

**DESIGN REPORT**

**Temporary Sedimentation Structure**

**J19-D**

**Kayenta Mine**

**Navajo County, Arizona**

**For**

**PEABODY WESTERN COAL COMPANY**

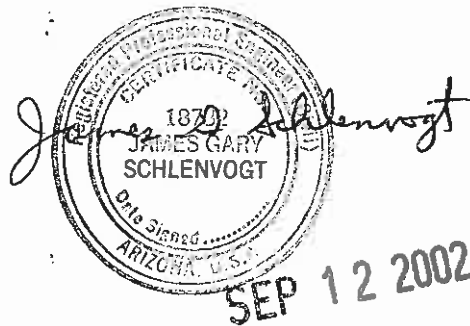


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## INTRODUCTION

Sedimentation Structure J19-D will be an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary sedimentation structure to control runoff and sediment from portions of the proposed J-19 West disturbed surface mining area at the Kayenta Mine. The location of Structure J19-D and its watershed boundary are shown on Drawing No. 85400 (Sheets M-10) 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 J19-D. 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 J19-D was inspected in September, 2001 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions existed. 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

The J19-D Structure has a watershed of 130.5 acres and is located on a tributary upstream of Red Peak Valley Wash at the Kayenta Mine. The 130.5-acre watershed, which contributes directly to structure J19-D is classified as 19% undisturbed, 17% spoil, 32% reclaimed area, and 32% disturbed.

## DESIGN ANALYSES

### GENERAL

Structure J19-D 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 1999 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

Structure J19-D is assumed to be a Category A-3 embankment. The structure will be a homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 13 feet wide on top. A minimum upstream slope of 2.5H:1V and minimum downstream slope of 4.0H:1V were assumed. Based on the total embankment height of approximately 19.5 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.

Revised 09/12/02

## HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure J19-D 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 has capacity less than 20 acre-feet. The spillway was analyzed using the 25-year, 6-hour storm. Structure J19-D was conservatively assumed to be full to the emergency spillway at the time of the design storm event. The storage capacity of structure J19-D 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 volume, without discharging into the Red Peak Valley Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.657 mi.
2.	Elevation Difference, H	211 ft
3.	Time of Concentration, $T_c$	0.203 hr
4.	NRCS Curve Number	85
5.	Rainfall Depth, 10-year, 24-hour storm	2.1 in
	25-year, 6-hour storm	1.9 in
6.	Drainage Area	130.5 ac

Values reported represent the watershed, which drains directly to Pond J19-D.

## 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).

J19-D SEDIMENTATION POND HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway
<b>Inflow</b>			
Peak Flow	cfs	100.2	118.9
Volume	ac-ft	9.5	7.9
<b>Storage</b>			
Peak Stage	msl	N/A	6745.8
Emergency Spillway Elev.	msl	6744.5	6744.5
Peak Storage	ac-ft	N/A	22.1
Storage Capacity	ac-ft	19.8	19.8
<b>Outflow</b>			
Peak Flow	cfs	N/A	79.5
Spillway Elevation	msl	6744.5	6744.5
Embankment Crest Elev.	msl	6747.3	6747.3
Peak Stage	msl	--	6745.8
Freeboard	ft	--	1.5
<b>Emergency Spillway Channel</b>			
Flow Depth	ft	--	1.3
Critical Velocity	fps	--	4.7
Mannings "n"	--	--	0.03
Width	ft	--	20
<b>Outflow Channel</b>			
Slope	%		4.2      25
Normal Velocity	fps	--	5.4      7.1
Normal Depth	ft	--	0.7      0.5
Mannings "n"	--	--	0.041    0.064
Riprap D <sub>50</sub>	in	--	3          6

### EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J19-D will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

Minimum Channel Depth	(Spillway)	2.3	ft
	(Outflow)	1.5	ft
Channel Width		20	ft
Channel Length	(Spillway)	28.75	ft
	(Outflow)	100	ft
Side slopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6744.5	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 design topography. Structure J19-D is designed to contain approximately 19.8 acre-feet.

The calculations for the sediment load entering structure J19-D were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.24
3.	Slope Factor, LS	7.34
4.	Cover Factor, C	0.58
5.	Erosion Control Factor, P	0.78

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume is available for storing sediment. Structure J19-D has sufficient storage to contain the 10-year, 24-hour storm. The total storage capacity was determined for structure J19-D and the results of the analysis are presented below.

Storage for Structure J19-D

Total Storage Capacity	19.8 ac-ft
10-year, 24-hour Storm Inflow	9.5 ac-ft
Available Sediment Storage Capacity	10.3 ac-ft
Sediment Inflow Rate/Year	1.82 ac-ft/yr
Sediment Storage Life	5.7 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) 25-Year, 6-Hour Storm Event

Exhibit #1- J19-D Proposed Sedimentation Pond



APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

**PEABODY WESTERN COAL COMPANY  
CALCULATED HYDROLOGIC DATA**

**PROJECT: J19 AREA**

**STRUCTURE: J19D Pond**

**TIME OF CONCENTRATION:**

Start Elevation (ft) = 6931  
 End Elevation (ft) = 6720  
 Elevation Difference, E (ft) = 211

Watercourse Length (ft) = 3469  
 Watercourse Length, L (mi) = 0.657

$T_c = (11.9L^3/E)^{0.385} =$  0.203 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
Pinyon Juniper	B	65	0	0
Pinyon Juniper	D	83	25.2	2091.6
Sagebrush	D	79	0	0
Disturbed - Mine		90	41.3	3717
Disturbed - Spoil		86	22.7	1952.2
Reclaimed	C	81	41.3	3345.3
<b>TOTAL:</b>			<b>130.5</b>	<b>11106.1</b>

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

**DRAINAGE BASIN AREA:**

130.5 Acres

PEABODY WESTERN COAL COMPANY  
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J19D Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
3DE	0.15	19.9	2.99
			0.00
3BC	0.16	5	0.80
16E,F	0.05	0.3	0.02
			0.00
			0.00
34-spoil	0.12	22.7	2.72
Reclaimed	0.38	41.3	15.69
Mine Pits	0.22	41.3	9.09
TOTAL:		130.5	31.30

Weighted K = Total K\*Area / Total Area = 0.24

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
230	90	39.1%	0.6	21.4	11.23
400	75	18.8%	0.6	10.6	7.23
120	50	41.7%	0.6	22.6	8.06
330	60	18.2%	0.6	10.3	6.21
270	65	24.1%	0.6	13.5	7.55
235	65	27.7%	0.6	15.5	8.05
240	65	27.1%	0.6	15.2	7.97
120	5	4.2%	0.4	2.4	0.59
320	70	21.9%	0.6	12.3	7.52
290	65	22.4%	0.6	12.6	7.29
310	120	38.7%	0.6	21.2	13.30
250	65	26.0%	0.6	14.6	7.83
285	60	21.1%	0.6	11.9	6.73
355	90	25.4%	0.6	14.2	9.40
160	40	25.0%	0.6	14.0	5.74
420	60	14.3%	0.6	8.1	5.38
140	45	32.1%	0.6	17.8	6.88
200	80	40.0%	0.6	21.8	10.54
270	25	9.3%	0.5	5.3	2.02

Average LS = 7.34

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

PROJECT: J19D Pond

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pinyon Juniper	20%	25%	25.2	0.22	5.54	1.00	25.20
Sagebrush/Grass					0.00	1.00	0.00
Disturbed	0%	0%	41.3	1.00	41.30	1.00	41.30
Spoil	0%	0%	22.7	1.00	22.70	0.80	18.16
Reclaimed	40%	0%	41.3	0.15	6.20	0.40	16.52
TOTAL:			130.5		75.74		101.18

Weighted C = Total C\*Area / Total Area = 0.580

Weighted P = Total P\*Area / Total Area = 0.775

RAINFALL FACTOR:

R = 40

PEABODY WESTERN COAL COMPANY  
CALCULATED SEDIMENT YIELD

PROJECT: J19D 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	0.24
Length Slope Factor	7.34
Cover Factor	0.58
Practice Factor	0.78
Gross Annual Sediment Yield	31.71 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0155 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0139 acre-feet/acre/year
Watershed Area	130.5 acres
Watershed Annual Sediment Yield	1.82 acre-feet/year
Number of years	1 years
Calculated Sediment Volume	1.82 acre-feet

## Pond J19-D Emergency Spillway Outflow

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	25.0	1.00		

### PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	79.50 cfs	
Depth:	0.52 ft	1.52 ft
Top Width:	23.10 ft	29.10 ft
Velocity:	7.13 fps	
X-Section Area:	11.15 sq ft	
Hydraulic Radius:	0.479	
Froude Number:	1.81	
Manning's n:	0.0640	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

# Pond J19D Emergency Spillway Outflow

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	4.2	1.00		

## PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	79.50 cfs	
Depth:	0.67 ft	1.67 ft
Top Width:	24.04 ft	30.04 ft
Velocity:	5.36 fps	
X-Section Area:	14.82 sq ft	
Hydraulic Radius:	0.611	
Froude Number:	1.20	
Manning's n:	0.0410	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

J19-D, Em. Spillway Critical Velocity  
Worksheet for Trapezoidal Channel

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Project Description	
Project File	untitled.fm2
Worksheet	J19D Critical Velocity
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

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Input Data	
Mannings Coefficient	0.030
Channel Slope	0.015000 ft/ft
Left Side Slope	3.000000 H : V
Right Side Slope	3.000000 H : V
Bottom Width	20.00 ft
Discharge	79.50 cfs

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Results	
Depth	0.76 ft
Flow Area	16.91 ft <sup>2</sup>
Wetted Perimeter	24.80 ft
Top Width	24.56 ft
Critical Depth	0.76 ft
Critical Slope	0.015053 ft/ft
Velocity	4.70 ft/s
Velocity Head	0.34 ft
Specific Energy	1.10 ft
Froude Number	1.00
Flow is subcritical.	

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APPENDIX B

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

**Peabody Western**  
**Pond J19D**

*10-year, 24-hour*

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

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	130.500	130.500	100.20	9.45

***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	130.500	0.203	0.000	0.000	85.000	F	100.20	9.452
	$\Sigma$	<b>130.500</b>						<b>100.20</b>	<b>9.452</b>

APPENDIX C

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

**Peabody Western**  
**Pond J19D**

*25-year, 6-hour*

djk

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

Phone: 303 763-5140

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***General Information***

***Storm Information:***

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



***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1 In			118.91	7.86
Out	130.500	130.500	79.47	7.40

### Structure Detail:

Structure #1 (Pond)

runoff volume

Pond Inputs:

Initial Pool Elev:	6,744.50
Initial Pool:	19.83 ac-ft

#### Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,744.50	28.75	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	6,745.81
Dewater Time:	2.83 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)
6,725.00	0.460	0.000	0.000	
6,725.50	0.485	0.236	0.000	
6,726.00	0.511	0.485	0.000	
6,726.50	0.537	0.747	0.000	
6,727.00	0.564	1.022	0.000	
6,727.50	0.592	1.311	0.000	
6,728.00	0.620	1.614	0.000	
6,728.50	0.649	1.931	0.000	
6,729.00	0.679	2.263	0.000	
6,729.50	0.709	2.610	0.000	
6,730.00	0.740	2.973	0.000	
6,730.50	0.765	3.349	0.000	
6,731.00	0.791	3.738	0.000	
6,731.50	0.817	4.139	0.000	
6,732.00	0.843	4.554	0.000	
6,732.50	0.870	4.983	0.000	
6,733.00	0.897	5.424	0.000	

# SEDCAD 4 for Windows

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Civil Software Design

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,733.50	0.925	5.880	0.000	
6,734.00	0.953	6.349	0.000	
6,734.50	0.981	6.832	0.000	
6,735.00	1.010	7.330	0.000	
6,735.50	1.040	7.843	0.000	
6,736.00	1.070	8.370	0.000	
6,736.50	1.101	8.913	0.000	
6,737.00	1.133	9.472	0.000	
6,737.50	1.165	10.046	0.000	
6,738.00	1.197	10.636	0.000	
6,738.50	1.229	11.243	0.000	
6,739.00	1.262	11.866	0.000	
6,739.50	1.296	12.505	0.000	
6,740.00	1.330	13.162	0.000	
6,740.50	1.363	13.835	0.000	
6,741.00	1.396	14.525	0.000	
6,741.50	1.430	15.231	0.000	
6,742.00	1.464	15.955	0.000	
6,742.50	1.498	16.695	0.000	
6,743.00	1.533	17.453	0.000	
6,743.50	1.568	18.228	0.000	
6,744.00	1.604	19.021	0.000	
6,744.50	1.640	19.832	0.000	Spillway #1
6,745.00	1.720	20.672	0.159	63.96*
6,745.50	1.767	21.544	45.568	3.60
6,745.81	1.796	22.098	79.470	0.35 Peak Stage
6,746.00	1.814	22.439	100.324	
6,746.50	1.862	23.358	165.457	
6,747.00	1.910	24.300	249.561	
6,747.30	1.950	24.879	309.768	

*\*Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

## Detailed Discharge Table

# SEDCAD 4 for Windows

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Civil Software Design

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,725.00	0.000	0.000
6,725.50	0.000	0.000
6,726.00	0.000	0.000
6,726.50	0.000	0.000
6,727.00	0.000	0.000
6,727.50	0.000	0.000
6,728.00	0.000	0.000
6,728.50	0.000	0.000
6,729.00	0.000	0.000
6,729.50	0.000	0.000
6,730.00	0.000	0.000
6,730.50	0.000	0.000
6,731.00	0.000	0.000
6,731.50	0.000	0.000
6,732.00	0.000	0.000
6,732.50	0.000	0.000
6,733.00	0.000	0.000
6,733.50	0.000	0.000
6,734.00	0.000	0.000
6,734.50	0.000	0.000
6,735.00	0.000	0.000
6,735.50	0.000	0.000
6,736.00	0.000	0.000
6,736.50	0.000	0.000
6,737.00	0.000	0.000
6,737.50	0.000	0.000
6,738.00	0.000	0.000
6,738.50	0.000	0.000
6,739.00	0.000	0.000
6,739.50	0.000	0.000
6,740.00	0.000	0.000
6,740.50	0.000	0.000
6,741.00	0.000	0.000
6,741.50	0.000	0.000
6,742.00	0.000	0.000
6,742.50	0.000	0.000
6,743.00	0.000	0.000
6,743.50	0.000	0.000
6,744.00	0.000	0.000
6,744.50	0.000	0.000

# SEDCAD 4 for Windows

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Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,745.00	0.159	0.159
6,745.50	45.568	45.568
6,746.00	100.324	100.324
6,746.50	165.457	165.457
6,747.00	249.561	249.561
6,747.30	309.768	309.768

***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	130.500	0.203	0.000	0.000	85.000	F	118.91	7.859
	$\Sigma$	<b>130.500</b>						<b>118.91</b>	<b>7.859</b>