSPECTION .....	1
SITE DESCRIPTION.....	2
LAND USE .....	2
DESIGN ANALYSES.....	2
GENERAL .....	2
STABILITY .....	2
HYDROLOGY .....	3
HYDRAULICS.....	4
EMERGENCY SPILLWAY AND OUTLET CHANNEL .....	6
STORAGE CAPACITY .....	6
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) 100-Year, 6-Hour Storm Event
EXHIBIT #1	-J21-I2, J21-I1, and J21-I Proposed Sedimentation Ponds

## INTRODUCTION

Sedimentation Structure J21-I will be an earthen embankment, designed and constructed by Peabody Western Coal Company (PWCC) as a temporary sedimentation structure to control runoff and sediment from portions of the J21 disturbed surface mining area at the Kayenta Mine. In addition, J21-I will be designed and permitted approximately 2 years prior to the bond release request submittal, as a permanent impoundment. This is one of the structures included in Chapter 6 – Permanent Impoundment section as a postmining water source. The location of Structure J21-I and its watershed boundary are shown on Drawing No. 85400 (Sheet M-11) 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 J21-I that is in series with sedimentation structures J21-I2 & J21-I1. J21-I is the most downstream pond in the series. 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 construction site of the proposed Structure J21-I was inspected in January, 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 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.

## HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure J21-I will be constructed in series with proposed Structures J21-I2 and J21-I1. Structure J21-I is the most downstream pond in the series and 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 three structures have a combined capacity greater than 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm event in lieu of the 25-year, 6-hour storm. In addition, PWCC plans to retain Structure J21-I as a permanent structure. Therefore, the J21-I spillway structure was analyzed with the upper two ponds (J21-I2 & J21-I1) removed from the watershed during the design storm. The structure was conservatively assumed to be full to the emergency spillway at the time of 100-year storm event. The storage capacity of structure J21-I was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Dinnebito Wash.

The following parameters were used in the hydrologic analysis (see Appendix B & C):

1.	Water Course length, L	<u>J21-I</u> 0.098 mi.
2.	Elevation Difference, H	120 ft
3.	Time of Concentration, T <sub>c</sub>	0.028 hr
4.	SCS Curve Number	60
5.	Rainfall Depth, 10-year, 24-hour storm	2.1 in
	100-year, 6-hour storm	2.4 in
6.	Drainage Area	7.7 acres

Values reported represent the watershed, which drains directly to Pond J21-I. Hydrologic input parameters for structure J21-I2 and J21-I1 are presented in separate design reports.

J21-I SEDIMENTATION POND HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway
<b>Inflow</b>			
Peak Flow	cfs	436.5	690.6
Volume	ac-ft	0.05	0.09
<b>Storage</b>			
Peak Stage	msl	N/A	6807.5
Emerg. Spillway Elev.	msl	6804.9	6804.9
Peak Storage	ac-ft	N/A	23.8
Storage Capacity	ac-ft	18.6	18.6
<b>Outflow</b>			
Peak Flow	cfs	N/A	631.4
Spillway Elevation	msl	6804.9	6804.9
Embankment Crest Elev.	msl	6810	6810
Peak Stage	msl	--	6807.5
Freeboard	ft	--	2.5
<b>Emergency Spillway Channel</b>			
Flow Depth	ft	--	2.6
Critical Velocity	fps	--	6.8
Mannings "n"	--	--	0.03
Width	ft	--	55
<b>Outflow Channel</b>			
Slope	%	--	15
Normal Velocity	fps	--	9.95
Normal Depth	ft	--	1.1
Mannings "n"	--	--	0.059
Riprap D <sub>50</sub>	in	--	9

Note: Design peak flow for spillway based on modeling with Ponds J21-I1 & J21-I2 removed from watershed.

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 J21-I has sufficient storage capacity to contain the 10-year, 24-hour storm and has additional capacity to store excess runoff from the J21-I2 and J21-I1 watersheds. The combined storage capacity was determined for all three structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures J21-I, J21-I and J21-I

	J21-I2	J21-I1	J21-I	COMBINED
Total Storage Capacity	19.8	19.3	18.6	57.7 acre-ft.
10-Year, 24-Hour Storm Inflow	36.69	6.08	0.05	42.82 acre-ft.
Available Sediment Storage Capacity	-	-	-	14.88 acre-ft.
Sediment Inflow Rate/Year	4.54	1.03	0.02	5.59 acre-ft.
Sediment Storage Life	-	-	-	2.7 years

\*

\*

\*

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) 100-Year, 6-Hour Storm Event

Exhibit #1- J21-I2, J21-I1 and J21-I Proposed Sedimentation Ponds

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations



**PEABODY WESTERN COAL COMPANY  
CALCULATED HYDROLOGIC DATA**

**PROJECT: J21 AREA**

**STRUCTURE: J21-I Lower Pond**

**TIME OF CONCENTRATION:**

Start Elevation (ft) = 6910  
 End Elevation (ft) = 6790  
 Elevation Difference, E (ft) = 120

Watercourse Length (ft) = 515  
 Watercourse Length, L (mi) = 0.098

$T_c = (11.9L^3/E)^{0.385} = \underline{\underline{0.028 \text{ hours}}}$

**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
Sagebrush	B	60	7.7	462
TOTAL:			7.7	462

Weighted CN = Total CN\*Area/ Total Area = 60

**DRAINAGE BASIN AREA:**

7.7 Acres

PEABODY WESTERN COAL COMPANY  
CALCULATED SEDIMENT YIELD

PROJECT: J21-I Lower Pond

*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
Annual Rainfall Factor	40.00
Soil Erodibility Factor	0.16
Length Slope Factor	4.33
Cover Factor	0.20
Practice Factor	1.00
Gross Annual Sediment Yield	5.55 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0027 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0024 acre-feet/acre/year
Watershed Area	7.7 acres
Watershed Annual Sediment Yield	0.02 acre-feet/year
Number of years	1 years
Calculated Sediment Volume	0.02 acre-feet

# J21-I EMERGENCY 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)
55.00	3.0:1	3.0:1	15.0	1.00		

## PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	631.40 cfs	
Depth:	1.09 ft	2.09 ft
Top Width:	61.54 ft	67.54 ft
Velocity:	9.95 fps	
X-Section Area:	63.47 sq ft	
Hydraulic Radius:	1.026	
Froude Number:	1.73	
Manning's n:	0.0590	
Dmin:	5.00 in	
D50:	9.00 in	
Dmax:	12.00 in	

APPENDIX B

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

**PEABODY WESTERN**  
**KAYENTA MINE**  
**PONDS J21-I2, J21-I1, & J21-I**

*10-Year, 24-Hour Storm*

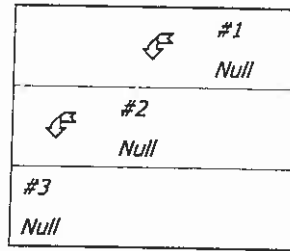
DJK

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

Phone: 303 763-5140

***Structure Networking:***

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.025	0.401	J21-I2 Spillway
Null	#2	==>	#3	0.001	0.449	J21-I1 Spillway
Null	#3	==>	End	0.000	0.000	J21-I Spillway



## ***Structure Detail:***

*Structure #1 (Null)*

*J21-I2 Spillway*

*Structure #2 (Null)*

*J21-I1 Spillway*

*Structure #3 (Null)*

*J21-I Spillway*

APPENDIX C

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



**PEABODY WESTERN**  
**KAYENTA MINE**  
**POND J21-I**

*100 Year, 6-Hour Storm*  
*Pond J21-I Only*

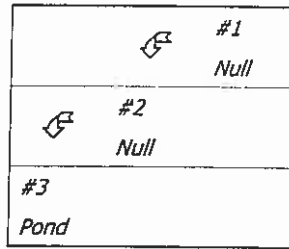
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Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.025	0.401	J21-I2 Spillway
Null	#2	==>	#3	0.001	0.449	J21-I1 Spillway
Pond	#3	==>	End	0.000	0.000	J21-I Spillway



### Structure Detail:

Structure #1 (Null)

J21-I2 Spillway

Structure #2 (Null)

J21-I1 Spillway

Structure #3 (Pond)

J21-I Spillway

Pond Inputs:

Initial Pool Elev:	6,804.90
Initial Pool:	18.60 ac-ft

#### Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Slideslope	Right Slideslope	Bottom Width (ft)
6,804.90	32.00	3.00:1	3.00:1	55.00

Pond Results:

Peak Elevation:	6,807.48
Dewater Time:	0.20 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)
6,785.00	0.120	0.000	0.000	
6,785.50	0.139	0.065	0.000	
6,786.00	0.159	0.139	0.000	
6,786.50	0.181	0.224	0.000	
6,787.00	0.204	0.321	0.000	
6,787.50	0.229	0.429	0.000	
6,788.00	0.255	0.549	0.000	
6,788.50	0.282	0.683	0.000	
6,789.00	0.311	0.832	0.000	
6,789.50	0.341	0.994	0.000	
6,790.00	0.372	1.172	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,809.50	2.355	28.325	1,750.074	
6,810.00	2.410	29.516	2,098.482	

## Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,785.00	0.000	0.000
6,785.50	0.000	0.000
6,786.00	0.000	0.000
6,786.50	0.000	0.000
6,787.00	0.000	0.000
6,787.50	0.000	0.000
6,788.00	0.000	0.000
6,788.50	0.000	0.000
6,789.00	0.000	0.000
6,789.50	0.000	0.000
6,790.00	0.000	0.000
6,790.50	0.000	0.000
6,791.00	0.000	0.000
6,791.50	0.000	0.000
6,792.00	0.000	0.000
6,792.50	0.000	0.000
6,793.00	0.000	0.000
6,793.50	0.000	0.000
6,794.00	0.000	0.000
6,794.50	0.000	0.000
6,795.00	0.000	0.000
6,795.50	0.000	0.000
6,796.00	0.000	0.000
6,796.50	0.000	0.000
6,797.00	0.000	0.000
6,797.50	0.000	0.000
6,798.00	0.000	0.000
6,798.50	0.000	0.000
6,799.00	0.000	0.000
6,799.50	0.000	0.000
6,800.00	0.000	0.000
6,800.50	0.000	0.000

***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	539.900	0.420	0.000	0.000	81.000	F	552.09	39.223
	$\Sigma$	<b>539.900</b>						<b>552.09</b>	<b>39.223</b>
#2	1	183.500	0.225	0.000	0.000	74.000	F	152.65	8.454
	$\Sigma$	<b>723.400</b>						<b>689.95</b>	<b>47.677</b>
#3	1	7.700	0.028	0.000	0.000	60.000	F	2.44	0.094
	$\Sigma$	<b>731.100</b>						<b>690.60</b>	<b>47.772</b>